# Getbol, Korean Tidal Flat

For Inscription on the World Heritage List

Republic of Korea

Section 0

# Executive Summary

# Executive Summary

## State Party

Republic of Korea

## Province

Seocheon County, Chungcheongnam-do Province

Gochang County, Jeollabuk-do Province

Shinan County, Jeollanam-do Province

Boseong County and Suncheon City, Jeollanam-do Province

## Name of Property

Getbol, Korean Tidal Flat

# Geographical coordinates to the nearest second

| No. | Name of the Component | Region(s) / District(s) | Coordinates of the Central Point | Property Area (ha) | Area of the Buffer Zone (ha) |
|---|---|---|---|---|---|
| 1 | Seocheon Getbol | Seocheon County | 36°02'43.01"N 126°36'46.69"E | 6,809 | 3,657 |
| 2 | Gochang Getbol | Gochang County | 35°33'06.67"N 126°32'01.35"E | 6,466 | 1,785 |
| 3 | Shinan Getbol | Shinan County | 34°49'43.76"N 126°06'16.00"E | 110,086 | 67,254 |
| 4 | Boseong-Suncheon Getbol | Boseong County, Suncheon City | 34°49'11.25"N 127°27'32.19"E | 5,985 | 1,801 |
| Total Area | | | | 129,346 | 74,497 |

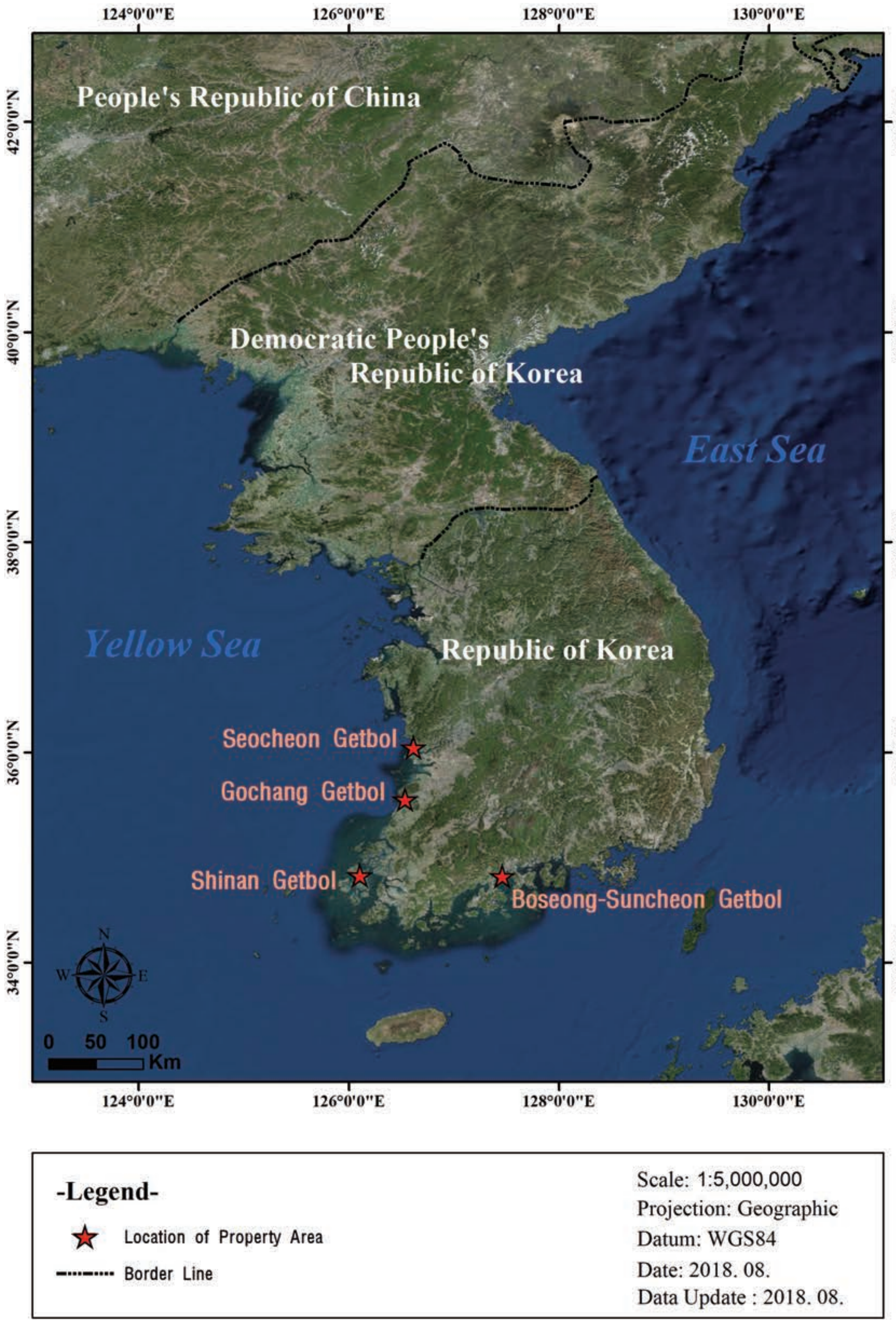
# Textual description of the boundaries of the nominated property

The nominated property comprises intertidal and subtidal areas basically with waters up to 6 m deep (and up to 40 m in tidal channels). The property encompasses the habitat of endangered species, unique communities of living organisms and geological and geomorphological features, which together display the intact integrity of the nominated property. The property zone is protected under a single law, the Wetlands Conservation Act, and is managed under a consistent system.

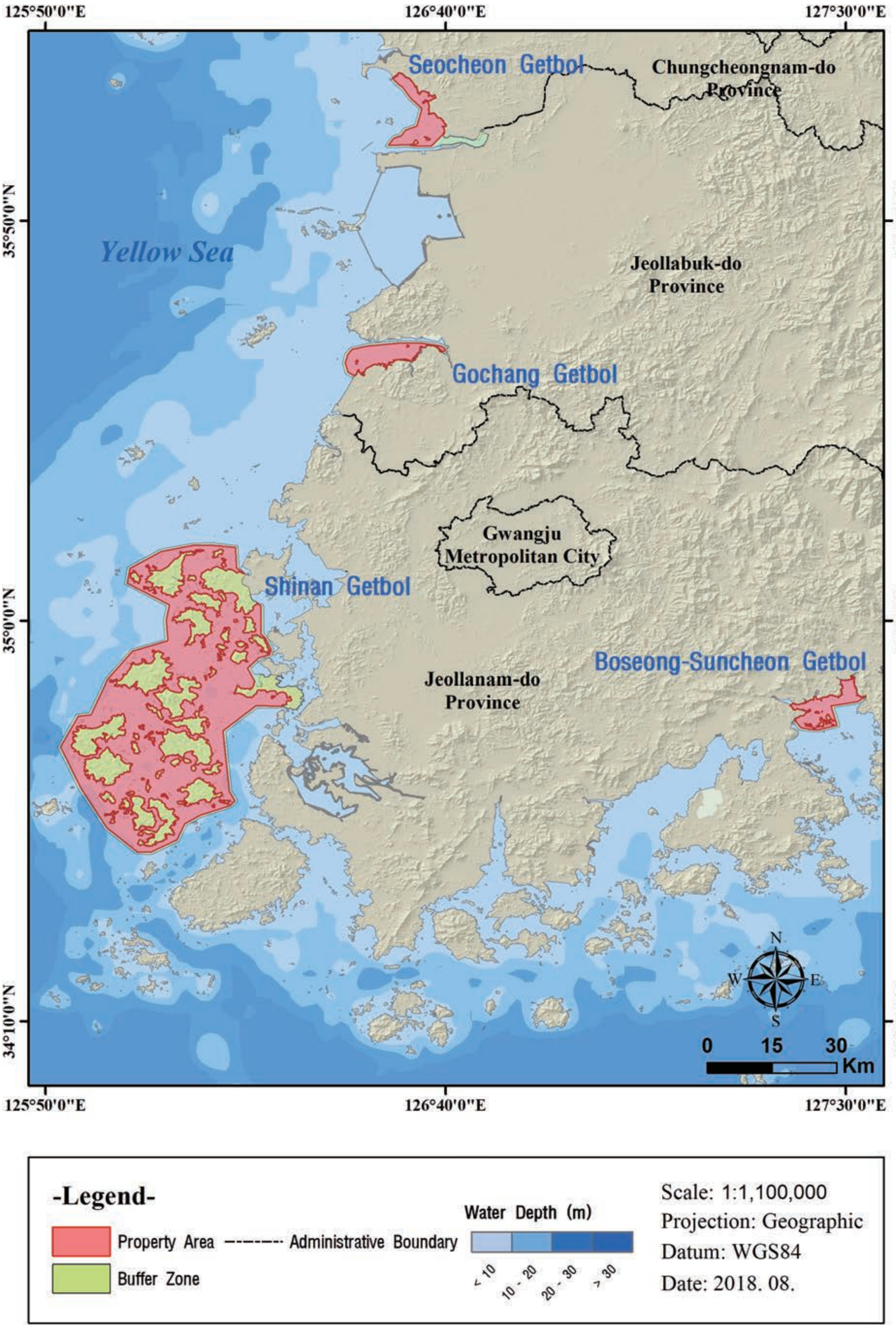
The buffer zone is divided into terrestrial and marine areas. The buffer zone on land stretches inwards up to 100 m from the coastline. This is to prevent ecosystem disturbance caused by human activity and various development projects. Most of the terrestrial buffer zone consist of farmland, forest and rocky areas, and include villages with less than 50 households. The terrestrial buffer zone is designated as preserved management areas and as natural environment conservation areas under Korean national Act (National Land Planning and Utilization Act, 2002) and thus has very little development pressure.

The marine buffer zone is set as a 500 m wide stretch along the coastal boundaries of the property area. There is barely any threat from the water itself. However, the marine buffer zone has been set with consideration of the following factors: geological, geomorphological and environmental features including distribution of suspended sediments and the influence of climate change; and ecosystem features including the scope of young living organisms being recruited within the tidal range, which is crucial in maintaining biodiversity and biological processes, and their freedom of movement within their habitat. Any contamination actions that might damage the set buffer zone are prohibited by domestic Act (Public Waters Management and Reclamation Act, 2010).

# A4 size map(s) of the nominated property, showing boundaries and buffer zone



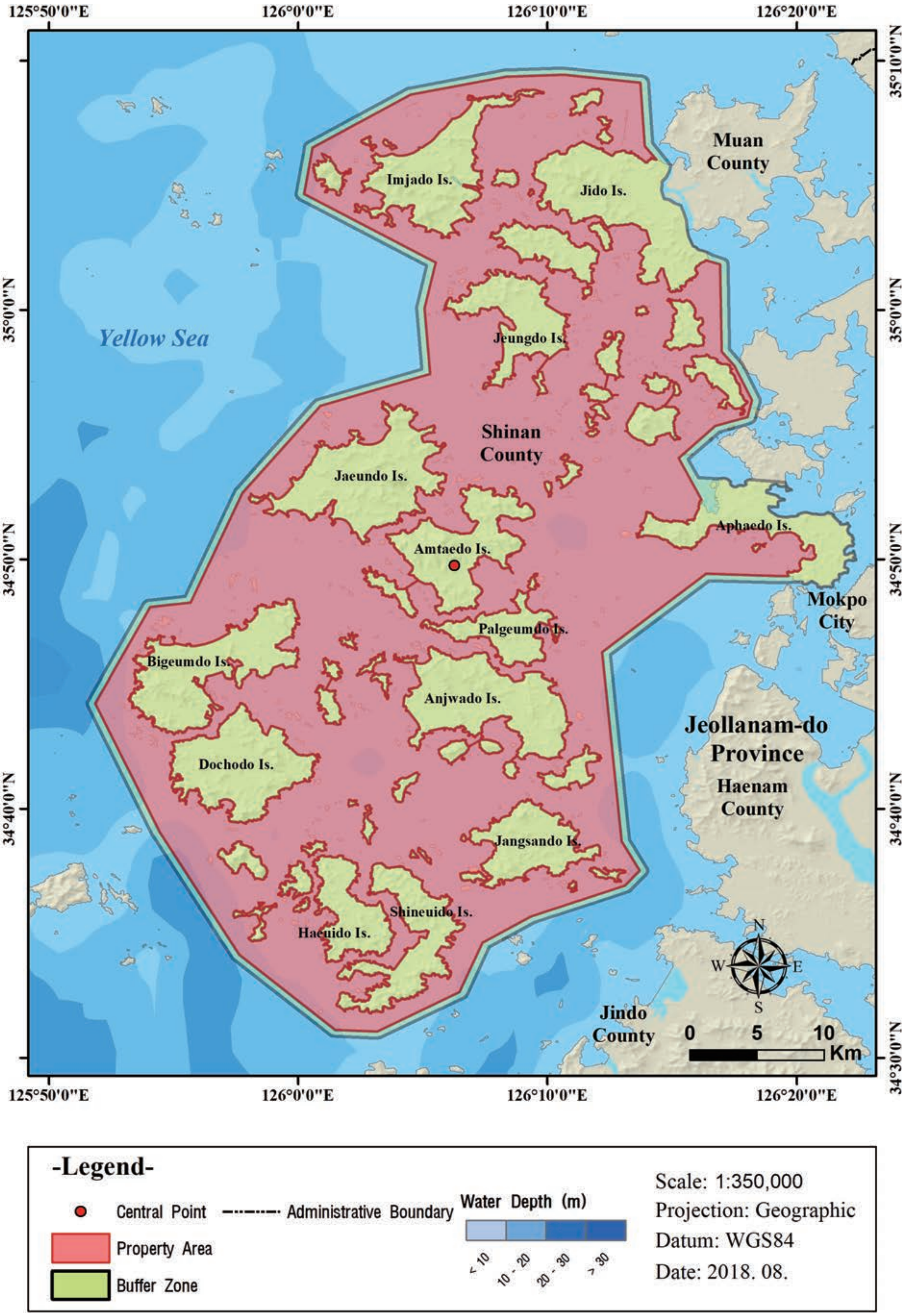

**Map 0-1.** Location of the nominated property



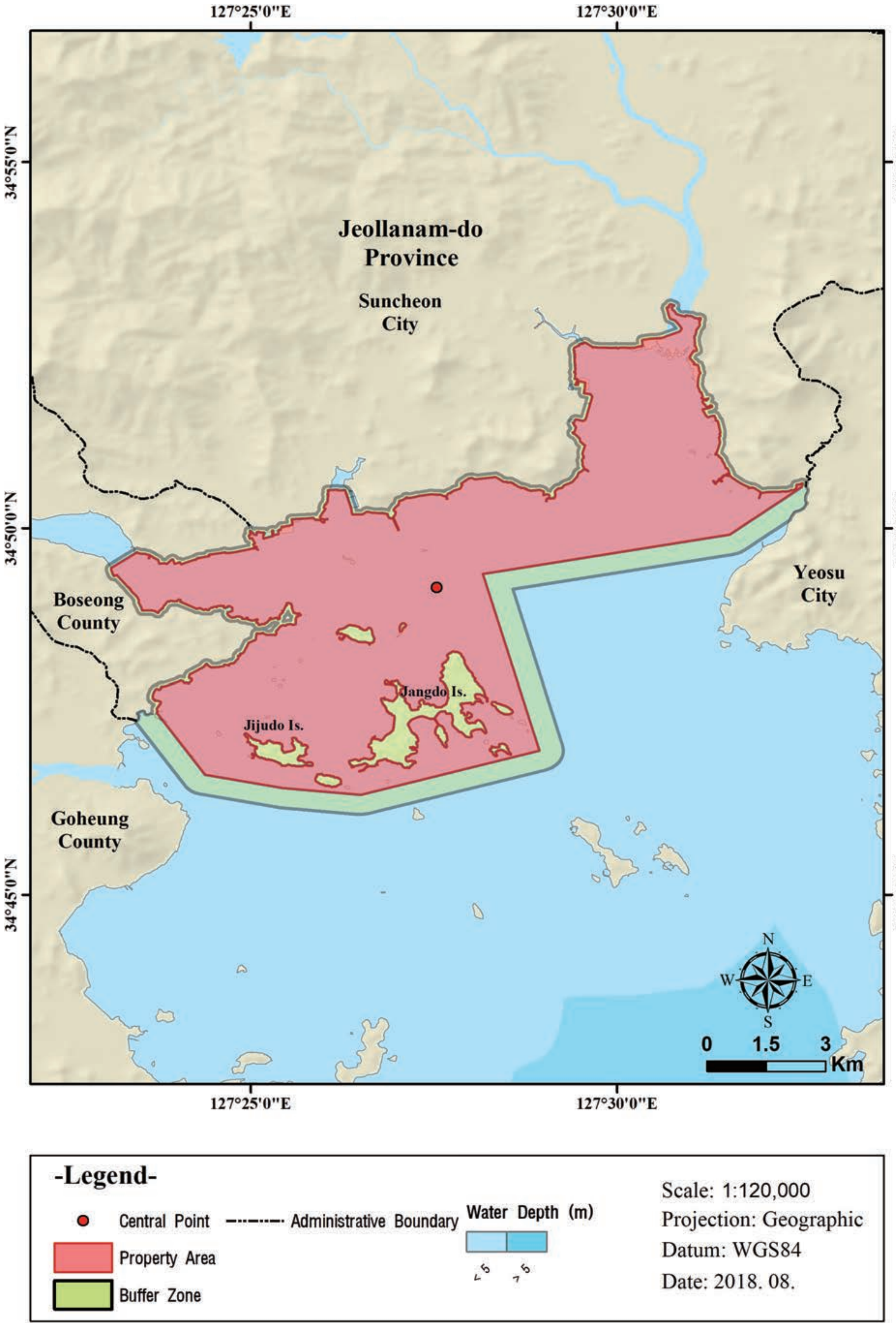

**Map 0-2.** Zonation map of the nominated property (refer to appended maps for details)


**Map 0-3.** Zonation map of Seocheon Getbol (refer to appended maps for details)


**Map 0-4.** Zonation map of Gochang Getbol (refer to appended maps for details)




**Map 0-5.** Zonation map of Shinan Getbol (refer to appended maps for details)




**Map 0-6.** Zonation map of Boseong-Suncheon Getbol (refer to appended maps for details)

# Criteria under which property is nominated

Criterion (viii): To be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features

Criterion (ix): To be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals

Criterion (x): To contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of Outstanding Universal Value from the point of view of science or conservation

# Draft Statement of Outstanding Universal Value

**• Brief Synthesis**

The nominated property is located on the south and west coasts of Republic of Korea, corresponding to the southeastern coast of the Yellow Sea. It is a serial site, encompassing a complex combination of geological, oceanographic and climatic conditions. It displays by world standards a rare and complex coastal sedimentary system with diverse tidal ecosystems; and is made up of Seocheon Getbol, Gochang Getbol, Shinan Getbol and Boseong-Suncheon Getbol. Each component has its own unique and diverse geological and biological features. The area has an OUV that reflects the diversity of the island-type (archipelagic) tidal flat ecosystem and its geological and geomorphological features.

Thousands of islands are scattered across an area of over a thousand square kilometers, like a fishing net spread out to sea. Fast macrotidal currents that change direction every 6 hours run between these islands through channels that are either narrow or wide, short or long, shallow or deep, according to the state of tide. This creates one of nature's most spectacular coastal phenomena. In addition to this geological complexity, the nominated property is also deeply affected by seasonal changes emanating from the East Asian monsoon. Together, these factors have contributed to the overall diversity found in the property's tidal flats and habitats.

These macrotidal island-studded tidal flats display a high level of geodiversity in the nominated property. The geodiversity has created a stable equilibrium that has enabled a complex geological environment to evolve and to be maintained. This has resulted in the world's thickest intertidal mud flat sediments deposited during Holocene period.

The high biodiversity and habitat diversity, backed by high primary production in the property, are indicative of its strong ecological sustainability. A distinctive evolution of communities has successfully developed in the property. For example, mud octopuses in muddy flats and waterbirds in sandy flats exist as keystone species. Especially, the habitat connectivity of the nominated property is an outstanding example that shows the formation of an ecosystem where some waterbirds are seen resting in rocky habitats and feeding in muddy or sandy habitats. The richness of biodiversity and their habitats is supported by the geodiversity that exists in the property.

The nominated property is characterized by its high capacity to support 22 endangered waterbird species, including the spoon-billed sandpiper (CR on the IUCN Red List) on the East Asian-Australasian Flyway (EAAF). The various habitats in the property provide the food and space that is much needed for all waterbirds. This strongly testifies to the essential values embodied by the property.

Should World Heritage inscription be successfully accomplished, then managers of the nominated property will work to add more tidal flats areas in ROK that have similar outstanding attributes to the nominated area. These activities will be conducted as part of the effort to contribute further to the protection of the Yellow Sea Eco-region.

### • Justification for Criteria

Criterion (viii): No other property on the World Heritage List has attributes similar to those found in the nominated property. The area concerned would be the only example of an island-studded tidal flat with a macrotidal range, set in a monsoonal environment. The area has formed within an integrated tectonic, oceanographic, and climatic system. It shows the most complicated, thus the most outstanding on-going geological coastal processes to date.

The nominated property includes various types of tidal flats, namely estuarine type, open-embayed type, archipelago type and semi-enclosed type. It also has high geodiversity with its numerous rocky islands, macrotidal range and seasonal changes. The property has maintained a stable geodiversity for the past 8,500 years and as a result now has the world’s thickest Holocene mud sediments. Therefore, the high geodiversity of the tidal flats produced by dynamic ongoing coastal processes is extremely significant and of outstanding value.

Criterion (ix): The nominated property is a representative multi-faceted ecosystem where muddy, sandy and rocky habitats are interconnected in a complex manner. In the various habitats on different substrates biotic communities are found that have gone through exceptional evolutionary processes, and now constitutes a dynamic ecosystem.

In the muddy flats, mud octopuses dominate as a top predator and a keystone species, and deposit feeders like Japanese mud crabs, fiddler crabs and polychaetes are dominant species. In the sandy flats, waterbirds are a keystone species, with deposit feeders including Stimpson's ghost crabs, Yellow Sea sand snails, and polychaetes as well as various suspension feeders like clams are dominant species.

Criterion (x): The nominated property plays a critical role in maintaining biodiversity and in supporting internationally endangered species of migratory birds in the Yellow Sea. It hosts one of the most jeopardized flyways amongst the world's three major flyways.

The property is providing for migratory waterbirds, including 22 IUCN Red List species such as spoon-billed sandpipers (critically endangered species), with ideal grounds for feeding, breeding and resting. It thus serves as a core stopover site on the East Asian-Australasian Flyway.

This crucial habitat is supported by the highest primary production and biodiversity of benthic diatoms, marine algae and other benthic organisms among tidal flats under temperate climates worldwide. A total of 2,150 species of flora and fauna are supported in multiple stable ecosystems where the terrestrial, coastal and marine ecosystems are closely connected in the property. The property embraces 375 benthic diatoms, 118 waterbirds, 857 macrobenthos, 152 marine macroalgae, 47 endemic and 5 endangered marine invertebrate species.

### • Statement of Integrity

In setting boundaries for the property, the OUV of the nominated property has been considered. Features that make up the OUV include high geodiversity coming from the sedimentation system, diverse habitats for the endangered species and endemic species, and the tidal flat ecosystem.

Therefore, the property zone includes a) diverse sand flats, mud flats, mixed flats and rocky habitats that support the evolution of the unique ecological communities; b) the high biodiversity of the endangered migratory birds and endemic species; and c) the geological and geomorphological features such as tidal channels and tidal gullies that influence sedimentation.

Moreover, the serial sites of the property constitute an independent, single, sedimentary circulation system that includes the source of suspended sediments all the way to the sink. Each component has four different sedimentary systems in four types of Getbol, featuring distinctive tidal circulation and sedimentation patterns, as well as various results of thick mud flat sequences.

In addition, the nominated property sustains its intactness through conservation efforts, where the geological and ecological constituents affected by human activities are naturally restored to their original state by strong monsoons in winter and typhoons in summer.

### • Requirement for Protection and Management

The entire area of the nominated property is designated as Wetland Protected Area (WPA) under the Wetlands Conservation Act (1999). Thus, there is a single consistent protection and management system in place. Parts of the property are designated as international protected areas including Ramsar Sites under the Ramsar Convention, Biosphere Reserves under the UNESCO MAB program, and the East Asian-Australasian Flyway (EAAF) habitats network, contributing to the enhancement of global biodiversity. The local municipalities where the property is located have formulated ordinances to further strengthen the protection and management of the property. In addition, the local communities have in place their own traditional tidal flats management system to further support the sustainable protection and management of the property. As such, the property has a multi-layered integrated protection and management system in place.

The ROK government provides the budget for the protection and management plan of the nominated property. By conducting integrated monitoring, the government is working to appropriately respond to any threats to the property and to protect and manage the OUV in a sustainable manner. Following inscription, the Getbol World Heritage Center and the local management offices at each of the components will be established and lead the implementation of the integrated protection and management plan in close cooperation with the central government, local governments, experts, local residents and the NGOs.

# Name and contact information of official institution/agency

Organization: Cultural Heritage Administration (CHA)
Address: Government Complex-Daejeon, 189, Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea
Tel: +82-42-481-3180
Fax: +82-42-481-3199
E-mail: worldheritage@korea.kr
Web address: http://www.cha.go.kr

Section 1

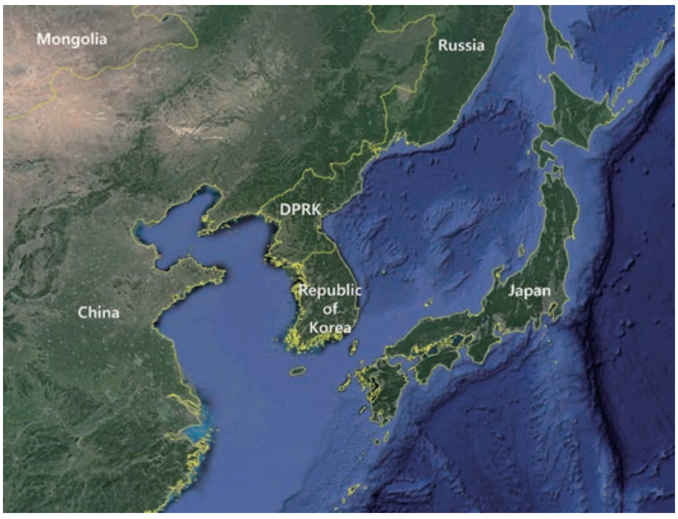
# Identification of the Property

Section 1

# Identification of the Property

## 1.a State Party

Republic of Korea



# 1.b State, Province or Region

Seocheon County, Chungcheongnam-do Province

Gochang County, Jeollabuk-do Province

Shinan County, Jeollanam-do Province

Boseong County and Suncheon City, Jeollanam-do Province

# 1.c Name of Property

Getbol, Korean Tidal Flat

# 1.d Geographical Coordinates to the Nearest Second

| No. | Name of the Component Part | Region(s) / District(s) | Coordinates of the Central Point | Area of Nominated component of the Property (ha) | Area of the Buffer Zone (ha) |
|---|---|---|---|---|---|
| 1 | Seocheon Getbol | Seocheon County | 36°02'43.01"N 126°36'46.69"E | 6,809 | 3,657 |
| 2 | Gochang Getbol | Gochang County | 35°33'06.67"N 126°32'01.35"E | 6,466 | 1,785 |
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| Total Area | | | | 129,346 | 74,497 |

The nominated property is a serial site with four components. Each component has distinctive geological and ecological values, which contribute to the overall value of the nominated property and establishes its Outstanding Universal Value.

On the basis of the description in Section 2 in conjunction with the comparative analysis in Section 3, each component has been selected to represent the distinctive characteristics of what constitutes the Getbol, the Korean tidal flat systems. In a future phase, further areas of the Getbol will be nominated to enhance its OUV and provide these areas with benefits similar to those found in the nominated property. These areas have not been included in the nomination pending a further enhancement of their protection and management in order to meet the requirements stipulated in the Operational Guidelines and enable sufficient time for local consultations.

The extension strategy aims to achieve the higher level of protection and management for the entire Yellow Sea. Republic of Korea will prepare to coordinate any future phase cooperation.

# 1.e Maps and Plans, Showing the Boundaries of the Nominated Property and Buffer Zone

| No. | Name of the Component Part | Map | Scale | Map | Page |
|---|---|---|---|---|---|
| 1 | Property Area | Topographic Map | 1:1,100,000 | 1-1 | 034 |
| | | Satellite Map | | 1-2 | 035 |
| 2 | Seocheon Getbol | Topographic Map | 1:150,000 | 1-3 | 036 |
| | | Satellite Map | | 1-4 | 037 |
| 3 | Gochang Getbol | Topographic Map | 1:150,000 | 1-5 | 038 |
| | | Satellite Map | | 1-6 | 039 |
| 4 | Shinan Getbol | Topographic Map | 1:350,000 | 1-7 | 040 |
| | | Satellite Map | | 1-8 | 041 |
| 5 | Boseong-Suncheon Getbol | Topographic Map | 1:120,000 | 1-9 | 042 |
| | | Satellite Map | | 1-10 | 043 |

Appendix 2-1: Satellite Maps

| No. | Name of the Component Part | Scale | Map | Page |
|---|---|---|---|---|
| 1 | Property Area | 1:750,000 | Property location | 03 |
| 2 | Seocheon Getbol | 1:110,000 | Whole map of Seocheon Getbol | 05 |
| | | 1:25,000 | Detail Map 01 | 06 |
| | | | Detail Map 02 | 07 |
| | | | Detail Map 03 | 08 |
| | | | Detail Map 04 | 09 |
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| | | | Detail Map 07 | 12 |
| 3 | Gochang Getbol | 1:110,000 | Whole map of Gochang Getbol | 14 |
| | | 1:25,000 | Detail Map 01 | 15 |
| | | | Detail Map 02 | 16 |
| | | | Detail Map 03 | 17 |
| | | | Detail Map 04 | 18 |
| | | | Detail Map 05 | 19 |
| 4 | Shinan Getbol | 1:250,000 | Whole map of Shinan Getbol | 21 |
| | | 1:25,000 | Detail Map 01 | 22 |
| | | | Detail Map 02 | 23 |
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| | | | Detail Map 22 | 43 |
| | | | Detail Map 23 | 44 |

| No. | Name of the Component Part | Scale | Map | Page |
|---|---|---|---|---|
| 4 | Shinan Getbol | 1:25,000 | Detail Map 24 | 45 |
| | | | Detail Map 25 | 46 |
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| | | | Detail Map 54 | 75 |
| 5 | Boseong-Suncheon Getbol | 1:80,000 | Whole map of Boseong-Suncheon Getbol | 77 |
| | | 1:25,000 | Detail Map 01 | 78 |
| | | | Detail Map 02 | 79 |
| | | | Detail Map 03 | 80 |
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| | | | Detail Map 06 | 83 |

Appendix 2-2: Topographic Maps

| No. | Name of the Component Part | Scale | Map | Page |
|---|---|---|---|---|
| 1 | Property Area | 1:750,000 | Property Location | 03 |
| 2 | Seocheon Getbol | 1:110,000 | Whole map of Seocheon Getbol | 05 |
| | | 1:25,000 | Detail Map 01 | 06 |
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| 3 | Gochang Getbol | 1:110,000 | Whole map of Gochang Getbol | 14 |
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| 4 | Shinan Getbol | 1:250,000 | Whole map of Shinan Getbol | 21 |
| | | 1:25,000 | Detail Map 01 | 22 |
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| No. | Name of the Component Part | Scale | Map | Page |
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| 4 | Shinan Getbol | 1:25,000 | Detail Map 25 | 46 |
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| 5 | Boseong-Suncheon Getbol | 1:80,000 | Whole map of Boseong-Suncheon Getbol | 77 |
| | | 1:25,000 | Detail Map 01 | 78 |
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Appendix 2-3: Land Use Maps

| No. | Name of the Component Part | Scale | Map | Page |
|---|---|---|---|---|
| 1 | Property Area | 1:750,000 | Property Location | 03 |
| 2 | Seocheon Getbol | 1:110,000 | Whole map of Seocheon Getbol | 05 |
| | | 1:25,000 | Detail Map 01 | 06 |
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| 3 | Gochang Getbol | 1:110,000 | Whole map of Gochang Getbol | 14 |
| | | 1:25,000 | Detail Map 01 | 15 |
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| 4 | Shinan Getbol | 1:250,000 | Whole map of Shinan Getbol | 21 |
| | | 1:25,000 | Detail Map 01 | 22 |
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| No. | Name of the Component Part | Scale | Map | Page |
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| 4 | Shinan Getbol | 1:25,000 | Detail Map 24 | 45 |
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| | | | Detail Map 54 | 75 |
| 5 | Boseong-Suncheon Getbol | 1:80,000 | Whole map of Boseong-Suncheon Getbol | 77 |
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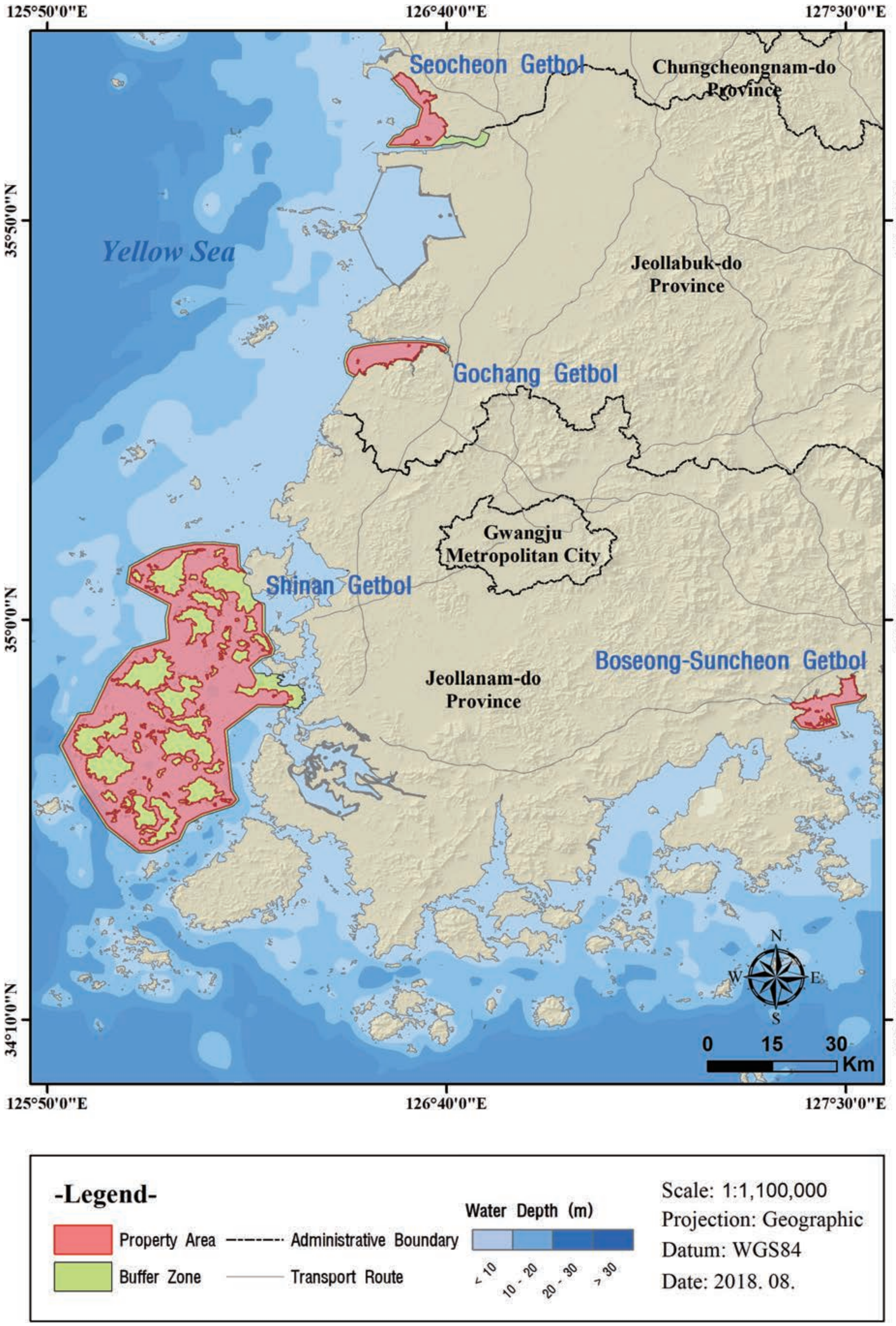
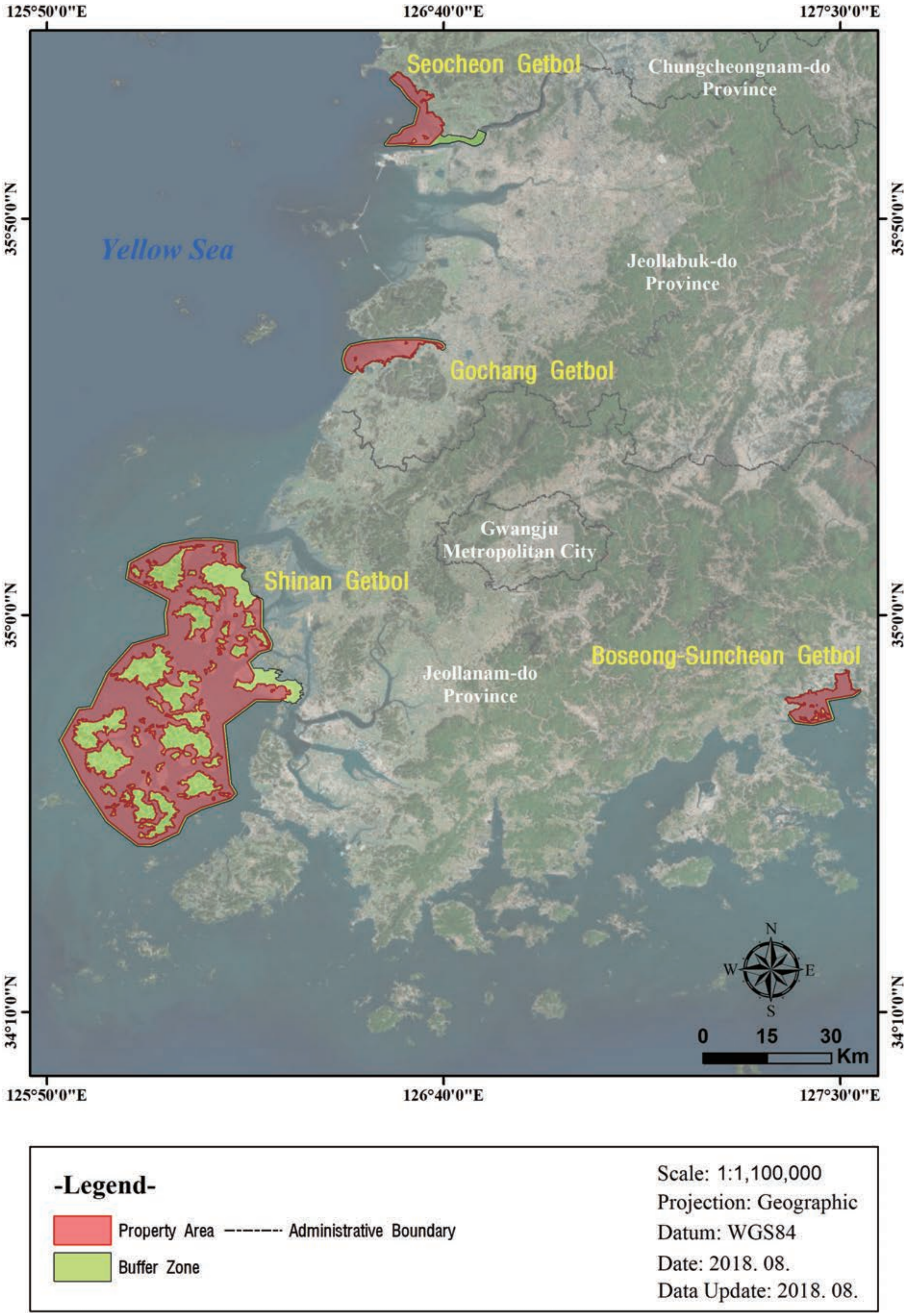
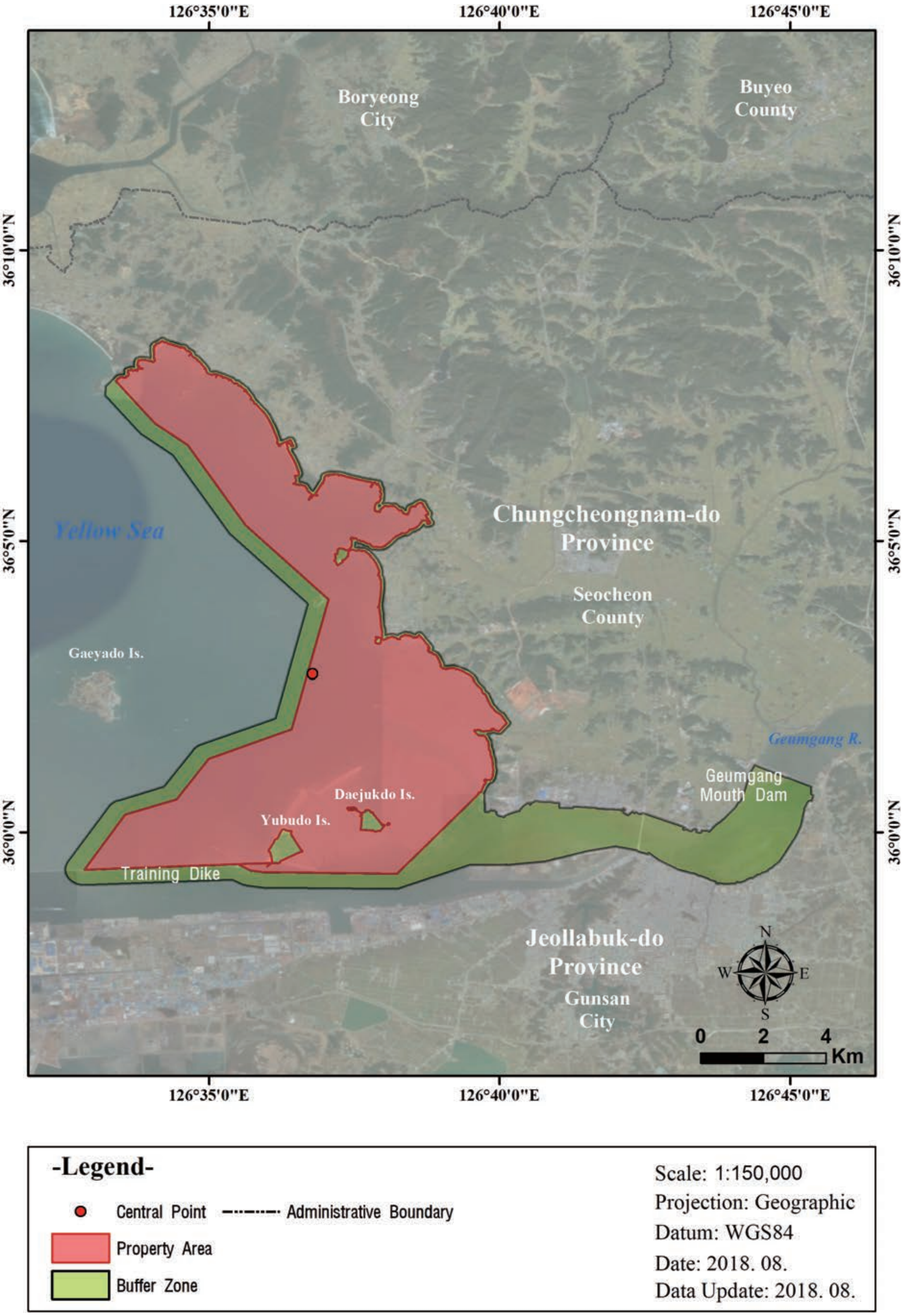



**Map 1-1.** Topographic map of the nominated property location (refer to appended maps for details)



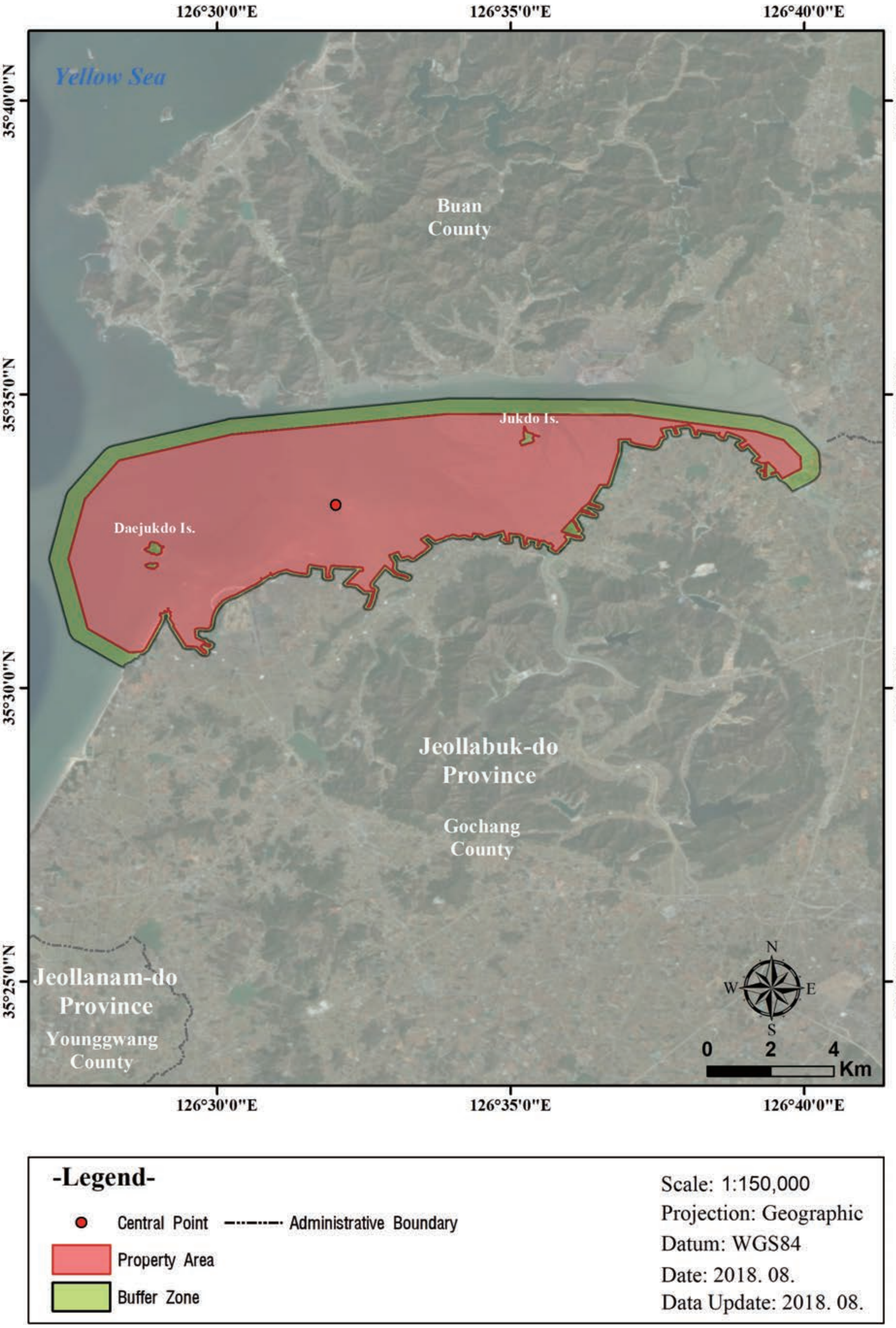

Map 1-2. Satellite map of the nominated property location (refer to appended maps for details)


**Map 1-3.** Topographical zonation map of Seocheon Getbol (refer to appended maps for details)

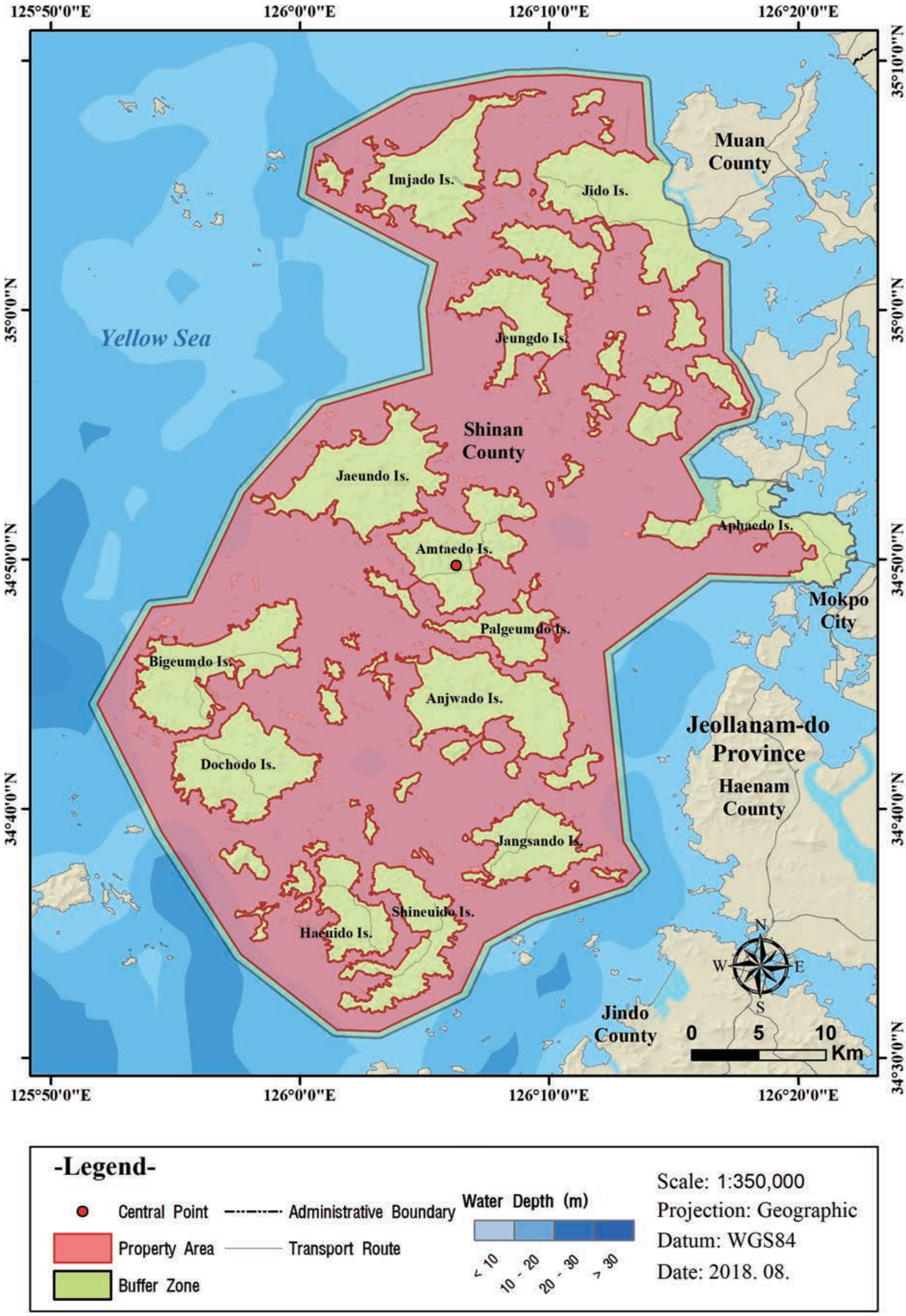



**Map 1-4.** Satellite zonation map of Seocheon Getbol (refer to appended maps for details)

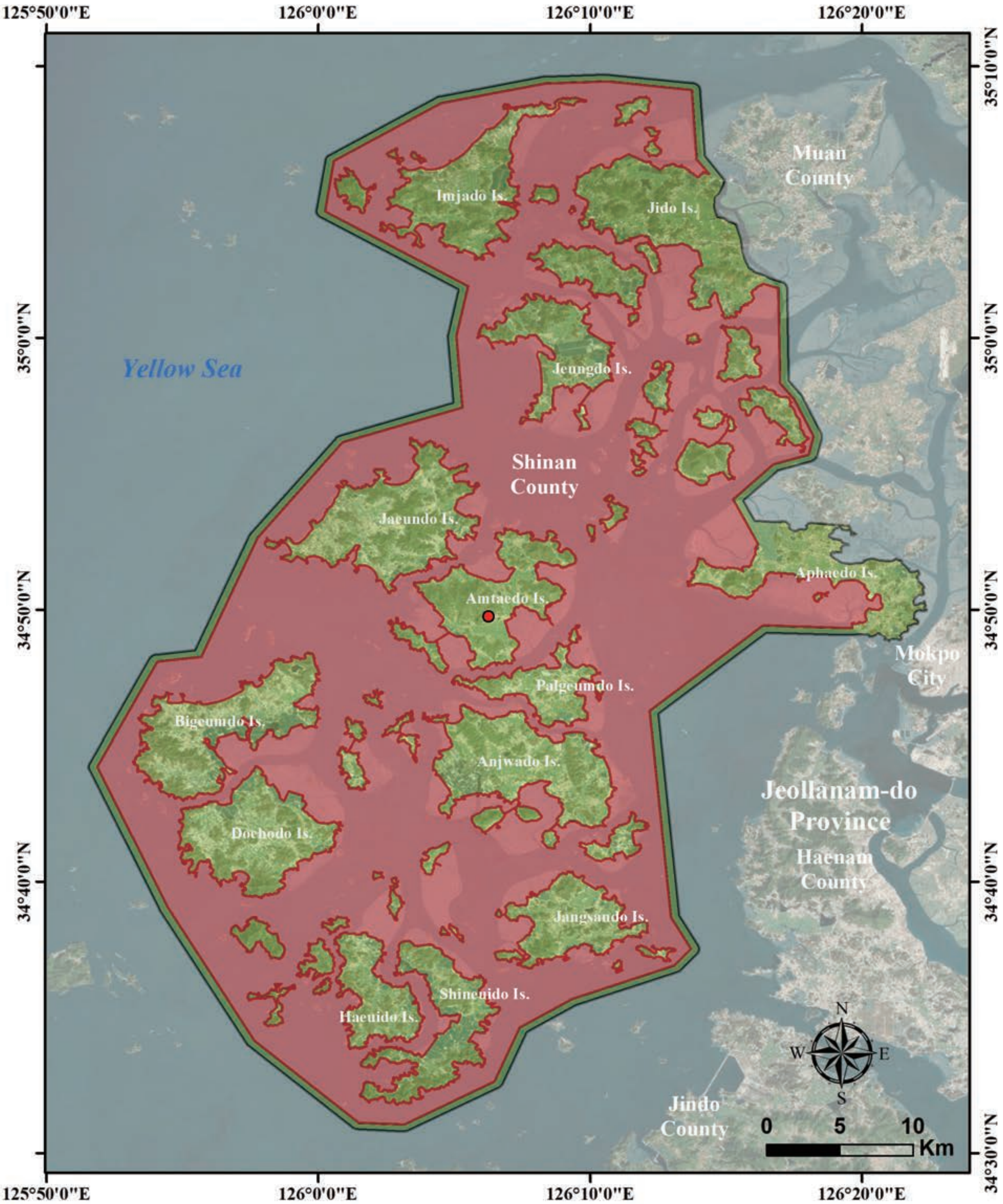

**Map 1-5.** Topographical zonation map of Gochang Getbol (refer to appended maps for details)




**Map 1-6.** Satellite zonation map of Gochang Getbol (refer to appended maps for details)




**Map 1-7.** Topographical zonation map of Shinan Getbol (refer to appended maps for details)

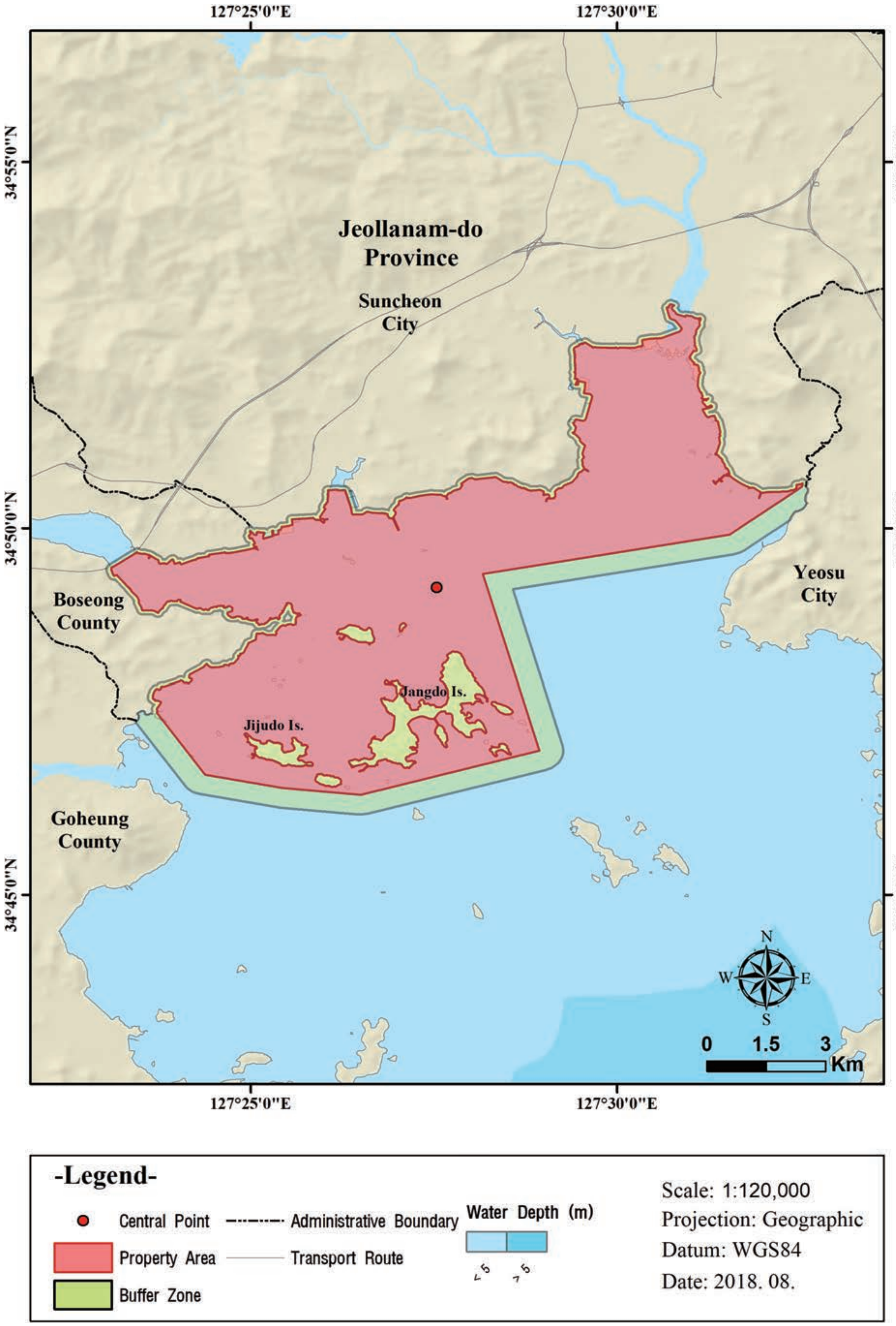



-Legend-

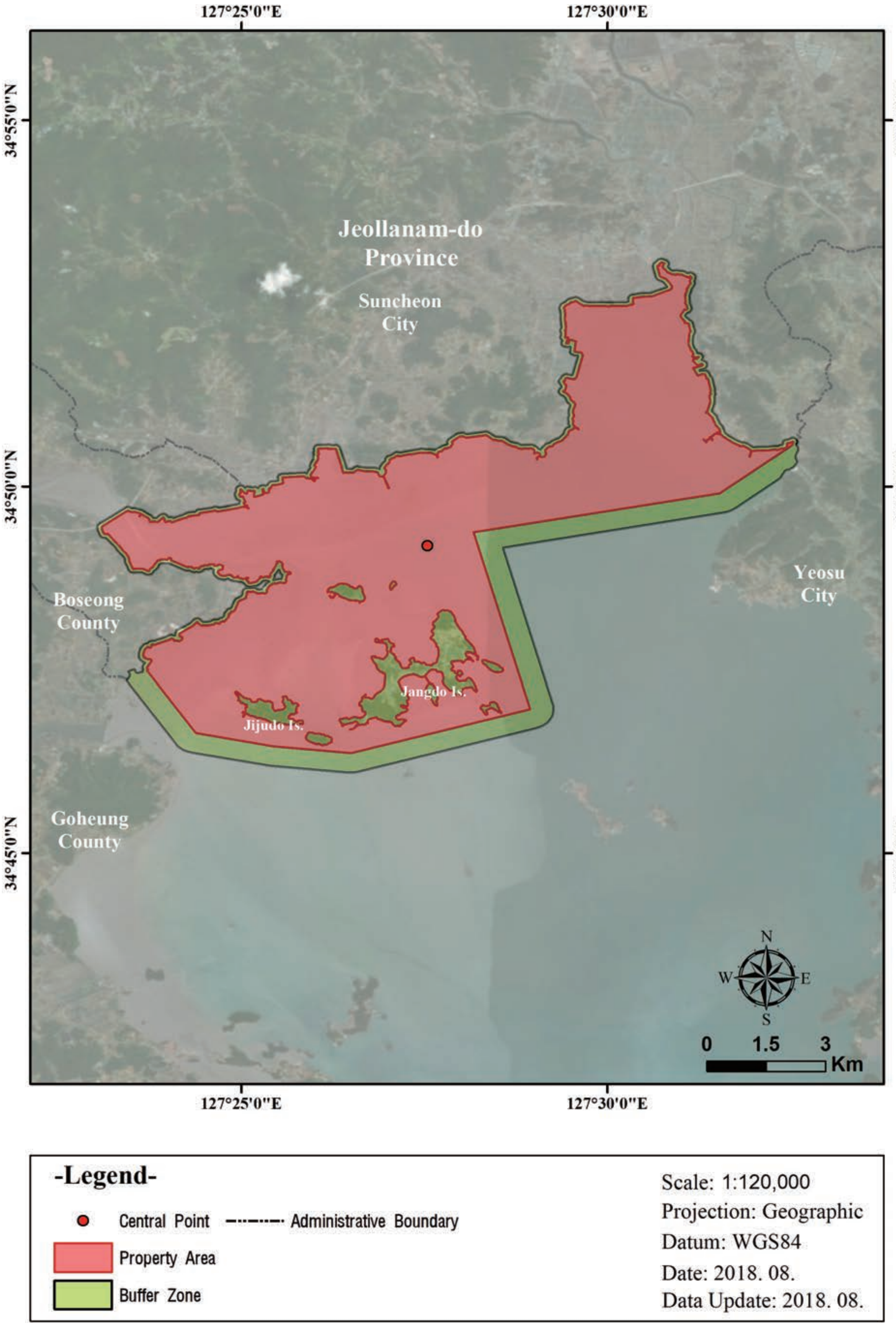
Central Point
Administrative Boundary
Property Area
Buffer Zone

Scale: 1:350,000
Projection: Geographic
Datum: WGS84
Date: 2018. 08.
Data Update: 2018. 08.

**Map 1-8.** Satellite zonation map of Shinan Getbol (refer to appended maps for details)




**Map 1-9.** Topographical zonation map of Boseong-Suncheon Getbol (refer to appended maps for details)




**Map 1-10.** Satellite zonation map of Boseong-Suncheon Getbol (refer to appended maps for details)

# 1.f Area of Nominated Property and Proposed Buffer Zone

| No. | Name of the Component | Regions | Property Area (ha) | Buffer Zone (ha) | | |
|---|---|---|---|---|---|---|
| | | | | Terrestrial Area | Marine Area | Subtotal |
| 1 | Seocheon Getbol | Seocheon County | 6,809 | 400 | 3,257 | 3,657 |
| 2 | Gochang Getbol | Gochang County | 6,466 | 382 | 1,403 | 1,785 |
| 3 | Shinan Getbol | Shinan County | 110,086 | 57,322 | 9,932 | 67,254 |
| 4 | Boseong-Suncheon Getbol | Boseong County Suncheon City | 5,985 | 406 | 1,395 | 1,801 |
| Total Area (ha) | | | 129,346 | 58,510 | 15,987 | 74,497 |

The nominated property comprises intertidal and subtidal areas basically with waters up to 6 m deep (and up to 40 m in tidal channels). The property encompasses the habitat of endangered species, unique communities of living organisms and geological and geomorphological features, which together display the intact integrity of the nominated property. The property zone is protected under a single law, the Wetlands Conservation Act, and is managed under a consistent system.

The buffer zone is divided into terrestrial and marine areas. The buffer zone on land stretches inwards up to 100 m from the coastline. This is to prevent ecosystem disturbance caused by human activity and various development projects. Most of the terrestrial buffer zone consist of farmland, forest and rocky areas, and include villages with less than 50 households. The terrestrial buffer zone is designated as preserved management areas and as natural environment conservation areas under Korean national Act (National Land Planning and Utilization Act, 2002) and thus has very little development pressure.

The marine buffer zone is set as a 500 m wide stretch along the coastal boundaries of the property area. There is barely any threat from the water itself. However, the marine buffer zone has been set with consideration of the following factors: geological, geomorphological and environmental features including distribution of suspended sediments and the influence of climate change; and ecosystem features including the scope of young living organisms being recruited within the tidal range, which is crucial in maintaining biodiversity and biological processes, and their freedom of movement within their habitat. Any contamination actions that might damage the set buffer zone are prohibited by domestic Act (Public Waters Management and Reclamation Act, 2010).

Section 2

# Description

Section 2

# Description

## 2.a Description of Property

Tidal flats are sandy to muddy or marshy flats in the intertidal zone that are emergent during low tide and submerging during high tide. In general, they include the subtidal zone which is the area influenced by tidal current below the low-water line, and supratidal zone which is the area above the high-water line but sometimes under water during extremely high tides and storms. The sediments, affected by daily tidal currents, are transported toward the shore from the ocean. Sand particles are deposited on the lower part of the flats, whereas finer sediments accumulate on the upper part closer to the shore. Different types of tidal flats formed by this sedimentation provide various habitats for many living organisms and create an important coastal ecosystem.

Getbol, a word of native Korean origin, means tidal flats. This word in a narrow sense refers to an intertidal zone. Its meaning or use is, however, often extended to include supratidal, intertidal and subtidal zones. Tidal channels, tidal beaches and salt marshes are also considered as a part of Getbol as they are influenced by tides.

The nominated property, the ‘Getbol, Korean Tidal Flat' has distinctive features when compared to common coastal tidal flats elsewhere. The property is formed by terrigenous sediments that are deposited around the numerous bedrock islands along the rocky coast. The term ‘Getbol’ used in this nomination dossier refers to the characteristic tidal flats formed around the islands including some bays and estuaries along the southwest coast of Republic of Korea (ROK).

The nominated property abuts the shores of the Korean Peninsula in the southeastern part of the Yellow Sea, which is located in the northwest of the Pacific Ocean. It is an outstanding representative system to conserve the coastal ongoing geological processes induced by unique geological systems combined with special oceanographic and climatic conditions. It also is an outstanding example of an ecosystem closely interrelated with the geological processes, being characterized by a variety of habitats. The geodiversity and biodiversity provide us with important ecosystem services for human society.

## 2.a.i The Yellow Sea

The Yellow Sea, similar to the Black Sea, the Red Sea and the White Sea, takes its name from its water color. Land-derived suspended sediments color the waters yellow. Located in the northwest of the Pacific Ocean, the Yellow Sea is situated on the margin of the Eurasian Plate. This sea, surrounded by ROK, DPRK, and China, is a submerged part of the huge Asian continent that has become a shallow sea due to sea level rise after the Last Glacial Maximum. With the Holocene sea level rise, this land area was transformed into a shallow sea just like the Persian Gulf and the Sunda Shelf and became one of the few remaining epicontinental seas. The Yellow Sea has an average depth of 44 m (the deepest part being 103 m). It has a vast and flat seafloor surface: The eastern side, neighboring the Korean Peninsula, is deeper and has a more rugged base than the western side close to China. Post-glacial sea level rise, which increased rapidly after the Last Glacial Maximum, began to slow down from about 9,000 yr BP and thus tidal flats began to form along the shores.

The Yellow Sea is characterized by a variety of tidal ranges. Tidal waves originating from the Pacific Ocean enter the Yellow Sea and move counterclockwise, pushing against the gently-shelving shores on the east. As a result, ROK's west coasts on the eastern side of the Yellow Sea all have macrotidal ranges (3.5-10 m), whereas all the Chinese coasts experience microtidal (<2 m) or mesotidal ranges (2-3.5 m). The tidal flats in the Yellow Sea region are supplied with the world's largest volumes of terrigenous sediments. Situated next to the eastern part of the gigantic Asian continent, the Yellow Sea presents a coastal environment with distinct seasonal changes due to the strong continental monsoon climate. Huge amounts of sediments come from the Yellow and Yangtze rivers in China as well as from Yalu, Daedonggang, Hangang, Geumgang and Yeongsangang rivers on the Korean Peninsula. The sediments discharged are redistributed around the shores by tides and waves generating vast mud and sand flats around the edge of the Yellow Sea.

Thanks to the large amounts of nutrients supplied by the rivers, primary production in the Yellow Sea is more than double that of the world's oceans. This high primary production in the nominated property has provided diverse invertebrates and fish with well-established habitats. These tidal flats are also a vital stopover site for over ten million migratory birds traveling from the breeding grounds in Siberia and Alaska to the overwintering grounds in Australia and New Zealand during austral summers. In particular, the Yellow Sea hosts the world's highest ratio of endangered migratory bird species along the East Asian-Australasian Flyway (EAAF), the most vulnerable route among the three main global flyways. More than 30% of the total population of 25 shorebirds and plover species traveling to and from their breeding grounds use the Yellow Sea tidal flats as a stopover site. Among these birds, the population of 15 species, which include the great knot (*Calidris tenuirostris*), essentially rely on the Yellow Sea tidal flats for their survival. Above all, the Yellow Sea tidal flats are the last refuge for spoon-billed sandpipers (*Eurynorhynchus pygmeus*). There are only 300 to 600 sandpipers left in the world. These waterbirds have been decreasing in number due to human influence. Therefore, the area is receiving much attention from around the world, including the IUCN.

The rich biodiversity found in the nominated property plays an important role not only for the living organisms in the tidal flats, but also for us humans. Humans have been living near the tidal flats for thousands of years, using them as necessary food resources. Traditional fishing activities based on indigenous knowledge have become a part of the tidal flat ecosystem itself. The property has kept alive traditional fishing techniques, and thus all human activities have a direct lineage from ancient times to the present day and will continue to be practiced into the future.

At World Conservation Congresses in 2012 and 2016, the IUCN adopted resolutions 5.028 and 6.026 emphasizing, respectively, the importance of the Yellow Sea region intertidal zone and the urgent need for its protection. The nominated property, located on the southeastern side of the Yellow Sea, is an intertidal zone with thousands of islands. The property displays very different geological features and diverse biological processes compared to those found on the western and northern sides of the Yellow Sea, which are characterized by open-coast and deltaic-estuarine environments. This clearly shows that the property makes a distinct and unique contribution to the geodiversity and biodiversity of the Yellow Sea, as well as assisting in its conservation.

The three countries surrounding the Yellow Sea have been making efforts to protect the Yellow Sea's natural environment. With the inscription of the nominated property as a UNESCO World Natural Heritage site, the Yellow Sea region will play a very important role in conservation of the natural heritage that is dear to all humankind.

**Figure 2-1.** Representative scenery of the inner part of rocky island-type (archipelagic) mud flat in the nominated property (Shinan Getbol)

# 2.a.ii Physical Setting

## 2.a.ii.1 Tectonics and Geomorphology

### • Formation of Archipelagic Coast

The tectonic framework of East Asia in general, including the Korean Peninsula, can be characterized by two major factors: the northwestward-directed subduction of oceanic crust beneath the Japanese Island Arcs and the eastward expulsion of continental crust by the collision of the Indian and Eurasian plates. The Korean Peninsula has experienced a complex tectonic history, although it now stands in a tectonically less active region at the margin of the stable, eastward-pushed continental crust. During the Paleozoic Era, the small and independent continents, located near the equator but not far away from the Gondwana Supercontinent, gradually moved to the north. They then collided and merged with the Laurentian Supercontinent during the Mesozoic Period to attain their present shape and position.

During these tectonic movements, the Yellow Sea region, including the Korean Peninsula and southeastern China, merged (obducted) as part of the same continent on the margin of the Eurasian Plate. Subsequently, as the Pacific Plate continued to subduct to the west, the southern region of ROK as well as the Yellow Sea area were influenced by severe tectonic movements and volcanic activities in various forms during the Jurassic to Cretaceous periods. In some areas, plutonic rocks were intruded.

The northeast-southwest tectonic structure of sedimentary basins on the Korean Peninsula and the Yellow Sea is attributable to the relative movement of the Eurasian and Pacific Plates. The Korean Peninsula, being located closer to the subduction zone than China, witnessed the uplift of many uplands induced by active tectonic movements and intrusion of plutonic rocks since the Jurassic Period. Explosive volcanic activities were widespread in the southern part of the peninsula during the Cretaceous Period. These are why the Peninsula and its western coastal area show very irregular landforms with high topographic relief. Thus the movement of the two plates has also influenced the formation of the coastal geomorphology of the sedimentary basins.

With the long period through the Quaternary of alternating glacial and interglacial cycles, repeated sea level rise and fall has resulted in submergence and emergence of the area. Different styles and rates of erosion and weathering occurred during these episodes, with rugged relief being developed across the area during times of low sea level. Since the Last Glacial Maximum, sea level rise has resulted in submergence of the lower parts of the Yellow Sea, transforming the more rugged and hilly eastern regions of the Yellow Sea into islands. Consequently, the southeast coasts of the Yellow Sea (or the southwest coasts of the Korean Peninsula) evolved into an archipelagic coastal region with over 3,000 rocky islands and complex coastlines. The nominated property includes more than 900 islands, between which are vast areas of tidal flats. The height of the rocky islands is mostly under 100 m, but some islands reach 300 m. The outer islands of the archipelago dampen ocean waves and disperse their energy, and so prevent the tidal flat sediments from being washed out to the sea. This results in a stable region of tidal flats within the protected inner area of the archipelago.

Because of the tectonic movements and the high rate of sedimentation in the western Yellow Sea, the deepest parts are found on the eastern side. The terrigenous sediments coming from the Yellow and Yangtze rivers in China become widely dispersed upon reaching the sea, and the western side of the Yellow Sea therefore displays a relatively gentle seafloor topography. On the ROK's side, by contrast, terrigenous sediments supplied by Hangang and Geumgang rivers are transported southwards by strong coastal currents. These flows have generated the north-to-south-oriented shallow marine and coastal sedimentary deposits with a relatively steep sea-floor topography.


**Figure 2-2.** Bathymetry and distribution of surface sediments in the Yellow Sea and the northern part of East China Sea (after Koh and Khim, 2014)

## • Sea Level Rise and Formation of Tidal Flats

Sea level during the Last Glacial Maximum was approximately 130 m lower than the present and it began to rise towards its present level from about 20,000 years ago in the southern part of the Yellow Sea. Sea waters flooded the continental shelf of the South China Sea and eventually also the Yellow Sea. It was only 14,000 years ago that the Yellow Sea became a sea. It is suggested that the sea level around the Yellow Sea shows a step-like rising pattern of submergence (Figure 2-3). The sea level rose rapidly until about 9,000 years ago, to reach the level of 15 to 20 m lower than the present. From then onward, the rate of sea level rise decelerated and the modern coastline became defined some 4,000-6,000 years ago.

The Yellow Sea is largely a shallow and wide gulf, the shorelines of which are lined by extensive tidal flats produced in the course of the Holocene sea level rise. The slowing down of sea level rise about 9,000 years ago also resulted in the reduction of capacitive (accommodation) space in the Yellow Sea basin (Figure 2-4). As a consequence, terrigenous sediments began to accumulate along the shores to produce the modern tidal flats.

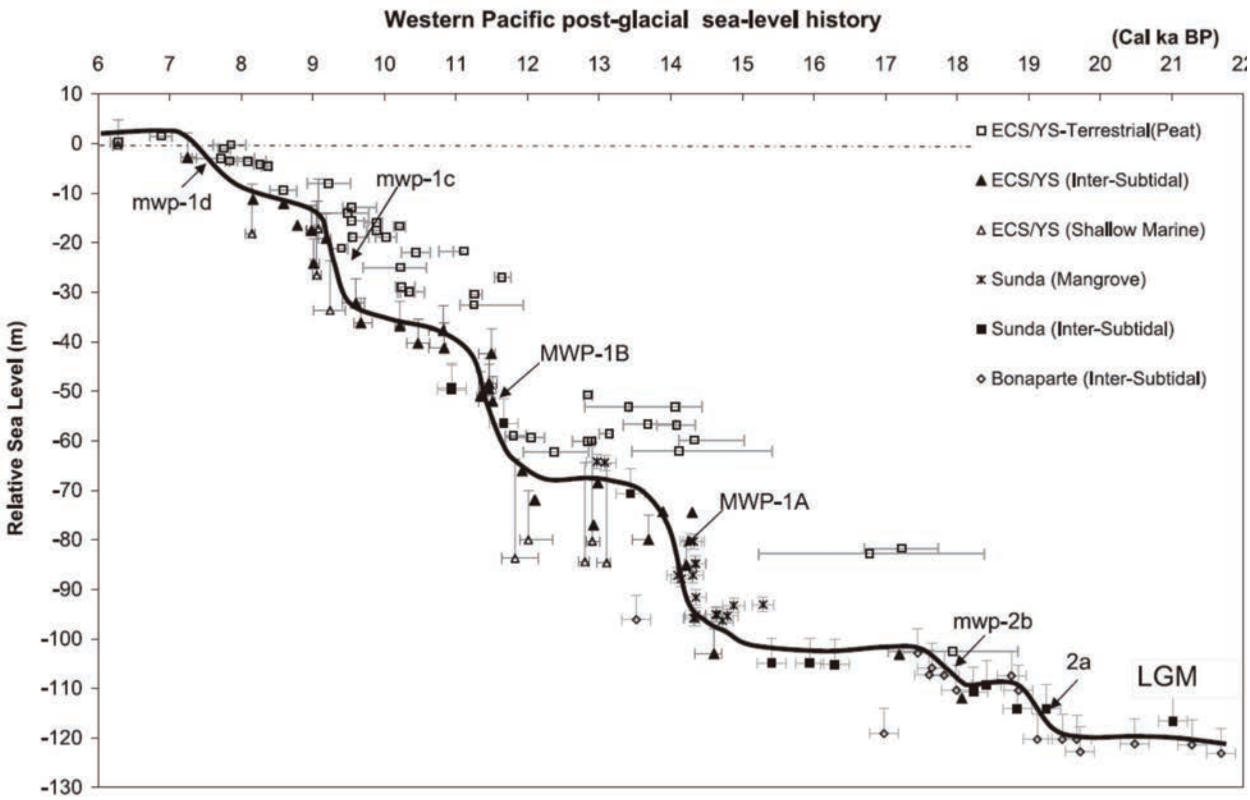



Figure 2-3. The Holocene sea level rise after the Last Glacial Maximum in the region of the Yellow Sea (Liu et al., 2004)

Large-scale tidal flats along the coasts of the Atlantic Ocean, including those of the Wadden Sea in Germany-Netherlands-Denmark and Georgia Coast in U.S.A. have been formed in general from offshore sediments, carried by tidal currents towards coastal areas with recent sea level rise. The sediments have been supplied and redistributed mostly from Quaternary glacial deposits, although there has also been a contribution by rivers, such as the Rhine.

The tidal flats along the west coast of the Korean Peninsula have been formed by the accretion of terrigenous sediments supplied by the Peninsula's rivers in the course of their dispersal by tidal flat currents, wave action and wind-driven longshore currents. As a result, vast tidal flats have developed along the southwest coast, with even wider tidal flats forming around the estuary of large rivers and the island coasts. The open coasts, estuaries and bays of ROK's southwest coast mostly display the characteristics of the archipelagic and/or rias coast and thus wide tidal flats have developed close to the islands.

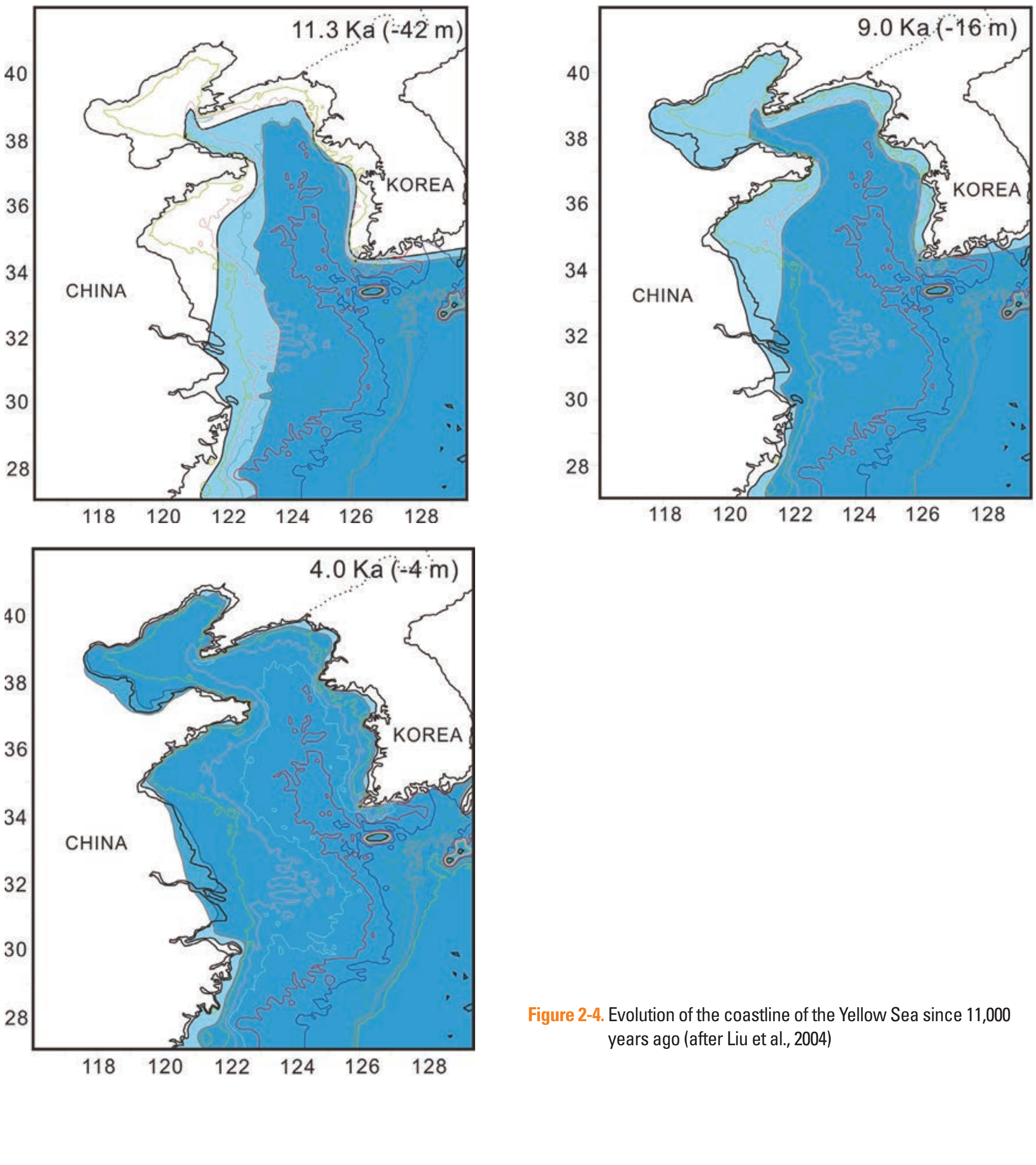


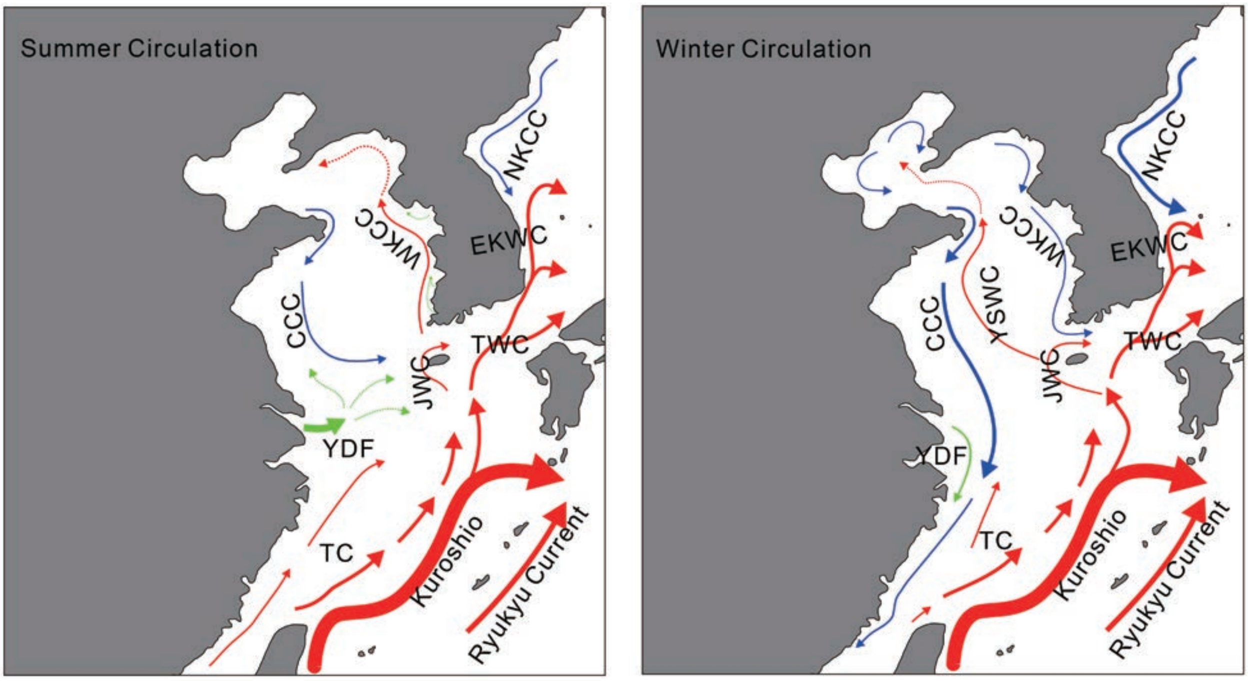

**Figure 2-4.** Evolution of the coastline of the Yellow Sea since 11,000 years ago (after Liu et al., 2004)

## 2.a.ii.2 Hydrology

### • Oceanic Currents

The North Equatorial Current turns to the north near the Philippines in the western Pacific Ocean and evolves into the Kuroshio Current as it moves along Taiwan and Japan. This current soon diverges into two streams: the Yellow Sea Warm Current, which enters the Yellow Sea through the southern sea of the Korean Jeju Island, and the Tsushima Warm Current, which flows through the waters between ROK and Japan to arrive at the East Sea. The Yellow Sea Warm Current even forms a longshore current in winter near China until it reaches Bohai Bay.

Those currents that affect the west coast of ROK change their flow patterns with the season (Figure 2-5). In winter, cold water from Bohai Bay moves down to the south and strong northwesterly winds change it into the powerful West Korea Coastal Current. In summer, waters discharged from the Yangtze River are sometimes pushed by the southeast monsoon to become the Yellow Sea Warm Current towards the west coast of ROK. A longshore current is then formed and moves up along the west coast of ROK. This seasonal change of the West Korea Coastal Current plays an essential role in containing suspended sediments that contribute to the extensive mud flats in the nominated property.




CCC : Chinese Coastal Current
TC : Taiwan Warm Current
YDF : Yangtze River Discharge Flow
WKCC :West Korea Coastal Current
JWC : Jeju Warm Current
YSWC : Yellow Sea Warm Current
NKCC : North Korea Cold Current
EKWC : East Korea Warm Current
TWC : Tsushima Warm Current

**Figure 2-5.** Schematic diagram illustrating major current systems in the Yellow and East China seas and the adjacent areas (after Guan, 2004)

• **Tides and Waves**

Tidal-wave shoals from the Pacific Ocean traverse the entrance of the Yellow Sea and a shallow continental shelf and run to the northwest. Rotating counterclockwise, they then form a tidal system with four amphidromic points in the inner part of the Yellow Sea (Figure 2-6). With zero amplitude between the tidal rise and fall, an amphidromic point serves as an axis of rotation for tidal waves. The points in the Yellow Sea are tilted towards the west. For these reasons, most of the coastal areas in China have mesotidal ranges of less than 3.0 m , whereas the ROK's coastal region shows a macrotidal range of more than 4.0 m . The tidal range even reaches up to 10 m around the estuary of Hangang River. The coasts near the nominated property are all macrotidal with ranges between 3.5 to 6.8 m . The tides in the property are semidiurnal with two tides that create two high and two low tides a day in N-S to NW-SE cycle. The macrotidal conditions in and around the islands have a significant influence on tidal flat sedimentation. The tidal flats surrounding individual islands are separated by deep channels in which the strong tidal currents change direction every 6 hours. In areas where the distance between islands are wide or where the island is connected to the Korean Peninsula, very wide tidal flats are created.

**Co-tidal Chart (M2)**

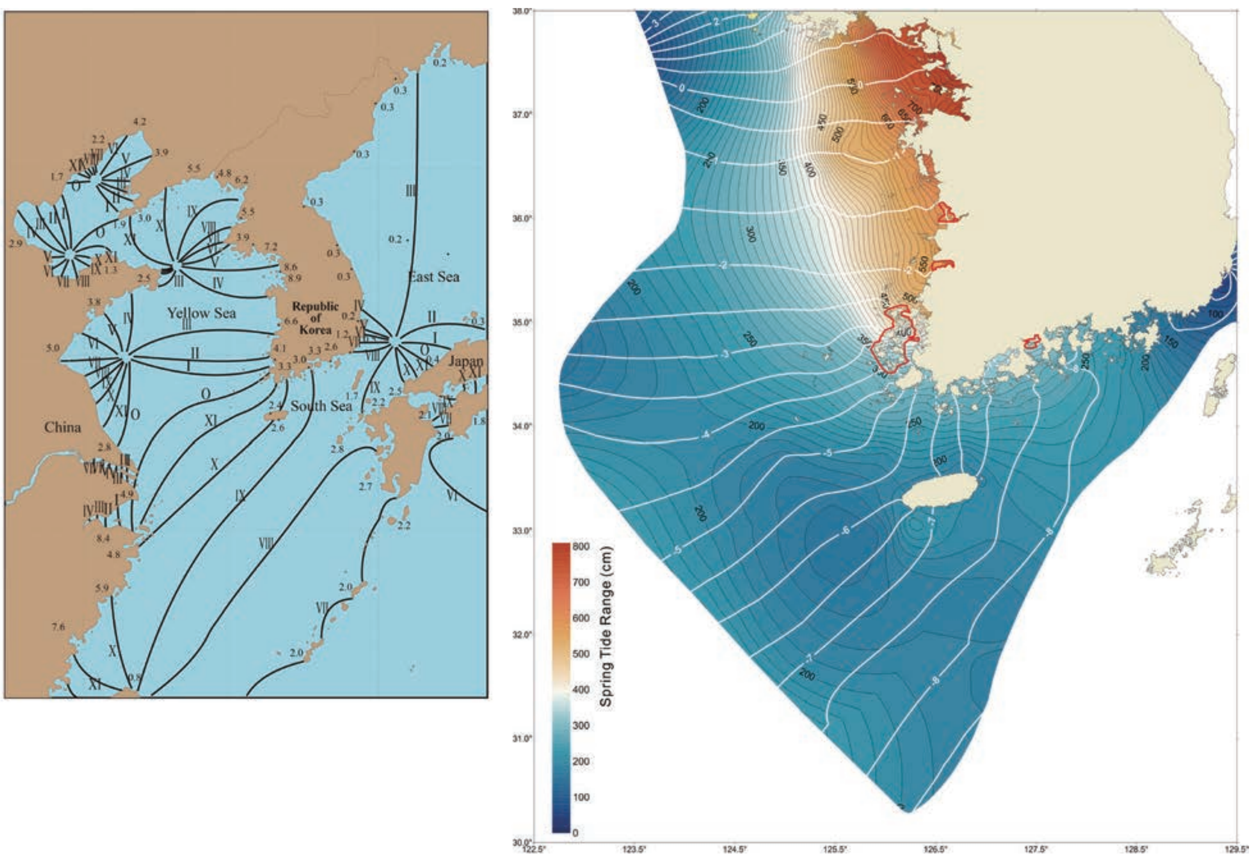



Figure 2-6. Co-tidal chart (M2 tide only) in the Yellow Sea and spring tidal range on the southwestern coast of ROK (after Guo and Yanagi, 1998; Kang et al., 2002)

Being located in the eastern parts of the Yellow Sea, the property is greatly influenced by the continental-monsoon-driven seasonal change of wind waves. The height of waves reaches generally 3 to 5 ㎧ in winter in the open seas of the property and lowers to 1 to 2 ㎧ in summer. Yet, the inland seas of the property experience only small waves with height no greater than 50 ㎝ regardless of the season.

### • Cold Water Mass

The seasonal Yellow Sea Cold Watermass forms in the bottom layers in the middle part of the Yellow Sea from April to November. When compared to nearby waters, these waters have lower temperatures and are highly saline. Its distribution and scale changes with the seasons. In fact, this cold watermass is formed when the chilled coastal waters of Bohai Bay sink below the surface in winter. Due to the Yellow Sea Cold Watermass, the sediments discharged from major ROK's rivers or others delivered by the West Korea Coastal Current are not washed away to the open sea. As a result, the property maintains a stable sediment supply system.

## 2.a.ii.3 Climate

### • Continental Monsoon Climate

Being in a warm and humid continental temperate climate zone (Dfa), the nominated property is hot and rainy in summer and cold and dry in winter. With four clearly distinct seasons throughout the year, the property is generally humid and shows a big difference in temperature between summer and winter months. The property is dominantly influenced by the ocean in summer and by continent in the winter, as it is strongly affected by East Asian continental monsoon climate (Figure 2-7).

The presence of a continental monsoon climate is strong across the entire Yellow Sea. Hence, strong northwesterly winds blow during winter time and these turn to the weak southeasterly winds in summer. When the winter comes, the dominant northwesterly wind travels longer distances southeast across the Yellow Sea. With longer fetch (the travel distance) and duration (the travel time), the waves near the property grow higher. The outer coast of the property is hit by an average of 4 to 7 storms a month during the winter, but almost none during the summer with the exception of occasional typhoons (Figure 2-8).

As a result of such activities, ROK's west coast becomes wave-erosion-dominated because of storms in winter and changes into tide-deposition-dominated in summer. The alternation of summer deposition and winter erosion are clearly evident in the open-coast tidal flats along the west coast of ROK. Among the components of the nominated property, it leaves a particularly clear geological record in outer parts of the Gochang and Shinan Getbols, which are characterized by wave-dominated sand flats influenced by winter monsoon activities. This phenomenon is a critical feature affecting the redistribution and stable deposition of sediments onto the tidal flats in the property. The warm and humid temperate climate of the Korean Peninsula has resulted in sufficient chemical weathering and contributes significantly to the sedimentation that forms the tidal flats.

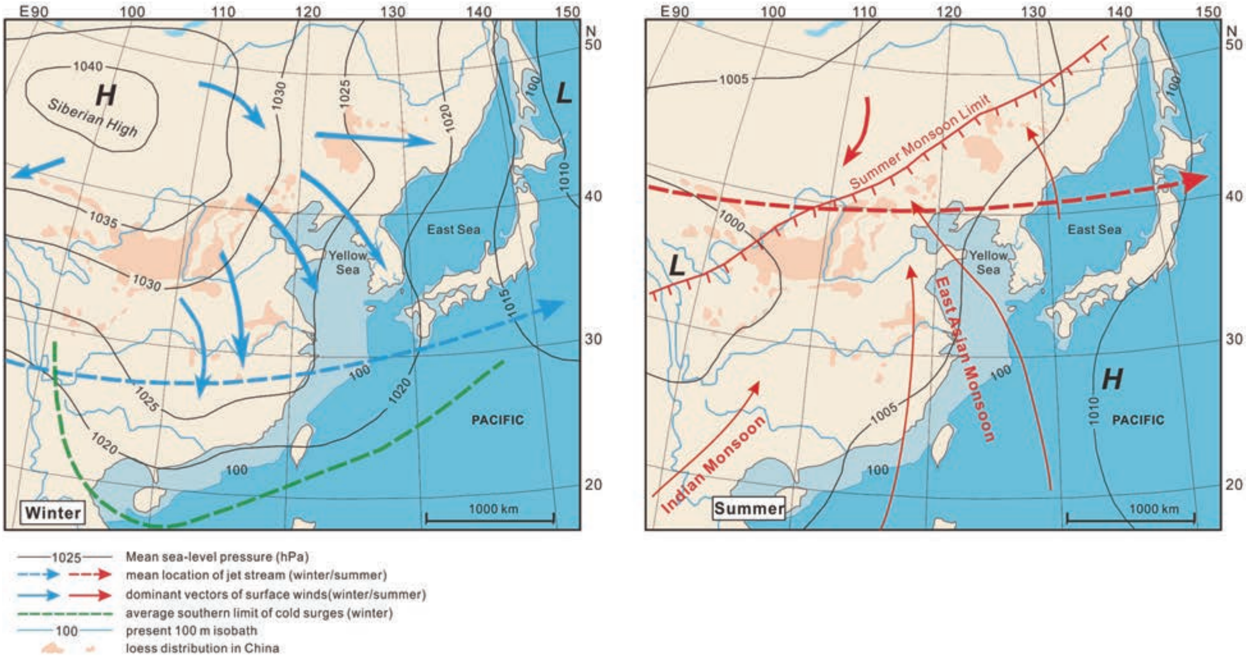



**Figure 2-7.** Seasonal changes in the wind system of the East Asian monsoon area (modified after Yi, 2011)

### • Localized Heavy Rains and Typhoons during Summer

The annual average precipitation in ROK reaches about 1,300 ㎜. About 60% of the precipitation is concentrated between June and September with rains as heavy as over 400 ㎜ per day, often accompanying a typhoon. Such strong rainfall delivers large amounts of suspended sediment to the ROK's west coast. The Yellow Sea is one of the basins that contains the world's largest volumes of terrigenous sediments, due to its climate, large rivers nearby and the geological and the climatological characteristics of drainage basins.

Typhoons created in the southwest part of the Pacific Ocean bring heavy rains and strong winds as they visit the property several times a year in summer and early autumn (Figure 2-9). One or two typhoons in a decade can be strong enough to erode up to 10 to 30 ㎝ of the upper layer of the tidal flats. These typhoons erode and redistribute much of the surface sediments of tidal flat from the nominated property. The tidal-flat surface disturbed by human activities returns to its natural state within three months after a typhoon attack (Chun et al, 2004b). This plays a crucial role in maintaining the overall health of the sedimentary system and associated habitats.

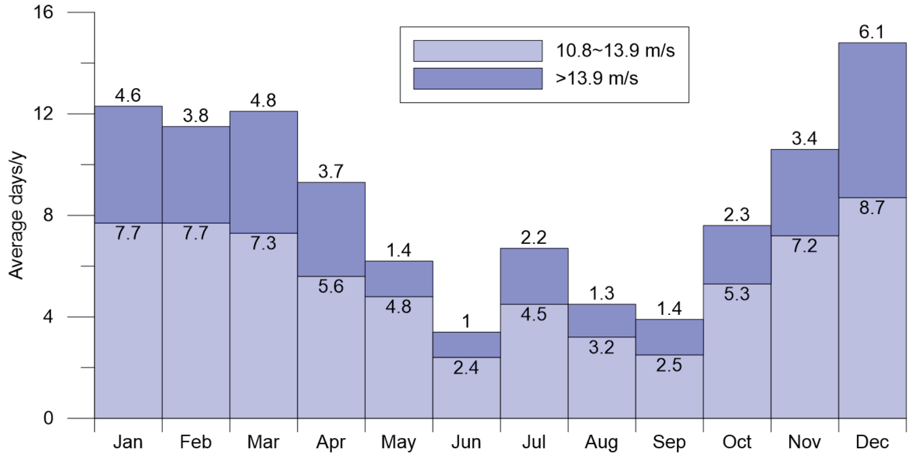



Figure 2-8. Annual distribution of the frequency and intensity of storm winds over the period 2007-2017

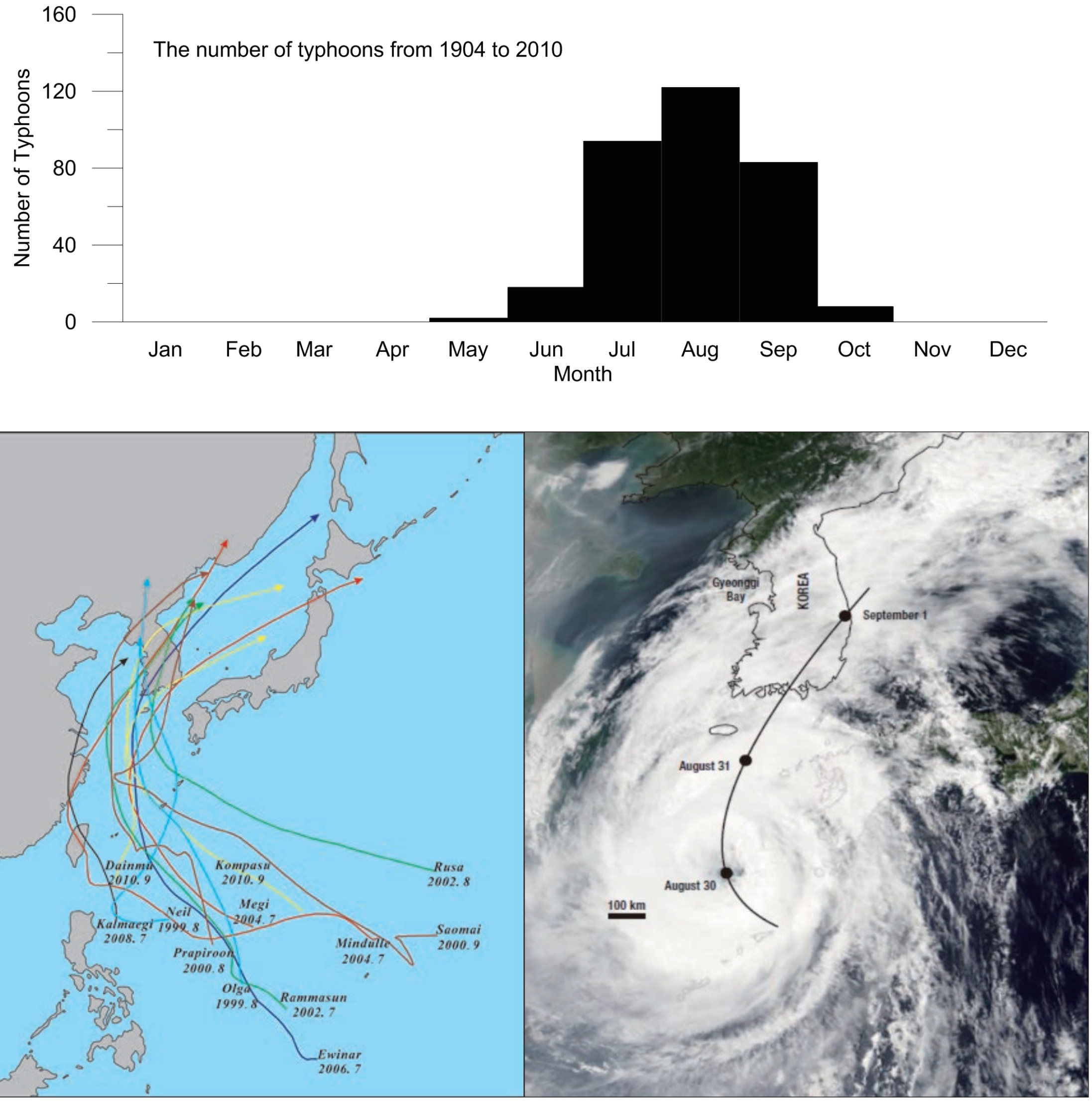



Figure 2-9. Frequency of typhoons that passed through the Yellow Sea from 1904 to 2010, the simplified pathways of typhoons since 2000 and an image of Typhoon Rusa (August 2002)

## 2.a.ii.4 Circulation of Sediments: supply and transport

### • Supply of Terrigenous Sediments

Due to the high mountain ranges of the eastern Korean Peninsula, slopes to the east coast are narrow and steep, whereas those to the west coast toward the Yellow Sea are wide and gradual. Thus, the peninsula clearly shows an asymmetrical, high-east-low-west terrain. This is why most of the major rivers on the Korean Peninsula flow to the west into the Yellow Sea. Terrigenous sediments from the rivers, including Amnokgang (Yalu), Daedonggang, Hangang and Geumgang rivers (over 400 ㎞ long) as well as Yeongsangang River (150 ㎞ long) which are all major rivers flowing to the coasts of the Yellow Sea, are as bountiful as those found in other major rivers around the world. This is partly due to active chemical weathering under warm and humid temperate climate. This process produces large quantities of terrigenous sediments enriched in nutrients. With the aid of perennial rivers, the sediments are continuously transported to the sea. Geumgang and Yeongsangang rivers together, for instance, supply an average of 10 ㎦ of sediments per year to the coastal zone of the property.

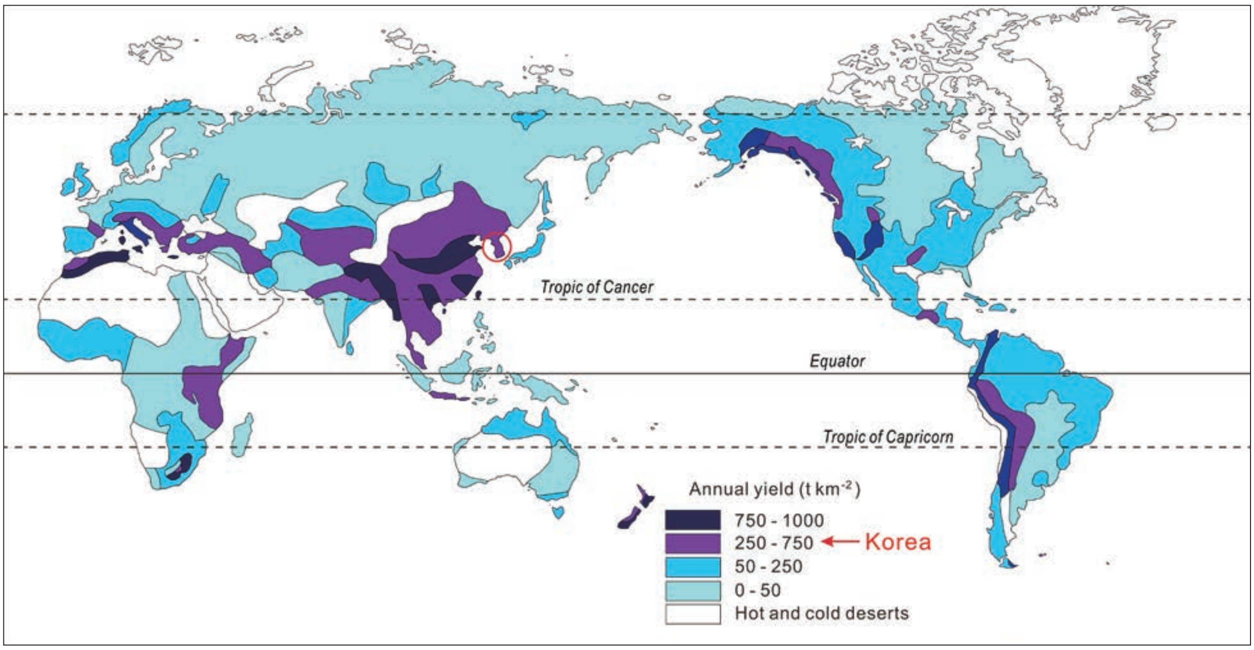



Figure 2-10. Map of the world indicating annual terrestrial sediment yields (after Smithson et al., 2002)

The coasts along the Yellow Sea are one of the areas that receive the largest volume of terrigenous sediments in the world. The western coasts, in particular, receive the largest volume of terrigenous sediments due to multiple environmental factors – geologic, geomorphologic and climatic conditions as well as the basin areas being drained. The supply of sediments to the western coasts outpaces the increasing rate of accommodation space induced by sea level rise. This explains why most of the tidal flats here are of the deltaic-estuarine type. The eastern coast of the Yellow Sea also sees a lot of terrigenous sediments flowing into the Yellow Sea. On the eastern coast, the sea level rise has created more space for the sediments to accumulate and the riverine sediments from the Korean Peninsula has filled that space continuously. Also, multiple factors including currents with macrotidal range, waves caused by the East Asian monsoon climate and the ocean currents that flow in the Yellow Sea all contribute to the repeated sedimentation, erosion and transportation, ultimately pushing the sediments towards the shore and thus forming the tidal flats of the nominated property.

### • Transport of Sediments

When torrential rain falls in summer, sediments transported from Geumgang and Yeongsangang rivers (Figure 2-11) are temporarily stored near the coast in the front of estuaries. The fine-grained sediments lying on the upper part of tidal flat sediments are resuspended by strong waves in winter and are transported further to the southern coasts by the West Korea Coastal Current and redistributed onto the intertidal flats by tidal currents.

The resuspended fine-grained sediment passes through Seocheon Getbol near Geumgang River estuary and then onto Gochang Getbol until they arrive at Shinan Getbol by the seasonal coastal process. Some fine-grained suspended sediments make the trip to Boseong-Suncheon Getbol within Yeojaman Bay in the South Sea. Parts of the suspended sediment even voyage out to the open Yellow Sea, pushed along by the coastal current, to be deposited onto the Heuksan Mud Belt (HMB) (Figure 2-12). The HMB, on the inner continental shelf, serves as a reservoir of muds and doubles as a storage for the stable sedimentation of the property.

The volumes of suspended sediment reaching the south coasts are relatively small compared to the sediments accumulating in other parts of the property. However, they continue to move eastward carried by the Jeju Warm Current (JWC in Figure 2-5), one of branches of Kuroshio Current, and eventually settle onto the sea floor near coasts or inside Yeojaman Bay where wave energy is weak. Sediment that does not reach the bays of the southern coasts is deposited in the subtidal zone, accumulating as the Central South Sea Mud (CSSM). The suspended sediment that successfully moves from Geumgang River to the entrance of the Yeojaman Bay ends up by being deposited in Boseong-Suncheon Getbol, a part of the nominated property. Therefore, the property is characterized by a single sedimentary system from source (Geumgang River) to sink (Yeojaman Bay).

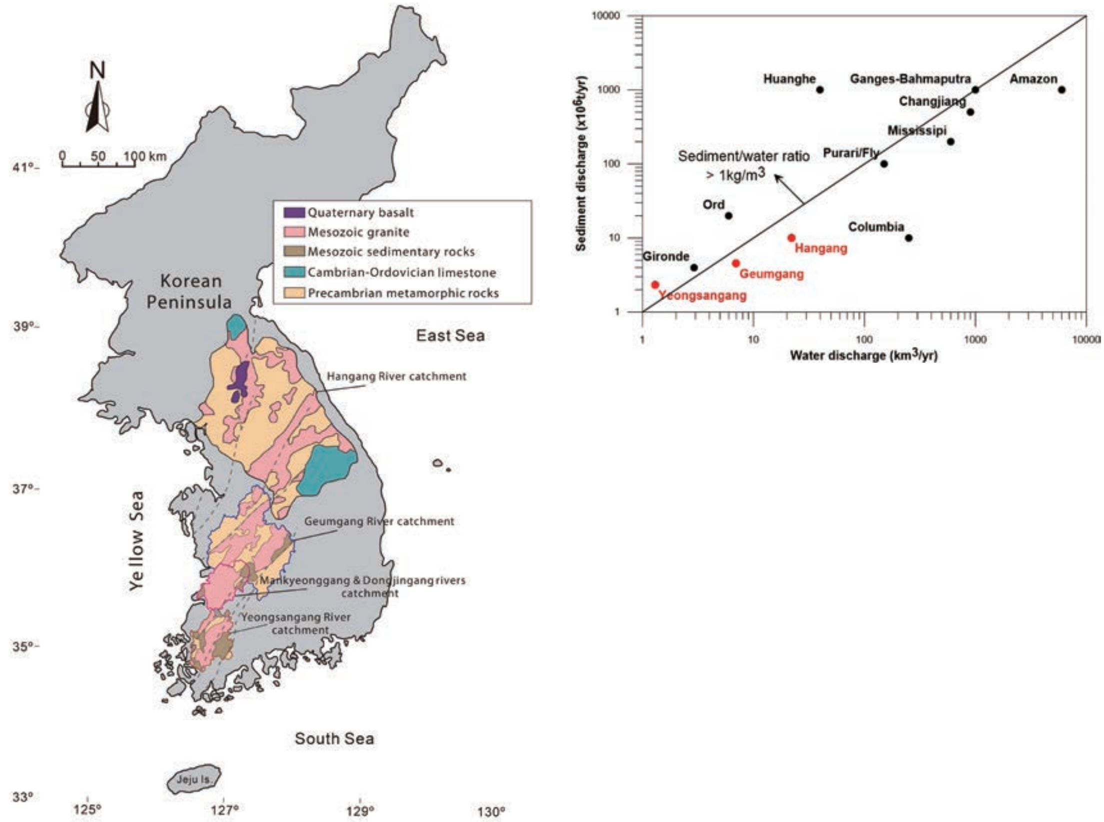



**Figure 2-11.** Bedrock geology in Hangang, Geumgang and Yeongsangan rivers catchment and their water and sediment discharges compared to other well-known rivers (modified after Smithson et al., 2002; Walling and Webb, 1983; Wright and Nittrouer, 1995; Chough et al., 2004)

### • Dynamic Circulation System of Suspended Sediments

The characteristic features of the nominated property – numerous islands, complex coastlines, deep tidal channels and macrotidal range – help ensure the dynamic circulation of tidal currents. At the same time, waves, whose energy regime changes seasonally under the continental monsoon climate, and summer floods dynamically refresh the whole circulation of supply, reworking, transport and redistribution of suspended sediments. The tidal currents in the property change their speed and direction dramatically due to the geomorphological characteristics, resulting in complex inner tidal channels and various sedimentary sequences of tidal flats. In addition, the fast running currents in deep tidal channels between islands cause erosion or nondeposition at the channel base. Consequently, deep tidal channels are maintained even in the inner parts of the property despite slow sea level rise and the rapid sedimentation of mud flats around the island coasts. Tidal ebb currents rushing southward in the inner parts of the property even move suspended sediments far offshore, contributing to the formation of a sedimentary circulating system in the property as a whole and probably to a uniform redistribution of sediments.

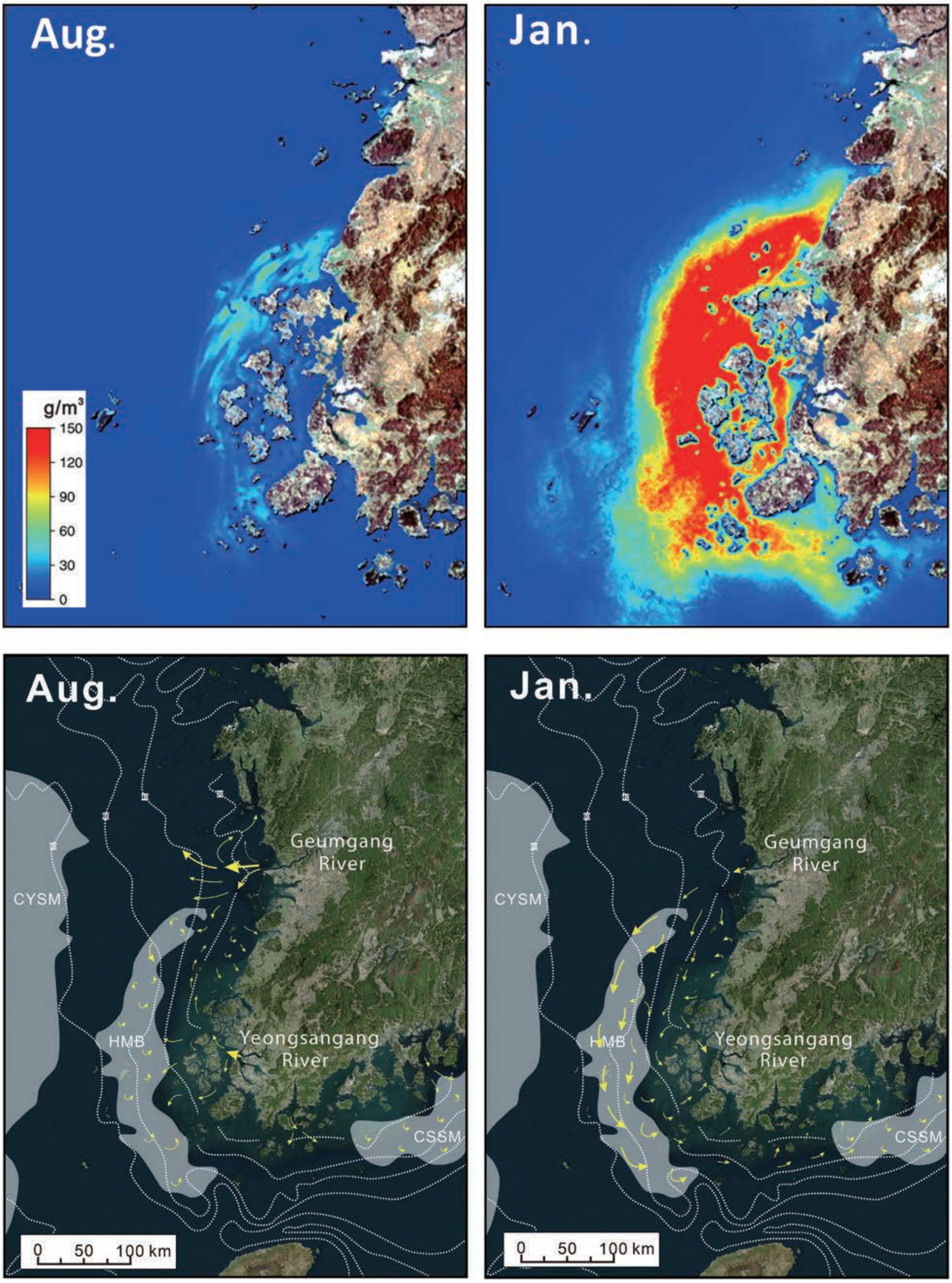



**Figure 2-12.** Satellite images of suspended sediment concentration and distribution and its transport pattern in the South and West Coasts of ROK (Chun, 2018). HMB, Heuksan Mud Belt; CYSM, Central Yellow Sea Mud; and CSSM, Central South Sea Mud

## 2.a.iii Geological and Geomorphological Features

### 2.a.iii.1 Geological Diversity and Seasonal Change

The nominated property is composed of numerous small-scale tidal flats in which the sedimentation in each tidal flat may differ according to the difference of the hydraulic energy that changes by season, complicated topography and the distance from sediment source. Each tidal flat is characterized by a different topography and distinctive physical features (sediment supply and interaction and reactivation between tides and waves). As a result, each tidal flat has evolved into a coastal environment that houses diverse habitats including mud flats, sand flats, mixed flats, gravel beaches, rocky substrates, tidal beaches, sand dunes, tidal channels and tidal gullies. The location of these tidal deposits also differs depending on the relative strength of the tidal current and wave, as well as the distribution and location of the islands. In the tide-dominated inner archipelagic area, thick mud flats and deep tidal channels have developed. But on the wave-dominated outer parts of the archipelago, sand flat, gravel beach, rocky substrate, tidal beach and sand dune have developed (Figure 2-13). Various transitional habitats are also formed due to the physical and/or seasonal changes especially in the northwestern and southwestern corners of some islands located in outer parts.

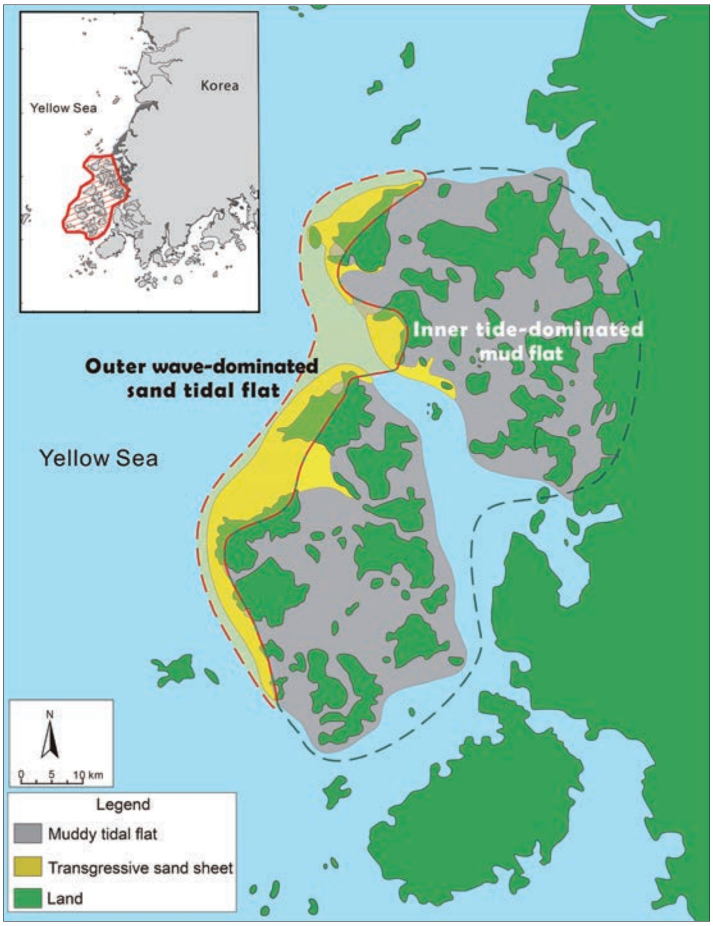



Figure 2-13. Surface sediment distribution in Shinan Getbol, displaying the typical sediment pattern of island type (archipelagic) tidal flats under East Asian monsoon climate system (Chun et al., 2015; Chun, 2018)

Seasonal movement of mixed-flat areas is seen on the coasts where waves compete with tides. The diverse physical features associated with the macrotidal range and many islands craft complex tidal creeks of various shapes on the mud flats. This physical diversity maximizes not only geodiversity but also biodiversity. Event processes such as typhoons in summer or formidable storms in winter produce the characteristic sedimentary bodies, which include typhoon deposits, storm deposits (tempestites), cheniers (elongate shelly ridges) and sand-gravel strings. These variable sedimentary bodies offer diverse habitats for the organisms.

Furthermore, some tidal flats in the outer parts of the property exhibit seasonal changes: some mud flats change into sand flats or mixed flats, governed by geomorphologic factors and monsoons. For instance, the mud layers made up of summer sediments on the outer parts of Gochang Getbol are eroded by 5 to 10 ㎝ in winter, which transform into sand flats. The outer parts of the property are also hit by powerful typhoons in summer and each invasion erodes the mud flat surface by 10 to 30 ㎝. This erosion is again rapidly compensated by a seasonal cycle of erosion and recovery. In contrast, the inner parts have no or very weak seasonal changes even by strong wind in winter time and typoon in summer, because they are protected by rocky islands. As a consequence, the outer or the western parts of numerous islands of the property show a wave-dominated coastal environment, whereas the inner parts develop wide, tide-dominated wide mud flats.

## 2.a.iii.2 Geomorphological Diversity and Types of Getbol

The archipelagic landforms refer to the areas where tectonic features and past climate change have resulted in erosional landforms with high peaks and low valleys, that eventually became submerged in the course of sea level rise. The nominated property has immensely diverse terrains. It has rocky shores which rise above and fall under the water continuously by tides, as its altitude is near the sea surface; it also has tall islands over 300 m in elevation. Thus, it furnishes a variety of habitats together provided by diverse landforms and various substrates. The habitat diversity is further reinforced by the compound effect of tidal currents and waves.

Especially, the area where many islands are distributed has a more complicated coastal environment, because of the geomorphology of the archipelagic features combined with significant tidal action. Because of the surrounding archipelagic geomorphology, tidal currents traveling through the islands in the inner parts flow rapidly along tidal channels. Here, fine-grained sediments cannot settle due to the speed of the tidal currents. Instead, those fine-grained sediments are transported toward the island shores where weaker currents enable deposition. Sediments either build mud flats here or are transported to the open sea in suspension. On the other hand, the outer side of the archipelagic tidal flats are exposed to waves and longshore currents that encourage formation of wave-dominated sand flats, tidal beaches, sand dunes and some rocky intertidal areas.

The nominated property can be categorized according to geological and geomorphological characteristics. The relationships between the island and adjacent mainland determine the different categories (Figure 2-14). All the Getbol types are in one way or another associated with islands. The first, 'estuarine type', experiences a depositional regime of suspended sediment around islands near river mouths. The second, 'open-embayed type', shows a deposition of suspended sediment around islands developed near and/or in embayments. The third is an 'archipelago type', in which numerous islands located close to mainland shore induce the deposition of suspended sediment between islands. The final type is a 'semi-enclosed type', in which island located within a bay trap sediments supplied from the land. The outer parts of the archipelago type have the features of the open-embayed type. Between islands, on the other hand, the mud flats show stable sedimentation. The two, therefore, can be distinguished. The open-embayed type may have similar shape and sedimentation process in the initial stage of development. According to these categorization, Seocheon Getbol represents the estuarine type, Gochang Getbol the open-embayed type, Shinan Getbol the archipelago type and Boseong-Suncheon the semi-enclosed type, together defining the serial sites of the nominated property.

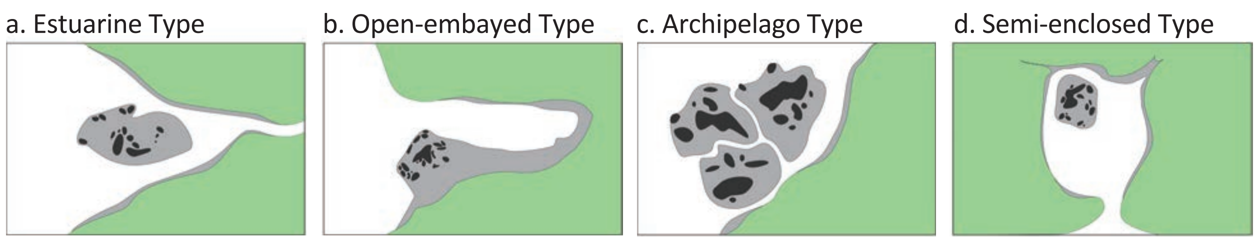



**Figure 2-14.** Various types of Getbol by geomorphological characteristics (Chun, 2018)

## 2.a.iii.3 Formation of Thick Mud-flats

### • Formation of Inner-side Thick Mud-flats

Sea level rise since the Last Glacial Maximum enabled sea waters to invade coastal areas of the eastern valleys of the Yellow Sea. At the deep valleys, tidal channels started to form by macrotidal currents, rushing into and out of the valleys. The tidal channels were able to maintain their depth due to the erosion processes of rapid tidal currents despite the ample supply of mud sediments onto the inner side of area which consists of numerous islands. The suspended sediments introduced by tidal currents were deposited on both sides of the tidal channels during high tide, forming narrow mud flats. As sea level continued to rise, the width and depth of the mud flats increased. Nonetheless, the depth of tidal channels was maintained since the speed of the currents running through the channels accelerated at the same time. As a result, thick intertidal mud flats were formed by vertical aggradation on the flank of channels in the inner parts of the islands, except for the bottom of tidal channels.

Unlike the inner parts, the outer parts of the islands go through winter erosion and summer deposition because of the hydrodynamics in the eastern regions of the Yellow Sea.

Sea level rise and subsequent increased wave activity have produced a transgressive erosional surface on sand-flat layers, which have moved towards the land, repeating the process of erosion and deposition. The marine transgression continued to erode mud and mixed flats on the upper tidal-flat surfaces and its shoreline moved in an inland direction. The Holocene sedimentary deposits in the outer parts are mostly thin (0.5 to 5 m ) and only parts of the preexisting mud flats remain due to the transgressive erosion. With the continuous rise in sea level, the property has witnessed a sustained formation of thin mud flats, laterally-migrating transgressive sand flats in the outer side and thick, vertically-aggraded mud flats inside.

The mud flats are found around the inner sides of the many islands. For about 8,500 years, Holocene mud sediments reaching more than 25 m thick have accumulated between the basement rock islands in a very stable and continuous manner in most places (Figure 2-15; Table 2-1). The surface of all mud flats in the inner side of the islands has kept up with the mean sea level rise. Their grain sizes and sedimentary structures of mud sediments are very similar to those of the upper intertidal mud flats and display a fining-upward, albeit weak sequential pattern. These sedimentary features are commonly observed when mud flats on the upper intertidal zones have formed following the sea level rise. It means that for 8,500 years, a sedimentary sequence of 25 m or more has been deposited on the upper intertidal mud flat. This is good evidence that the equilibrium between the sediment supply and the increasing rate of accommodation space induced by the sea level rise has been maintained for this long period. This stabilized and long-sustained intertidal mud accumulation on coastal zone is a critical, ongoing geological process and thick Holocene intertidal mudflat may be a unique characteristic of the property.

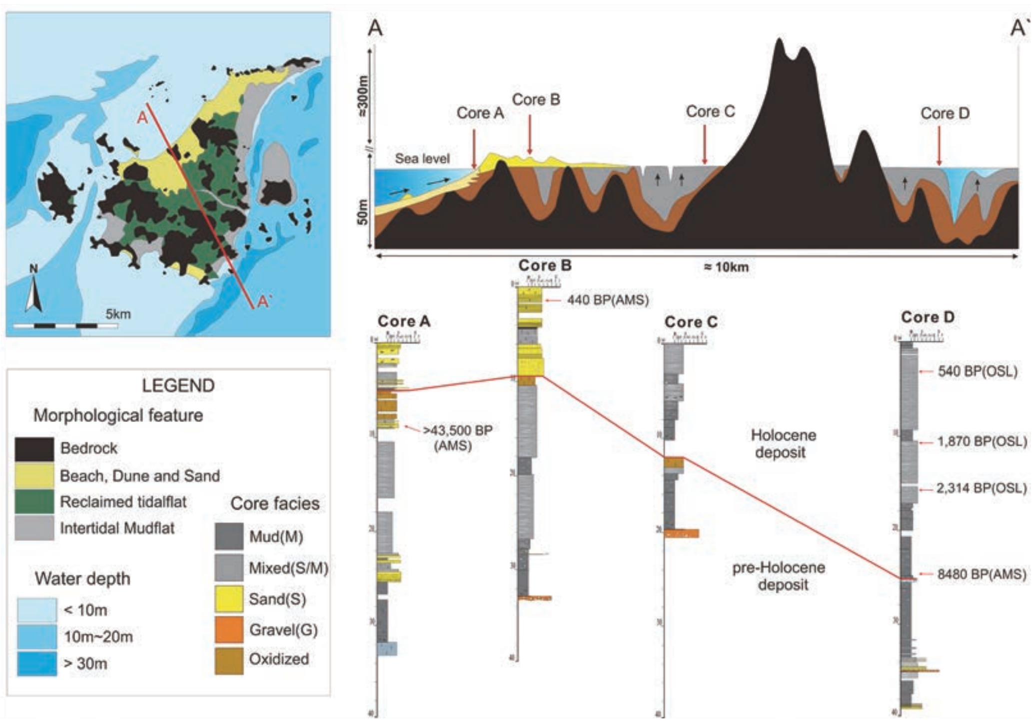



**Figure 2-15.** A representative cross section showing the Holocene and Pleistocene sequences in the Imjado Island of Shinan Getbol (Chun et al., 2015; Chun, 2018)

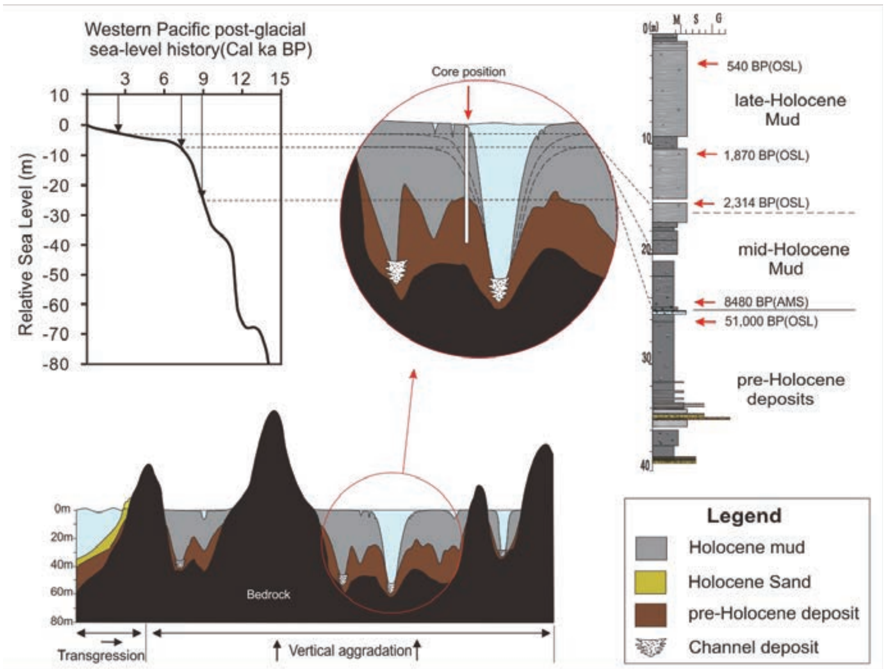



**Figure 2-16.** A schematic diagram of cross profile near Imjado Island showing the thickness of mud flats adjusted with sea level curve (Chun et al., 2015; Chun, 2018)

**Table 2-1.** Thickness of Holocene intertidal mud flat sequences (<9,000 yr BP) in the nominated property based on core data

| Components | Tidal Flat | | Holocene Sedimentary Sequences | |
|---|---|---|---|---|
| | | | Upper Sequence | Lower Sequence |
| Seocheon Getbol | Inner | Type | Mud Flats | Mud Flats |
| | | Thickness | > 6 m | |
| | Outer | Type | Sand Flats | Mud Flats |
| | | Thickness | ~ 3 m | > 3 m |
| Gochang Getbol | Inner | Type | Mud Flats | Mud Flats |
| | | Thickness | > 20 m | |
| | Outer | Type | Sand Flats | Mud Flats |
| | | Thickness | ~ 5 m | ~ 3 m |
| Shinan Getbol | Inner | Type | Mud Flats | Mud Flats |
| | | Thickness | > 25 m | |
| | Outer | Type | Sand Flats | Mud Flats |
| | | Thickness | > 4 m | ~ 6 m |
| Boseong-Suncheon Getbol | Inner | Type | Mud Flats | Mud Flats |
| | | Thickness | > 4 m | |
| | Outer | Type | Mud Flats | Mud Flats |
| | | Thickness | > 4 m | |

About 8,500 years ago, the mean sea level was 10 to 15 m lower than the present. Most tidal flats around the world began to be formed at this time. Considering this sea level change, the thickness of the tidal deposits around the world should be approximately 15 m or thinner. Actual thickness of intertidal deposits is generally about 6-10 m across the world and that of mud layers on the upper intertidal deposits is even thinner.

Where there is a high supply of terrigenous sediment, deltaic-estuarine tidal flats tend to have very thick tidal sedimentary sequences including subtidal layers when the sea level rise and sediment supply are balanced. Despite this potential, most of the deltaic-estuarine tidal flats in the world usually do not contain sedimentary deposit over 10 m in thickness. It is because delta fronts cannot be free from the influence of sea level rise. Besides, deltaic sediments tend to prograde towards offshore instead of aggrading vertically. Therefore, tidal Holocene mud flats are not commonly thick. Exceptionally in Wadden Sea tidal flats which correspond to lagoonal setting protected by barrier islands, the thickness of the Holocene tidal-flat sequence including subtidal and channel deposits reaches up to 18 m.

Very thick intertidal mud sequences have formed in the middle-to-upper tidal flats, dominantly by tidal currents with large suspended loads. The Holocene intertidal sequences in the property started to deposit below 10 to 25 m in depth (Table 2-2). The intertidal mudflats thicker than 25 m have also formed in some places in the nominated property over the last 8,500 to 9,000 years BP, when sea level was roughly 15 to 20 m lower than the present. This fact may seem like a scientific contradiction. This is partly explained by the fact that the coasts of the nominated property have experienced higher tidal range than 4 m. However, the intertidal mud flats are developed at the middle-to-upper part of intertidal flat near and over mean sea level in the property area. Therefore, it is hard to fully explain the formation of the intertidal mud flats only with tidal difference, which are thicker than the height of sea level rise. The property is representative of macrotidal, archipelagic setting with deep tidal channels and sufficient supply of suspended sediments. About 8,500-9,000 years ago, macrotidal currents might have run through tidal channels situated 10 to 20 m lower than the sea surface (mean sea level) because of the macrotidal archipelagic characteristics. Tidal currents containing large amounts of suspended sediments contributed to forming the intertidal mud flats on the margin of deep tidal channels and on the flats between the tidal channels and rocky islands at high tide. As sea levels rose rapidly, the surface of the mud flats climbed rapidly as well, forming intertidal mud flats more than 25 m thick near the narrow margin of current tidal channels as of today (Figure 2-16). The property may be the thickest Holocene intertidal mud flats in the world ever known. It is also a unique tidal flat that has sustained the oldest and thickest and ongoing intertidal mud-flat formation that has occurred in the literatures.

**Table 2-2.** Comparison of the maximum thickness of inter-/sub-tidal mud flat deposits around the world

| | Nominated Property | Open-coast tidal flat | | Chenier plain tidal flat | | Delta | | | Lagoon | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | King Sound, NW Australia | Chinese Coast, China | Gulf of carpentaria, Australia | Firth of Thames, New Zealand | Colorado River delta, U.S.A. | Mekong Delta, Vietnam | Yangtze River Delta, China | Georgia U.S.A. | Wadden Sea, Denmark, Germany, Netherlands |
| Thickness of mudflat sequences | > 25 m | < 6 m | < 10 m | < 6 m | < 6 m | < 1 m | < 10 m | < 10 m | - | < 18 m |
| | intertidal flat | intertidal flat | intertidal + subtidal flats | intertidal + subtidal flats | intertidal + subtidal flats | intertidal flat | intertidal + subtidal flats | intertidal + subtidal flats | marsh | intertidal flat |

### • Types of the Thick Mud-flat Sequences

Mud-flat sequences in the nominated property shows different characteristics and sequencial types according to geomorphological features, the location and altitude of the islands, the sediment supply and the pattern of tidal currents (Figure 2-17).

Type A is a sequencial type showing thick mud flats and very steep/deep tidal channels with islands that have high altitudes. Shinan Getbol is a Type A tidal flat, with its 25 m deep mud sediments in the intertidal area. The Optically Stimulated Luminescence (OSL) time stamp at the border lines of the layers is prior to the Holocene. The 25 m thick Holocene mud-flat sediments commence around 8,500 years ago, indicating that the mud sedimentation began to form on the intertidal area between channels and rocky coasts mainly due to vertical aggradation. Shinan Getbol, even with the sea level rise, has a sedimentation environment where the current tidal sedimentation via vertical aggradation is maintained in a stable manner.

Type B is representative of a type having low sedimentation rate with thin tidal-flat sequences in the inner sides of the islands. The islands still keep the initial shape of archipelagic islands with high relief. Boseong-Suncheon Getbol is a Type B tidal flat. It also seems to be deficient in supply of suspended sediments or is far away from the source. Boseong-Suncheon Getbol are less than 6 m of thickness of its mud-flat sequences in intertidal area.

Type C has only a few islands remaining and is mostly covered by mud flats. Partially, the wave-dominated and transgressed sand flats have begun covering up the mud flats from the outer sides. Seocheon Getbol is a Type C tidal flat with most of its tidal channels in between the islands covered with mud and has a more than 6 m thick intertidal zone mud sediments. If sea level rises continuously, the Seocheon Getbol has a high probability of its entire mud flats being covered up by sand flats.

In Type D, most of the rocky islands are covered by sediment. The upper layers of the inner side mud flats have turned into wave-dominated sand flats. Gochang Getbol is a Type D in which most of the archipelagic islands and tidal channels are covered with sand flats that transgressed due to sea-level rise. At the depth of 20 m, the boundary between pre-Holocene layers and Holocene sediments is observed, which can be dated at 8,300 years BP by the OSL method.

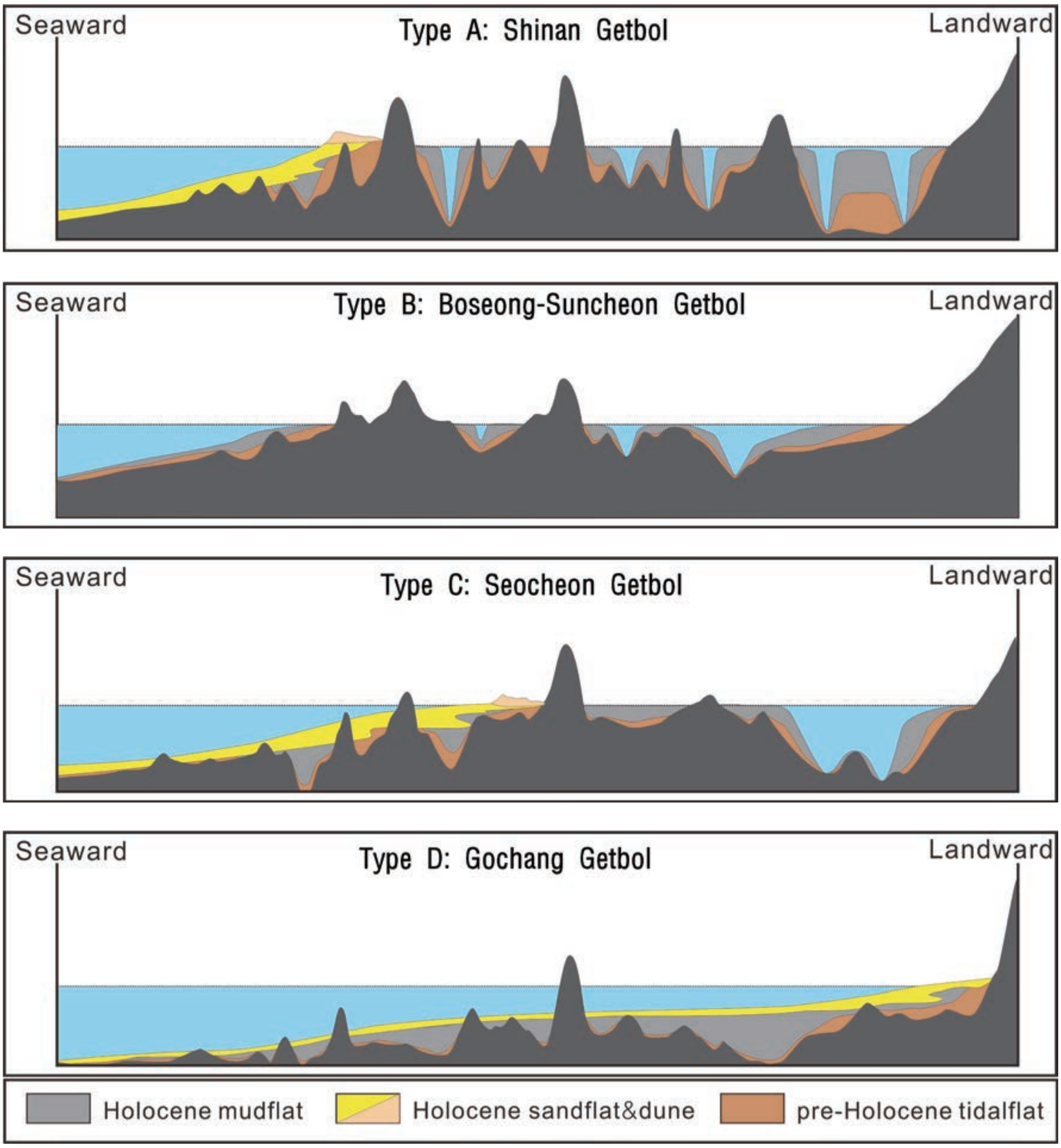



**Figure 2-17.** Schematic diagrams of cross profiles showing formation of Getbol sequences (Chun, 2018)

# 2.a.iv Habitats and Ecological Features

## 2.a.iv.1 Evolution of Communities in the Ecosystem by Getbol Formation

The formation of the nominated property began about 8,500 years ago, giving birth to the first mud flat in the property. The inundation by Holocene sea-level rise gradually spread northward, reaching the nominated property area to form mud flats which started to change into sand-dominated flats 3,000 years ago on its outside, lasting to the present day.

When a habitat is formed on tidal flats, the primary producers are the first to nestle in and develop a community. Benthic invertebrates with a pelagic larval stage are then recruited, evolving into a stable community together with numerous polychaetes, clams and small crustaceans. With macrobenthos joining the community, the evolution of the community is greatly stimulated, allowing for higher biodiversity. Finally, the community enters a stable stage when carnivores such as waterbirds and mud octopuses (*Octopus minor*) start to appear and make the community structure more complex and stable.

For the mud flats in the property, the initial terrestrial rocky ecosystem is replaced with a community of primary producers as mud continues to be deposited. Afterwards, those that feed on organic matter in sediments, such as polychaetes, small gastropods, clams, and Japanese mud crabs (*Macrophthalmus japonica*) emerge as the dominant species with a large biomass. Their predators, mud octopuses and waterbirds, join the habitat and settle as a keystone species, completing the transition of the community into a stable condition.

Mud octopuses are carnivorous predators that have a preference for Japanese mud crabs. It is a keystone species that controls the entire community. Mud octopuses live in U-shaped burrows that reach 1 m deep into the mud, and play an important role as ecosystem engineers that influence the habitat environment of other living organisms in the tidal flats, because its burrowing activities oxygenate the muds (Figure 2-18).

Mud octopus is also an important fishery resource that sustains the lives of the local fishermen (Figure 2-19), the annual catch of mud octopuses in Shinan Getbol being about 600 tons. To catch them the fishermen utilize an ‘octopus long line’ that use Japanese mud crabs as bait. Some fishermen will also rummage in the muds to find the burrows and plow the mud octopuses up by hand or use a small shovel to find them. These traditional fishing activities are based on the indigenous knowledge of local residents and take place within ecologically sustainable bounds. Locals eat the octopus raw, chopped up, grilled, or boiled, enriching the diversity of local cuisines. Mud octopus is considered a symbolic species that is closely interrelated not only to the ecosystem but also to the economic, social, and cultural lives of the local residents.

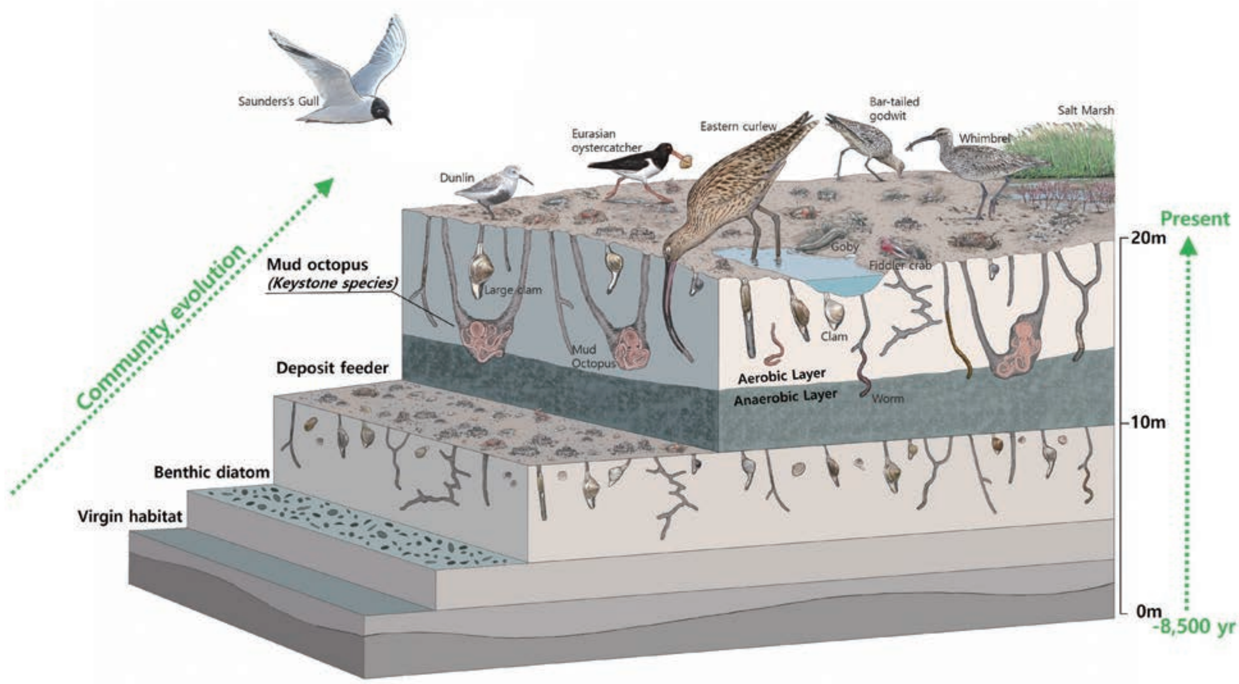



**Figure 2-18.** Schematic diagram of the community evolution on mud flat habitat

**Figure 2-19.** Mud octopus, a keystone species in muddy habitat

Sand flats are formed when sands supplied by rivers and eroding cliffs are transported to shorelines. Eventually a community dominated by clams, filter feeders that live on organic matter in the water, evolved here. Such a community also accommodates amphipods and polychaetes, which feed on organic matter in the sand. In particular, hard clams (*Meretrix lusoria*) joined and completed a stable community structure. Their density may be low but their biomass per individual is high. Eventually, waterbirds became top predators and functioned as a keystone species in this community (Figure 2-20). This is why the property offers an indispensable stopover site for migratory birds including some endangered species.

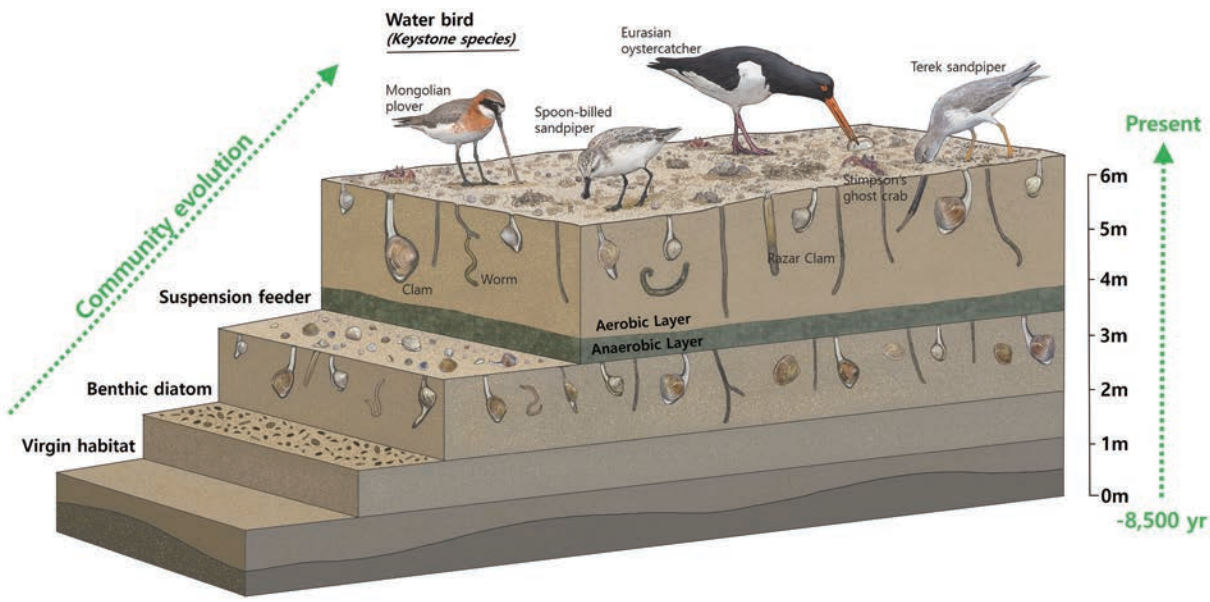



**Figure 2-20.** Schematic diagram of community evolution on sand flat habitat

## 2.a.iv.2 Food Chain and Energy Flow

A well-established food chain and an effective energy flow are prerequisites to maintaining active ecosystems within the property. An active energy transfer from primary producers to last consumers and the decomposition of organic matter by aerobic bacteria are essential for proper energy flow (Figure 2-21). This energy flow allows a variety of species to survive in the tidal flats and to maintain high biodiversity.

The food chain in mud flats of the property is initiated from benthic diatoms (Figure 2-22), whereas in rocky habitats benthic diatoms and marine algae are the primary producers of the food chain. The primary producers here are directly consumed by deposit feeders such as Japanese mud crabs, fiddler crabs, polychaetes, clams, and gastropods. These benthic organisms are again fed upon by top predators, including mud octopuses, waterbirds, and starfish. This prey-predator relationship maintains equilibrium in the dynamic ecosystem. Continuous visits of migratory birds and the high proportion of internationally endangered species are further strong evidence for active ecosystem processes and the stabilized evolution of communities.

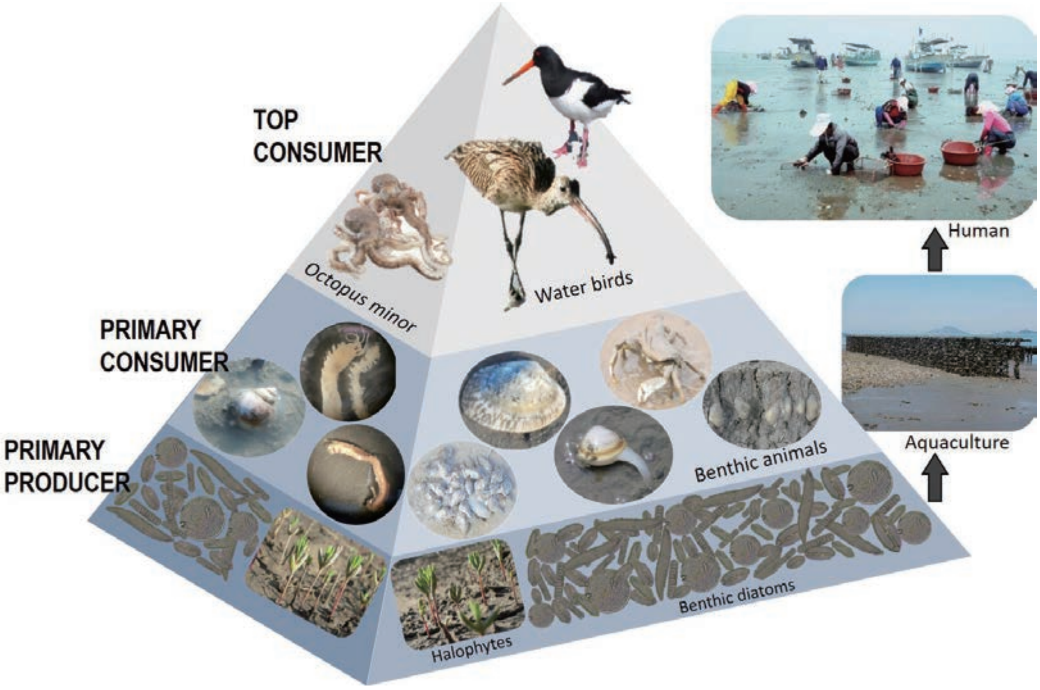



**Figure 2-21.** Food pyramid in the tidal flat ecosystem

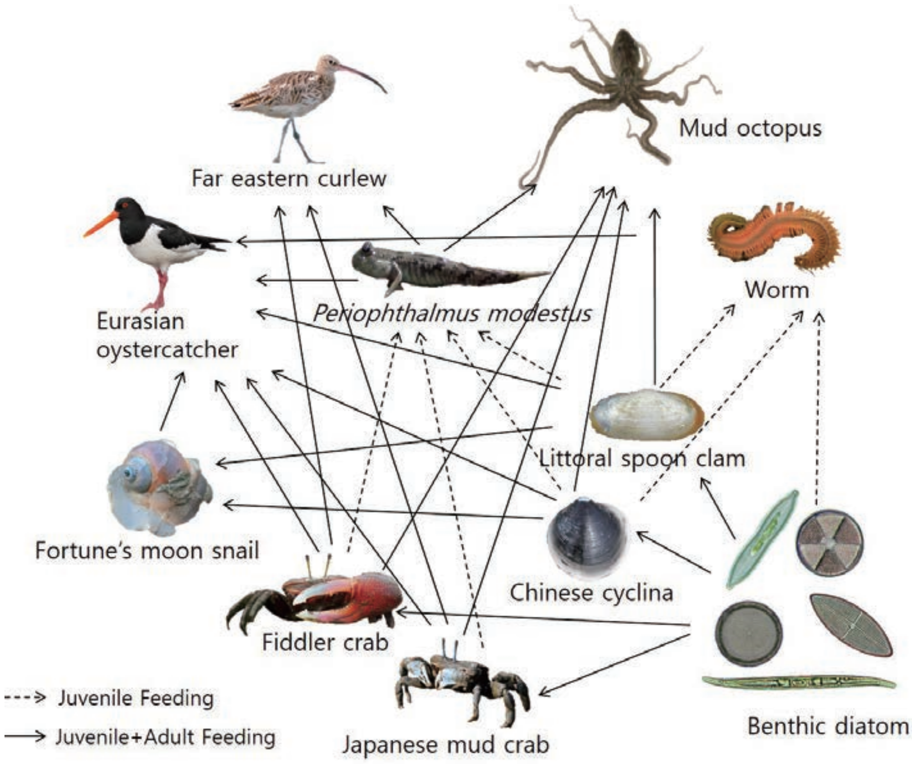



**Figure 2-22.** Food web in the tidal flat ecosystem

Plovers feeding on tidal flats almost double their weight on average to prepare themselves for a long journey. They need to uptake sufficient protein and fat at their stopover sites to continue their migration. The large population of plovers visiting the property proves that there is enough energy supply.

**Figure 2-23.** Dunlin (*Calidris alpina*) running with just-caught polychaete worm

The property has four distinct seasons. Marine organisms breed in spring, and grow to the fullest extent in summer and fall enjoying abundant food. Despite its location at a relatively high latitude in the temperate zone, the property maintains stable ecosystem because it rarely freezes in winter and macrobenthos in tidal flats tend to burrow deeper to avoid cold weather.

High primary production and an efficient energy flow in tidal flats are evidenced by: (1) frequent visits of numerous waterbirds, (2) high biomass of benthic invertebrates as their prey and (3) large amounts of coastal fishery products for humans that live on the energy produced here.

It should be noted how long-lasting sustainable fishery activities by the locals in the property actually attest to a perfect balance among the different tidal flat organisms. Even with continued human activity, the richness of the ecosystem has rarely been affected. It is because local residents have been wise enough not to overfish using only their indigenous knowledge and methods handed down for generations (Figure 2-24). An example of the most simple energy flow from primary production to humans is laver (*Porphyra* spp.). Also, Manila clams and cockles are important intermediators as they indirectly convey the energy of primary producers to humans. At both juvenile and adult stages they are consumed by others and thus play an essential role in completing an energy flow and a community evolution process in the nominated property. Thus, the property has enough area to maintain these two distinct community evolution patterns.

**Figure 2-24.** Cockle (*Tegillarca granosa*) harvest in Boseong-Suncheon Getbol

### 2.a.iv.3 Biotic Communities by Habitats

Depending on the type of substrates and their surrounding environmental conditions, mud flats, sand flats, and rocky substrates in the nominated property include their own unique biotic community. The seasonal differences produced by the East Asian monsoon climate and by rapid tidal currents running between numerous islands have generated a variety of complex habitats across the wide region.

The property, including numerous uninhabited islands and their surrounding mud flats, represents a unique, well conserved and interconnected terrestrial-coastal-marine ecosystem. Because each rocky-muddy, rocky-sandy and sandy-muddy substrate pairs forms individual sub-ecosystem of great complexity in this broad region, they are represented by very complicated smaller interconnected ecosystems. The types of ecosystem are as follows:

## • Muddy Habitats

Mud flats in the property have been developed in areas where the influence of waves and tidal currents are not significant. These areas have narrow salt marshes. Flowing sediments along complex tidal channels actively bring and distribute mud and nutrients. Some mud flats are 90% made up of muds. But there are also mixed flats consisting of both muds and sands. Japanese mud crabs, which are deposit feeders, are commonly found in mud flats. Their carnivorous predators like mud octopuses and waterbirds join the communities as a keystone species.

Sufficient supply of organic matter is absolutely necessary to grow a stable community in muddy habitats and to maintain high biodiversity. Most of the organic matter is produced by primary production by benthic diatoms with the rest coming from salt marshes. As a variety of organisms with different feeding structures dwell in muddy habitats, high biodiversity is achieved and the community evolution processes become more complete. Even though planktonic jellyfish mainly swim and dwell in neritic or pelagic realms, sometimes they are left on mud flats during low tides. Fortunate nassa mud snails feed on them, thus making the energy transfer between the pelagic and the benthic ecosystem possible (Figure 2-25).

**Figure 2-25.** Fortunate scavenging mud snails (*Reticunassa festiva*) feed on full moon jelly fish (*Aurelia aurita*) during low tide

Densely populated deposit feeders like Japanese mud crabs, capitellid polychaetes, or fiddler crabs gain energy by eating mud containing organic matter and then are eaten by their predators. In addition, they burrow and thereby supply oxygen-rich sea waters into anaerobic layers that have insufficient dissolved oxygen in interstitial water (Figure 2-26). Their burrowing at the same time carries sediments upwards and enables decomposition of organic matter by aerobic bacteria, thus circulating nutrients. The habitats on the tidal flats in the property have brown aerobic layers of about 10 ㎝ in depth, the theoretical depth of the organism dwelling zone.

Spats of clams, polychaetes and brachyuran juveniles burrow down deeper as they grow. When fully grown, each species dwells beneath the floor at different depths, a phenomenon called an interspecific vertical distribution pattern. Even in the same aerobic layers, smaller ones prefer to live near the surface layer, whereas larger or those with remarkable burrowing skill tend to dwell in deeper layers, exhibiting clear intraspecific vertical distribution.

This is the result of adaptation for thousands of years, by managing to use deeper sediments vertically to avoid inter- or intra-species competition for space and to share the habitat resources more efficiently.

**Figure 2-26.** Polychaete worms dwelling in aerobic and anaerobic layers of the sediment

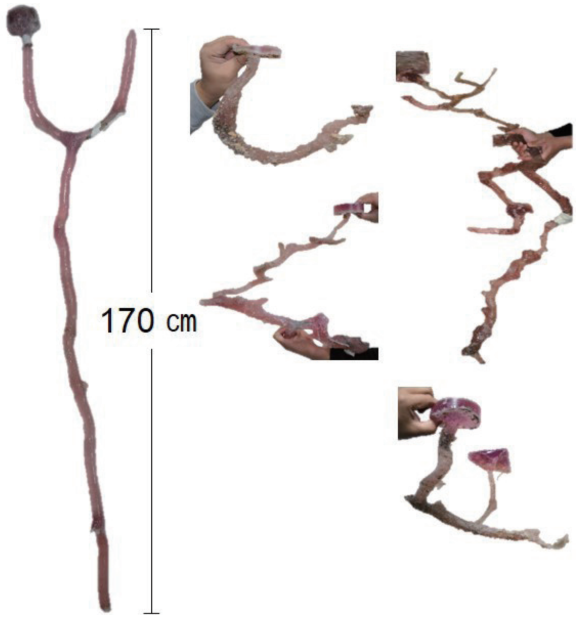


Figure 2-27. Burrows made by Japanese mud shrimp and crabs in the tidal flat

Those who live in anaerobic zones, below aerobic zones, have to find a way to survive such harsh condition or must shield themselves from the anaerobic environment by pasting mucus onto the inner surface of their burrows to create comfortable living conditions while bringing water down into their homes. Each macrobenthos has different level of burrowing capability depending on its body size. Clams with a long siphon – razor clams, soft clams and angel's wings (*Barnea davidi*) - live 20 ㎝ beneath the surface, while Japanese mud shrimps (*Upogebia major*) can build their burrows 170 ㎝ or more in depth (Figure 2-27).

Depending on the living depths of habitats, different sizes and types of organisms are eaten by different predators at different timings and depths (Figure 2-28). This enables a very efficient distribution of the food resources in the ecosystem. Small-sized amphipods, living on the surface of substrates, are eaten by waterbirds with short beaks. Larger organisms living further below are fed by waterbirds with longer beaks. As a result, bioturbation-induced ecosystem processes take place very actively in the nominated property and characteristic patterns of the vertical distribution can be established.

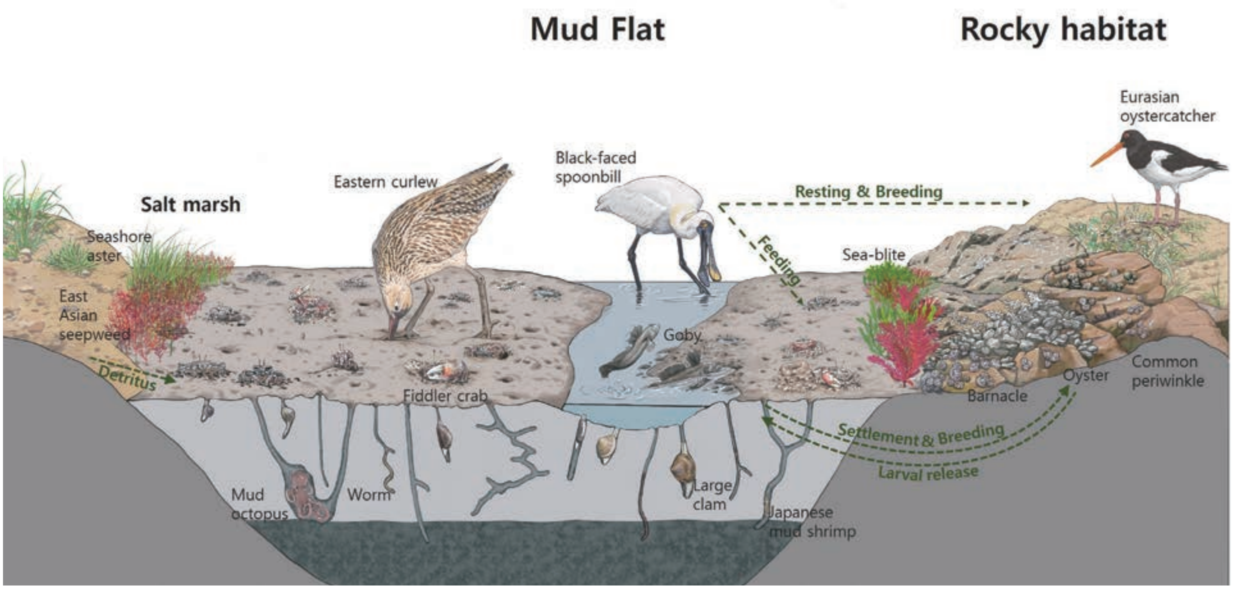


Figure 2-28. A schematic diagram showing the interconnected ecosystem in mud flats

### • Sandy Habitats

Within the property, areas that face directly the open sea (the outer part of archipelago and open-coast tidal flat) are wave-dominated regions. In these tidal flat settings, distinctive ecosystems have developed on the gentle/wide sand flats and steep/narrow tidal beaches. Toward the land sand dunes are developed where dune plants grow. Compared to mud flats or rocky substrates, the habitat is simpler in these wave-dominated environments. The most common dwellers here are suspension feeders, clams, and detritus-feeding polychaetes and small-sized crustaceans. In this community, the keystone species are waterbirds who feed on the suspension and detritus feeders. The waterbirds regulate the density of certain species they prey on, enhancing the biodiversity in the region they belong to.

On the sand flats, suspension feeders such as surf clams (*Mactra veneriformis*) and hard clams (*Meretrix lusoria*) and deposit feeders including Yellow Sea sand snails (*Umbonium thomasi*) and milky fiddler crab (*Uca lactea*) are commonly found. The upper zone of sand flats that are closer to land is a favored site for mud pea crabs and Stimpson's ghost crabs, which live in burrows and produce sand granules through their feeding activities.

Primary producers such as benthic diatoms and phytoplankton in the water column build the base of the trophic level in sand flats. Their consumers are macrobenthos, mainly polychaetes and clams. Highly abundant polychaetes and clams in turn, are consumed by waterbirds (Figure 2-29). This process bridges the food chain starting from the primary producers and ending with the top predators.

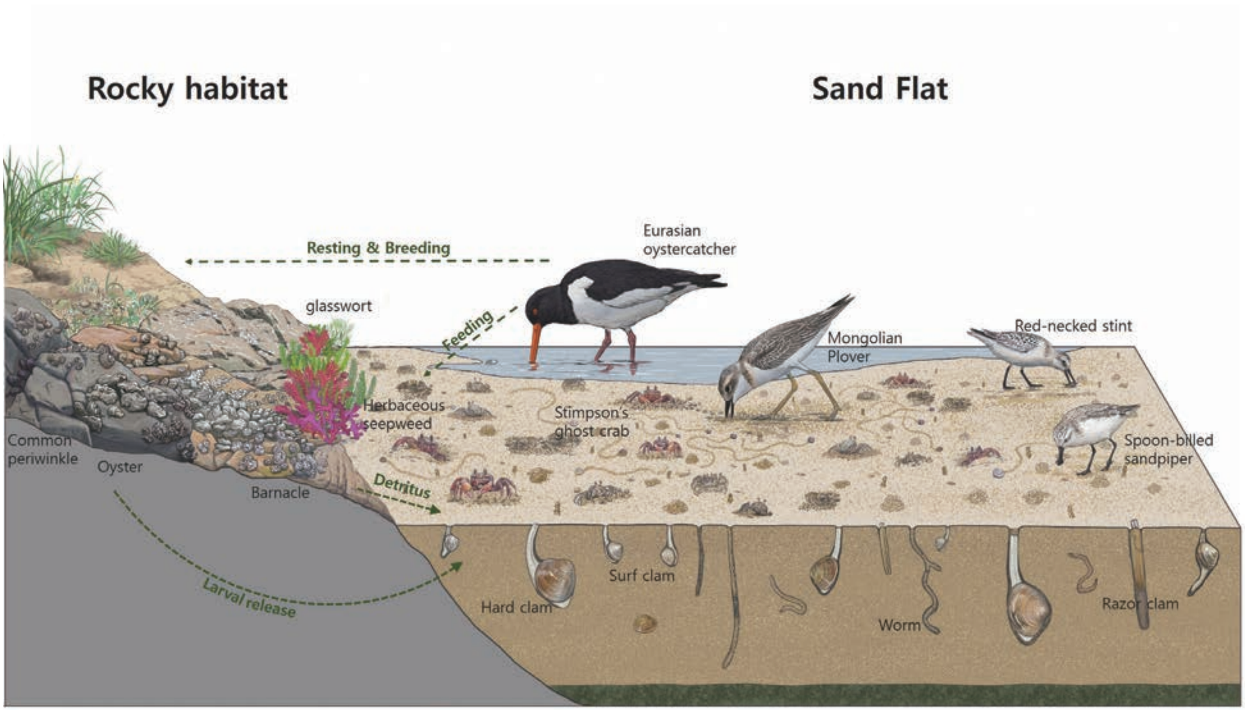



Figure 2-29. A schematic diagram showing the interconnected intertidal ecosystem in sand flats

### • Rocky Habitats

The major supplier of organic matter on rocky habitats are benthic diatoms and marine macroalgae, the primary producers prospering on the surface of rocks. Herbivores who feed on them and the top predators who prey on these herbivores lead to even more vibrant ecosystem in rocky habitats.

Rocky ecosystems near mud or sand flats in intertidal zone are usually not developed as offshore rocky ecosystem. However, rocky habitats in the property offer variable physical possibilities and challenges to living creatures, depending on the bedrock's inclination and curvature, the amount of surface area facing the sea, and the duration and direction of exposure to air. Different physical conditions result in the formation of a variety of microhabitats in each of the rocky habitats thereby enhancing biodiversity in general and resulting in a vertical ecological zonation. For example, the exposure duration to air makes a difference on rocky habitats. In the upper layers, granulated periwinkle (*Nodilittorina radiata*) and the Korean common periwinkle (*Littorina brevicula*) are dominant. The middle layers are mostly inhabited by common sessile barnacles and Pacific oysters. The leaders of the lower layers are mussels or marine macroalgae. Common sessile barnacles and Pacific oysters are eaten by the Korean common dog whelks. The carnivores weak to air exposure, such as starfishes and gastropods, tend to dwell in the lower layers. Starfishes in particular serve as a keystone species that prevent any one organism type from dominating the entire rocky habitat and contribute to stabilizing the community with a high biodiversity.

Macrobenthos living on rocky habitats release planktonic larvae into the water column during their breeding season. Drifting larvae grow by consuming on phytoplankton (primary producers) but they are also eaten by other tidal organisms. The larvae soon finish drifting and settle onto a rock completing their life cycle and stabilizing the community.

Marine algae including seaweeds (*Sargassum thunbergii*), green laver (*Enteromorpha* sp.), seaweed fusiformes (*Hizikia fusiforme*), and sargassums (*Sargassum fulvellum*) serve as a habitat for herbivores, a nursery ground for juveniles, and a food source for humans. They also produce particulate organic matter by absorbing nutrients. Tide pools construct their own proprietary ecosystem where endemic species like gobies live. These tide pools are another important element of biodiversity in the nominated property with numerous rocky islands.

The rocky habitats also serve as resting areas for Eurasian oystercatchers after feeding themselves on mud or sand flats and flying off to nearby land for breeding. It is a representative example of the connected ecosystem where the linkage between tidal flats and land is evident.

## 2.a.v Biodiversity and Endangered Species

1,610 species of flora and fauna have been reported in the nominated property. In the neighboring land ecosystem 540 species of flora and fauna have been reported. Together it has been confirmed that over 2,150 species of flora and fauna are living in the nominated property (Table 2-3). In particular, 22 of the endangered species recognized by IUCN, including the spoon-billed sandpipers, are reported along with 47 species of endemic marine organisms that are found only in the property.

**Table 2-3.** Number of species reported in the marine and terrestrial ecosystems in the nominated property

| Fauna / Flora | Number of Species |
|---|---|
| Benthic diatoms | 375 (215.7 ㎎/㎡) |
| Marine algae | 152 |
| Halophytes | 54 |
| Macrobenthos | 857 |
| Waterbirds | 118 |
| Fishes | 54 |
| Vegetation | 406 |
| Insects | 114 |
| Birds | 20 |
| Total | 2,150 |

### 2.a.v.1 Taxonomic Biodiversity

#### • Benthic Diatoms

As many as 375 benthic diatom species are found in the nominated property. Major dominant species among benthic diatoms include temporary-pelagic benthic diatom (tychopelagic plankton) and they frequently appear in every component site. In addition, coscinodiscus species, *Thalassiosira eccentrica* and *Amphora holsatica*, also boost the primary production as major dominant species.

Primary production (Chlorophyll-*a*) reaches up to 74.7-215.7 ㎎/㎡ providing a sufficient foundation for a healthy tidal ecosystem. As a primary producer, benthic diatoms are the foundation of the energy flow. They produce organic matter which accounts for 50 to 80% of the total primary production in tidal flats or in coastal waters, providing a basis for survival of numerous organisms. Benthic diatoms' primary production has strengthened the biodiversity and their high abundance has enabled the property to be a major stopover site on the East Asian-Australasian Flyway.

### • Halophytes

The property is inhabited by 54 species of halophytes. Shinan Getbol has the majority of 42 species and Seocheon, Gochang, and Boseong-Suncheon Getbol contain 27, 25, and 24 species, respectively. Most of the representative halophytes around the world can be found in the property, and its coastal vegetation belongs to one of the nine major global vegetation groups called the Sino-Japanese Group (Table 2-4).

Halophytes build a new habitat in the upper intertidal to supratidal flats and they generally tend to spread rapidly when the salt level of soil is over 0.5%. They also enhance sedimentation and reduce erosion at the same time. As a result, they contribute to maintaining the habitats. From time to time, living halophytes are fed upon by animals on salt marshes, but in most cases, they are consumed by other organisms as a detritus in the process of being decomposed after death.

Organic matter generated by halophytes is quantitatively less abundant than that generated by benthic diatoms, and its quality is also inferior. Yet their detritus contributes to accomplishing the complete detrital food chain in the tidal flats. Taking up nitrates and phosphates, they prevent red tides in the coastal areas of the property and complete the energy flow of the ecosystem (Figure 2-30). The salt marsh vegetation is indispensable for the integrity of the ecosystem, as it forms quintessential ecotone for terrestrial, tidal, and marine ecosystem.

Table 2-4. Main groups of halophytes around the world

| Group | Genus |
|---|---|
| 1. Arctic group | *Puccinellia, Carex* |
| 2. Northern European group | *Puccinellia, Juncus, Salicornia, Aster, Limonium, Triglochin* |
| 3. Mediterranean group | *Arthrocnemum, Limonium, Juncus, Salicornia, Salsola, Suaeda* |
| 4. Western Atlantic group | *Puccinellia, Juncus* |
| 5. Pacific American group | *Spartina* |
| 6. Sino-Japanese group | *Triglochin, Salicornia, Limonium, Suaeda, Atriplex* |
| 7. Australasian group | *Salicornia, Suaeda, Triglochin* |
| 8. South American group | *Spartina* |
| 9. Tropical group | mangrove |

* Underlined species are the genera present in the nominated property.

**Figure 2-30.** Common reed and *Suaeda japonica* community in Boseong-Suncheon Getbol

**Figure 2-31.** *Enteromorpha* growing abundantly on a rocky habitat in Gochang Getbol

### • Marine Macroalgae

The property provides a suitable environment for a total of 152 marine macroalgae species. Marine macroalgae are vital primary producers for rocky habitats. Their diversity and biomass influences the transfer process of nutrients in rocky substrates and underpins the ecosystem's biodiversity (Figure 2-31). Moreover, they provide numerous microhabitats for rocky-habitat organisms quite different from those in the muddy or sandy substrates.

Interestingly, a variety of marine algae living on or being cultured in tidal flats or rocky substrates in the property are widely used as a food product for humans. Over 90% of edible marine algae produced here are laver. Others include sea strings, kelps, sargassums, sea staghorns, seaweed fusiformes, green laver, seaweed fulvescens and agars (*Gelidium amansii*).

Laver has been cultivated in large areas of lower intertidal and subtidal areas of the property. Laver grown from fall to winter in these tidal zones has been an important source of income for locals over 400 years. The laver production does not have an impact on the natural environment, so that laver production and harvest is sustainable. Seaweed fulvescens growing on the surface of tidal flats during the winter season is also consumed by humans.

Organic matter from these marine algae is an important food source for most of the marine organisms and humans around the coast of the property. They take up nutrients from the surrounding marine environment and this process contributes to the circulation of elements in the tidal flats. As a result, the biodiversity is increased and the community structures and functions are maintained in a stable manner.

### • Macrobenthos

In the property, 857 macrobenthic species have been found. Among them, 649 are soft and 307 are hard substrate dwelling types. This accounts for 86% of the whole macrobenthic species diversity in Korean tidal flats with a total of 1,004 species (817 soft and 307 hard substrate dwelling types). Soft and hard substrates have different compositions of organisms, but organic interaction between substrates during their life cycle leads to enhanced biodiversity.

Among the 649 species of macrobenthos observed in the soft substrate, over 62% are annelids and molluscs which form a dense population on mud and sand flats. They deliver life energy to the entire ecosystem through vigorous feeding activities. Salt marsh also serves as an important habitat for the endangered benthic fauna.

A total of 307 species of macrobenthos can be observed on hard substrates (Table 2-5). Molluscs that attach to or crawl on rock surfaces comprise 45%. Arthropods that hide between or beneath rocks or attach to rock surfaces account for 34%. Literally, the rocky habitats in the property are paradise for these two types of macrobenthos.

Macrobenthos refers to organisms with a body size of over 1 ㎜. They can be commonly seen in tidal flats with the naked eyes. They provide waterbirds and humans with good sources of protein and bridge the energy flow of the marine ecosystem. Salt marshes, mud flats, sand flats and rocky habitats take in different kinds of macrobenthos, and the entire biodiversity grows accordingly. Macrobenthos with a considerable amount of biomass are an appetizing food source for higher predators and help complete the energy flow in the ecosystem. The property with its excellent biodiversity of macrobenthos, therefore, is an optimal place for waterbirds as they can accumulate enough energy before flying to other locations. Macrobenthos in the property also maintain a rich fishery stock.

**Table 2-5.** Number of species of macrobenthic organisms present in the nominated property

| Taxon | Nominated Property (%) | | |
|---|---|---|---|
| | Soft Substrates (including salt marshes) | Rocky Habitats | Property Area |
| Annelida | 204 (31.4) | 18 (5.9) | 212 (24.7) |
| Mollusca | 201 (31.0) | 137 (44.6) | 297 (34.7) |
| Arthropoda | 171 (26.4) | 104 (33.9) | 237 (27.7) |
| Echinodermata | 23 (3.5) | 9 (2.9) | 30 (3.5) |
| Others | 50 (7.7) | 39 (12.7) | 81 (9.5) |
| Sum | 649 (100.0) | 307 (100.0) | 857 (100.0) |

### • Waterbirds

The total number of waterbirds and raptor species in the property tallies up to 277 (231 and 46 respectively). Including the 22 IUCN Red List species, the property is visited by over 300,000 migratory birds of 118 species (101 waterbirds and 17 raptor species). Among waterbirds (50 million individuals of 250 species) coming to the nominated property following the East Asian-Australasian Flyway, 33 species (13.2%) are either threatened or near-threatened species, which is the highest ratio among the flyways for migratory birds reported by IUCN in 2012. The property supports 22 species or 66.7% of them, showing how crucial this site is. It also has ample food for migratory birds such as polychaetes, amphipods, bivalves and Japanese mud crabs. Thus, the property plays a critical role as feeding and resting sites for migratory birds along the East Asian-Australasian Flyway.

**Table 2-6.** Annual diversity and population of migratory birds present in the nominated property

| Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Max. |
|---|---|---|---|---|---|---|---|---|
| Number of Species | 78 | 96 | 93 | 95 | 101 | 95 | 78 | 118 |
| Population | 87,089 | 132,395 | 182,022 | 144,230 | 198,306 | 142,478 | 152,620 | 302,465 |

Source: Korean Shorebirds Network Secretariat (2015)

Major dominant species in the nominated property include dunlins (26%) as well as bar-tailed godwits (10%) and great knots (9%), which all appear on the IUCN Red List. The property is essential for the survival of internationally protected species such as black-faced spoonbills, eastern curlews, Eurasian oystercatchers and Nordmann's greenshanks, all on the IUCN Red List. Dunlins, coming to the ROK during spring and fall, mainly feed on Yellow Sea sand snails, sand wormes and Japanese mud crabs that are abundant in the property. The arrival of dunlins corresponds to the period when the biomass of these food species grows higher helping to generate a perfect ecosystem process.

The property can serve as a substitute for previously damaged tidal flats nearby. After the Saemangeum reclamation, some waterbirds which lost their stopover sites began flying to the nearby Gochang or Seocheon Getbol (Figure 2-32). Thus, it is certain that the property is a reliable refuge for the biodiversity of endangered species. It is also the last remaining tidal flats as a feeding and resting site for the internationally protected species of waterbirds due to its high production and biodiversity.

**Figure 2-32.** Eurasian oystercatcher on Seocheon Getbol

• **Fish**

A total of 54 coastal fish species are caught in the property (Table 2-7). Among them, 29 species (54%) directly feed off benthic invertebrates in tidal flats and the remaining species also capitalize the tidal flats to some degree. However, the actual number of fish that preys upon benthic invertebrates on the tidal flats is far bigger.

Fish eat benthic diatoms with mud in the tidal flats or prey upon benthic invertebrates or small fishes. They are directly or indirectly relevant to the primary production in tidal flats and coastal zones. Top predators that feed off demersal mysids, shrimps, mantis shrimps, squids and polychaetes include bighead croakers (*Collichthys niveatus*), butter fish (*Pampus* spp.), rays and croakers (*Miichthys miiuy*).

The property's outstanding primary production and abundant benthic invertebrates maintain vibrant coastal fisheries. Since the property's coastal zones are used as feeding and breeding sites by fish and benthic invertebrates coming from the offshore, it contributes to combining all the marine ecosystems into a large single system.

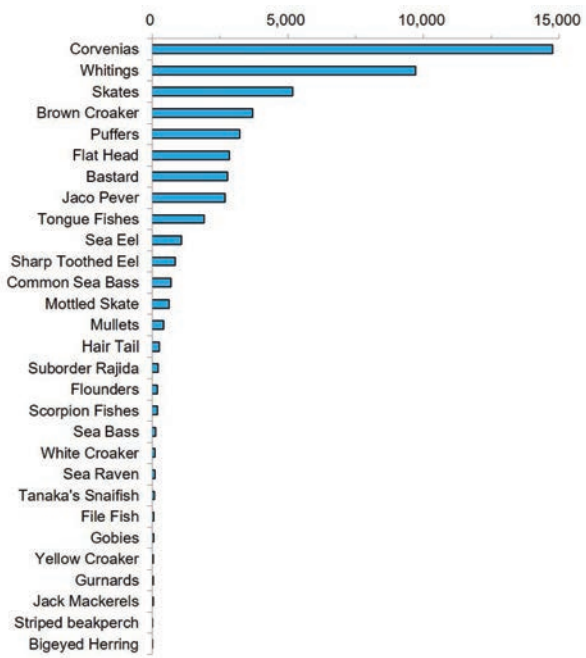



**Figure 2-33.** Total catch of fish feeding on benthic organisms in the nominated property from 2005 to 2015 (Unit: 1,000 ㎏)

**Table 2-7.** Number of fish species present in the nominated property from 2005 to 2015

| Category | Coastal Fish Species | Demersal Fish Species |
|---|---|---|
| Seocheon | 30 | 20 |
| Gochang | 46 | 27 |
| Shinan | 41 | 25 |
| Boseong-Suncheon | 44 | 26 |
| Total | 54 | 29 |

**• Mammals**

Coasts near Shinan Getbol are inhabited by finless porpoises (*Neophocaena phocaenoides*). They are listed as vulnerable IUCN Red List species and are commonly found within 3-5 ㎞ of coasts with a water depth of 20 to 50 m. It is reported that there are about 36,000 finless porpoises in the west coast of ROK and they directly and indirectly utilize the coastal ecosystem tidal flats. Terrestrial otters (*Lutra lutra*) also from time to time come down to salt marshes to feast on tidal organisms. Such feces of the otter have been found in many uninhabited islands (22.3% of total uninhabited islands) in Shinan Getbol not to mention near the other component. This exemplifies a close connection between the property and the neighboring coastal marine ecosystems, as well as the terrestrial ecosystems.

## 2.a.v.2 Endangered Species

The number of migratory birds living in the nominated property stands at over 300,000 of 118 different species (101 waterbirds and 17 raptor species), including 22 IUCN Red List birds. The East Asian-Australasian Flyway is used by 250 species of birds. It was reported by IUCN (2012) that the flyway also supports 33 (13.2%) threatened or near-threatened species out of the 250 species, which is the highest ratio among all the flyways for migratory birds. In 2015 alone, six additional waterbirds were newly listed as either a threatened or a near-threatened species. Unfortunately, waterbirds that rely heavily on the property have experienced a serious decrease in population (IUCN Resolution 26, WCC 2016). This paradoxically proves the critical role of the nominated property in offering shelters for waterbirds and other endangered species using the East Asian-Australasian Flyway. The property not only supports 101 species or 40.4% of the waterbirds out of the total 250 species that use the flyway but also supports 22 species or 66.7% of the total 33 endangered species.

It should be noted that the property is inhabited or stopped over by many internationally protected species on the IUCN Red List: endangered species (EN) such as black-faced spoonbills, Nordmann's greenshanks, eastern curlews, oriental storks and great knots as well as vulnerable species (VU) including swan geese, pochards, Chinese egrets, white-naped cranes, hooded cranes and Saunders's gulls. The major species in the property are bar-tailed godwits (10%) and great knots (9%), which are known to travel the longest distances from Alaska to the non-breeding grounds in Australia and New Zealand.

These migratory shorebirds cannot survive the migration unless they have proper stopover sites for feeding and resting. A regrettable example is the case of the Saemangeum reclamation, where the global population of shorebirds was reduced by 20% upon the destruction of natural tidal flats. The property is one of the three East Asian-Australasian Flyway zones where the density of endangered shorebirds that demand priority protection is the highest. A total of 24 species out of 63 or 38% of shorebird species have been supported by the property.

**Figure 2-34.** Spoon-billed sandpiper, critically endangered species (CR) on the IUCN Red List

It has been shown that the nominated property is one of the most crucial sites on the flyway that supports the highest number of endangered species in the world. Every year on the Yubudo Island in Seocheon Getbol, 2 to 6 spoon-billed sandpipers, which are classified as a critically endangered species (CR) on the IUCN Red List, are observed (Figure 2-34). Their expected remaining population is only about 300 to 600 in total worldwide. This area also serves as the largest habitat in ROK for Eurasian oystercatchers, a near-threatened species (NT) on the IUCN Red List, with a maximum population of 6,000. In addition, the Yubudo Island is known as a core habitat for internationally protected waterbirds such as great knots (EN) and bar-tailed godwits (NT) on the IUCN Red List with maximum populations of about 15,000 and 20,000 respectively.

Moreover, eleven species such as eastern curlews, Eurasian oystercatchers, bar-tailed godwits and red-necked stints are observed throughout the property (Table 2-8). As for the eleven species, including spoon-billed sandpipers (CR) out of the 22 endangered waterbirds appearing in the property, more than 1% of the world's population has been observed in this area. These findings show how important the property is in terms of conservation of endangered species.

Along with waterbirds, the nominated property is also inhabited by endangered macrobenthos species. Convexed crabs (*Chasmagnathus convexus*), red mitten sesarmid crabs (*Sesarmops intermedius*) and Chinese midas-ear snails (*Ellobium chinense*) are found in salt marshes of the upper intertidal to supratidal flats, while neritid freshwater snails (*Clithon* *retropictus*) live in the brackish water zone of streams flowing into the supratidal flats. Since these species can only live in limited habitats with specific conditions, protection for their habitats is absolutely needed.

Convexed crabs and red mitten sesarmid crabs can live only in common reed habitats. Chinese midas-ear snails live only in the community of reeds and seaside lawn grass. Neritid freshwater snails only inhabit brackish water zones of clean, small streams flowing into the tidal flats. Thus, their presence itself is a sign of well-preserved ecosystem of salt marshes in the nominated property.

Colonies of milky fiddler crabs (*Uca lactea*), indicators of healthy tidal flats, occur only in limited areas with high sand contents in upper intertidal to supratidal mud flats (Figure 2-35). For this reason, special care and protection should be in place so as not to cause any changes to their habitat due to the change of sedimentary environments.

**Figure 2-35.** Milky fiddler crab (*Uca lactea*), endangered species in the nominated property

**Table 2-8.** List of species and maximum observed population of waterbirds out of IUCN Red List (2009~2015)

| IUCN Red List | Scientific Name | Common Name | Nominated Property | | | | | IUCN Red list | % of World total |
|---|---|---|---|---|---|---|---|---|---|
| | | | Seocheon | Gochang | Shinan | Boseong-Suncheon | subtotal | World total | |
| CR | *Eurynorhynchus pygmeus* | Spoon-billed Sandpiper | 6 | 4 | - | - | 10 | 300-600 | 1.7 |
| EN | *Calidris tenuirostris* | Great Knot | 14,858 | 7,921 | 459 | 244 | 23,482 | 380,000 | 6.2 |
| | *Ciconia boyciana* | Oriental Stork | - | 5 | - | - | 5 | 3,000 | 0.2 |
| | *Numenius madagascariensis* | Far Eastern Curlew | 5,096 | 392 | 299 | 199 | 5,986 | 38,000 | 15.8 |
| | *Platalea minor* | Black-faced Spoonbill | 52 | - | - | 2 | 54 | 3,356 | 1.6 |
| | *Tringa guttifer* | Spotted Greenshank | 13 | 4 | - | 3 | 20 | 999 | 2.0 |
| VU | *Anser cygnoides* | Swan Goose | 1 | - | - | 15 | 16 | 90,000 | 0.0 |
| | *Aythya ferina* | Common Pochard | - | 15 | 70 | 1,945 | 2,030 | 570,000 | 0.4 |
| | *Egretta eulophotes* | Chinese Egret | 38 | 2 | 12 | - | 52 | 3,400 | 1.5 |
| | *Grus monacha* | Hooded Crane | - | - | - | 900 | 900 | 11,600 | 7.8 |
| | *Grus vipio* | White-naped Crane | - | - | - | 32 | 32 | 6,750 | 0.5 |
| | *Larus saundersi* | Saunders's Gull | 774 | 41 | 15 | 1,219 | 2,049 | 14,400 | 14.2 |
| NT | *Anas falcata* | Falcated Duck | 14 | 120 | 120 | 32 | 286 | 89,000 | 0.3 |
| | *Calidris canutus* | Red Knot | 114 | 19 | 9 | 152 | 294 | 979,000 | 0.0 |
| | *Calidris ferruginea* | Curlew Sandpiper | 4 | 1 | - | 3 | 8 | 1,285,000 | 0.0 |
| | *Calidris ruficollis* | Red-necked Stint | 2,183 | 563 | 1,770 | 85 | 4,601 | 315,000 | 1.5 |
| | *Haematopus ostralegus* | Eurasian Oystercatcher | 6,000 | 2,980 | 70 | 16 | 9,066 | 1,160,000 | 0.8 |
| | *Heteroscelus brevipes* | Grey-tailed Tattler | 154 | 670 | 215 | 673 | 1,712 | 44,000 | 3.9 |
| | *Limosa lapponica* | Bar-tailed Godwit | 20,014 | 536 | 2,581 | 1,678 | 24,809 | 1,149,000 | 2.2 |
| | *Limosa limosa* | Black-tailed Godwit | 1,050 | 40 | 101 | 729 | 1,920 | 809,000 | 0.2 |
| | *Numenius arquata* | Eurasian Curlew | 9,018 | 133 | 512 | 294 | 9,957 | 1,310,000 | 0.8 |
| | *Vanellus vanellus* | Northern Lapwing | - | 28 | 1 | 25 | 54 | 10,500,000 | 0.0 |
| | | | 17 | 18 | 14 | 19 | 22 | | |

Source: Korean Shorebird Network Secretariat (2015) / National Institute of Biological Resources (2009-2015) / IUCN Homepage (2017)

## 2.a.v.3 Endemic Species

The number of animal species regarded as endemic species amounts to 285 of all the marine organisms in ROK and, among them, 47 species or 16.4% appear in the nominated property (Table 2-9). Among the 47 species, 24 species or 51% of the macrobenthos are endemic species that appear only in the property (Table 2-10).

These endemic species in the tidal flats are mostly new species recently identified. In particular, many of the newly added are endemic species from amphipods that have been subject to active taxonomic research. The number of endemic species will increase as new species are further identified through further research.

The Gochang Getbol is a habitat for tiger crabs (*Orithyia sinica*), a species endemic to the Yellow Sea, and has been reported to have only one species in a genus worldwide (Figure 2-36). Tiger crabs are 55 ㎜ wide and produce as many as 54,000 eggs, each 0.7 ㎜ in size. Local fishermen deploy traditional fishing techniques based on their indigenous knowledge to capture the crabs. The local community exercises tight self-imposed rules to control a total amount of its catch. Its hind legs at the very end are wide just like blue crabs, but they are not good swimmers. Instead, they have evolved as a tidal flat digger.

Endemic species such as *Grandifoxus cuspis* or *Haustorioides nesogenes* usually stay on sand flats and hatch their eggs in the brood pouch on their ventral part of body. Their juveniles thus do not go through a larval stage. Even though they are small in size and live on shallow sand near the surface, they are still an important source of food for waterbirds because of their dense population.

**Figure 2-36.** Tiger crab (*Orithyia sinica*), an endemic species in the Yellow Sea

**Table 2-9.** Number of marine endemic species in coastal area of ROK

| Taxon | Republic of Korea | Nominated Property |
|---|---|---|
| Porifera | 30 | 0 |
| Cnidaria | 23 | 0 |
| Bryozoa | 10 | 1 |
| Annelida | 6 | 4 |
| Mollusca | 4 | 2 |
| Arthropoda | 204 | 40 |
| Echinodermata | 2 | 0 |
| Chordata | 6 | 0 |
| Total | 285 | 47 |

Source: National Institute of Biological Resources, 2014 (Invertebrates) / National Environment Information Network System (Chordates)

**Table 2-10.** List of endemic marine species present or potentially present in the nominated property

| No | Taxon | Seocheon | Gochang | Shinan | Boseong-Suncheon |
|---|---|---|---|---|---|
| **Phylum Bryozoa** | | | | | |
| 1 | *Parasmittina contrar* | | | ○ | |
| **Phylum Annelida** | | | | | |
| 2 | *Clymenella koreana* | ○ | ○ | ○ | |
| 3 | *Microclymene propecaudata* | ○ | ○ | ○ | |
| 4 | *Petaloproctus macrodentatus* | ○ | ○ | ○ | ○ |
| 5 | *Phyllodoce koreana* | ○ | ○ | ○ | ○ |
| **Phylum Mollusca** | | | | | |
| 6 | *Duplicaria koreana* | ○ | ○ | | |
| 7 | *Tugalina (Scelidotoma) vadososinuata hoonsooi* | | | ○ | ○ |
| **Phylum Arthropoda** | | | | | |
| 8 | *Ampithoe koreana* | | | ○ | ○ |
| 9 | *Anthessius kimjensis* | | ○ | | |
| 10 | *Colobomatus floridus* | | | ○ | ○ |
| 11 | *Colobomatus orientalis* | | | ○ | ○ |
| 12 | *Conchyliurus dispar* | ○ | ○ | ○ | |
| 13 | *Critomolgus malmizalus* | | | | ○ |
| 14 | *Critomolgus nudus* | ○ | ○ | ○ | |
| 15 | *Critomolgus vicinus* | ○ | ○ | ○ | ○ |

| No | Taxon | Seocheon | Gochang | Shinan | Boseong-Suncheon |
|---|---|---|---|---|---|
| 16 | *Cryptopontius dong* | | | | ○ |
| 17 | *Diastylis koreana* | ○ | ○ | ○ | ○ |
| 18 | *Diastylis paratricinta* | ○ | | ○ | |
| 19 | *Dimorphostylis namhaedoensis* | | | ○ | |
| 20 | *Enterophilus cercomegalus* | ○ | ○ | ○ | ○ |
| 21 | *Eohaustorius setulosus* | | | ○ | |
| 22 | *Haustorioides koreanus* | | | ○ | |
| 23 | *Haustorioides nesogenes* | | | ○ | |
| 24 | *Hemadona clavicrura* | | | | ○ |
| 25 | *Hemicyclops nasutus* | ○ | ○ | ○ | |
| 26 | *Hemicyclops parilis* | | ○ | ○ | ○ |
| 27 | *Hemicyclops saxatilis* | | ○ | | |
| 28 | *Hemicyclops ventriplanus* | | | ○ | ○ |
| 29 | *Herrmannella exigua* | | ○ | | |
| 30 | *Herrmannella soleni* | | ○ | | |
| 31 | *Lepeophtheirus gusevi* | | | | ○ |
| 32 | *Lichomolgus similis* | ○ | ○ | ○ | |
| 33 | *Lutumidomus tertius* | ○ | ○ | ○ | |
| 34 | *Mandibulophoxus hongae* | | | ○ | |
| 35 | *Mandibulophoxus mai* | ○ | ○ | ○ | |
| 36 | *Membranobalanus koreanus* | | | | ○ |
| 37 | *Monoculodes koreanus* | ○ | | ○ | |
| 38 | *Nitokra koreanus* | | | ○ | |
| 39 | *Perioculodes seohae* | | | ○ | |
| 40 | *Presynaptiphilus minutus* | ○ | ○ | ○ | ○ |
| 41 | *Protomolgus singularis* | | | ○ | ○ |
| 42 | *Rhodinicola laticauda* | ○ | ○ | ○ | |
| 43 | *Sinoediceros hwanghaensis* | | | ○ | |
| 44 | *Synaptiphilus longicaudus* | ○ | ○ | ○ | ○ |
| 45 | *Synchelidium trioostegitum* | | | ○ | |
| 46 | *Synstellicola paracarens* | | ○ | | |
| 47 | *Triacanthus luteus* | | | | ○ |
| Total number of species | | 19 | 23 | 35 | 20 |

Source: National Institute of Biological Resources, https://www.nibr.go.kr

## 2.a.v.4 Harmony between Nature and Human Activities

The nominated property, Getbol, is an exceptional case because it displays a close relationship among different criteria for World Natural Heritage. The property is influenced by a very unusual tidal system and contains what is by international standards a usually diverse ecosystem. The main contributing elements can be summarized as follows:

1) The Yellow Sea is a wide epicontiental sea with an average depth of 50 m on an extensive continental shelf created by special geological conditions;

2) The irregular terrain has been created by tectonic forces as the area is adjacent to a subduction zone, and numerous islands and a complicate coastlines are partly a consequence of processes associated with changing sea level as climate changed in the past;

3) The nominated area experiences the highest tidal range observed in the Yellow Sea;

4) The seas around the nominated area receive abundant and nutrient-rich terrigenous sediments supplied by abundant runoff in warm temperate regime strongly influenced by continental monsoon climate.

The islands and coasts associated with the nominated property host diverse sedimentation environments with high geodiversity. In the coastal environment with its diverse mixture of sand, mud and mixed sediments, each with different density and porosity characteristics makes for tidal flats with diverse habitats and high biodiversity, this being further enhanced by the complex ecosystems of neighboring rocky shores.

Thus, the nominated property is an outstanding example displaying the interrelationships between geodiversity and biodiversity with the geodiversity directly influencing organisms, their habitats, and productivity along both tidal flats and rocky shores.

The vast organic-rich tidal flats have also provided an important stopover site for migratory birds on their annual migrations. It is interesting to observe that different birds visit different parts of the tidal flats according to the substrate type (grain size) and its composition, which again testifies to the strong linkages between water bird habitats and geodiversity.

As the sea level rose and began to intrude and form tidal flats from ancient times, humans gained food from the tidal flats. Shell mounds found in different locations along the coast provide evidence that fishing activities have taken place in the tidal flats for thousands of years. The tidal-flats monitoring results show that traditional fishing activities have successfully maintained the tidal flat ecosystem in a balance that includes human processes.


**Figure 2-37.** The nominated property as a unique example showing interconnected geodiversity, biodiversity and even cultural diversity

This example shows the traditional place of Man as part of the ecosystem, and the Republic of Korea government is determined to maintain a level of human resource use that continues to be sustainable and to exclude non-sustainable activities. Getbol, Korean Tidal Flat shows a high biodiversity based on the geodiversity of the tidal flats, and human activities relying on the biodiversity have become an integral part of a natural and healthy ecosystem.

## 2.a.vi Features of Each Serial Site

The four components of the nominated property display typical, but distinctive geological and geomorphological biological and ecological features of Getbol, and contribute to the overall value of the property. The significant values of each component are explained as follows.

Seocheon Getbol is a relatively small-sized island-type (archipelagic) tidal flat made up of 15 islands. As an estuarine type, located near the Yubudo Island of the Geumgang River estuary, Seocheon Getbol is a Type C in terms of the formation of the thick mud-flat sequences (Figure 2-17). Suspended sediments from Geumgang River and the mud sediments transported from offshore by the tidal currents converge near Yubudo Island and its surrounding islands. Geumgang River is an important source of all sediments, not only to Seocheon Getbol, but to the entire nominated property, as it provides rich nutrients. As a result, Seocheon Getbol area has the highest primary production among all the serial sites of the property, even to impact on the other three areas. Seocheon Getbol also sees the highest number of endangered migratory birds among the serial sites. About 147,000 waterbirds of 85 species, including 17 species on the IUCN

Red List, visit Seocheon Getbol. Yubudo Island, in particular, is the largest habitat for Eurasian oystercatcher (*Haematopus ostralegus*) in ROK and as many as 35,000 great knots and bar-tailed godwits (*Limosa lapponica*) visit the islands. Furthermore, the Seocheon Getbol supports 24 species (38 %) of 63 shorebird species that travel along the East Asian-Australasian Flyway.

Gochang Getbol is a typical open-embayed type tidal flat (macrotidal range about 7.2 m) and has developed in both the inner and outer sides of Gomsoman Bay. As a Type D in terms of the formation of the thick mud-flat sequences (Figure 2-17), Gochang Getbol currently has eight islands and some rocks exposed above the tidal flats, while many more islands are buried below the mud sediments. With the seasonal changes in dynamics of tide and wave, Gochang Getbol shows distinctive patterns of surface sediment distribution. This provides a unique habitat distribution pattern for living organisms. The location and the distribution of the sand flats and mixed flats in Gochang Getbol change in different seasons. Among the serial sites, Gochang Getbol is a representative site that shows the most dynamic and remarkable changes of sedimentary patterns as a result of the East Asian monsoon climate. Gochang Getbol hosts as many as 18 waterbird species on the IUCN Red List. Spoon-billed sandpipers, a critically endangered species (CR), are observed in this area. A total of 255 species of macrobenthos is also present in the property. Importantly, oriental storks (EN) appear only in Gochang Getbol among the serial nominated sites for feeding on Japanese mud crabs and gobies in fall to get through winter. Gochang Getbol is a habitat for tiger crabs, an endemic species to the Yellow Sea, and is reported to be a monospecific genus worldwide.

Shinan Getbol, representing the archipelagic type, is located near the coast surrounded by some over 850 islands. Shinan Getbol is a Type A in terms of the formation of the thick mud-flat sequences (Figure 2-17). The region demonstrates typical island-type (archipelagic) tidal flats with distinctive geological and geomorphological features as well as diverse habitats. The tidal currents run with vigor with a macrotidal range through the numerous islands, demonstrating the typical features of island-type tidal flats. Shinan Getbol also has broad tidal flats and deep tidal channels in between the islands. The overall sedimentary pattern demonstrates a high level of geodiversity and an associated complex ecosystem. The mud octopuses, found abundantly in this area, clearly show the evolutionary process operating within the mud flats ecosystem.

Boseong-Suncheon Getbol is a semi-enclosed Type B in terms of the formation of the thick mud-flat sequences (Figure 2-17). The tidal currents that run counterclockwise inside the relatively large Yeojaman Bay help to create a unique shape of tidal flats around the 20 islands that surround Jangdo Island. Deep channels run between the islands. The river that discharges into this area is small and so the amount of sediment supplied is not large enough to form an estuarine tidal flat. However, the suspended sediments that are carried in by the tidal currents from the outer seas of Yeojaman Bay accumulate around the islands and contribute significantly to the formation of the tidal flats. So, the Boseong-Suncheon Getbol area is a sink where the tidal flats sediments finally settle, having first started their journey in Geumgang River. The area has developed wide salt marshes and an active halophyte community. This site exemplifies the survival pattern of halophytes at the point where river water flows into the sea. The area is also the largest winter stopover site for hooded cranes (VU).

**Table 2-11.** Various features of each serial property and their distinctions

| Category | | Seocheon Getbol | Gochang Getbol | Shinan Getbol | Boseong-Suncheon Getbol |
|---|---|---|---|---|---|
| Geological, geomorpho-logical features | Complexity level of sedimentation system | Very complex (estuary, waves, high waves, macrotidal range) | Complex (Open bay, high waves, macrotidal range) | Very complex (many islands, waves, High waves, macrotidal range) | Complex (semi-enclosed tidal flat bay, macro and mesotidal range) |
| | Number of Island | 15 | 8 | 857 | 20 |
| | Thickness of mud flats | Thick ( > 6 m) | Very thick ( > 20 m) | Very thick ( > 25 m) | Thick ( > 4 m) |
| | Type of Getbol | Estuarine | Open-embayed | Archipelago | Semi-enclosed |
| | Formation results of Getbol sequence | Type C | Type D | Type A | Type B |
| Biological and ecological features | Primary production (Chlorophyll-*a*, $mg/m^2$) | Very High (Average 81.0) | Very High (Average 67.6) | Very High (Average 52.2) | Very High (Average 66.8) |
| | Featured communities of organisms | Very well developed (Benthic diatoms, clams, gastropods, polychaete worms, amphipods, waterbirds) | Very well developed (Japanese mud crabs, sand crab, polychaete worms, surf clams, waterbirds) | Very well developed (clams, polychaete worms, amphipods, Japanese mud crabs, sand crab, mud octopus waterbirds) | Very well developed (Japanese mud crabs, cleistostoma dilatatum, polychaete worms waterbirds, halophytes) |
| | Multi-faced ecosystem | Excellent (mud-rock, sand-rock) | Excellent (mud-sand-rock-salt marsh) | Excellent (mud-rock, sand-rock) | Excellent (mud-rock, mud-salt marsh) |
| Biological and ecological features | Species diversity | Very High (Benthic diatoms 181 species algae 49 species, macrobenthos 181 species, waterbirds 85 species) | Very High (Benthic diatoms 194 species algae 9 species, macrobenthos 255 species, waterbirds 90 species) | Very High (Benthic diatoms 224 species algae 144 species, macrobenthos 568 species, waterbirds 90 species) | Very High (Benthic diatoms 188 species algae 23 species, macrobenthos 445 species, waterbirds 99 species) |
| | Supporting endangered species and endemic species | Very High (IUCN Red List 17 species spoon-billed sandpiper included) | Very High (IUCN Red List 18 species spoon-billed sandpiper and oriental white stork included/endemic species tiger crab) | Very High (IUCN Red List 14 species) | Very High (IUCN Red List 19 species Hooded cranes included) |

## 2.a.vi.1 Seocheon Getbol

### • Geological and Geomorphological Features

#### Distribution of Tidal Flats and Tidal Channels

Two big tidal channels are located in the east and north of Seocheon Getbol. The eastern tidal channel, connected directly to Geumgang River, serves as the main tidal channel. A river-mouth dam in Geumgang River blocks freshwater from flowing out continuously. However, on average, its flood gates open about 10 times a month to adjust the level of freshwater in order to manage flood prevention. Therefore, freshwater from Geumgang River and suspended sediment are released when the gates open. During the rainy season in summer, all flood gates are open to discharge freshwater, thereby supplying a huge volume of suspended sediment to the estuary. With the aid of tidal currents, the discharged suspended sediments flow into Seocheon Getbol, as well as to the other nominated sites, playing an important role in forming the mud flats.

The northern tidal channel (called 'Gaeya' tidal channel) is gradually becoming shallower due to the decreased speed of the tidal current caused by the river-mouth dam on Geumgang River. Therefore, the tidal channel in the north plays a lesser role in the movement and spread of sediments. This phenomenon contributes to expanding the tidal flats on the Yubudo Island and the tidal flat on the northeastern part of property. It also causes fine-grained sedimentation in the subtidal area and lower intertidal flats.

#### Surface Sediments and Seasonal Changes

Among the components, Seocheon Getbol is the first tidal flat where sediment from Geumgang River is accumulated. It is also strongly affected by waves from the west coast. This wave energy explains why tidal flats around the coast in this region are mostly sand flats with the exception of tidal flats on the inner parts surrounded by islands where the protection reduces wave energy.

During summer, surface sediments of Seocheon Getbol are composed mainly of medium to very fine sand and silt with about 10% clay. Sand sediment tends to decrease toward the east from the west of Yubudo Island. Sediment distribution changes dramatically in the east and west sides due to splitting by bars and spits connected to the west of Yubudo Island. Mud flats are widespread in the inner area between Yubudo Island and Daejukdo Island. Mud facies are dominant in the eastern part of the bars and spits, whereas sand facies are observed in a narrow eastern zone along the main tidal channel where tidal current is rapid. In the western intertidal area, sand and muddy sand facies prevail. These facies show a repetitive strip pattern as muddy sediments accumulate in the troughs between swash bars developed in the sandy intertidal area.

A number of spits have formed in the northwest of the Yubudo Island tidal flat (Figure 2-42). Sandy mud facies are observed along the lower shore-face of the spits, implying that the pre-existing mudflat sediments are eroded and replaced by present sand sediment. A training dike is located in the southwestern part of Yubudo Island. In the case of mud flats adjacent to the training dike, mud-dominant sedimentary facies are mainly formed, because the inflow and outflow of sediment is limited due to the dike. The dike, together with small islands, protects the western side from waves, creating a lower energy environment there and limiting the movement of sandy sediment. Tidal flats located on the western coast of Yubudo Island show weak seasonal changes. There, sand flats and sand spits are dominant during winter. In contrast, a little muddy sediment covers the top of sand flats during summer.

Surface sediments in Seocheon Getbol during winter show similar sedimentary facies patterns to those observed in summer (Figure 2-38). However, mud flats decrease in distribution or occur partly on sand flats. In the western and northern sandy intertidal areas of Yubudo Island, muddy sand facies are repeatedly distributed in parallel with sand bars during summer. In winter, however, muddy sand facies are rarely observed. In the tidal flats on the easternmost side along the margin of tidal channel, mud and sandy mud facies prevail, and sand facies occur only in summer. In winter, sand facies are widely distributed in the northern area, showing diminishing mud and sandy mud facies in distribution.

The seasonal changes result from the heavier influence from waves in winter than in summer. In winter, sand sediments are dominant in the western intertidal area facing the open sea. The northern parts of the easternmost intertidal area are also greatly affected by waves, which contribute to a wider area of sand sediment. During summer, weaker waves and relatively stronger tidal currents lead sand sediments to flow deep in the tidal channels of Geumgang River.

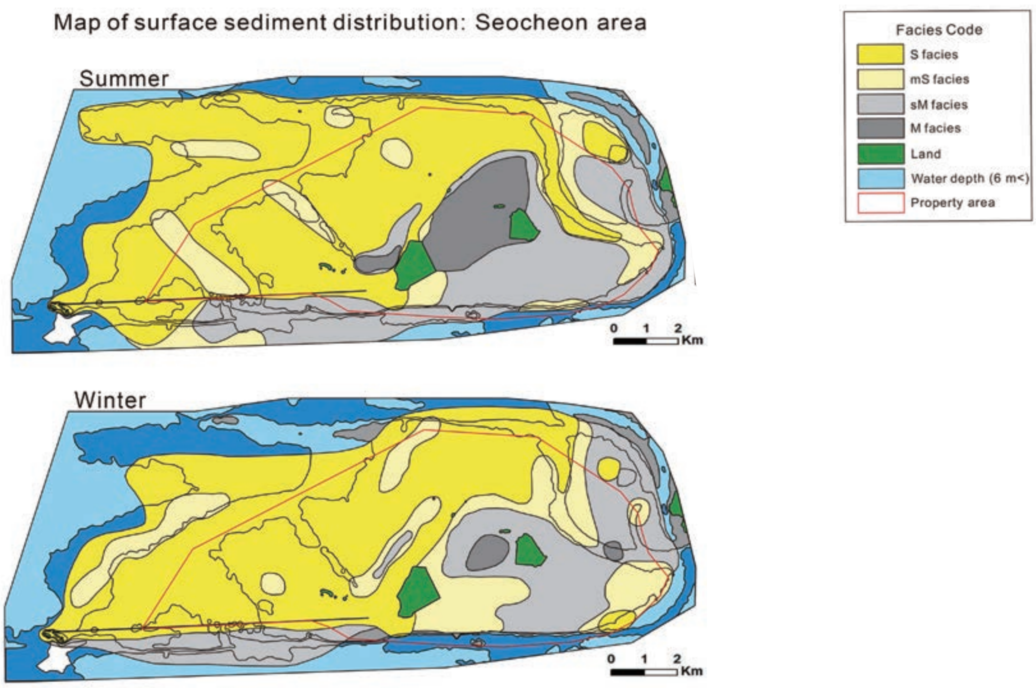



**Figure 2-38.** Seasonal changes of tidal-flat surface sediment in Seocheon Getbol

### Basement Rocks and Holocene Tidal Flat Sequences

Before there was a significant cover of tidal sediments in this area, Seocheon Getbol was a small-sized archipelagic feature with more islands than at present. Judging by the depth to the basement rocks, the thickness of the Holocene sedimentary deposits may range from 10 to 15 m, although this may include some Pleistocene tidal-flat sediment. The inner tidal flats surrounded by islands are all mud flats thicker than 6 m as confirmed by vibra cores. However, it is expected that there could be even deeper mud flats formed in the pre-existing tidal channel between Yubudo and Daejukdo islands (Figure 2-41).

### Individual Component of Sedimentary Subenvironment

***Mud flats***: Wide mud flats are formed in the southeastern part of Seocheon Getbol. The mud flats are located near the estuary of Geumgang River where abundant amounts of suspended sediment have been supplied. Most suspended sediments are delivered to the outer part by the combined strong current of ebbing tidal and river flows, but they can be returned to the estuary again by flood tide currents. Since islands were formed where these sediments could accumulate, the sedimentation rate is very high (4.8-7.3 ㎜/yr). Also, the top surface level of the mud flats on Yubudo Island is relatively high due to a high sedimentation rate, which leads to limited development of tidal gullies compared to other components of the nominated property. Mud flats on the east side near to the estuary of Geumgang River have relatively high sand content, although on the north side the mud flats contain much less sand. The amount of sand incorporated in mud flat sediments varies by season; generally, sand content is higher in winter.

Figure 2-39. A scenery of Yubudo Island intertidal flat in the Seocheon Getbol from the south.
Wide mud flats are distributed in the inner part which are surrounded by spits and small islands.

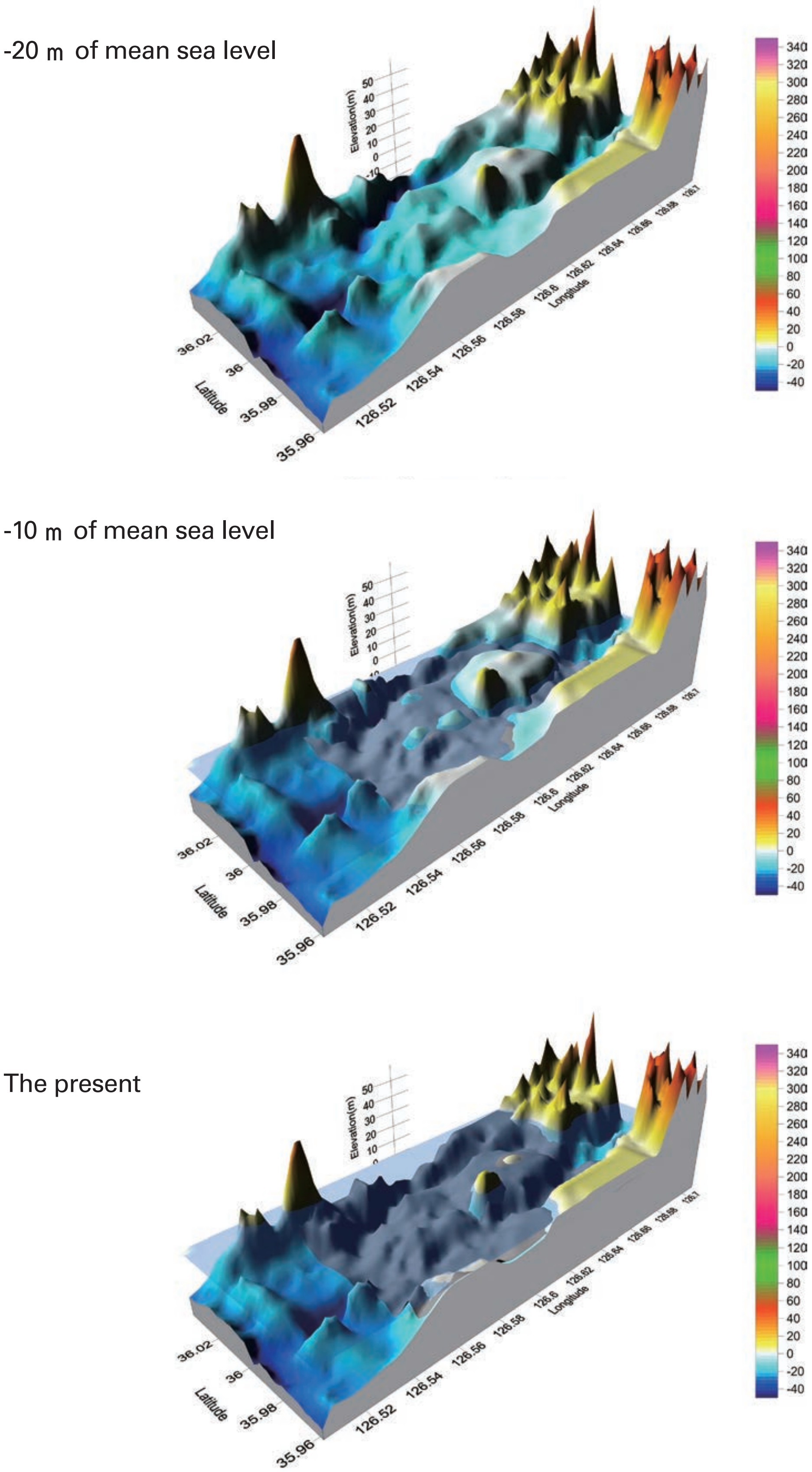



**Figure 2-40.** Paleo-bathymetry based on acoustic basement in the Seocheon Getbol, showing the formation of tidal-flat sequences and some islands covered by mud flats according to sea levels of -20 m, -10 m and the present

***Sand flats and spits***: Sand flats usually formed on the west and northwest coasts which are affected mainly by waves. During winter, the flats are wave-dominated, therefore, the formation and movement of swash bars is easily observed. But in summer, some parts of the sand flats are covered with mud flats. On the north side of Seocheon Getbol, islands are connected to each other by narrow spits. During winter, the spits become connected to multiple swash bars and form wide sand flats. Narrow spits are also observed during summer along the connected islands. They contribute to providing suitable sedimentary environments where migratory birds can feed and rest safely.

***Sand dunes and salt marshes***: Narrow belts of sand dunes and salt marshes have formed on the west side of Seocheon Getbol. A small salt marsh is present behind the sand dunes. Another relatively large salt marsh formed in an artificial, abandoned saltpan.


Figure 2-41. Depositional Components formed in Seocheon Getbol

### Thick Mud-flat Sequences

The western and eastern intertidal areas of Yubudo Island clearly show different vertical sedimentary sequences. In the western area, a coarsening-upward trend is dominant, whereas fining-upward trend is observed in the eastern area. Mixed flats are dominant in the lower part of the western intertidal area and sand facies become prevalent toward the upper part. At the uppermost parts of the intertidal sequences formed near the rocky island in the north, the sedimentary layers of sand bars or spits are present in the subsurface. Mixed flat facies are observed at the lower part of the eastern intertidal area of Yubudo Island, and muddy intertidal facies dominate towards the top. Coarse-grained sediments are intercalated in the muddy layers at the top; these sediments having been washed over from sand bars and spits in the north during winter windstorms or summer typhoons. In the inner part of intertidal area, where wave energy coming from the open sea is blocked by the rocky islands and sand bars, muddy sediments have been vertically aggraded in a stable manner over an extended time period. This shows that sandflat sediments already covered some rocky islands during transgression. Interestingly, landward-prograding transgressive sand sequences borders with mud flat deposits in the inner sides of the archipelago.

**Figure 2-42.** A scenery of the northern Yubudo Island intertidal flat in Seocheon Getbol showing multiple swash bars and spits connected with islands. These are mostly used by migratory waterbirds as places for feeding and resting.

For the formation of the thick mud-flat sequences, Seocheon Getbol represents an example where mud flats start to be covered with sand flats as sea level rises. A large amount of sediment flows out from the estuary and comes back again, being driven by tidal currents that start to cover most islands and penetrate tidal channels. The sandy sedimentary layers have already started to move from the outer sides into the inner side of the islands. If sea level continues to rise, the physiographical features of this island with tidal flats may be slightly changed into a sand ridge, but a fixed or stable one, not involving moving sand islands like barrier islands, which are common in Wadden Sea and along the eastern coast of U.S.A.

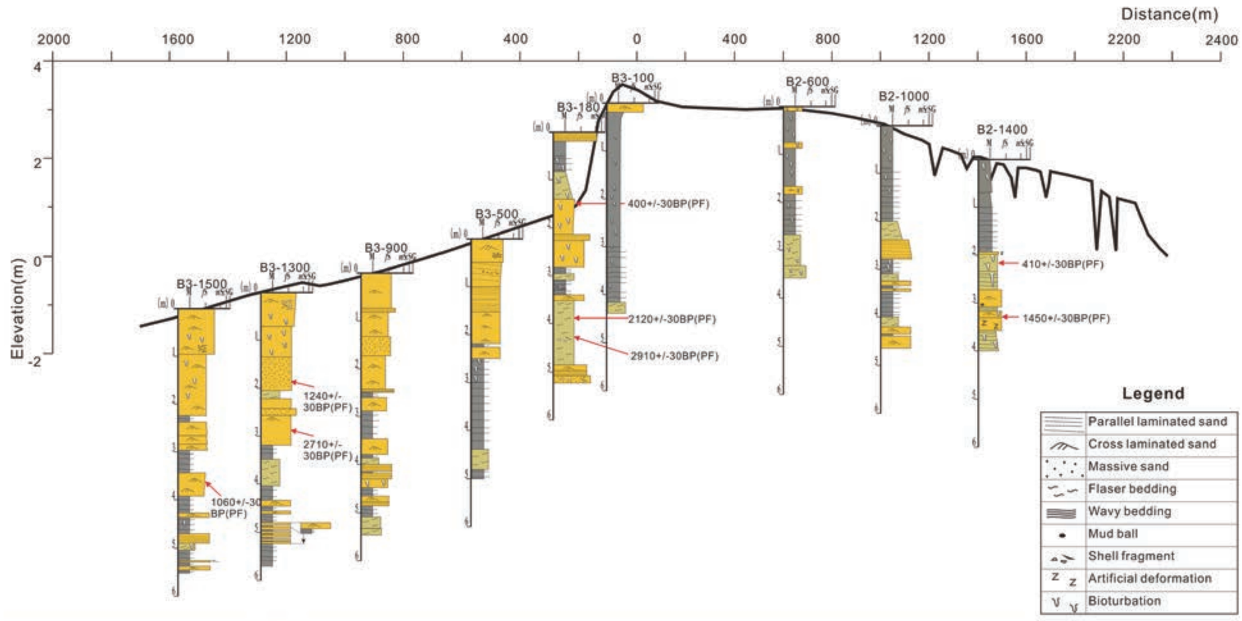


Figure 2-43. Holocene sedimentary sequences across the Yubudo Island tidal flat in Seocheon Getbol based on core data

## • Biological and Ecological Features

### Various Habitats and Community Evolution

Seocheon Getbol is characterized by mud flats in the central area surrounded by small islands where wave energy is low, but also by sand flats toward the offshore with high wave energy. Rocky habitats lie between these two flats, which provide Seocheon Getbol with a comprehensive coastal ecosystem containing all the different types of habitats.

One of the most distinctive features of Seocheon Getbol is the communities of hard clam, surf clam, Yellow Sea sand snail and polychaetes, and of the waterbirds that prey on them. At the early stage of tidal flat formation, benthic diatoms (primary producers) were a flagship species of the initial mud flat. As sand flats started to be developed, the communities of clams, gastropods, polychaetes and amphipods in a planktonic larval stage have settled in. Since then, the communities have evolved into their present forms where waterbirds preying on them serve as a keystone species. Such community evolution indicates that a complete ecological process is at work starting from primary producers through benthic organisms and to waterbirds which are the top consumers.

Narrow salt marshes of East Asian seepweed (*Suaeda japonica*) are formed in upper intertidal to supratidal mud flats on Yubudo Island. The landward side of the sand flats has sand dunes which provide more variety of habitat. The salt marshes and sand dunes also contribute a connection between terrestrial and marine ecosystems.

Training dikes have been constructed to block sediments from flowing into the commercial sea routes of Gunsan Port at the estuary of Geumgang River. These dikes play an important role in keeping Seocheon Getbol healthy by blocking contaminated fine-grained sediments from flowing into the tidal flats. Pollution indicators such as two bivalve species are observed in muddy sediments offshore at the outer side of the dikes. However, such indicators do not appear in Seocheon Getbol, which means that Seocheon Getbol remains unaffected.

## Biodiversity and Endangered Species

### *Benthic diatom and primary production*

About 181 species of benthic diatoms are observed in mud and sand flats of Seocheon Getbol. Dominant species include pennate diatoms (*Paralia sulcata, Amphora holsatica* and *Navicula* sp.). The measured value of Chlorophyll-*a*, an indicator showing primary production, ranges from 33.2-81.0 ㎎/㎡ on average. The primary production supports a high secondary production of macrobenthos such as filter feeding clams and deposit feeding polychaetes. The primary production supports a high secondary production of macrobenthos including filter feeding clams and deposit feeding polychaetes.

### *Macrobenthos*

High levels of primary production and habitat diversity indicate that Seocheon Getbol provides a good environment for macrobenthos. The 181 species present constitute an average density and biomass of 1,736 individuals/㎡ and 442.2 g/㎡, respectively. Surf clams, hen clams, polychaetes with high biomass, and amphipods with low biomass are dominant in this area. They fall prey to waterbirds coming to Seocheon Getbol, thereby facilitating the development of a community where waterbirds have become a keystone species. Because clams such as surf clam, corbulid bivalve and hard clam are found in high density and are suspension feeder (Table 2-12), high primary production in tidal flats and pelagic ecosystem are significantly responsible for the growth and reproduction of these species. The growth and reproduction of the snails, such as Yellow Sea sand snails, are also affected by the primary production in the tidal flats even though they are deposit feeders. Thus, the snails also contribute to the overall energy cycle process. Certain fish come back to tidal areas during flood tides. For those fish, including gobies, high primary production is also a key condition for their good feeding site and nursery ground. Tidal flat organisms directly or indirectly utilize the tidal flats for their livelihood; thus contributing to completing an ecosystem stretching from the coast out to the open sea.

**Table 2-12.** Dominant species of macrobenthos present in Seocheon Getbol. Only the species higher than 1% in abundance are indicated.

| Scientific name | Common name | Taxon | Mean density (ind./㎡) | % |
|---|---|---|---|---|
| *Mactra veneriformis* | surf clam | Bivalvia | 779±105 | 31.7 |
| *Potamocorbula amurensis* | corbulid bivalve | Bivalvia | 304±84 | 12.4 |
| *Umbonium thomasi* | Yellow Sea sand snail | Gastropoda | 277±58 | 11.3 |
| *Mactra chinensis* | hen clam | Bivalvia | 270±95 | 11.0 |
| *Heteromastus filiformis* | capitellid polychaete | Polychaeta | 81±13 | 3.3 |
| *Nephtys californiensis* | nephtyid polychaete | Polychaeta | 56±7 | 2.3 |
| *Mandibulophoxus mai* | phoxocephalid amphipod | Amphipoda | 55±12 | 2.3 |
| *Lagis bocki* | bock's pectinated-worm | Polychaeta | 44±9 | 1.8 |
| *Monoculodes koreanus* | oedicerotid amphipod | Amphipoda | 41±8 | 1.7 |

### *Waterbirds*

Compared to other components of the serial nominated sites, Seocheon Getbol supports the largest number of species and population of waterbirds. A total of 147,000 waterbirds from 85 species, including 17 species on the IUCN Red List, visit Seocheon Getbol. Yubudo Island is the largest habitat for Eurasian oystercatcher in ROK and as many as 35,000 great knots and bar-tailed godwit make appearances on the island (Figure 2-44). Furthermore, Seocheon Getbol hosts 24 species (38%) of 63 shorebird species that travel along the East Asia-Australasian Flyway. This is attributed to the high density benthic organisms with high biomass that the waterbirds can feed on.

**Figure 2-44.** Eurasian oystercatcher, keystone species and NT on IUCN Red List, flying up after resting and feeding in Seocheon Getbol

*Endangered species*

Notably spoon-billed sandpipers, a critically endangered species (CR), are crucial visitors to Seocheon Getbol (Figure 2-45). The entire global population of this species is about 300 to 600. From 2009 to 2015, 2 to 6 of them appeared on Yubudo Island. Spoon-billed sandpiper feed on polychaetes, crabs and gastropods. High primary production and abundant prey on Yubudo Island has led this species to appear on the site. Therefore, it is very important to protect this stopover site for spoon-billed sandpipers and to increase the population of the species.

Seocheon Getbol is also the largest habitat for Eurasian oystercatchers in the ROK. As many as 6,000 of them appeared from 2009 to 2015; recently the number rose to 11,000. About 15,000 great knots and 20,000 bar-tailed godwits also visit the tidal flat. A population of 178,279 from 24 shorebird species out of 63 species coming to the whole tidal flats in the ROK are observed, which means Seocheon Getbol supports 38% of the total shorebirds.

**Figure 2-45.** Spoon-billed sandpiper (*Eurynorhynchus pygmeus*) in Seocheon Getbol

## 2.a.vi.2 Gochang Getbol

### • Geological and Geomorphological Features

#### Tidal Channels

Along the southward coast of the bay mouth, narrow sand tidal flats and sand dunes are developed. A deep (about 15 m ) main tidal channel has been formed along the northern rocky cliff of the bay, running from east to west. The velocity of the tidal currents in the center of the tidal channel is 115 ㎝/s at spring tide and 150 ㎝/s at ebb tide, showing that the ebb current is stronger. However, the sedimentary structures in the depositional bodies indicate much stronger flood currents than ebb currents on the intertidal flat. Another two small tidal channels are formed on its southern and eastern coasts, which are connected to small streams and so form small estuarine tidal flats. However, their sediment supply is very small, not enough to support the historical formation of Gochang Getbol.

### Surface Sediment and Seasonal Changes

Suspended sediments flowing in from Geumgang River in the north move to the south and are temporarily deposited on the upper intertidal flats during summer. In winter, those sediments are eroded and moved further down to the south by longshore currents. In this process, the bay-mouth area of Gochang Getbol serves as a temporary deposition site for fine-grained sediments coming to Shinan Getbol. Some suspended sediments are transported inside the bay, forming a typical embayed mud-flat sequence.

Sand flats, mixed flats composed of silty sand and sandy silt, and mud flats gradually spread from the outer to inner part of Gomsoman Bay. Thus, surface sediments in Gochang Getbol become finer toward the inner part of the bay; a typical characteristic of an embayed tidal flat. However, such a general distribution pattern of surface sediments tends to be changed every year due to seasonal changes such as strong wave energy in winter and typhoons in summer.

Since Gochang Getbol is located on an open coast, it is greatly affected by the continental monsoon. Therefore, distinctive seasonal changes in tidal flat sediments are clearly observed in the outer part. Due to such climatic and oceanographic conditions, the seasonal changes in tidal flat sediments, from sand flats to mud flats, can be seen.

In summer, mud facies are observed partly in the front and back of Daejukdo and Sojukdo islands in the outer part of Gochang Getbol. But overall sand and mixed flats of silty sand are generally dominant. Mud flats are predominant in the central and inner parts of the bay. However, on the west side of a small stream at the center, coarse-grained sediments are more common. Sediments here also become finer toward the coast. In winter, most mud facies partially accumulated in the outer part during summer are eroded by the strong waves and flow out to the offshore, changing the surface to sand facies. The overall surface sediments continue to become finer toward the inner part of the bay in winter. On the other hand, mud facies located in the east side of the stream at the center rarely change even in winter.

About 5 to 10 ㎝ of mudflat deposits are eroded during winter. Sand flats in the outer part tend to be eroded by more than 20 ㎝ in thickness and accumulate again later. The outer part of Gochang Getbol is exposed to 10 wind storms in average per month during winter. This is why the most preserved sand-flat sequences of Gochang Getbol show sedimentary structure formed by strong storm or rapid tidal currents.

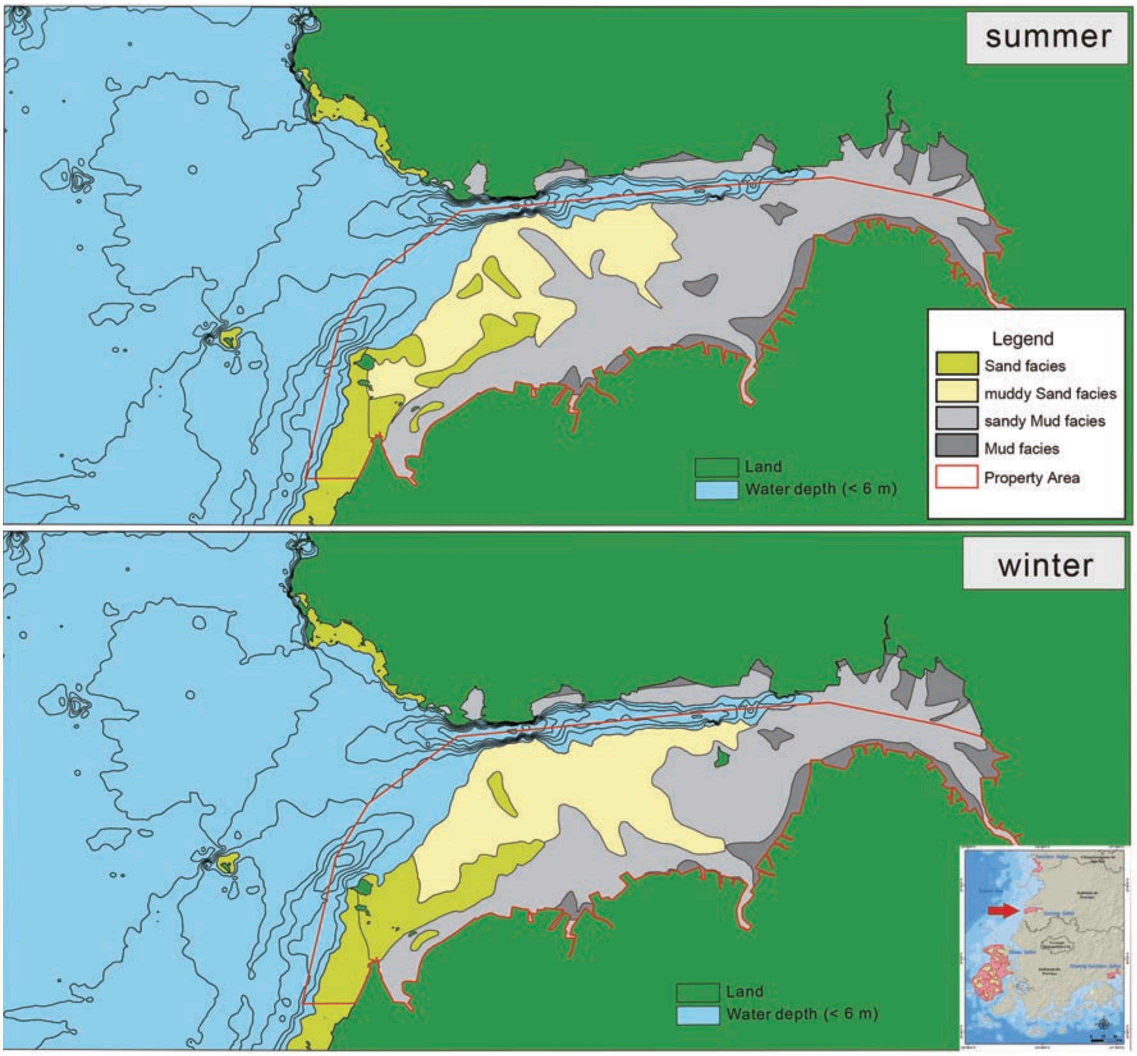



Figure 2-46. Seasonal Changes of tidal-flat surface sediment in Gochang Getbol

### Basement Rocks and Holocene Tidal Flat Sequences

Quite a large number of small islands and rocks are found in the subsurface sedimentary layer of the subtidal area. An isopach map of basement rocks indicates that Daejukdo Island and other islands in the outer part of Gochang coast have blocked the wave energy induced by the northwesterly monsoon, enabling muddy sediments to be deposited in the sheltered rear of these islands.

About 9,000 years ago, when the sea level was 20 m lower than it is today, dozens of islands were present at the mouth of Gomsoman Bay, forming an archipelago. Mud flats more than 20 m deep had been deposited in pre-existing tidal channels inside the islands. As sea level began to rise to near its present position, sand flats started to cover the mud flats in the outer parts. After that time, the fine-grained sediments were supplied to the inner parts of the bay, forming wide inner mud flats on the bay-head area.

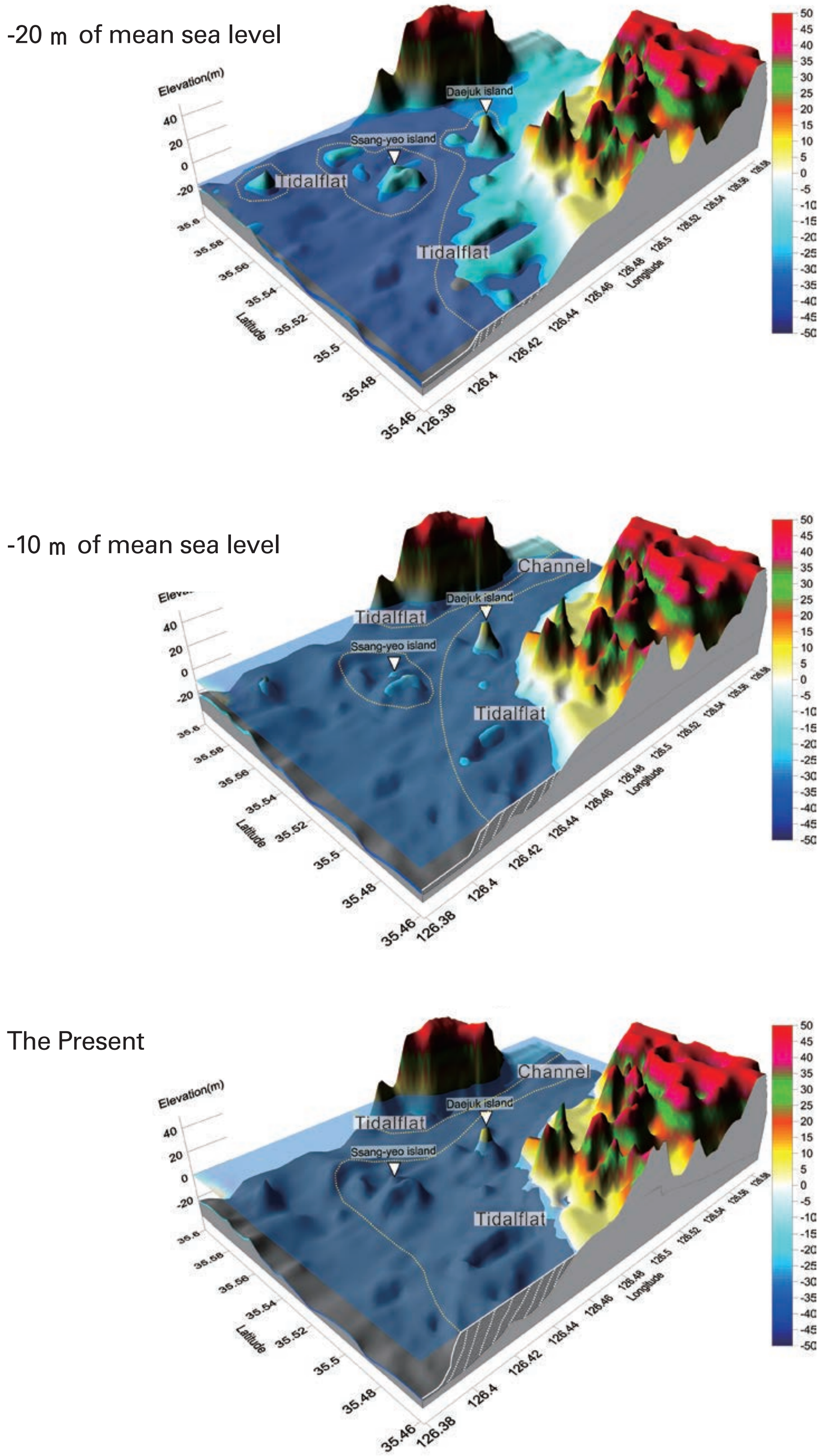



**Figure 2-47.** Paleo-bathymetry based on acoustic basement in Gochang Getbol showing the formation of tidal-flat sequences and some islands covered by tidal flats according to sea levels of -20 ㎧, -10 ㎧ and the present

### Characteristic Tidal-flat Sedimentary Bodies

A chenier, independently formed by sandy and gravel sediments, is observed on mud flat in the upper-intertidal part of Gochang Getbol. The chenier moved toward the land at the speed of 4-23 m/yr from 1989 to 2016. But, more recently, the speed declined dramatically and now the chenier seems to be at standstill. Currently the chenier is about 30-70 m wide and 1 ㎞ long. It was much smaller in the past. Not all parts of the chenier are submerged at high tide, but they are located in an area where some parts of them are submerged at maximum high tide. It would be also a nice place for all birds to use it as nesting and resting site because of isolated and protected dry area surrounded by mudflat.

The chenier deposits consist of pebbles, coarse-grained sand and shells. It is 1-3.5 m high, and its shape tends to arch like a bow as it approaches the land. Landward cross stratifications are observed in a cross section. All these characteristics indicate that the chenier is a storm deposit and moves slowly toward the land. Coarse-grained sediments are supplied to the chenier by storms or typhoons at high tide.

In general, multiple overlapped cheniers form a chenier plain. In case of Gochang Getbol, one or two cheniers move and form an independent and characteristic sedimentary body on the mud flat. It appears to be formed due to insufficient supplies of coarse-grained sediments. Several cheniers in Gochang Getbol seem to disappear naturally or artificially.

**Figure 2-48.** A scenery of outer part in Gochang Getbol showing a curved chenier formed on the uppermost tidal flat. Two islands of Daejukdo (right) and Sojukdo(left) are shown in the upper center.

### Individual Components of Sedimentary Sub-environments

***Sand flats***: Near the bay-mouth a 5 ㎞-wide tidal flat has developed as the outer part of Gochang Getbol. A sand flat about 3 ㎞-wide is present in the lower intertidal area. The width of the sand flat increases in winter and narrows in summer. Mud sedimentary layers are temporarily formed near the lowermost intertidal area, which is located at the lower part of the sand flat. However, those sediments are eroded away seasonally and reveal a sand flat in winter.

***Storm deposits, tidal beaches and sand dunes***: On the front side of the linear coast in southern Gochang Getbol, a 10 to 20 m wide tidal beach has developed with sand dunes around its landward edge. A sand flat about 500 to 700 m wide also develops along the coast of the tidal beach. This sand flat is an open-coast tidal flat which is directly exposed to the strong waves of the open sea. Therefore, a mud flat is not observed even during summer. During winter, erosion structures such as deep swash bars and hollows and ridges are developed on the sand flat by strong waves, but they are rapidly covered again with sands under lower energy conditions. Sedimentary sequences with hummocky cross or distinct parallel stratification often accumulate. These are upper-flow regime or storm deposits. To prevent damage further inland caused by sands blown in by the wind, local people planted pine trees on the sand dunes in the past. Consequently, the belt of sand dunes became narrow and the dune vegetation was restricted.

***Mud and mixed flats***: Mud flats in Gochang Getbol are found only in the uppermost part of the tidal flat in the inner bay and rarely develop on the outer part of the bay. Mixed flats are more commonly found, and distributed in a wide area on Gochang Getbol. Both sand and mixed flats there show a seasonal waning and waxing, competing with each other seasonally. A small stream divides the bay into the inner and outer parts. Mud and mixed flats which are not affected by seasonal changes are formed in the inner part. The altitude of the tidal flat surface inside is about one meter higher than that of tidal flats in the outer part. Seasonal changes can be observed only in the outer part.

***Rocky substrates***: Gochang Getbol has only a few rocky islands that are exposed to tides. As a result, the Getbol has fewer rocky substrates compared to other components of the serial nomination. However, rocky substrates and gravel flats on Daejukdo Island, in the outer part of Gochang Getbol, are exposed to strong waves and tidal currents. This creates dynamic rocky habitats which may be small but are very rich in biodiversity.

### Thick Mud-flat Sequences

Most pre-existing former islands on Gochang Getbol have been covered with tidal flat sediments. This causes sand flats in the outer part to prograde inward to the bay. In contrast, seaward progradation of mudflat sedimentary layers, developed by vertical aggradation, is observed in the inner part of the bay. The sand flats and mud flats compete with each other at the middle part of the bay. Wave-dominated sand flats, mixed flats with balanced wave and tidal energies, and tide-dominated mud flats are all well developed from the outer to inner parts of the bay. Small streams located in the central and bay-head parts cannot play an effective role as an estuary as only small amounts of sediments are supplied from inland. Mud flats formed inside the bay are typical semi-enclosed embayed flats. Gochang Getbol is currently exhibiting a typically transgressing process of an open-coast tidal flat changing to a semi-enclosed tidal flat as it continues to be covered up with sand flats.

The boundary which distinguishes the Pleistocene from Holocene deposits is observed at about 20 m in depth from the tidal flat surface in the outer part of Gochang Getbol. It shows that the formation of the mud flats in the intertidal zone started 8,300 years ago. Gochang Getbol sedimentation rate is about 2.4 mm/yr on average which is similar to that of Shinan Getbol. Core data indicates that mud had been deposited rapidly until 6,000 year ago and has slowed since then. Coarsening upward trend is present from about three meters below the surface, indicating that Gochang Getbol changed to open-coast tidal flat at this depth.

With sea level rise, most pre-existing islands were submerged. Compared to Shinan Getbol, the altitude of the coastal land area along Gomsoman Bay is lower with smaller relief. Therefore, tidal flats in the outer part of Gochang Getbol were changed to open-coast tidal flats, transgressing toward the inside of Gomsoman Bay. At present, seasonal sediment movements induced by tides or waves can be observed. This is because islands are no longer able to protect the sediments from hydraulic energy as sea level has become high enough to submerge neighboring islands.

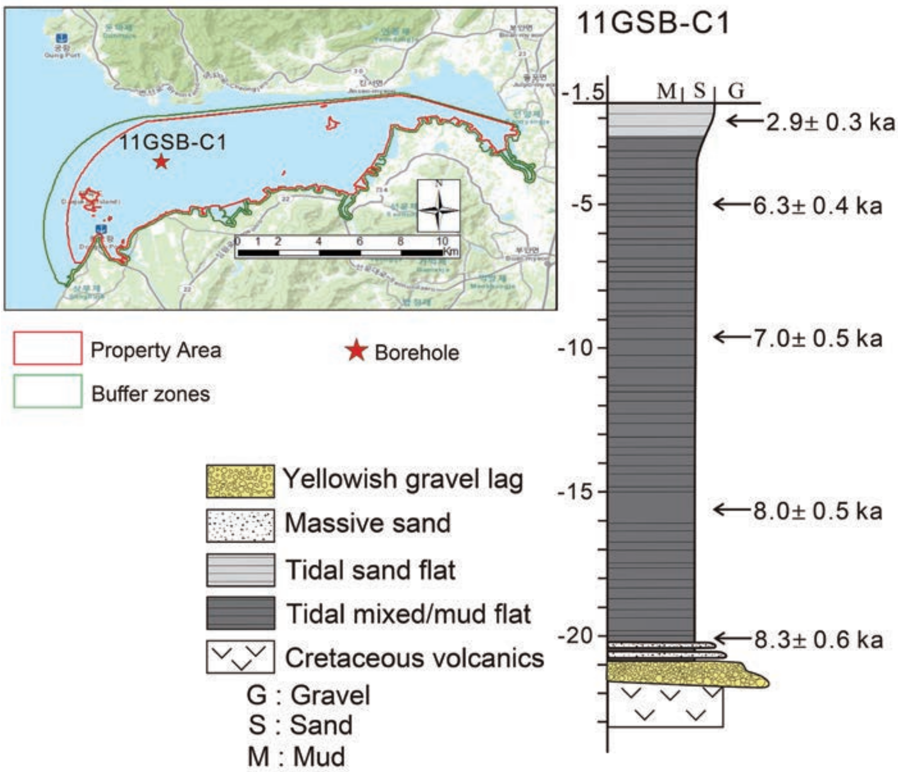



Figure 2-49. Long-core with age data obtained in Gochang Getbol, showing the bottom of the Holocene sequence at -20 m (ca. 8,300 yr BP)

## • Biological and Ecological Features

### Various Habitats and Community Evolution

Gochang Getbol has a unique ecosystem that is composed of salt marshes, mud flats, mixed flats, sand flats and rocky substrates. A community dominated by Japanese mud crabs and fiddler crabs is observed in mud flats inside the bay. Polychaetes and surf clams are dominant in a community formed in sand flats. In both communities, waterbirds play roles as a keystone species.

In the rocky habitats, a community dominated by starfish, brown turban shell (*Omphalius rusticus*) and filter feeding Pacific oysters is established. Starfish control the ecosystem as a keystone species by predation. The organisms on rocky habitats produce planktonic larvae during their breeding season. These larvae contribute to maintain the food chain as food, and also to stabilize the ecosystem after settlement.

Tide pools of various sizes serve as refuges for those organisms once the rocks are subaerially exposed at low tide. Tide pools closed to subtidal environment serve as a conduit to the coastal ecosystem. A wide variety of communities of macrobenthos, including manicure ghost crabs and milky fiddler crabs, dwell in salt marshes. In particular, milky fiddler crabs are a marine protected species. Those communities enhance the biodiversity of Gochang Getbol. Macrobenthos transfer energy from primary producers to the upper trophic level, thus contributing to the maintenance of a healthy tidal community.

Winter monsoon winds help to mix the sediments, which enables oxygen-rich water to penetrate into the sediments, thereby expanding the aerobic layer. This active bioturbation in mud and sand flats contributes to form an aerobic layer of 6 ㎝ or more, improving the habitat environment and maintaining the density and biodiversity of benthic organisms.

### Biodiversity and Endangered Species

#### *Benthic diatoms and primary production*

Gochang Getbol hosts 51.7% (194 species) of the whole benthic diatom biodiversity observed in the nominated property. Pennate diatoms including *Diploneis* sp. and *Amphora libyca*, and centric diatoms including *Coscinodiscus* sp. and *Cyclotella stylorum* appear as key dominant species.

The measured value of Chlorophyll-*a*, an indicator showing primary production, ranges from 35.6-67.6 ㎎/㎡ on average. It is noteworthy that the primary production peaks at 215.7 ㎎/㎡ at one site in Gochang Getbol. High primary production of benthic diatoms in turn enables to increase the production of suspension feeders, such as the Manila clams and surf clams. The rocky habitats of Daejukdo Island are rich in these benthic diatoms and marine algae and thus enhance the whole biodiversity in the nominated property.

### *Macrobenthos*

A total of 255 species of macrobenthos is present in Gochang Getbol accounting for 29.9% of the macrobenthos diversity observed in the nominated property. Salt marshes, mud flats and sand flats host 184 species, while 80 species are observed on the rocky habitats. The top two dominating taxa are arthropods (33%) and mollusks (31%) with 84 and 79 species respectively. Sand flats developed on Gochang Getbol have a high density of Manila clams and surf clams, and deposit feeding polychaetes. These organisms are nutrient diets for migratory waterbirds visiting this area. Importantly, tiger crabs (*Orithyia sinica*) [only a single species of this genus has been reported in the world] and lamp shells (*Lingula anatina*) [known as living fossils] are observed in Gochang Getbol.

Tiger crabs inhabiting inside sand flats lay about 54,000 eggs, but only few of them grow into adults. Due to its low density, it is hard to estimate its exact population size and they only live in limited areas. Some local fishermen catch them with traditional indigenous fishing methods.

**Figure 2-50.** Lamp shell (*Lingula anatina*), living fossil in Gochang Getbol

Lamp shells, which have long and blunt-end tails called peduncles, live within sand flat sediments (Figure 2-50). Their tails are occasionally consumed by humans. Lamp shells are filter feeders that consume benthic diatoms and other species. They enable dissolved oxygen to penetrate into sediments, thus helping to make a favorable environment for other organisms. With a lifespan of about 5 to 8 years, the density of these lamp shells on Gochang Getbol stands at 10-140 individuals/㎡.

### *Waterbirds*

About 41,000 waterbirds from 90 species inhabit Gochang Getbol. This is because Gochang Getbol is rich in large benthic organisms and small potential prey, both of which are eaten by waterbirds. Dominant species include dunlins, great knots, whimbrels and black-tailed gulls.

### *Endangered species and endemic species*

Gochang Getbol hosts as many as 18 waterbird species on the IUCN Red List. Spoon-billed sandpipers, a critically endangered species (CR), are observed in this area as in Yubudo Island. Endangered species (EN) such as great knots, oriental storks, far eastern curlews and spotted greenshanks; vulnerable species (VU) such as Saunders's gull, pochards and Chinese egrets; near-threatened species (NT) including Eurasian oystercatchers, northern lapwings red knots, bar-tailed godwits, red-necked stints and curlew sandpiper are all seen on Gochang Getbol. Importantly, oriental storks (EN) appear only in Gochang Getbol among the serial nominated sites. They visit Gochang Getbol only in winter and feed on Japanese mud crabs and gobies. Oriental storks inhabit the inland wetlands in Mongolia for breeding, fly down to the property in fall to get through winter, and go back to their breeding sites in early spring.

Narrow sand flats are formed in the upper intertidal and supratidal mud flats inside the Gomso tidal flat, where a limited number of milky fiddler crabs are observed in the sand flats. As explained above, many endangered and protected species are observed on Gochang Getbol, and this clearly demonstrates how the habitats in Gochang Getbol are well equipped to feed the observed species while also being protected from various threats by humans.

**Figure 2-51.** Oriental stork (*Ciconia boyciana*), EN on IUCN Red List, in Gochang Getbol

## 2.a.vi.3 Shinan Getbol

### • Geological and Geomorphological Features

#### Tidal Channels

At Shinan Getbol there are two large tidal channels that run from north to south (N-S) and eight tidal channels from east to west (E-W). The N-S tidal channels are wide and deep, whereas the E-W tidal channels are narrow and shallow. Of the two N-S tidal channels, the one on the east side has an average width of 5 kilometers and is located between Aphaedo and Amtaedo islands (Figure 2-52). It divides Shinan Getbol into northeast and southwest areas. The other N-S tidal channel on the west side strongly influences the sedimentation processes around the big islands in the southwest part of the archipelago. With a width less than 1 ㎞, the E-W tidal channels are located between the 13 large islands. A wide variety of small tidal channels and tidal gullies is also developed in between the islands with various shapes and irregular distribution.

The depth of tidal channels becomes greater from east to west and from north to south. The wider the tidal channels are, the deeper they are. Some tidal channels with a width of 3-5 ㎞ are deeper than 50 m, but also some channels with a width less than 1 ㎞ are as deep as 20 m. The tidal channels do not show much curvature, but are rather straight. In coastal areas without any tidal flats, bedrock is directly connected to tidal channels. Wide tidal flats show steep slopes at the seaward end of the intertidal zone. They show sometimes a fluctuation of surface topography, which reflects the irregular shape of the rugged bedrock. In the western open-coast part of Shinan Getbol, most islands have steep slopes down to 10 m below sea level, and then are less steep beyond it.

Currents in the tidal channels are variable in flow pattern, depending upon geomorphic characteristics such as distribution/shapes of islands and channel direction/width. The tidal current velocity can at times exceed 200 ㎝/s and in some southern tidal channels can exceed 400 ㎝/s. As for the waves, the height of waves in the inner part is less than 50 ㎝, even when waves in the outer part reach 3-4 m high.

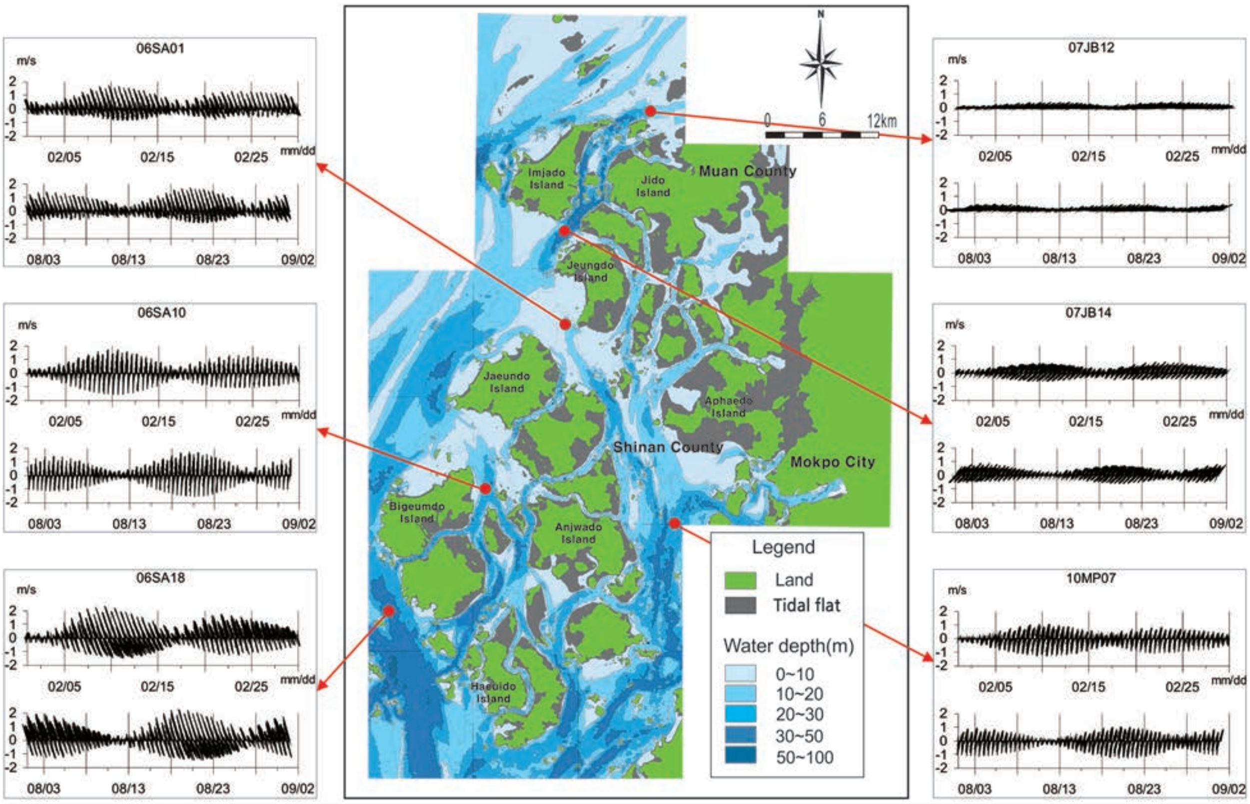



**Figure 2-52.** Complicated flow directions and velocities of tidal currents in Shinan Getbol

## Surface Sediments and Seasonal Changes

The outer part of Shinan Getbol is surrounded by Imjado, Jaeundo, Amtaedo and Bigeumdo islands. On the northwestern or western coasts of these islands, narrow and long sand flats, tidal beaches and sand dunes have formed. In contrast, tidal flats in the east of these islands, that is the inner part of the archipelago, are almost all mud flats. Likewise, all the rocky islands in the inner part are surrounded by mud flats. Narrow sand flats are located on the western coast of the islands facing the open sea. Some of these sand sediments are transported through tidal channels to the inner part, thus forming sand flats in places at the southern and northern corners of islands. Depending on the relative influence of the waves and tidal currents, Shinan Getbol has, in general, developed wave-dominated sand flats in outer parts and tide-dominated mud flats in inner parts (Figure 2-53).

Along the outer coasts of the islands located in the south of Shinan Getbol, sand flats and mixed flats have formed in places. However, mud flats are dominant in both the inner and outer parts of Shinan Getbol, indicating that the waves are less influential than the tidal currents. The characteristics of the surface sediments indicate that Shinan Getbol is affected by the continental monsoon climate typically seen in the eastern part of the Yellow Sea.

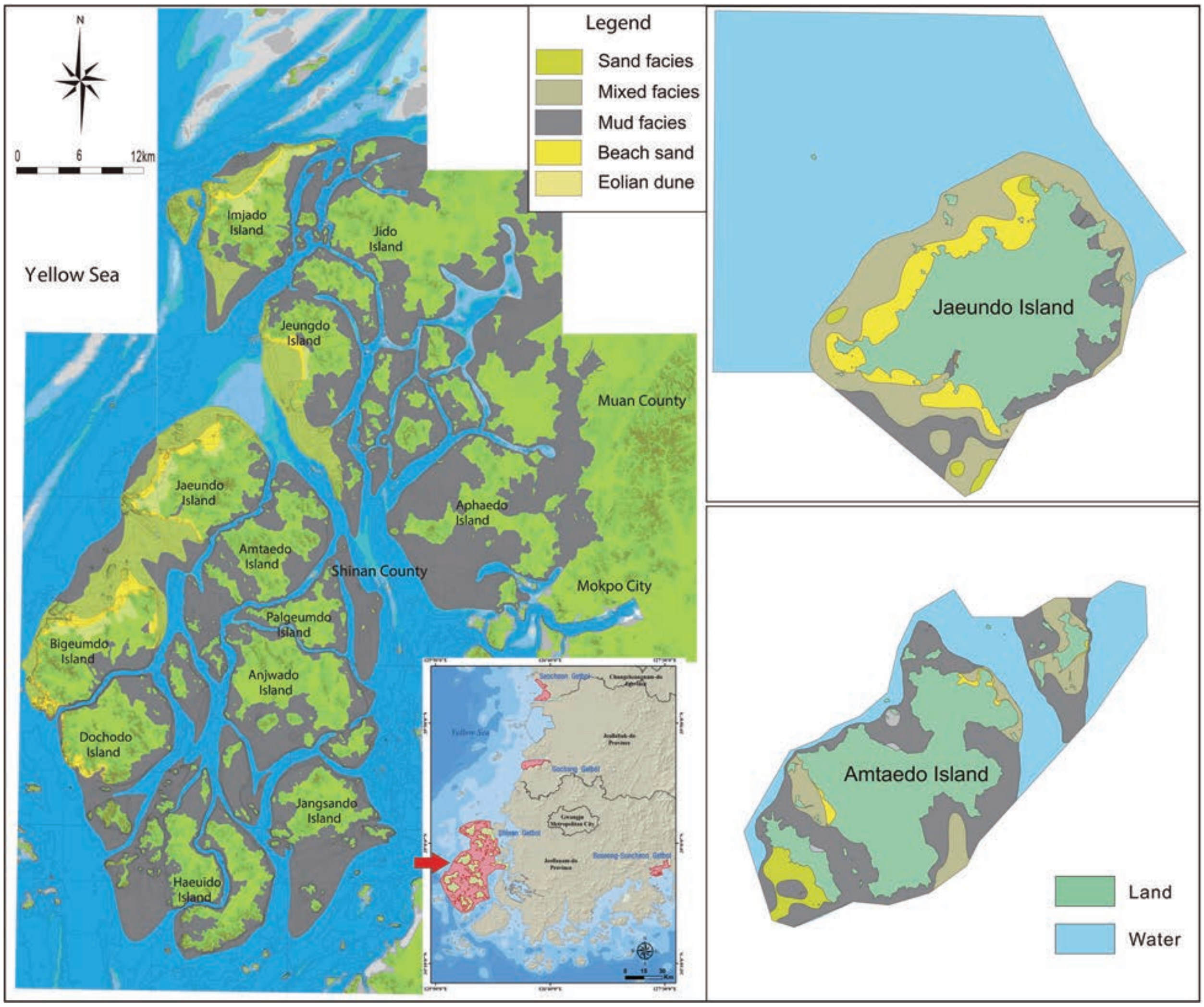



**Figure 2-53.** Surface sedimentary facies in Shinan Getbol, showing tide-dominated mud-flat facies and wave-dominated sand-flat facies on the inner and outer parts, respectively

Compared to Gochang Getbol, the seasonal changes in the surface sediments are not clearly shown in Shinan Getbol. Sand flats are dominant in both summer and winter in the outer tidal flats of Imjado, Jeungdo, Jaeundo, Bigeumdo and Dochodo islands. In contrast, inner tidal flats consist mainly of mud flats regardless of season. Sand flats in some islands are developed on the southern and northern tips; of them, sand flats that face directly with offshore tend to expand in area or the sediments become a bit coarser in grain size during winter.

### Basement Rocks and Holocene Tidal Flat Sequences

In seismic data obtained from the subtidal area of Shinan Getbol, isopach maps indicate that complicated small-scale and shallow tidal channels existed when the sea level was lower than the present. It also implies that Shinan Getbol had a more complex sedimentary system. However, the deep tidal channels we see today have kept their position and dimensions since the Holocene sea level has risen to fill island valleys.

The outer part of Shinan Getbol hosts a Holocene tidal flat and sand dune deposits which are 5-10 m deep. Intertidal deposits with a depth of more than 25 m have developed in the inner part of Shinan Getbol. Based on the depth of tidal channels, tidal sedimentological processes and the movement of the suspended sediments, the Holocene tidal-flats sequence in the inner parts are estimated to be as thick as 40 m in maximum.

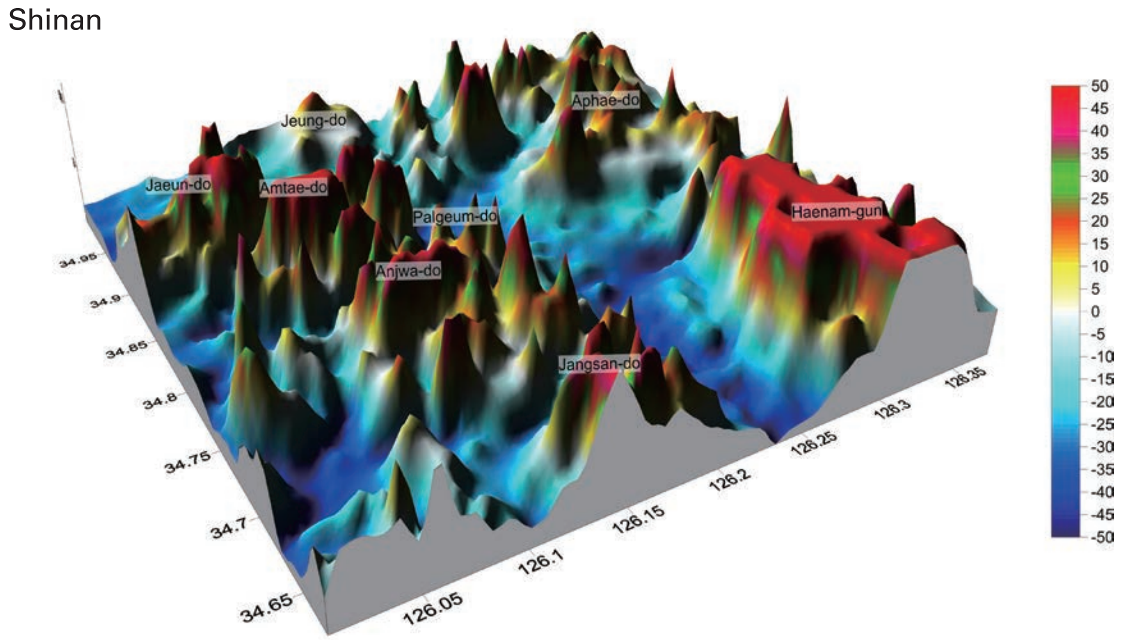



**Figure 2-54.** Acoustic basement of Shinan Getbol area showing a typical archipelagic environment and much steeper slopes of basement rocks

### Characteristic Tidal-flat Sedimentary Bodies

Shinan Getbol displays unique sandy sedimentary bodies developed across the uppermost part of the mud flats. In general, they start from a small island and align in certain directions. The size of these sedimentary bodies varies: they can be longer than 2 ㎞ with a width of 50 m while others may be shorter at less than 100 m in length. Sediments are mainly composed of coarse-grained sand, pebbles and shell fragments. At the upper part of mud flats of open-coast tidal flats, cheniers can be independently formed parallel to the coastlines. However, some sedimentary bodies observed on the uppermost mud flats of Shinan Getbol are different from the typical cheniers. They are narrow and long, developed along the rocky islands, and are formed normal to the coastlines.

Among these characteristic sedimentary bodies observed on mud flats of Shinan Getbol, the one that has developed to the east of the Keunpojakdo Island starts from Galwooseom Island and stretches to the south for 2.5 ㎞ (Figure 2-56). It is very narrow with a width of just 10 m, but at the last 700 m toward the southern end, it widens to 20 to 25 m. Based on the large pebbles and their shapes, they are interpreted as the remnants of typhoon sediments, which were developed, transported and grown by strong typhoons. This kind of the characteristic sedimentary body has not yet been reported worldwide. It is named "sand-gravel string" here.

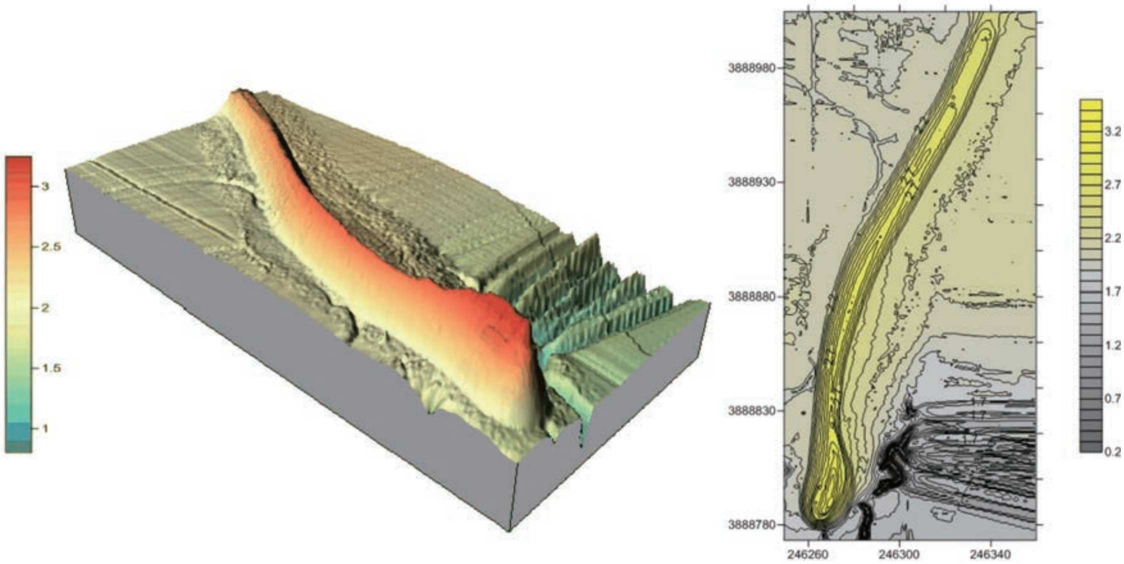



Figure 2-55. 3-D shape of a sand-gravel string developed on Shinan Getbol

Figure 2-56. A picture of a sand-gravel string developed on Shinan Getbol. The second island from left side in Galwooseom Island from which the formation of sand-gravel string seems to be started.

Figure 2-57. A scenery of Shinan Getbol, showing archipelagic feature and tidal channels near Aphaedo and Goido islands

### Tidal Gullies

Various complex tidal gully networks have developed on the surface of mud flats in Shinan Getbol. The shape of a tidal gully depends on a number of factors: the slope, sediment type, the supply of suspended sediment, the amount of organic matter included, the dominant direction of tidal currents and the characteristics of adjacent landforms. The tidal channels on sand flats can frequently change, whereas the tidal channels on mud flats see little change because of the cohesiveness of muds. Tidal gullies on mud flats of Shinan Getbol show complex dendritic patterns and vary in shape. In homogeneous sediments, dendritic tidal gullies appear to develop rather randomly. Most tidal gullies on mud flats are not wide, and start from large tidal channels and end in the middle of mud flats. However, in the south of Jido Island and in the west of Aphaedo Island, wide tidal gullies directly connected to the land are present. It appears that these channels start inland, and tidal currents flow back and forth through the widened tidal creeks.

### Individual Components of Sedimentary Sub-environments

***Mud flats***: Mud flats are the most widely distributed sedimentary facies in Shinan Getbol, usually adjoining directly bedrocks or dikes. They exhibit a gentle topographic relief with almost flat slopes toward tidal channels. However, the slopes suddenly become steeper as they come closer to tidal channels. The elevation of the boundary between mud and mixed flats is nearly the same as the local mean sea level. Tidal gullies have developed where mud flats have a gentle slope. Mud flats are mainly composed of silt and clay with less than 20% sand. Due to active bioturbation, horizontal stratification is rarely preserved.

**Figure 2-58.** Various and complicated patterns of tidal gully networks on the inner mud flats of Shinan Getbol

***Sand flats***: The coastlines of Imjado, Jeungdo, Jaeundo and Bigeumdo islands face the west coast of ROK. Sand flats are observed mostly in the western coast with some in the southern coastlines of these islands. Sand flats have steeper slopes than mud flats, and sedimentary structures such as ripple marks and swash bars are commonly observed on the surface. The sediments are composed of very fine- to fine-grained, well sorted sand. Most common sedimentary structures include parallel and cross laminations. Massive sand facies are sometimes observed as well. These sedimentary structures have developed under a very strong hydraulic energy regime.

***Beaches and aeolian dunes***: Beaches and sand dunes are successive sedimentary deposits, because dunes are formed by wind-driven sand from sand flats and tidal beaches. The moving sands are occasionally captured by sand dune vegetation. Sand dunes are commonly observed along the coasts affected by strong wave or wind. On the western coast of Imjado, Jeungdo, Jaeundo and Bigeumdo islands, long and narrow sand dunes are developed from the northeast to southwest. Sand dunes developed in the northwestern coast tend to grow in size southward. The orientation of the sand dune formation is due to the northwesterly winds dominant in winter. Dune marshes formed in low-lying areas of sand dunes are also present behind coastal sand dunes. They are developed where sand dunes block the existing freshwater channels or where the dune swale meets the water table. Sand dunes are mainly composed of very fine-grained sand and can move easily when there is no impermeable layer underneath. The existence of a dune marsh indicates that there is an impermeable layer below the marsh.

***Rocky intertidal zones and gravel beaches***: Rocky intertidal zones with exposed bedrock occasionally occur along the coast. The zones submerge and emerged repetitively due to the tidal cycle. Depending on lithological characteristics of the bedrocks, the intertidal zones can show distinctive attributes. Gravel eroded from the bedrock may form some gravel beaches.

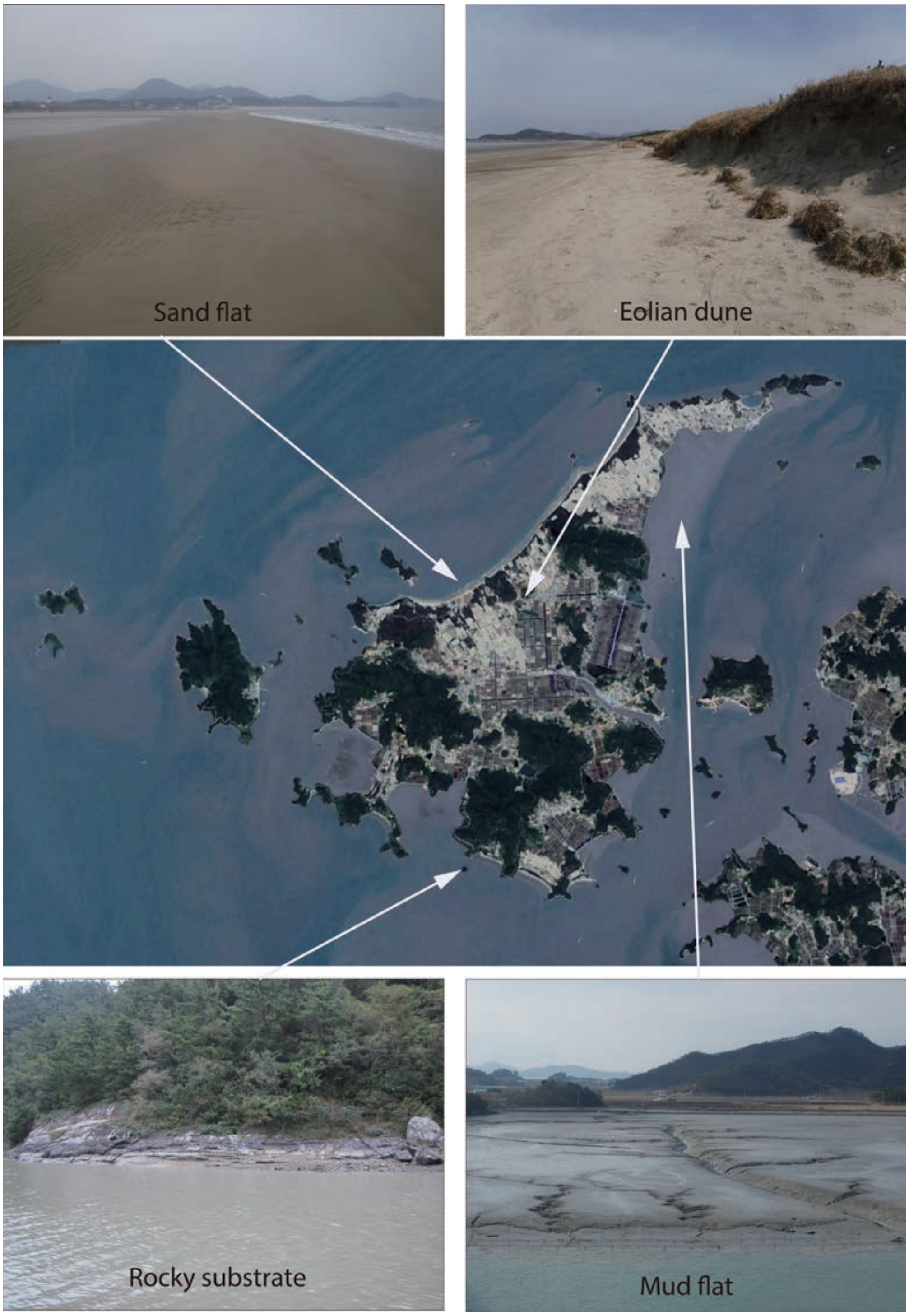



**Figure 2-59.** Sub-environments formed around a rocky island (Imjado Island) in Shinan Getbol

### Thick Mud-flat Sequences

Sand dunes behind the outer islands of Shinan Getbol host sedimentary deposits as thick as 40 m. At the base of the deposits, well rounded gravel lags are present. Above the gravel lag layer, mud facies containing coarse sands and several layers of peat occurs as well as homogeneous mud facies. These layers are tidal deposits formed during the Late Pleistocene Epoch when the sea level was lower than the present. Unconformably above the Pleistocene deposits, Holocene mud layers, intercalated with sands, have a pattern, 5-10 m in thickness, of coarsening and thickening upwards. The mid-Holocene deposits started to form about 7,000 years ago in this region, and indicates the development of transgressive sedimentary sequences in the outer part of Shinan Getbol. This sequence was deposited during the Holocene sea level rise when transgressive marine sediments encroached inland, but was interrupted by repeated erosional episodes. Here, sand flats, sand beaches and sand dunes were deposited after the Pleistocene intertidal muds were eroded, and led to the formation of the transgressive coastal facies up to 10 m in thickness. The thickness does not exceed 10 m even when sand dunes are included.

Very thick intertidal mudflat sequences have been deposited near the deep tidal channels at the inner part of Shinan Getbol over about the last 8,500 years. These intertidal deposits are as thick as 25 m and were formed by vertical aggradation of suspended sediment, a process that is still ongoing.

**Figure 2-60.** Various shapes of tidal gullies in the inner part of Shinan Getbol

## • Biological and Ecological Features

### Various Habitats and Community Evolution

Shinan Getbol features well-developed mud, sand and rocky habitats. Each habitat has distinctive communities which lay the foundation for high biodiversity. The uninhabited islands within the nominated property are rich in biodiversity. In the mud flats, a clear evolution of communities is observed, where the mud octopuses are keystone species.

### Biodiversity and Endangered Species

#### *Benthic diatoms and primary production*

A total of 224 benthic diatoms are responsible for primary production in Shinan Getbol. Imjado Island hosts 166 species, while Jeungdo Island hosts 102 species. Dominant species include pennate diatoms such as *Achnanthes brevipes* and *Nitzschia apiculata* which are the food sources for benthic organisms. The measured value of Chlorophyll-*a*, an indicator showing primary production, of Imjado and Jeungdo islands ranges from 3.5-185.9 ㎎/㎡ (47.1 ㎎/㎡ on average) and 24.3-74.7 ㎎/㎡ (50.1 ㎎/㎡ on average), respectively.

Rocky habitats of Shinan Getbol are home to 144 marine macroalgae species. These macroalgae are partially responsible for primary production. Among marine algae, laver, fusiforme seaweed, green laver and seaweed fulvescens are edible food resources for the locals. For more than 400 years, laver has been cultured at the lower part of the tidal flats from fall to winter.

#### *Halophytes*

Salt marshes are not well developed on Shinan Getbol. Halophytes are observed only at the limited upper part of mud flats. In the nominated property, 54 species of halophytes are seen, and 52 species are present on Shinan Getbol (Figure 2-61). The Imjado Getbol hosts 37 species of halophytes with well-developed communities of sea wheatgrass (*Elymus molli*), common reed and herbaceous seepweed (*Suaeda maritima*). The community of sea wheatgrass prevents erosion of sand, protecting the ecosystem. The Jeungdo Island tidal flat has 38 species, while Hauido Island has 35, and sand dunes at Myeongsasimni on Bigeumdo and Jaeundo islands host 37 species.

#### *Macrobenthos*

Shinan Getbol hosts a total of 568 species of macrobenthos with an average density of 594 individuals/㎡, comprising an average biomass of 336.1 g/㎡. In mud flats, polychaetes, Japanese mud crabs, amphipods, littoral spoon clams (*Laternula marilina*) are present (Table 2-13). In contrast, amphipods appear abundantly in sand flats. Mud and sand flats have completely different benthic communities. On rocky habitats, a variety of species are observed in high densities. At the upper part of the rocky habitats, granulated periwinkles and Korean common periwinkles are found. From the middle to lower part, black barnacles, Pacific oysters, Korean common dogwhelks, sea anemones, blood clams, Japanese nerite and needle chitons are present in high densities.

A large number of mud octopuses, which are top predators, are found in the mud flats of Shinan Getbol due to abundant Japanese mud crabs providing them with a rich food supply (Figure 2-63). Tidal flats in Jeungdo area have wide sand flat and are very rich in hard clams and amphipods. Hard clams are a major income source for the local people, and amphipods provide food for waterbirds. At the upper part of the sand flats, Stimpson's ghost crabs, which live in burrows, are present. They facilitate the circulation of organic matter by spitting sand grains out of burrows at low tides after feeding.

Continuous production of hard clams and visits by waterbirds indicate that energy flow is actively taking place. Organic matter is being generated by primary producers and decomposed by microorganisms constantly. In addition, regional specialties such as flathead mullet, blue-spotted mud hopper and gobies, which feed on polychaetes are constantly produced. This is another indicator that the energy circulation functions perfectly in these tidal flats.

**Figure 2-61.** Marshfire glasswort (*Salicornia europaea*) community in Shinan Getbol

Figure 2-62. An inner mud flat with a small sand spit and ebb-tide road in Jeungdo Island of Shinan Getbol

Table 2-13. Dominant species of macrobenthos present in the Shinan mud flats. The only species higher than 1% in abundance are indicated.

| Scientific Name | Common name | Taxon | Mean density (ind/㎡) | % |
|---|---|---|---|---|
| *Heteromastus filiformis* | capitellid polychaete | Polychaeta | 208±35 | 32.6 |
| *Laternula marilina* | littoral spoon clam | Bivalvia | 105±54 | 16.4 |
| *Perinereis aibuhitensis* | sand worm | Polychaeta | 24±5 | 3.8 |
| *Assiminea* sp. | assimineid gastropod | Gastropoda | 23±18 | 3.6 |
| *Stenothyra edogawensis* | stenothyrid gastropod | Gastropoda | 19±6 | 3.0 |
| *Aphelochaeta* sp.2 | cirratulid polychaete | Polychaeta | 16±7 | 2.5 |
| *Assiminea japonica* | Japanese blackish snail | Gastropoda | 11±4 | 1.7 |
| *Ennucula tenuis* | nuculid bivalve | Bivalvia | 11±3 | 1.7 |
| *Megastomia* sp. | pyramidellid gastropod | Gastropoda | 10±7 | 1.6 |
| *Theora fragilis* | fragile semele | Bivalvia | 10±3 | 1.6 |
| *Macrophthalmus japonicus* | Japanese mud crab | Decapoda | 10±2 | 1.5 |

Figure 2-63. School of Japanese mud crab (*Macrophthalmus japonica*) on mud flat habitat in Shinan Getbol

Figure 2-64. Chinese egret (*Egretta eulophotes*), EN on IUCN Red List, in Bigeumdo and Dochodo islands of Shinan Getbol

### *Waterbirds*

More than 54,000 waterbirds from 90 species, including 14 on the IUCN Red List, visit Shinan Getbol for feeding. On Jeungdo tidal flat, 5,460 waterbirds from 53 species are observed; 3,290 waterbirds from 43 species visit the tidal flats on Bigeumdo and Dochodo islands; and 20,440 waterbirds from 63 species appear on Aphaedo Island. Dominant species on the Jeungdo tidal flat include dunlins, Kentish plovers, lesser sand plovers and terek sandpipers. Meanwhile, mallards, cormorants, Kentish plovers and black-tailed gulls are dominant in the tidal flats of Bigeumdo and Dochodo islands. However, since Shinan Getbol is large and hosts different habitats, it is possible that the number of waterbirds and their species could be much higher than has been reported. A large number of waterbirds inhabit Shinan Getbol because of ample amounts of benthic organisms providing food for them.

**Figure 2-65.** Great knot (*Calidris tenuirostris*), EN on IUCN Red List in Jeungdo Island of Shinan Getbol

### *Endangered species*

Shinan Getbol is large and rich in food for waterbird (Figure 2-64 and 2-65). The tidal flat provides a wide variety of endangered waterbirds with habitats. Eastern curlews and great knots which are on the IUCN Red List as an endangered species (EN) are continuously observed on Shinan Getbol. Vulnerable species (VU) including pochards, Chinese egrets and Saunders's gulls are also present. Furthermore, nine near-threatened (NT) species including falcated ducks, red-necked stints, and bar- tailed godwits appear as well.

## 2.a.vi.4 Boseong-Suncheon Getbol

### • Geological and Geomorphological Features

#### Tidal Channels

Boseong-Suncheon Getbol is developed around Jangdo Island in the northern part of Yeojaman Bay. It also consists of the small estuarine tidal flat in the uppermost bay-head area influenced by two small streams from Boseong County and Suncheon City. Main tidal channels flow from north to south in the east and west of tidal flats of Jangdo Island. Water flows into the channels at average speeds of 54 ㎝/s at ebb tide and 63 ㎝/s at spring tide, the flow becoming a little faster during ebb tide. The topographic relief of the whole tidal flats is relatively very flat with a seawards slope gradient of 0.0007-0.002 degrees.

#### Surface Sediments and Seasonal Changes

The tidal flats surrounding Jangdo Island are mostly composed of very fine muds. Sand sediments are less than 2% on average. Some suspended sediments supplied from Geumgang and Yeongsangang rivers make their way to the Heuksan Mud Belt in the open sea. Only small amounts of sediments are supplied to Boseong-Suncheon Getbol through the mouth of the Yeojaman Bay, passing through the South Sea of ROK. In this process, a low energy environment is created inside the bay with a small amount of sediment supplied. This leads to very fine sediments being deposited around these islands.

Even though Boseong-Suncheon Getbol is a typical semi-enclosed tidal flat, general characteristics of an island-type (archipelagic) tidal flat are also found around Jangdo Island. Wave energy on Boseong-Suncheon Getbol is very weak, because the tidal flat is formed deep inside the bay. Thus little seasonal change is observed, compared to the other serial nominated sites. However, in terms of the distribution of surface sediments, there is a slight seasonal change: silt contents in the surrounding areas of the tidal channels increase in summer and decrease in winter. This tidal flat has only one mud facies with a mixture of silt and clay. During summer, silt is dominant near tidal channels, whereas clay is the dominant sediment during winter. Due to concentrated rainfall in summer, sediments supplied from streams after rain flow into the tidal flats, temporarily with higher silt content. During winter, suspended sediments supplied from the open sea and clay transported inside the bay are redistributed and deposited. In other words, Boseong-Suncheon Getbol has been formed not by sorting caused by erosion and transportation, but rather by the supply of sediments alone.

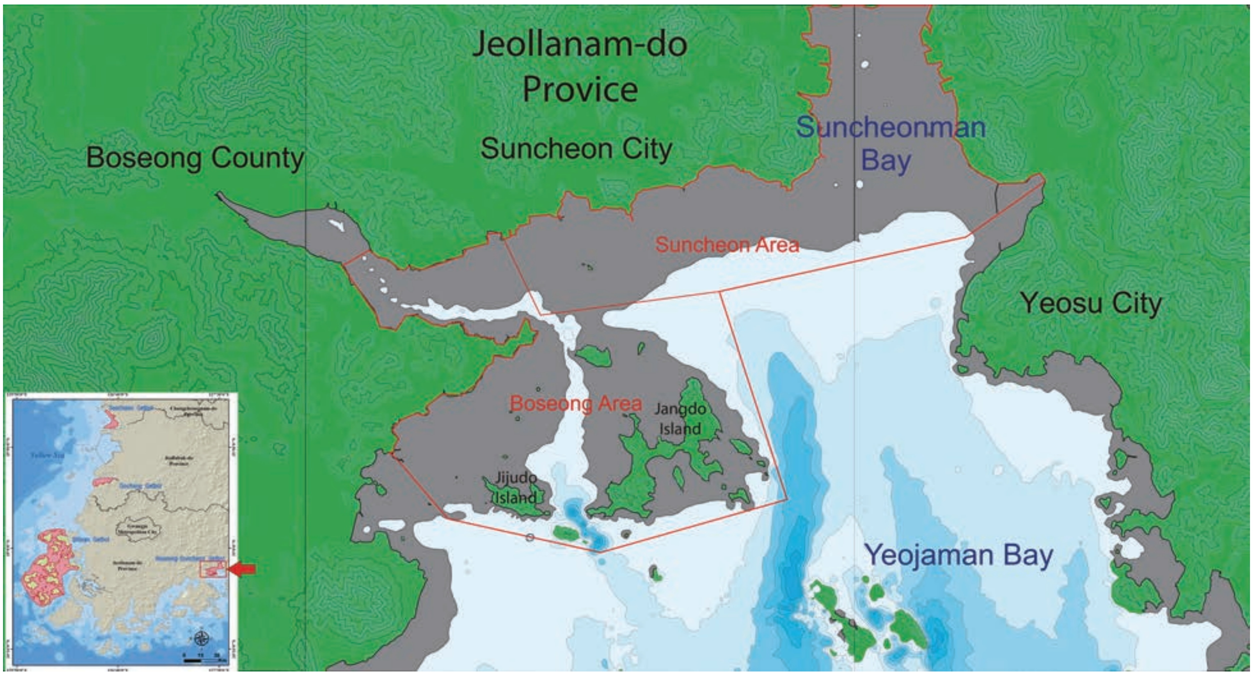



**Figure 2-66.** Intertidal-flat distribution in Boseong-Suncheon Getbol in which the surface sediments of tidal flat consist only of mud-flat facies

### Basement Rocks and Holocene Sequence

Based on paleo-bathymetry, even when sea level was lower than the present, Boseong-Suncheon Getbol appears to have been almost the same as it is today (Figure 2-67). Surface sedimentary facies are all mud facies and do not show a clear vertical evolution pattern. Judging by the overall characteristics, Boseong-Suncheon Getbol has been formed due to vertical aggradation caused by sea level rise. However, the sedimentation rates seem to have been lower than that of other serial nominated sites.

Boseong-Suncheon Getbol does not have enough supply of sediments and thus is in the early stage of the mud-flat formation in the archipelagic tidal-flat setting. Thick mud sediments are deposited near the small estuary situated in the northeast of the property. The mud-flat sequence shows 4 m or more in thickness near the estuary. It is expected, however, that some tidal flats might have much thicker sedimentary deposits.

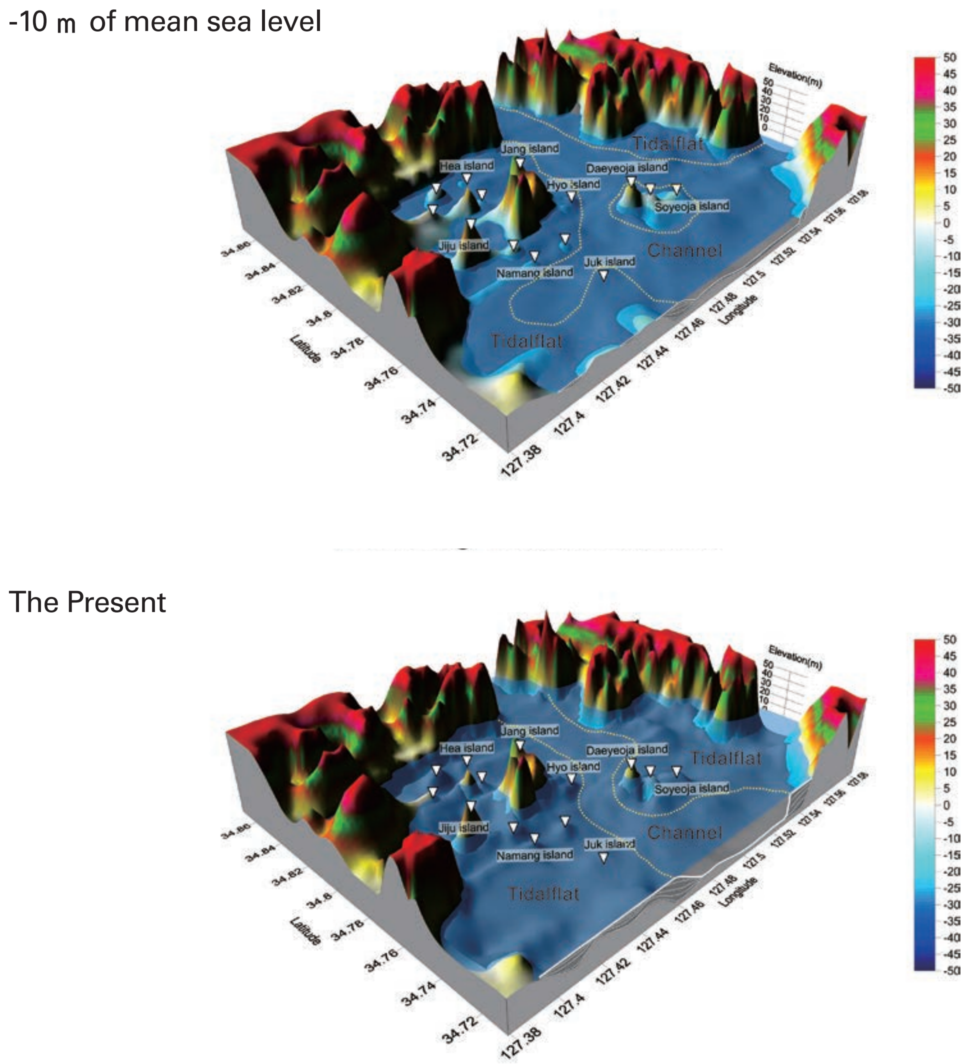



**Figure 2-67.** Paleo-bathymetry based on acoustic basement in Boseong-Suncheon Getbol area, showing the formation of tidal-flat sequences according to sea levels of -10 ㎙ and the present

### Individual Components of Sedimentary Sub-environment

***Mud flats***: All surface sedimentary facies are mud flats in Boseong-Suncheon Getbol. Compared to the other serial sites, the suspended sediments travel the farthest from their origins to reach this Getbol. This is why Boseong-Suncheon Getbol has finer sediments compared to the other serial nominated sites. Mud flats surrounding Jangdo Island are the most fine-grained tidal flats, displaying characteristics of an enclosed embayed tidal flat as well as island-type tidal flat.

***Salt Marshes***: The upper tidal flat on Boseong-Suncheon Getbol hostes the largest salt marsh communities in the nominated property. Halophytes including sea-blites (*Suaeda* *asparagoides*), broad-leaf phaceluruses (*Phacelurus latifolius*), Gmelin's saltbushes (*Atriplex gmelinii*), seaside lawngrass (*Zoysia sinica*), and square-stem statices (*Limonium tetragonum*) are present, but common reed (*Phragmites communis*) and East Asian seepweed (*Suaeda japonica*) are dominant. The size of common reed community in the nominated property is 110 ㏊ as of 2009 (Figure 2-70). A community where East Asian seepweeds are dominant is as large as 25 ㏊. The sizes of salt marshes are slowly growing. Reed marshes are observed in the mud flats that are 1.1-1.8 ｍ higher than the average sea level, whereas the East Asian seepweed wetlands are observed in the mud flats that are 0.7-1.3 ｍ higher.

**Figure 2-68.** Tidal gullies and salt marshes in Boseong-Suncheon Getbol

## • Biological and Ecological Features

### Various Habitat and Community Evolution

Boseong-Suncheon Getbol has well-developed mud flats and rocky habitats around Jangdo Island, but it does not have any sand flats. This leads to relatively poor diversity of habitats, compared to the other nominated sites. However, Boseong-Suncheon Getbol is a good example of an ecosystem where rocky substrates are linked to a muddy substrate. Salt marshes comprised of communities of 24 species of halophytes including common reeds as a main species.

**Figure 2-69.** Salt marsh and common reed community in Suncheon area

Salt marshes play an important role for producing organic matter and providing habitats. A wide variety of tidal flat organisms inhabit salt marshes hiding from their predators. Also salt marshes limit temperature rise and prevent the organisms' bodies from drying out. Salt marshes have remained stable due to freshwater inflow from land. Therefore, salt marshes provide a variety of living organisms with healthy habitats: a) they provide stable habitats for protected marine species including macrobenthos, red mittens sesarmid crab, convexed crabs, Chinese midas-ear snails, freshwater neritid snails; and b) they serve as a breeding and resting site for waterbirds as well as a place to hide when terrestrial animals like racoons visit the salt marshes to feed on the tidal flat organisms. A community of Japanese mud crabs is well developed on these mud flats. Keystone species include bar-tailed godwits, Saunders's gulls and mud octopuses. Deposit feeders including Japanese mud crabs, manicure ghost crabs, three-spined shore crabs and polychaetes provide the mud flats with an ample amount of oxygen through bioturbation during their feeding and burrowing activities. As a result, about 10 ㎝-deep aerobic layer is created. Uninhabited islands surrounding Jangdo Island have a well-developed rocky ecosystem.

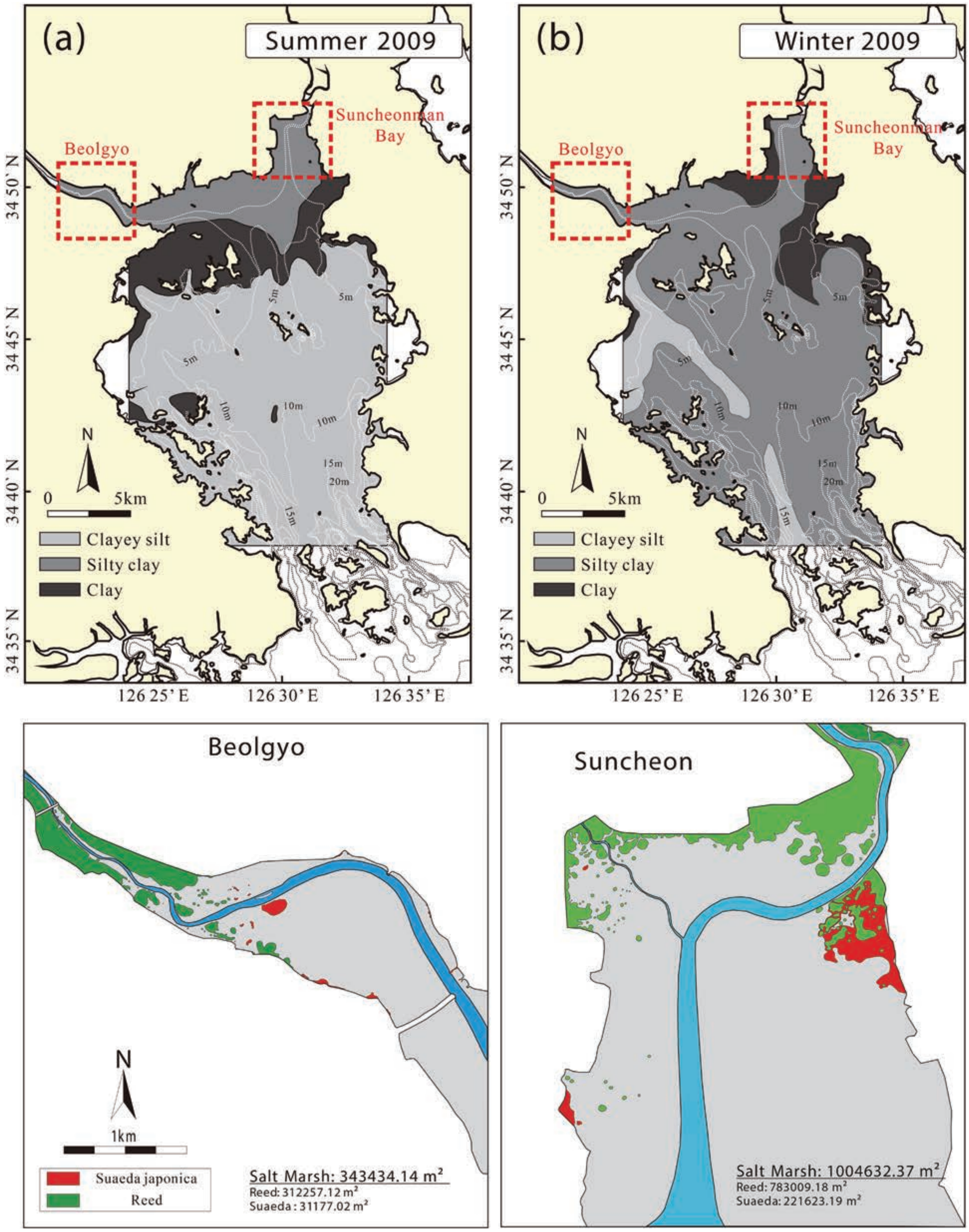



**Figure 2-70.** Seasonal distribution of surface sediments and salt marshes in Yeojaman Bay

## Biodiversity and Endangered Species

### *Benthic diatoms and primary production*

A total of 188 species of benthic diatoms or 50.1% of the biodiversity of benthic diatoms are present in Boseong-Suncheon Getbol. The measured value of Chlorophyll-*a*, an indicator showing primary production, ranges 35.9-66.8 ㎎/㎡ on average. The primary production supports a high secondary production of macrobenthos including filter feeding clams and deposit feeding Japanese mud crabs. Dominant species are pennate diatoms like *Frustulia vulgaris* and *Pleurosigma* sp. and centric diatoms like *Thalassiosira eccentrica*. They account for most of the primary production.

### *Macrobenthos*

Boseong-Suncheon Getbol hosts 445 macrobenthos species. The average density is 2,109 individuals/㎡ and the average biomass is 395.4 g/㎡. Those species become excellent food sources for the waterbirds visiting Boseong-Suncheon Getbol. In particular, there are ample amounts of cockles, which are filter feeders, and deposit feeding Japanese mud crabs, carnivorous blue-spotted mud hoppers in Boseong-Suncheon Getbol. They are all good food sources for visiting waterbirds, as well as protein sources for the local people. Bioturbation by burrowing benthic organisms facilitates the decomposition of organic matters in mud flats.

### *Waterbirds*

Boseong-Suncheon Getbol hosts about 40,000 waterbirds from 99 species. Every year 52 to 73 waterbird species visit, eat and rest on Boseong-Suncheon Getbol. What is notable is that 900 hooded cranes, the flagship species in this region, make their appearance only in Boseong-Suncheon Getbol among the serial nominated sites. In particular, 2,050 hooded cranes visited Boseong-Suncheon Getbol in 2015. Such an increasing trend is the result of the habitat protection activities based on mid- and long-term plans of the Suncheon City.

### *Endangered species*

A total of 19 waterbirds on the IUCN Red List including pochards appear. Most of the pochards (95.8%) visiting the nominated property are seen in Boseong-Suncheon Getbol. Along with hooded cranes, Saunders’s gulls, bar-tailed godwits, and other endangered species are seen as well (Figure 2-71). Those endangered species include eastern curlews and black-faced spoonbills. Boseong-Suncheon Getbol provides these endangered waterbirds with the best habitat environment. Boseong-Suncheon Getbol also provides habitats for endangered benethic invertebrates, which only inhabit in limited area (Figure 2-72).

**Figure 2-71.** Hooded crane (*Grus monacha*), VU on IUCN Red List, in Boseong-Suncheon Getbol

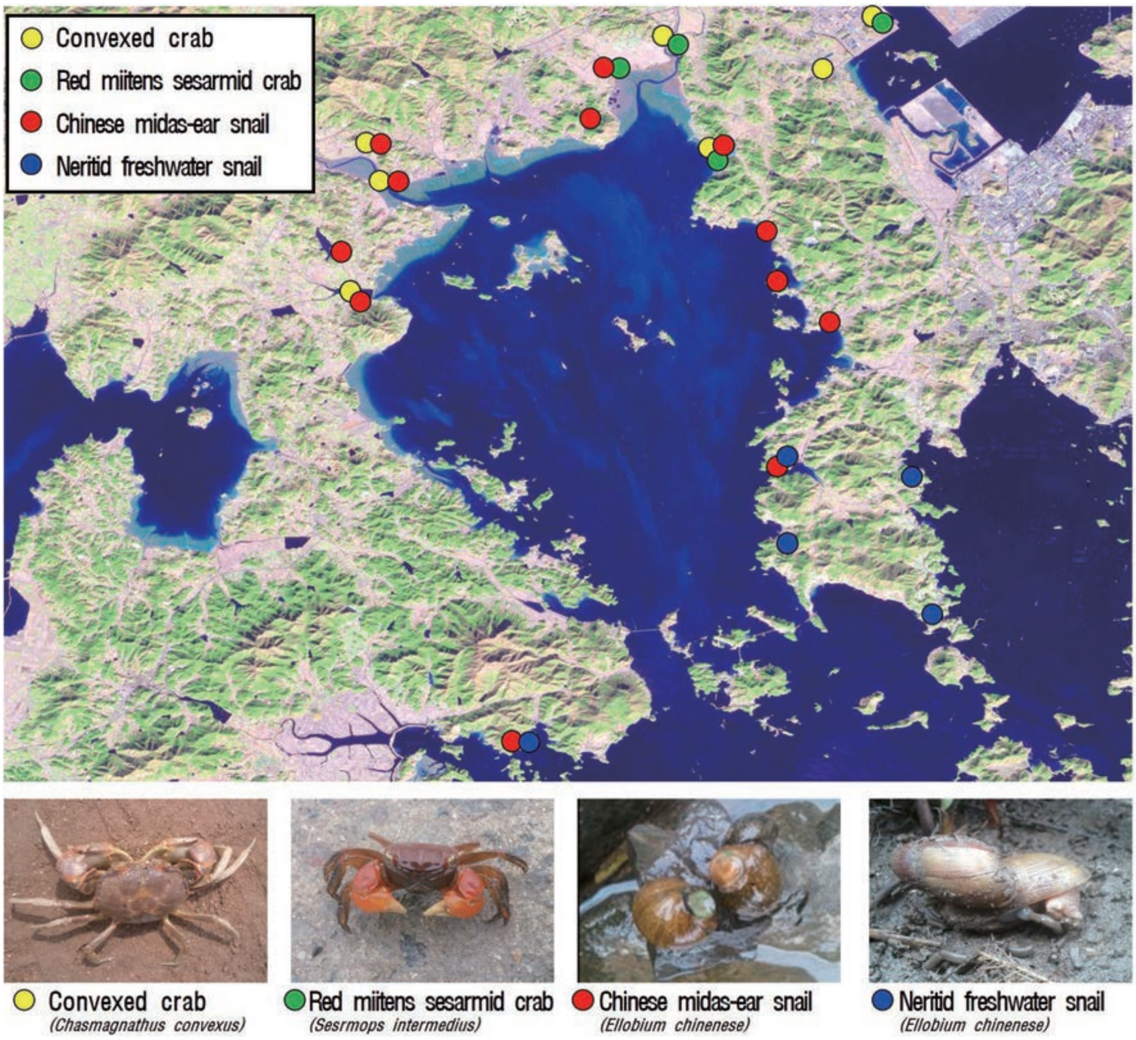



**Figure 2-72.** Spatial distribution of four endangered benthic invertebrates in Boseong-Suncheon Getbol

# 2.b History and Development

## 2.b.i Formation Process of the Nominated Property

During the Cretaceous Period of the Mesozoic Era, the Yellow Sea, unlike today, was occupied by several basins. Thick terrigenous volcaniclastic deposits accumulated in these basins that had been formed by partial rifting and trans-tensional tectonic activity. After several repeated episodes of subsidence and uplift during the Mesozoic, the Yellow Sea came into being in the Miocene about 23-16 million years ago. Marine sedimentary sequences started to accumulate followed by coastal sedimentation after 16 Ma. However, the coastal deposits were only partially preserved due to the sea level fluctuation. A 10-30 ㎙ thick Pleistocene sequence is underlain by weathered rocks along the coasts of the nominated property, which is also overlain unconformably by Holocene tidal-flat sequences.

The history of tidal-flat formation in the nominated property dates back to at least the Late Pleistocene (30,000-125,000 years BP). The boundary between Pleistocene and Holocene sequences in the property occurs at about 5-8 ㎙ below the surface in the sand flat of the outer part and at about 25 ㎙ in the mud flats of the inner part. The uppermost Pleistocene tidal-flat deposits formed around 40,000-50,000 years ago and the overlying Holocene tidal flats started to form around 8,500 years ago. Therefore they show a hiatus of more than 30,000 years. During this interval, the Pleistocene tidal flats were subaerially exposed and were subjected to weathering and erosion. This means that the Pleistocene and Holocene tidal flats have developed through the same processes and that the sedimentation process in the nominated property has continued intermittently over at least the last 125,000 years.

The formation of tidal flats in the property has been controlled mainly by macrotidal range and currents, deep tidal channels, sufficient amounts of suspended sediments as well as continental monsoon climate. About 8,500 years ago, the sea level was 15 to 20 ㎙ lower than the present. At that time, tidal currents ran through deep channels located about 20 to 40 ㎙ lower than the sea surface between numerous islands. Tidal currents carrying large amounts of suspended sediments contributed to forming mud flats between the tidal channels and rocky islands at high tides. As sea level rose, the surface of the mud flats was raised as well, and intertidal mud flats more than 25 ㎙ thick were built up to the present level near the margin of current deep tidal channels. This vertical aggradation is still in ongoing.

As for the inner parts of the tidal flats in the property, the conditions for ecological habitats have been sustained in a very stable manner since max. 8,500 to min. 4,000 years ago. At the early stage of Holocene tidal flat formation, the ecosystem initiated as muds accumulated on basement rocks, which in turn enabled the development of primary producer communities. This eventually led to the emergence of polychaetes, small gastropods, clams and Japanese mud crabs with high biomass as the dominant species. Ultimately carnivore communities evolved, including mud octopuses (*Octopus minor*) and waterbirds as keynote species. Sand flats in the outer part host communities of suspension-feeding clams, amphipods and polychaetes that feed on organic matter in sand. Waterbirds are the top predators as a keystone species in this community.

The nominated property saw changes in its topography in the modern era due to reclamation. Human activities also affected the supply of sediments and changed the flow of the tidal currents, which in turn led to disturbance in some of the habitats. However, the overall conditions of habitats in the components of the nominated property have all been stabilized.

## 2.b.ii History of Human Use

In terms of geodiversity and biodiversity, the most significant influences experienced in the nominated property and all other tidal flats in ROK during the Holocene have been human activities since prehistoric times. Historically, the human use of tidal flats has advanced: fishing has evolved from collection to aquaculture, and small-scale reclamation projects have become much larger. The advancement of technology enabled far-off islands to be connected by bridges.

### 2.b.ii.1 Fisheries

Fishing since prehistory was the first man-made activity to affect the property. Fishing on tidal flats was one of essential elements for the survival of humans living on the Korean Peninsula. Local people have utilized fish, bivalves and marine macroalgae for food. Traces of human activities in the property are found in shell middens left from the Neolithic Period. Those middens are concentrated on the south and west coasts of the Korean Peninsula. Some shell middens from the Neolithic Period have been discovered in the buffer zone of Shinan Getbol.

Fishing in the property began with simple harvesting on tidal flats. It evolved to simple tool-using methods, including the use of hoes and stone walls, building tidal weirs and traps. However, their influence on the ecosystem was negligible. It eventually evolved to fishermen directly catching marine products and sowing seed clams. Even today, as aquaculture is a widely used practice, the local fishermen still utilize conventional tools and hand methods that do not affect severely the topography of tidal flats or ecosystem.

Currently, all of ROK's tidal flats, including the nominated property, are designated as public waters. They are managed under an integrated control system developed by the Ministry of Oceans and Fisheries and are also subject to the voluntary rules and management applied by the locals. A fishing village cooperative consists of several village units, and the member units comply with the same rules. In general, the villagers practice collective fishing. Local villagers harvest a wide variety of marine products inhabiting the tidal flats, whilst also seeding and growing various marine products including Manila clam, Pacific oysters and laver, in a similar way to farmers planting seeds in the field. This explains the local term 'tidal-flats fields' ('Getbat' in Korean). Collective fishing is allowed only on approved tidal flats. Basically, tidal flats cannot be privately owned or traded and only the local residents are allowed to use the tidal flats. The rules and principles have been long established and practiced. Fishery grounds controlled by village cooperatives in most areas of the property are shared by local residents, and the income generated from the grounds are also equally.

Besides, fishing only with hands and with simple methods can have a positive influence on the area by supplying oxygen into sediments, just like the tidal flat living organisms that dig into the mud and increase the depth of the aerobic layer. There are also self-imposed regulations regarding the harvesting size and volume of bivalves that can be collected.

Active coastal fishing including aquaculture and hand catches in the property sometimes causes issues such as overfishing. The number of fish species and the amount of harvesting may change depending on season, but they have been largely maintained at a static and sustainable level based on the strong government policy suggested by local fishermen (see Section 4.a).

This fact would not have been possible without the strong commitment of regional communities using the property to restore marine resources and maintain the resilience of tidal flats. The tidal flat ecosystems and communities have been well-preserved, largely owing to fishermen who have followed sustainable fishing methods derived from long experience. It also means that fishing activities have become a sustainable part of overall ecological processes. Community fisheries in the property have become a healthy part of the tidal flat ecosystem for thousands of years, not only in the form of collection of the marine products in the tidal flats, but also as an active measure to enhance the resilience of the tidal flats. They have become a healthy part of the tidal flat ecosystem.

**Figure 2-73.** Joint harvesting by local residents through fishing village cooperative

## 2.b.ii.2 Reclamation

The first topographic changes of the property took place as reclamation. Reclamation is a much more intensive way of using the tidal flats than fishing. Rias coasts with wide tidal flats are well developed on the south and west coast of ROK and those areas are suitable for reclamation. Small-scale reclamation projects started from the 4th to 6th century and were widely carried out in the Ganghwado Island area in the 13th century. From the late 15th century, reclamation projects have been conducted on a certain scale to resolve food shortages induced by rising populations. In the late 15th century, reclamation projects were expanded to the Gyeonggi-do Province, Chungcheongnam-do Province and coastal areas in the Jeollanam-do Province. Some projects were extended to the estuaries of rivers and around islands.

ROK's reclamation projects in the modern sense began in the Japanese Colonial Period. After colonizing the Korean Peninsula, Japan reclaimed 55,950 ㏊ of tidal flats from 1924 to 1945 with the aim to mitigate flooding, to solve food supply problems in Japan, and to support the war. According to estimates made in 1987 by the then-Ministry of Construction, reclamation involved about 20% of the total area of tidal flats (280,000 ㏊). Many parts of the tidal flats, including salt marshes on the south and west coast of ROK, were reclaimed during the Japanese Colonial Period with no existing documentation. The artificial constructions, such as embankments built during this period, influenced the flow of tidal currents and caused changes not only in the circulation of sediment in the surrounding area, but also in the characteristics of the tidal flat sediments, the ecosystems and the coastlines. Overall, however, such embankments did not irreversibly change the character of the Getbol and its natural processes.

Until the Wetlands Conservation Act was enacted in 1999, government-led reclamation projects, varying in scale and purpose, took place on the tidal flats to secure farmlands and to build industrial complexes. The Saemangeum reclamation project which started in 1991 had a direct impact on the nominated property. The Saemangeum area includes one of big estuaries, merged by Mankyunggang and Dongjingang rivers, in the Korean Peninsula. It affected the flow of tidal currents and sediment supply in Gochang Getbol as well as in other areas of the west coast of ROK. These changes, in turn, directly resulted in the loss of habitats for many of the marine organisms and the reduction of stopover-sites for the migratory birds. The Saemangeum project is the last and final large scale embankment project. Though the impact on a regional scale has been significant, overall the rest of Getbol has maintained its exceptional natural value.

Other than the Saemangeum project, small-scale reclamation projects took place in the upper areas of the intertidal zone of Gochang, Shinan and Boseong-Suncheon Getbol up until the 1990s. These small-scale projects, however, were mostly carried out to create land for small-scale farmland, saltpans and fish farms. They did not block or alter the flow of the tidal currents. Any changes that were induced by these small-scale projects have now been stabilized and are considered to have had minimal effects on the nominated property.

## 2.b.ii.3 Other Factors (Economic Use for Multiple Purposes)

Along with fishing and reclamation projects, the economic uses of the tidal flats have had an impact on the topography and biodiversity of the property.

Seocheon Getbol had not experienced any topographical changes until the 1960s. The development of saltpans that began in 1965 led to some reductions in intertidal zones. In 1978, the Gunsan National Industrial Complex was completed in Gunsan City, which is adjacent to Seocheon Getbol. Osikdo Island and its intertidal zones, belonging to the Gunsan City's administrative district, were reclaimed for the construction of an industrial complex and the Gunsan Port. This changed the flow of the tidal currents in the area surrounding Yubudo Island. It is also assumed that biodiversity has declined a little by the introduction of sediments and the change of nutrition since the completion of Geumgang River Estuary Bank in 1990.

Gochang Getbol also had no topographical changes until the 1950s. Since then reclamation projects have been carried out to develop farmlands. Saltpans were created in the 1960s and cage aquaculture for fish farms was introduced in the 1990s. Due to these reclamation projects and changes, natural coastlines were artificially transformed. In addition, the Saemangeum Reclamation Project was conducted in the 1990s near Gochang Getbol. After the project, the flow of tidal currents, grain sizes as well as characteristics of marine habitats are confirmed to have been altered, leading to changes in species composition, distribution patterns and fish catch (reduced) in this tidal flat.

Composed of small bays and capes, in various shapes and sizes, Shinan Getbol has a very complex coastline. In 1917, a reclamation project for tidal flats of 682.27 ㏊ was carried out for the first time on Anjwado Island to create farmlands and saltpans. During 1930s to 1950s, a number of reclamation projects and dike construction works were carried out. Small-scale reclamation projects to form farmlands around islands were also conducted, but they had little impact on the natural values of the property.

To improve the mobility of people living on the islands, a total of 15 ebb-tide roads (stepping-stone bridges only exposed during low tides) were constructed with a total length of 10.7 ㎞ in Shinan Getbol. The ebb-tide roads that had been in place for a long time were repaired during the 1990s. All of the roads had built-in measures to allow the sea waters to pass through them. However, it was found that some parts of the bridges impeded too much the flow of tidal currents and sediments supply in the islands. Since 2010, the Ministry of Oceans and Fisheries has conducted an emergency survey on the stepping-stone bridges that were blocking the flow of sea waters and has been carrying out tidal flats restoration projects to widen passage ways for sea water.

After the completion of the Yeongsangang River Estuary Bank in 1991, it is assumed that the biodiversity and population declined slightly as the supply of nutrients from the upper streams also decreased. Other large-scale artificial constructions that are in use to-date are the seven land-to-island bridges and island-to-island bridges in Shinan County. Three additional island-to-island bridges are under construction, but they are built as island-connecting bridges and therefore will not impact the flow of sea water.

**Table 2-14.** Status of ebb-tide roads on islands in Shinan County

| Place | Name | Length (m) | Width (m) | Seawater Circulation |
|---|---|---|---|---|
| Jido Island | Sopojak-Daepojak | 260.0 | 3.0 | Yes |
| Jeungdo Island | Hwado | 1,200.0 | 3.5 | Yes |
| | Shinchu | 260.0 | 4.0 | Yes |
| | Daegijeom | 1,050.0 | 3.5 | Yes |
| | Sogijeom | 220.0 | 3.5 | Yes |
| | Soak 1 | 500.0 | 3.5 | Yes |
| | Soak 2 | 250.0 | 4.0 | Yes |
| Bigeumdo Island | Sangsuchi-Suchi | 1,000.0 | 3.0 | Yes |
| Anjwado Island | Buso | 520.0 | 4.0 | Yes |
| | Sachi | 260.0 | 3.0 | Yes |
| Palgeumdo Island | Maedo | 400.0 | 3.5 | Yes |
| | Geosa | 300.0 | 3.0 | Yes |
| Amtaedo Island | Chupo | 1,060.0 | 7.2 | Yes |
| Aphaedo Island | Maehwa-Hwangma | 1,500.0 | 3.0 | Yes |
| | Hwangma-Masan | 270.0 | 4.0 | Yes |

Boseong-Suncheon Getbol has also been affected by reclamation activities. In the 1980s, the upper parts of the intertidal zones in the north of Yeojaman Bay, Suncheonman Bay were reclaimed to create farmlands. Even though the reclaimed areas account for only a small portion of the entire area of the Yeojaman Bay, the loss of salt marshes was inevitable.

As described above, reclamation, dike construction, change in streams, the establishment of ports and industrial complexes and habitats destruction all are judged to have affected the biodiversity of the property. However, the nominated property is now under multiple layers of legal protection and management, including the Wetlands Conservation Act. Thus, the nominated property is now under a stable management condition with no artificial influence with regards to geology, geomorphology and biodiversity.

## 2.b.iii Changes in Tidal Flat Conservation Policies

The Saemangeum Reclamation Project (SRP) has had the greatest impact on the geology, geomorphology and biodiversity in the property. Of the government-led reclamation projects since the 1970s, the SRP, which began in 1991, has affected the supply of sediments and the biodiversity of the Gochang Getbol and partly Shinan Getbol of the nominated property.

Waterbirds used to visit the Saemangeum as a stopover site. However, the SRP deprived them of their habitat. The loss of habitats affected fishery production along the entire west coast of ROK. As the number of species and abundance of macrobenthos declined, the biodiversity of migratory waterbirds that visited the area also decreased. On the other hand, Seocheon Getbol and Gochang Getbol, which are adjacent to the Saemangeum tidal flats gained significance as substitute stopover sites, and saw a temporary increase in the number of species and population of birds that flew in.

Large-scale reclamation projects including the SRP have also stirred national controversy, particularly over the Shihwa, Hwaseong and Saemangeum regions in the 1990s. Those controversies also helped raise public awareness concerning the need for various values and conservation of the tidal flats.

Since the establishment of the Ministry of Oceans and Fisheries in 1996 having the purpose of supervising sustainable fishing industry and wise marine conservation, systematic management of public waters reclamation projects commenced. Enacted in 1999, the Wetlands Conservation Act laid a legal foundation for control of reclamation projects and preservation of tidal flats. As a result, by sweeping changes, the second public waters reclamation plan was established in 2001, allowing reclamation in only in 186 regions, covering 3,820 ㏊. A second plan allowed only 2.7% of the 140,300 ㏊ that had originally been approved for reclamation in the first plan.

Since the mid-1990s, environmental protection agencies and academia have continued to raise issues related to the Saemangeum Reclamation Project. This led to increased public awareness about the importance of tidal flats and marine ecosystems as well as the need for their conservation, and eventually strong public support developed in ROK's population against the reclamation projects. Amid such changes, a dramatic turn in policy was made possible.

Eventually, a phase IV Reclamation Project for Shinan Getbol with a size of 39,000 ㏊ near Yeongsangang River was annulled in 1998. In addition, a reclamation project for Janghang National Industrial Complex with a size of 1,250 ㏊ in Seocheon Getbol was also cancelled. Recognition of the importance of Seocheon Getbol and Gochang Getbol as stopover sites for migratory birds has been growing ever since the Saemangeum Reclamation Project was initiated. Multiple small-scale reclamation projects to create farmland and saltpans have been conducted in Shinan Getbol as well in the past. However, strong tidal flat conservation policies are now in place at the national and local government level. With the support of these policies, the UNESCO Biosphere Reserve that had been designated in 2009 for parts of the Shinan archipelago area was expanded in 2016 to cover the entire Shinan County. Also, the designation of Wetland Protected Area for parts of Shinan Getbol in 2010 and 2015 were also expanded to cover the entire Shinan Getbol in 2018.

In the past, the upper part of intertidal zones of Boseong-Suncheon Getbol were reclaimed for farmlands. Now, tidal flats near the Suncheonman Bay are protected as a Scenic Spot as well as Boseong tidal flats are protected as a Wetland Protected Area and as a Provincial Park.

No more new large-scale reclamation projects will be allowed in ROK. In 2008 the Republic of Korea government hosted the 'World Wetland Day' ceremony, where the ministers of the Ministry of Oceans and Fisheries and the Ministry of Environment made a joint declaration stating the overall direction of tidal flats conservation policy. The declaration included the following measures: 20% of the coastal wetlands (tidal flats) to be designated as protected areas; to ban large-scale reclamation in principle; to conduct scientific survey on the wetlands; to promote wise and sustainable use of the wetlands; and to actively restore the damage to wetlands.

As a result, ROK's tidal flats, including the nominated property, are all systematically protected by multiple legal measures such as the Wetlands Conservation Act. This prevents any further geomorphological changes or damage to the biodiversity. The Republic of Korea government is also continuing to expand the designation of marine protected areas in its marine ecosystem including the nominated property. Active restoration projects are also being conducted for the damaged tidal flats, backed by further fortified conservation policies. The application being made for World Heritage inscription of the nominated property is an important outcome of these tidal flats conservation policies.

## Section 3

# Justification for Inscription

Section 3

# Justification for Inscription

## 3.1.a Brief Synthesis

The nominated property is located in the southeastern part of the Yellow Sea, which is in the northwestern part of the Pacific Ocean. The property is a serial site composed of Seocheon Getbol in Chungcheongnam-do Province, Gochang Getbol in Jeollabuk-do Province, and Shinan Getbol and Boseong-Suncheon Getbol in Jeollanam-do Province, Republic of Korea.

The area is affected by a combination of geological, oceanographic and climatic conditions and displays a unique, one-of-a-kind coastal environment produced by ongoing geological processes. Thousands of rocky islands stretching over hundreds of square kilometers like a fishing net lie scattered in the area. Macrotidal currents run rapidly through these islands, following diverse and complicated channels, and change their direction four times a day. These macrotidal currents are one of nature's most dynamic phenomena along present-day coastlines. Hence the property provides an outstanding case that shows dynamic, ongoing coastal processes, and is located in an area where various, complicated and vast intertidal sedimentary deposits have developed amongst islands in the southeastern part of the Yellow Sea. This region is in the mid-latitude zone and under the strong influence of the seasonal East Asian continental monsoon.

In the Mesozoic period, smaller continental fragments, including the Korean Peninsula, merged with the Asian continent. The nominated property is located at the edge of a relatively shallow epicontinental sea that formed beside this newly merged continent. Irregular terrain created by the tectonic forces and erosion was flooded by the rise of sea level after the last glacier period, resulting in numerous islands (archipelago). With active weathering under the humid temperate climate, fine-grained terrigenous sediments were carried into the Yellow Sea. These sediments were dispersed and deposited by macrotidal currents over a wide area surrounding the Korean Peninsula. The East Asian monsoon climate, with its marked seasonal changes, influenced the pattern and type of sediment distribution in the areas surrounding the islands, partly because of different process regimes in summer and winter. The outer parts (generally western side of the nominated property) of the islands developed sandy tidal flats, while the inner areas of the islands accumulated thick tidal mud flats. This results in complex sedimentary environments and diverse habitats.

Daily changes to the tidal flat sediments caused by living organisms and local human activity are offset every winter during the season strongly influenced by storm due to the East Asian monsoon, when the flats are reworked by energetic climate-driven marine processes. The typhoons that pass through the area during summer season help to ensure the intactness of the tidal flats. Repetition of such processes for millenia has enabled the area to maintain a similar environment ever since sea level attained its present position in the mid-Holocene. Since about 8,500 years ago, an intertidal mud-flat sequence up to 25 m in thickness has accumulated. This is amongst the thickest known Holocene tidal sediments. Owing to the unique ongoing natural processes, the condition of the property will continue to be maintained in a stable manner.

The ongoing actions of natural processes in the nominated property provide for numerous tidal flat sedimentary environments, forming mud flats, mixed flats, sand flats, gravel beaches, rocky substrates, beaches, sand spits and sand dunes. With such high geodiversity, the area also hosts diverse habitats. The property also contains four different types of depositional systems and ecosystems that display different tidal currents and sedimentation patterns. These are the estuarine, open-embayed, archipelagic and semi-enclosed types.

The nominated property also shows contrasting ecosystem processes with different predator and keystone species in muddy, sandy, and rocky habitats. These include mud octopuses in muddy flats and different waterbirds according to various habitat conditions. The communities of organisms, from the early tidal flats of 8,500 years ago, went through active ecosystem adjustment processes to develop the complex stable ecosystem we know today. In particular, different types of migratory birds, shuttle between rocky and muddy substrates as well as rocky and sandy substrates, alternating the use of the tidal flats as resting and breeding grounds. All of these activities indicate that the nominated property has formed a unique ecosystem that embraces both land and tidal flats.

Due to seasonal rain and continued supply of nutrients from the neighboring rivers, the nominated property has a high level of primary production and species diversity. In the property, 1,610 species of flora and fauna from the marine ecosystem and 540 species from the terrestrial ecosystem are reported; a total of 2,150 species. Among them, there are 22 IUCN Red List species and 47 endemic species of marine organism that are found only in the property.

Of the world’s three migratory bird flyways, the most endangered route, East Asian-Australasian Flyway (EAAF) crosses the Yellow Sea. The nominated property supports the viability of this route. So it helps maintain internationally endangered species and contributes to biodiversity, because it provides migratory waterbirds with optimal feeding, breeding and resting grounds and serves as a stopover site between the Northern and Southern Hemispheres. The property supports a large number of endangered waterbird species, and having amongst the high primary production of any temperate tidal flat. It also has perhaps the highest species diversity of benthic diatoms, macrobenthos and marine algae. The property also supports the habitats of endemic species of marine invertebrates and waterbirds of the Yellow Sea.

The nominated property is a serial site with Seocheon Getbol, Gochang Getbol, Shinan Getbol and Boseong-Suncheon Getbol. Each of the component sites has distinctive geological features and different coastal ecosystems, while they contribute to the Outstanding Universal Value of the property as a whole.

The nominated property is protected under the Wetlands Conservation Act, which is the most powerful legal mechanism for the protection of coastal wetlands in Republic of Korea. By applying various protection and management measures including the Wetlands Conservation Act, the property fosters and requires cooperation between the central government and local municipalities for the implementation of consistent protection and management policies, implementation of integrated and systematic management plans, as well as the private-public cooperation between the local communities and NGO. With the participation of various stakeholders, the property enjoys sufficient and efficient protection and management. These measures also contribute to conserving the geodiversity and biodiversity of the Yellow Sea at an international level.

## 3.1.b Criteria under which inscription is proposed

Criterion (viii): *To be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features.*

The nominated property is the only temperate macrotidal island-type (archipelagic) tidal flats in the world. It has formed by integrated tectonic, oceanographic, and climatic processes. It provides an international quality example of the world's most outstanding cases of ongoing geological and coastal processes, together with the rich variety of landforms and sedimentary products that result from those processes. Thousands of islands are scattered across an area of over a thousand square kilometers like a fishing net spread out to the sea. The fast macrotidal currents that run between these islands through tidal channels that are either narrow or wide, short or long, shallow or deep, change their direction every 6 hours. As a result, this is perhaps the best area in the world to demonstrate a high level of geodiversity within tidal deposits, together with evidence that indicates an essentially stable natural system for the past 8,500 years.

These outstanding phenomena were created by a combination of many factors, including the geological process that formed the Yellow Sea, climate change, and regional oceanographic conditions. The Yellow Sea is a shallow sea created by tectonic processes and has been influenced by a long period of climatic change. In the past, smaller land masses, including the Korean Peninsula, merged with the Asian continent, and became lowlands. The eastern part of the Yellow Sea is relatively more adjacent to the subduction zone and thus high mountainous topography was formed by tectonic activities during the Mesozoic Era as well as by Cretaceous volcanic activities. Several stages of continuous uplift together with the erosion by rivers resulted in landforms with irregular topography. After the Last Glacial Maximum, the sea level rose rapidly to inundate the Yellow Sea, which only had an average depth of 44 m and turned it into an epi-continental sea. As a result, the nominated property, which used to be a mountainous terrain, turned into an area with many islands surrounded by shallow waters.

The nominated property in the eastern part of the Yellow Sea is subjected to semidiurnal macrotidal currents. They circulate with an overall ellipsoidal counterclockwise pattern, change their direction in a complicated manner among numerous islands four times a day and develop a very dynamic and unique tidal circulation system.

The East Asian monsoon climate with heavy summer rains and strong winter winds enhances the geodiversity found in the property. In summer, torrential rains erode and transport terrigenous sediments to the estuaries. In winter, strong waves redistribute the sediments and they travel south with longshore drift. This leads to the deposition of sandy sediments along the outer parts of the islands facing the sea, while muddy sediments are deposited in more sheltered locations between the islands. As a result, diverse types of tidal flat depositional environments such as mud flats, mixed flats, sand flats, tidal beaches, and sand spits have developed around and in between the numerous islands. This is possibly the best place in the world where such development can be seen.

Despite having a very dynamic intertidal environment, the geology and tidal sedimentary regime processes that began in the mid-Holocene have been maintained in a stable manner in the nominated property. The thick mud sediments and deep tidal channels in the inner parts of the archipelago are protected by the rocky islands, and this is the only case in the world where these circumstances co-exist.

The stable vertical aggradation of the mud flats is maintained to this day and has evolved into what may be the thickest mud flats in the world. The coastal processes are long-standing and ongoing, and are associated with exceptional geodiversity developed within very thick Holocene tidal flat deposits. These attributes provide the foundation of the Outstanding Universal Value of the nominated property.

Criterion (ⅸ): *To be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.*

The property, including numerous uninhabited islands and their surrounding mud flats, represents a unique, pristine and interconnected terrestrial-coastal-marine ecosystem. Because each rocky-muddy, rocky-sandy and sandy-muddy substrate pairs form individual sub-ecosystems of great complexity in this broad region, they are represented by very complicated smaller interconnected ecosystems. Also important is the fact that human being is an important part of the ecosystem as a top predator, because a sustainable balance has been achieved, involving traditional human activities such as shell fishing and 'gardening' the tidal flats, that have been carried out for many centuries.

Biotic communities that have evolved since the mid-Holocene are found in a variety of productive habitats on various substrates, and they now constitute a dynamic ecosystem. The benthic diatom community, which was initiated about 8,500 years ago, when sea level in the property was approaching its present level, was developed and facilitate the proceeding community. In the muddy flats, a mud octopus community has evolved in which the octopus is a top predator and a keystone species. Together with them, dominant species in the muddy flats are deposit feeders, such as Japanese mud crabs, fiddler crabs and polychaetes. Whereas in the sandy flats, the community is regulated by waterbirds as a keystone species in association with deposit feeders that include Stimpson's ghost crabs, Yellow Sea sand snails and polychaetes, as well as various suspension feeders like clams as dominant species. In contrast, in rocky habitats, sessile marine macroalgae, Pacific oysters, limpets and brown turban shell dominate the shoreline, and starfish serve as a keystone species.

The aerobic surface layers of the mud- and sand-flats, together with high primary production under temperate climatic conditions, provide an environment that facilitates ecological processes and have developed stable biotic communities. Japanese mud crabs and polychaetes turn over the substrate to obtain organic matter from mud or sand flats. Their burrowing activities accelerate ecological processes through cycling organic matter deep below and up to the surface and, in turn, bring oxygen-rich water deep down into the sediments. It is noteworthy that different organisms with different depth requirements, depending on their body size and digging capability, in this oxygenated zone support efficient ecological processes through the effective allocation of food and space resources. Therefore, the biotic communities in the property are home to a unique and valuable underground ecosystem in which bioturbation-induced active ecologic processes and high primary production helps to maintain community stability.

Furthermore, the nominated property is a representative, multi-faced ecosystem in which muddy, sandy and rocky habitats are interconnected in a complex manner. Chinese egrets, black-faced spoonbills, and Eurasian oystercatchers use muddy, sandy and rocky flats as feeding and breeding grounds to complete their life cycles. These are all telltale signs that the ecosystems on the different habitats of tidal flats have grown into distinctive biotic communities where each ecosystem is interconnected.

Criterion ( x ): *To contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of Outstanding Universal Value from the point of view of science or conservation.*

The nominated property plays a critical role in supporting internationally endangered species of migratory birds in the Yellow Sea, because of its role as an essential stopover site on the East Asian-Australasian Flyway. The nominated area functions as a sanctuary, both feeding ground and breeding ground, on one of the world's most jeopardized flyways.

The property provides for migratory waterbirds, including 22 IUCN Red List species such as spoon-billed sandpipers (critically endangered species), with ideal grounds for feeding, breeding and resting. It thus serving as a core stopover site on the East Asian-Australasian Flyway, the most at-risk of the world's three major flyways. Especially significant is that the property has the highest rate of supporting endangered waterbird species in the world. The natural resources provided by the nominated property are directly connected to the very survival of 101 (or 40.4%) of the 250 waterbird species; 22 (66.7%) of the 33 endangered species; and 24 (37.5%) of 62 shorebird species. Among them, there are spoon-billed sandpipers (1.7% of the global population), a critically endangered (CR) species whose global population is less than 600; 5 endangered (EN) species including eastern curlews and great knots (25.8% of the global population); 6 vulnerable (VU) species like Chinese egrets, pochards, and hooded cranes (24.5% of the global population); and 10 near-threatened (NT) species such as Eurasian oystercatchers, red knots, bar-tailed godwits, and red-necked stints (9.8% of the global population). These figures clearly validate the outstanding significance of the nominated area for globally endangered and endemic tidal flat species.

This crucial habitat is supported by the highest primary production and biodiversity of benthic diatoms, marine algae and macrobenthos among tidal flats under temperate climates worldwide. A total of 2,150 species of flora and fauna are supported in multiple stable ecosystems where the terrestrial, coastal and marine ecosystems are closely connected within the property.

The property embraces 375 benthic diatoms, 118 waterbirds, 857 macrobenthos, 152 marine macroalgae, 47 endemic and 5 endangered marine invertebrate species. The marine macroalgae species living on rocky habitats and tidal flats show the highest biodiversity among temperate climate tidal flats. Marine macroalgae are responsible for primary production and are regarded as a microhabitat and refuge for marine organisms, contributing to high biodiversity. Macrobenthos in tidal flats present an incomparable biodiversity among temperate climate tidal flats. As many as 54 of the species of halophytes that appear on salt marshes are present in upper tidal flats, and most representative halophytes around the world can be found in the area. These salt marshes also serve as organic matter providers and as specialized habitats.

Furthermore, the nominated property also hosts habitats for endemic marine invertebrates and waterbirds indigenous to the Yellow Sea region. A total of 47 endemic and 5 endangered marine invertebrate species are supported by the property. It is also regarded as a core habitat for black-faced spoonbills, Saunders's gulls, Chinese egrets and tiger crabs.

## 3.1.c Statement of Integrity

The nominated property encompasses an area that embraces all features of humid temperate tidal flats with islands, including associated geological, geomorphological, biological and ecological processes. The marine littoral area is composed of tidal flat sedimentary systems of the intertidal and subtidal zones and geomorphological features such as tidal channels and tidal creeks. These characteristics when taken together support a dynamic but stable sedimentary and landform system. The property also supports habitats for benthic microalgae with the world's highest level of primary production, plus a zoobenthos as primary consumers with rich species diversity, and then waterbirds and fish that are secondary consumers. Thus the property as a whole supports long-term conservation of the tidal flat ecosystem, including the maintenance of biodiversity. It includes all elements and features necessary to maintain its outstanding geodiversity and biodiversity.

The terrigenous sediments that are supplied from Geumgang and Yeongsangang rivers to the southwest archipelagic coast are deposited around the numerous rocky islands located near the intertidal zone and supratidal zone of the nominated property. The sediments that accumulated in the archipelago region are eroded repeatedly by the winter northwesternly winds and the strong waves created by the summer typhoons. The sediments travel from Seocheon Getbol at the Geumgang River estuary to the Boseong-Suncheon Getbol by means of coastal currents and tidal currents until they are deposited again. The sediments that travel along the southwest coast of the Korean Peninsula ultimately arrive at Yeojaman Bay, except for some sediments that move along with coastal current out to sea. The fact that a part of sediments supplied by the neighboring rivers reaches to the Yeojaman Bay area indicates that each component of the property form a single coastal sedimentation system.

The diverse geological and geomorphological conditions affecting the nominated property have developed various types of Getbol under the prevailing environment. The different types include the estuarine type (Seocheon Getbol), open-embayed type (Gochang Getbol), archipelagic type (Shinan Getbol) and the semi-enclosed type (Boseong-Suncheon Getbol). Moreover, each type of the property displays rich geodiversity, represented through the mud flats, sand flats, rocky substrates, gravel beaches, salt marshes, beaches and sand dunes. The property also shows various formation of Getbol sequence, and each component is representative of each type of the sequence: Type A (Shinan Getbol), Type B (Boseong-Suncheon Getbol), Type C (Seocheon Getbol), and Type D (Gochang Getbol).

As explained above, enabling the evolutionary process, having high biodiversity and functioning as the habitat for endangered species are all important functions of the nominated property, which cannot be maintained separately and only works effectively when the parts are sufficiently connected to each other. The fact that the property's key attributes are well maintained implies that the size of the property is enough. The proposed property area is large enough to embrace all types of habitats and feeding grounds, satisfying the biological and ecological integrity, as well as to display habitat diversity based on the geological and geomorphological diversity and the evolution of communities of organisms in each habitat.

Aside from the embankments built along the coastlines, the nominated property is in its original natural state, displaying complete conservation intactness. The embankments that began to be constructed in the early 2000s aimed at preventing erosion in the coastal areas and thus were built only where coastal erosion was occurring. Of the property's entire 1,314.89 ㎞ coastline, constructed embankments cover 414.29 ㎞, 31.43%. The embankments have an average width of 7 m and are relatively small. This small-scale embankment may partially block the biological and ecological processes on land and coast, but will have almost no impact. Most of all, since most of the areas in the property are connected to land through rocks, the constructed embankments do not greatly harm the natural intactness of the property.

With regard to natural integrity, the nominated property maintains its original natural state because natural processes continue undisturbed throughout most of the area. The only events that could affect the integrity of the tidal flats are the small-scale changes in tidal environment caused by human activities. In most of the tidal flats, human intervention occurs through the traditional form of fishing activities. However, those fishing activities are in balance with the nature and does not greatly damage the integrity of the nominated property (Refer to Section 4.a.). In the case of tidal flat sediments surrounding the Korean Peninsula, the strong seasonal winds during winter and the 3 to 5 typhoons per year that pass through the Korean Peninsula all serve to repeatedly restore the damaged surface of tidal flat sediments. Therefore, the property has natural events that restore any impacts caused by artificial disturbance. The conservational intactness is in place. Even with the anticipated sea level changes in the future, the property will have a sustainable evolutionary integrity.

## 3.1.d Protection and Management Requirements

The nominated property is under an integrated protection and management system via the Wetlands Conservation Act by being designated as a Wetland Protected Area and the Public Waters Management and Reclamation Act. Also, the customary management by local communities is strongly enforced by the local fishermen, who have maintained their livelihood and traditional culture in the tidal flats. In addition, the nominated property contains 4 Ramsar Sites (Seocheon, Gochang, Jeungdo and Suncheon Bay) and three UNESCO Biosphere Reserves (Shinan Dadohae, Gochang and Suncheon), backing up the effective protection and management of the property.

The integrated protection and management of the nominated property falls under the responsibility of the central and local governments, with necessary budget for protection and management provided by the central government. A Getbol World Heritage Integrated Management Committee and a Getbol World Heritage Center (GWHC) will be established following World Heritage inscription. The Committee will take a role like reviewing and deliberating the integrated management plan and its implementation. The GWHC will be in charge of the following activities: collecting and sharing of all information; conducting regular reports on the protection and management status of the OUV; analyzing any impact on the OUV; presenting overall management directions; integrated monitoring of the serial nominated property; and integrated PR activities. The GWHC will set up and operate the local resident committee network to promote participation and cooperation of the different stakeholders and to invite the local residents to take part in the protection of the sites. In a city and four counties where the property is located, local management offices will be set up to conduct protection and management operations through the establishment of an integrated protection and management system by each component of the property.

Despite the nominated property being designated as Wetland Protected Areas and being under integrated protection and management, there are various factors that may threaten the property. Marine trash, invasion of exotic species and overfishing activities are the current threats, plus climate warming induced sea level rise. However, a monitoring system to appropriately respond to such threats is already in place and operating. Following the inscription, the Getbol World Heritage Center will play a central role to strengthen the OUV monitoring activities and to regulate such activities, as appropriate. To prepare for the regular reporting required for World Heritage, a Management Effectiveness Evaluation will be conducted. The evaluation will include measures against one of the most serious threats to the property as acknowledged by the local residents - the marine trash issues.

A Visitor Center of tidal flats is located in each component of the nominated property. The centers serve as the gateways for public PR and awareness enhancement. The centers also train tidal flat eco-guides who will be leading various education and experience programs and will become the messengers who explain the significance and importance of the property to the general public and future generations.

As explained, the nominated property is under protection by institutional efforts such as Korean national Acts and international protection programs, as well as by customary community-based protection systems led by the local residents. In conclusion, the property's OUV is being protected via a multi-layered and integrated management system. New threats, including climate change, sea level rise and marine trash, which are expected to continue and grow in severity over the years, will be dealt with by additional measures so that pressures on the OUV of the property can be appropriately managed.

As a last point to be noted, the nominated property serves as the key stopover site of internationally recognized endangered migratory birds, which in turn testifies to the significance of the property as a World Heritage site. Unfortunately, the danger of extinction of these protected species is growing. Therefore, although the inscription of the property is a very solemn responsibility of the entire global community, success in preventing extinction of species also resides in the effective management of other refuges along the East Asian-Australasian Flyway. It is a shared international responsibility.

## 3.2 Comparative Analysis

The nominated property is characterized by the following features: macrotidal archipelagic coasts; deep tidal channels; complex coastal geomorphology and marine sedimentary sub-environments; sufficient supply of terrigenous sediment and nutrients; distinctive humid warm temperate climate modified by continental monsoon; various hard and soft substrate habitats with thick oxidized layers; and high biodiversity and primary production. It also supports a number of endangered waterbirds.

The nominated property is located in a macrotidal environment dotted with islands. The macrotidal regime and archipelagic or islands-related tidal flats guarantee wide intertidal flats with various sub-environments and physical and geological diversity, as well as sustained and active deep tidal channels. Geo- and habitat-diversity are also increased by continental monsoons and the complex geomorphology and oceanography. The humid warm temperate climate in which bare mudflats have developed without mangrove vegetation (because they are frost-tender), also guarantees warm tidal flats and resultant high primary productivity and biodiversity.

The comparative analysis is focused on such characteristics and then conducted between the property and other World Heritage sites, as well as other tidal flats with similar characteristics around the world. Comparative analyses between the nominated property and tidal flats developed on other coasts of the Yellow Sea are considered as well. For systematic comparative analysis, all characteristics of the nominated property can be divided into three major controlling factors that have contributed to the development of geo- and bio-diversities and biological productivity: 1) tectonical/geological controlling factors, 2) hydrological controlling factors, and 3) climatological factors.

Firstly, the nominated property has formed in the Yellow Sea Basin, which is a wide epicontinental basin, tectonically relatively rare although other examples are the Baltic Sea and Hudson Bay. The open nature of the Yellow Sea, its large bay shape and low topographic relief facilitated the development of the high tidal range on the eastern coast (ROK's coast). Together with abundant sediment supply, this assisted the development of wide macrotidal flats. Since macrotidal currents show a wide spectrum of speeds and therefore deposition times, they affect broad coastal areas with various types of tidal flat, compared to those developed under meso- or micro-tidal conditions. Very large amounts of terrestrial sediments have been discharged into the relatively small basin of the Yellow Sea during the Holocene period. Compared to other large embayments or epicontinental seas, it still receives the largest amount of terrestrial sediments from rivers in the world. The sediments have been redistributed by tides and waves for a long time on this coast, following with Holocene sea-level rise. Compared to most worldwide tidal flats in which glacial deposits have been redistributed, most tidal-flat deposits in the Yellow Sea have a riverine source. In particular in this case, most tidal-flat sediments in the nominated property are interpreted to be from riverine sources from the Korean Peninsula, which has not been influenced by continental glaciers during pre-Holocene period. Tidal flats are subaerially exposed for long periods on macrotidal coasts, thus biodiversity of benthos is enhanced. The zonal distribution of adult and young benthos is formed well even though they are the same species.

Secondly, most wide tidal flats in the world are classified into two types: non-barred (open-coast) and barrier island-type tidal flats. The latter is developed inbetween barrier islands and the land. The nominated property corresponds to non-barred or open-coast tidal flat-type. However, it shows a quite different pattern of formation compared to other open-coast tidal flats due to the presence of numerous islands (archipelago). The barrier island-type tidal flat has a relatively uniform tidal-current system, whereas that of the nominated property has a complex system that gives rise to complex tidal-flat intertidal and subtidal sedimentation. The location where the nominated property has developed, the eastern coast of the Yellow Sea, has given rise to complexity in hydrology as it is affected by very strong winter monsoonal wind. That is also facilitated by a long fetch as well as by strong winter northwesterly winds generated by the East Asian continental monsoon. Outer coastal areas of the nominated property are strongly affected by the seasonal change of hydrology, whereas its inner areas have stability sustained by the protection of scattered rocky islands. Macrotidal currents, seasonal differences of wave activity and coastal currents together with complexities of sedimentation controlled by hydrology and geomorphology make for a plentiful geo- and bio-diversity. The hydrological and geological characteristics of the nominated property have resulted in the formation of very thick Holocene intertidal mud-flat sequences in the inner areas, possibly the thickest of this age in the world.

Thirdly, the nominated property is formed under a warm and humid temperate climate. Sediments on coastal areas in the world are intensely affected by climate. In the tropical and subtropical areas, large-scale deltas have been developed where large amount of clastic sediments are supplied. In contrast, carbonate sediments are deposited when the supply of clastic sediments is limited. The most distinctive characteristic of tropical and subtropical tidal flats is a wide field of mangroves which grow along the coast. This limits the formation of large bare intertidal zones like the nominated property. Chemical weathering is not intensive under polar and subpolar climate, which leads to a lack of sediment supply from land or river. In contrast, chemical weathering is very active under warm and humid temperate climates, leading to a steady supply of sediment for the deposition of intertidal muds. The warm and humid temperate climate guarantees high primary productivity and biodiversity in the nominated property.

## 3.2.a Comparison with Other World Heritage Sites

As of 2018, a total of 209 Natural and 38 Mixed World Heritage sites are inscribed. The habitat type of the nominated property is a tidal flat which is a coastal wetland. Among all heritage sites, 40 sites are related to the ocean and coastal wetland ecosystem including tidal flats. 6 of the 40 sites include islands which are an important element of the island-type tidal flat (archipelagic) setting.

**Table 3-1.** Comparison to other World Heritage sites with marine ecosystems and islands

| World Heritage Site | Size (ha) | Tidal Range | Climatic Zone | Geomorphological Setting and Types of Habitat |
|---|---|---|---|---|
| Getbol, the nominated property (Republic of Korea) | 129,346 | Macrotidal | Temperate | • Rocky islands and island-type tidal flats on a ria coast, rocky islands with high geomorphological relief and ample supply of terrigenous sediments<br>• Mud flats, mixed flats, sand flats, tidal beaches, rocky substrates, gravel beaches, sand dunes, narrow salt marshes, dune, marshes and estuaries<br>• Island tidal flat ecosystem showing the highest known biodiversity in the temperate climate zone |
| Wadden Sea (Denmark, Germany, Netherlands) | 1,143,400 | Mesotidal | Temperate | • Lagoonal tidal flats behind barrier islands, plains behind barrier islands, insufficient terrigenous sediments<br>• Sand bar islands, sand flats (mud flats in part), large salt marshes, estuaries, beaches and sand dunes<br>• Various habitats for marine species, large-scale intertidal zones and salt marshes ecosystem |
| Banc d'Arguin National Park (Mauritania) | 1,200,000 | Mesotidal | Tropical | • Estuarine sandy islands and tidal flats in deserts and partly rocky islands<br>• Mangrove and shallow sea<br>• Contrast between the barren desert and marine ecosystem |
| Sundarbans National Park (Bangladesh) | 133,000 | Mesotidal | Tropical | • Delta-Estuarine tidal flats, the estuary of the anastomosing river<br>• Huge amounts of terrigenous sediments<br>• Mangrove salt marshes<br>• The bird, mammal and reptile communities in mangrove forests |
| Halong Bay (Vietnam) | 43,400 | Upper Mesotidal | Tropical | • Rocky island composed of carbonate rocky islands<br>• Few tidal flats |
| High Coast / Kvarken Archipelago (Sweden, Finland) | 336,900 | Microtidal | Subarctic | • Islands developed by crustal uplift and glacial-accumulated sand bars<br>• Less developed tidal flats |
| Galapagos (Ecuador) | 14,066,500 | Mesotidal | Tropic | • Volcanic archipelago<br>• Less developed tidal flats<br>• Textbook example of the evolution of living organisms on Earth |

The six World Heritage sites are the Wadden Sea, Banc d'Arguin National Park, Sundarbans National Park, Halong Bay, High Coast/Kvarken Archipelago and Galapagos. Halong Bay, High Coast/Kvarken Archipelago and Galapagos Islands have almost no tidal flats or less developed tidal flat habitats. Thus, the Wadden Sea, Banc d'Arguin National Park and Sundarbans National Parkare compared with the nominated property.

Table 3-2. Comparison to other World Heritage sites with island and tidal flat ecosystem

| Category | | Criteria | Nominated Property | World Heritage Site | | |
|---|---|---|---|---|---|---|
| | | | | The Wadden Sea | Banc d'Arguin National Park | Sundarbans National Park |
| Tidal Range | | viii | Macrotidal (6.8 m ) | Mesotidal (2-3 m ) | Mesotidal (2.1 m ) | Mesotidal/Macrotidal (3-5 m ) |
| Climate | | | Temperate (Warm & Humid) | Temperate (West coast oceanic) | Tropical (Dry) | Tropical (Humid) |
| Formation of Island | | viii | A total of 900 islands formed by the submergence of moun-tainous bedrock | 44 sand (barrier) islands developed on the front of coasts | About 20 islands formed by the submergence of desert areas | A total of 80 sand islands composed of sediments of the entire delta |
| Geodiversity | | viii ix | Estuarine island tidal flat, Open-embayed island tidal flat, Archipelago tidal flat Semi-closed embayment island tidal flat | Lagoonal tidal flat | Estuarine tidal flat, Open-embayed island tidal flat partly | Delta-estuarine tidal flat |
| | | viii ix | Mud flat, sand flat, mixed flat, gravel beach, rocky substrate, beach, sand dune, dune marsh, spit, narrow salt marsh, chenier, tidal channel, tidal gully | Mud flat, sand flat, sand island, wide salt marsh | Mangrove wetland, desert, sand island, sand flat | Mangrove wetland, mud flat, anastomosing river |
| Primary Production | | ix | 215.7 ㎎/㎡ | 198.9 ㎎/㎡ | Data unavailable | Data unavailable |
| Biodiversity | Benthic Diatoms | x | 375 species | 260 species | Data unavailable | Data unavailable |
| | Marine algae | x | 153 species | 80 species | Data unavailable | 9 species |
| | Macrobenthos | x | 857 species / 2,109 ind./㎡ | 400 species | 111 species / 1,404 ind./㎡ | 35 species |
| | Migratory Birds | x | 118 species | 106 species | 106 species | 219 species |

The Wadden Sea is a typical mesotidal lagoonal tidal flat formed on the leeward side of barrier islands in which sand flats are mostly dominant. Sand dunes and large salt marshes are unique characteristics of the ecosystem of the Wadden Sea. Barrier islands of the Wadden Sea have continuously migrated landward with the Holocene sea level rise. Sand flats, peat layer (remnants of salt marshes) and thin mud flats alternate in the tidal-flat sequences. Wave energy from the North Sea affects strongly the Wadden Sea, which contributes to a relatively simple sedimentation system with sand flats being dominant. This is different from the nominated property, which is representative of a macro-tidal-flat setting. Tidal flats of the nominated property are developed along the surrounding coasts of rocky islands (archipelago) showing various habitats of mud flats, sand flats, mixed flats, etc. Hence, the property has more complex and diverse sedimentary systems than the Wadden Sea.

Situated on the west coast of Mauritania of Western Africa, the Banc d'Arguin National Park includes a wide area of coastal wetland. It also includes several sand islands formed in the estuary of a desert under dry subtropical climate. It has a simple topographical relief with an altitude of less than 10 m located in a mesotidal region; it features characteristics of mangrove wetlands with sand flats being dominant. Unlike the nominated property, it does not have the characteristics such as macrotidal range, numerous islands (archipelago), complex depositional systems and very thick mud-flat sequences, as well as high primary production and biodiversity.

Wide delta-estuarine tidal flats are formed in the Sundarbans National Park. Mangrove vegetation covers most mud-flat surfaces, and inland wetlands have developed in the coastal zone of the park. The entire wetland area of the Sundarbans National Park corresponds to a deltaic depositional environment formed in the estuary of an anastomosing river where an abundant amount of terrigenous clastic sediments is supplied. In contrast, most tidal flats in the nominated property are macrotidal islands-related (archipelagic) coastal wetlands. Therefore, it has a different sedimentation system compared to Sundarbans National Park. In addition, the nominated property is under the warm and humid temperate climate, thus showing different habitat characteristics compared to tropical mangrove wetlands in the Sundarbans National Park.

For a detailed comparison between the same types of ecosystem, not only the geomorphological and geological characteristics, but also climate and the existence of wide tidal flats were studied as crucial factors. Among the three sites compared, the Wadden Sea is the only one that hosts wide tidal flats under a temperate climate like the nominated property. However, there is no rocky substrate near the Wadden Sea, which is located in a high latitude temperate zone. In contrast, the nominated property is formed in a rugged bedrock area under a warm and humid low-latitude temperate climate, presenting completely different characteristics compared to the tidal flats of the Wadden Sea. In the Wadden Sea, the density of benthic organisms living in sediments is low due to the cold climate leading to an anoxic environment. The nominated property has well-developed and thick oxidized layers, and a wide variety of benthic organisms are observed in sediments.

Compared to the three comparison sites, the nominated property has higher primary production and biodiversity. Macrobenthos is a very important player in the marine ecosystem as well as a healthy indicator. Macrobenthos also plays an important role as an energy transfer in the ecosystem, responsible for high biodiversity. A total of 857 macrobenthos species are observed in the nominated property, which is much higher than those of Wadden Sea (400 species), Banc d'Arguin National Park (111 species) and Sundarbans National Park (35 species) .

Consequently, when compared in terms of the important characteristics of the nominated property such as macrotidal regime, island-type tidal flats, and the climate, the nominated property demonstrates clearly contrasting and outstanding values against the existing World Heritage sites. The nominated property has a clearly distinctive and diverse geological and geomorphological features as well as an excellent ecosystem with high primary production and biodiversity, and thus strongly supports the OUV of the nominated property.

## 3.2.b Comparison with Other Similar Areas in the World

A total of 19 areas including the nominated property are representative of macrotidal coasts (higher than 3.5 ㎙ of average spring tidal range) in the world (Figure 3-1 & Table 3-3).

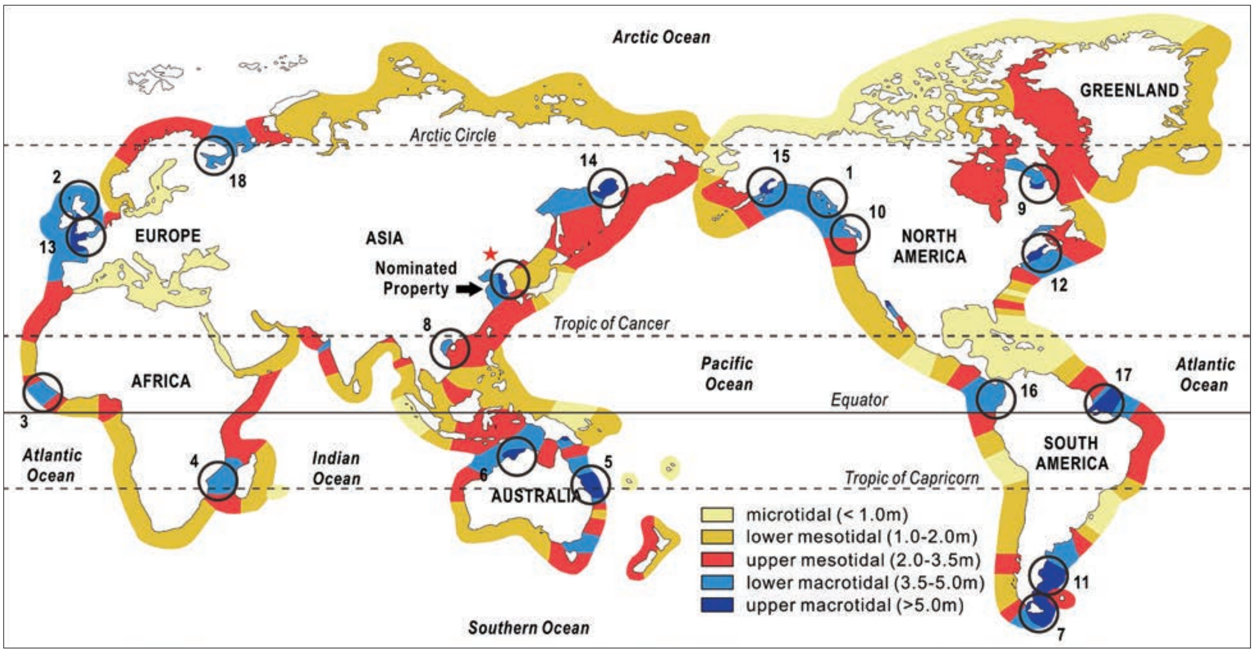



**Figure 3-1.** Macrotidal coasts in the world (Flemming, 2005, 2012)

Among those macrotidal areas, a total of 10 areas have an island-type (archipelagic) coast; the Alexander Area in Alaska (U.S.A.), the Tierra Del Fuego Coast in Argentina, Ungava Bay in Canada, the Northwest Coast of Scotland, Bissagos Area in Guinea-Bissau, the Coast of Sofala in Mozambique, Broad Sound in Queensland (Australia), the Buccaneer Area in Australia, Halong Bay in Vietnam, and the nominated property. However, Halong Bay in Vietnam and Ungava Bay in Canada are excluded from the comparison, as the tidal flats are not well developed in those bays.

Among the remaining seven macrotidal island-type tidal flats, the five tidal flats have different sedimentation patterns and climate conditions compared to the nominated property. Bissagos Area, the Coast of Sofala, Broad Sound and the Buccaneer Area are under the tropical or subtropical zones. Therefore, mud flats on those areas are covered with mangrove salt marshes. Mangrove forests reduce external wave energy and contribute to maintain the sedimentation of mud flats. This sedimentation process is totally different from that of the nominated property which is stimulated by macrotidal currents between islands without mangroves. Lastly, the Tierra Del Fuego Coast in Argentina has the characteristics of a macrotidal archipelagic tidal flat. However, this area is a fjord coast under the polar climate composed mostly of sands and gravels with weak mud flat deposits. These 5 regions show entitrely different sedimentary patterns and climate zones which lead to differences in the ecological features and ecological habitats type. Therefore, these 5 regions have very low geodiversity as tidal flats as well as associated habitats when compared to the nominated property.

**Table 3-3.** Comparison with macrotidal coasts in the world

| | Location | Name | Climatic Zone | Tidal Range | Geological Settings | Habitat Controlling Factor | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Macrotidal Range | Island-type (Archipela-go) | Temperate Zone |
| ★ | The South and West Coasts of Republic of Korea | Getbol, Korean Tidal Flat | Temperate (low-latitude) Dfa | Lower to Upper macrotidal | Rias Archipelago | Yes | Yes | Yes |
| 1 | Alexander Archipelago (U.S.A.) | Auke Bay, Eagle River, St. James Bay, Mud Bay | Temperate (high-latitude) Cfb, Dfc, Dsc | Lower macrotidal | Fjord-coast archipelago, delta & estuary | Yes | Yes | Yes |
| 2 | NW Scotland (U.K.) | Outer Hebrides | Temperate (high-latitude) Cfb | Lower macrotidal | Fjord-coast archipelago, Estuary | Yes | Yes | Yes |
| 3 | Guinean mangroves (Guinea-Bissau) | Bijagos Archipelago | Tropic Am, Aw | Lower macrotidal | Archipelago, Estuary | Yes | Yes | No |
| 4 | Eastern coast of the Mozambique (Mozambique) | Sofala Bank, Pungwe River esturay | Subtropic Aw | Lower macrotidal | Estuarine, Open-coast Archipelago | Yes | Yes | No |
| 5 | Queensland (Australia) | Broad Sound region | Subtropic BSh | Upper macrotidal | Archipelago & Bay | Yes | Yes | No |
| 6 | NW Australia (Australia) | Buccaneer Archipelago King Sound | Tropic Aw | Lower macrotidal | Archipelago, Bay & Estuary | Yes | Yes | No |
| 7 | Tierra del Fuego (Chile / Argentina) | San Sebastian Bay (Bahia San Sebastian) | Subantarctic BWk, Cfc, ET | Upper macrotidal | Fjord-coast Archipelago, Delta & embayed coast | Yes | Yes | No |
| 8 | Gulf of Tongking (Vietnam) | Ha Long Bay (WH) | Subtropic, Am | Lower macrotidal | Archipelago | Yes | Yes | No |
| 9 | Ungava Bay (Canada) | Ungava Bay | Arctic Dfc, ET | Lower to upper macrotidal | Bay, very small archipelago | Yes | Yes | No |
| 10 | British Columbia Coast (Canada) | Toba Inlet, Bute Inlet, Knight Inlet, Fraser River Delta | Temperate (high-latitude) Cfb,Dsc, Dfb,Csb | Lower macrotidal | Fjord coast, Estuary | Yes | No | Yes |
| 11 | Eastern Coast of Argentina (Argentina) | Bahia Blanca, Bahia de Samborombon | Temperate BWk, Csb | Upper macrotidal | Bay & Estuary, Open coast | Yes | No | Yes |

| Location | | Name | Climatic Zone | Tidal Range | Geological Settings | Habitat Controlling Factor | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Macrotidal Range | Island-type (Archipela-go) | Temperate Zone |
| ★ | The South and West Coasts of Republic of Korea | Getbol, Korean Tidal Flat | Temperate (low-latitude) Dfa | Lower to Upper macrotidal | Rias Archipelago | Yes | Yes | Yes |
| 12 | Bay of Fundy (Canada) | Shepody Bay, Southern Bright-Minas Basin | Temperate (high-latitude) Dfb, Dfc | Upper macrotidal | Estuary & Bay | Yes | No | Yes |
| 13 | Irish Sea, English Channel and Coast of Bretagne (U.K., France) | Nith River Estuary, Severn Estuary, Mont Saint-Michel Bay | Temperate (high-latitude) Cfb | Lower to upper macrotidal upper | Estuary & Bay | Yes | No | Yes |
| 14 | Shelikhova Bay (Russia) | Penzhina Bay | Temperate (high-latitude), Dfc | Lower macrotidal | Bay & Estuary | Yes | No | Yes |
| 15 | Alaska Western Coast (U.S.A.) | Cooper River Mouth & Cook Inlet | Subarctic Dfc | Lower to upper macrotidal | Estuary, Back barrier Delta | Yes | No | No |
| 16 | Colombia and Ecuador (Colombia / Ecuador) | Uramba Bahía Málaga Natural Park, Chone River Estuary | Tropic BWh, BWk | Lower to upper macrotidal | Estuary & Bay, Open coast | Yes | No | No |
| 17 | Amazon Mouth Region (Brazil) | Amazon River, Northeast Region | Tropic Af, Am, Aw | Upper macrotidal | Delta, Alluvial islands, Lagoon, Estuary & Bay | Yes | No | No |
| 18 | White Sea Region (Russia) | Onega Gulf, Mezen Gulf | Subartic Dfc | Macrotidal | Delta & Open coast, Bay & Estuary | Yes | No | No |

The Alexander Archipelago in Alaska and the Outer Hebrides on the northwestern coast of Scotland are the only two areas which have similar controlling factors – macrotidal island-type (archipelagic) tidal flats under temperate climates – to those of the nominated property (Table 3-4).

Comprised of 800 islands, the Outer Hebrides is a typical open-embayed tidal flat as well as an estuarine tidal flat. All coasts are wave-dominated fjord coasts supplied dominantly with sands and gravels, while some rocky tidal flats are observed.

The Alexander Archipelago in the U.S.A. consists of 1,100 big and small islands. In its outer part, archipelagic and estuarine tidal flats have developed. Delta-estuarine tidal flats have formed in the inner part. All coasts are wave-dominated fjord coasts with sand flats and rocky substrates. Wide mud flats are observed in the estuary of the inner part. However, these mud flats are affected less by tidal currents or waves. The tidal flats are supplied with an abundant amount of sediments, forming a delta-estuarine sedimentary environment.

**Table 3-4.** Comparison of macrotidal archipelago tidal flats developed under temperate climate conditions

| Category | | Criteria | Nominated Property | Northwest Coast of Scotland, U.K. | Alexander Archipelago in Alaska, U.S.A. |
|---|---|---|---|---|---|
| Tidal Range | | viii | Macrotidal | Macrotidal | Macrotidal |
| Climate | | | Temperate<br>(Warm & humid, lower latitude) | Temperate<br>(Higher latitude) | Temperate<br>(Higher latitude) |
| Type of Coast | | | Rias coast<br>(Tide-dominant) | Fjord coast<br>(Tide-dominant) | Fjord coast<br>(Tide-dominant) |
| Formation of Islands / Tidal Flat Characteristics | | viii | 900 rocky islands<br>Outer part: sand flat, beach<br>Inner part: mud flat | About 790 islands and 20 sand islands | About 1,100 large and small islands |
| Geology / Habitat Diversity | | viii<br>ix | Mud flat, sand flat, mixed flat, gravel beach, rocky substrate, beach, sand dune, dune marsh, spit, salt marsh, chenier, tidal channel, tidal gully | Rocky substate, sand flat, gravel beach, salt marsh | Sand flat, rocky substrate, estuarine mud flat |
| | | | Archipelago tidal flat<br>Estuarine tidal flat<br>Open-embayed tidal flat<br>Semi-closed embayment tidal flat | Open-embayed tidal flat<br>Estuarine tidal flat | Archipelago tidal flat<br>Estuarine tidal flat<br>Delta-estuarine sedimentation environment |
| Amount of Terrigenous Sediments | | viii | 250-750 t/㎢·yr | 50-250 t/㎢·yr | 750-1,000 t/㎢·yr |
| Biodiversity | Benthic Diatoms | x | 375 species | 68 species | Data unavailable |
| | Marine macroalgae | x | 152 species | Data unavailable | Data unavailable |
| | Macroben-thos | x | 857 species/<br>2,109 ind./㎡ | Data unavailable | Data unavailable |
| | Migratory Bird | x | 118 species | Data unavailable | 16 species |

Unlike these two sites, the nominated property has ria-type coastlines created by the sea level rise over mountainous terrain. Various types of tidal flats that can develop on an island-associated tidal-flat setting are observed in the nominated property. Also it has higher geodiversity with more varied types of sediment. The two sites compared are fjord coasts formed by glacial erosion. They are the island-type tidal flats but sand flats are dominant, thus having less geologic diversity than the nominated property.

In addition, one of the features of the property is that mud flats have been accumulated in a stable manner due to the protection of surrounding rocky islands in the inner part of the nominated property. However, the other two sites do not have wide and thick mud flats in the inner area of archipelago, thus presenting different geological process and associated habitats. Moreover, both sites are in the temperate climate but in high latitude zone. Therefore, they cannot have the variety of ecological characteristics observed in a warm-temperate climate zone such as that in which the nominated property is located.

## 3.2.c Comparison with Tidal Flats in the Yellow Sea

The Yellow Sea, where the nominated property is located, has tectonic and geological characteristics of an epicontinental sea. Ample amounts of terrigenous sediments are carried to the Yellow Sea. This is why wide and various tidal flats have formed along with its coastal zones. Macrotidal flats are formed in the nominated property situated in the eastern coast of the Yellow Sea. Mesotidal flats are found on its northern and western coasts. Comparison with four areas (tidal flats in the estuary of the Yalu, Yangtze and Yellow Rivers and Yancheng coast) situated on the coasts of the Yellow Sea was carried out based on geological, geomorphological and biological and ecological characteristics as well as biota.

Wide estuarine tidal flats have developed in the estuary of the Yalu River under the humid temperate/continental climate (Dwa) and a lower macrotidal environment. Estuarine coastal wetlands are closely associated with the supply of sediments from the river. Wide deltaic-estuarine tidal flats are developed in the mouth of the Yellow River as well as wide coastal plains formed by an enormous amount of riverine sediments. Deltaic-estuarine tidal flats have also developed in the estuary of the Yangtze River under a warm and humid subtropical climate, and mesotidal environment. The three areas compared are estuarine or deltaic-estuarine tidal flats, displaying different hydrodynamic processes and sedimentation patterns from those of the nominated property. The Yancheng coastal wetland also shows very wide tidal flat which is characterized by open-coast tidal setting including partly deltaic-estuarine setting. In contrast, the nominated property has archipelagic tidal flats in which its macrotidal setting and geological characteristics encourage a complex and dynamic tidal current circulation system among a number of islands.

Estuarine tidal flats developed in the mouths of Yalu and Yellow Rivers have been formed under the high-latitude temperate climate (Dwa). Thus, the surface of the tidal flats is mostly frozen during winter which lowers the temperature of the tidal-flat deposits. Estuarine tidal flats in the Yangtze River are in the humid subtropical climate zone, but enormous amounts of sediment and freshwater flow in from the river. The nominated property is also in the low-latitude warm and humid temperate climate zone (Dfa). However, it hosts a greater variety of habitats because of higher geomorphological diversity, thus presenting higher biodiversity than the other sites. Importantly, in the nominated area, 857 macrobenthos species play an important role in transferring energy in the tidal flat ecosystem. This is much higher number of species than occur in the other areas.

The sites compared are also located on the Yellow Sea coasts, but they are in the west and north of the Yellow Sea. Thus, they are less changeable in hydrodynamics by seasonal monsoon. Unlike the other sites, the nominated property is developed in the east of the Yellow Sea, thereby showing more distinctive seasonal changes in wave energy and its coastal impact. In addition, a sediment distribution system caused by winter-erosion and summer-deposition processes in the tidal flats exists only in the nominated property.

The nominated property contributes to the significance of the Yellow Sea eco-region, a globally important stopover-site for migratory birds, in a different way to the western parts of the Yellow Sea. Compared to other tidal flats formed on the coasts of the Yellow Sea, the nominated property has quite different geological characteristics, distinctive seasonal changes, high primary production, and rich biodiversity of benthic diatom, algae, and macrobenthos.

**Table 3-5.** Comparison with large-scale tidal flats on the coasts of the Yellow Sea

| Features | Nominated Property | Estuarine Tidal Flat of Yalu River (DPRK & China) | Estuarine Tidal Flat of Yellow River (Bohai Bay, China) | Estuarine Tidal Flat of Yangtze River (China) | Yancheng Coastal Wetland (China) |
|---|---|---|---|---|---|
| Tidal Range | Upper macrotidal (About 6.8 m) | Lower macrotidal | Mesotidal | Mesotidal | Mesotidal |
| Climate | Temperate / Continental (Dfa) (Warm & Humid) | Temperate / Continental (Dwa) (Warm & Humid) | Temperate / Continental (Dwa) (Warm & Humid) | Subtropic / Subtropical (Cfa) (Warm & Humid) | Subtropic (Cfb) (Warm & Humid) |
| Geological Setting | Open-coast & Island-type | Estuarine | Estuarine | Estuarine | Open-coast |
| Geomorphologic Diversity | Island Tidal Flat (Estuarine, Open-embayed, Archipelagic, Semi-enclosed) | Estuarine Tidal Flat | Delta-Estuarine Tidal Flat | Delta-Estuarine Tidal Flat | Open-coast & Estuarine Tidal Flat |
| Geomorphologic Diversity | Mud flat, sand flat, mixed flat, gravel beach, rocky substrate, beach, sand dune, dune marsh, sand spit, narrow salt marsh, chenier, tidal channel, tidal gully | Mud flat, sand flat, mixed flat, rocky substrate, narrow salt marsh, tidal channel, tidal gully | Mud flat, mixed flat, wide salt marsh, tidal channel, tidal gully | Mud flat, sand flat, mixed flat, wide salt marsh, tidal channel, tidal gully | Mud flat, mixed flat, sand flat, sand bank, wide salt marsh, tidal channel, tidal gully |
| Primary Production | 2.9-215.7 mg/m² (66.9 mg/m² on average) | Data unavailable | Data unavailable | 2.98-3.65 mg/m³ | Data unavailable |
| Benthic Diatoms | 375 species | Data unavailable | 36 species | 164 species | Data unavailable |
| Marine Macroalgae Diversity | 152 species | Data unavailable | 22 species | Data unavailable | Data unavailable |
| Macrobenthos | 857 species / 2,109 ind./m² | Data unavailable | 271 species | 38 species / 32.9 ind./m² | Data unavailable |
| Waterbirds (Endangered) | 118 species (22 species) | 15 species | 58 species | 257 species (23 species) | 415 species (23 species) |

## 3.2.d Comparison with Other Tidal Flats in ROK

A number of tidal flats formed on the southwestern and western coasts of ROK have the similar tidal range and climatic condition to the nominated property and feature similar geomorphological and geological diversity. The Geumgang and Yeongsangang rivers supply terrigenous sediments to the nominated property, thus creating archipelagic tidal flats in various forms and representing the evolution process of the islands-type tidal-flat sequences. Analysis was carried out to compare the nominated property with other major tidal flats to which terrigenous sediments are also supplied. All tidal flats compared are also formed under macro-tidal regime along with the southern and western coasts of the Korean Peninsula.

Terrigenous sediments from the Hangang, Yeseonggang and Imjingang rivers flow into the adjacent coastal area of Ganghwado Island tidal flat. In reality, this tidal flat area encompasses very wide coastal and islands-attached wetland distributed on the mouth of Hangang River. Since the tidal range is very high (higher than 10 m in spring tidal range) and the amount of sediment discharge is the biggest in ROK, especially during summer season, the Ganghwado Island tidal flat is classified as a tide-dominated, deltaic-estuarine tidal flat. Archipelagic mud flats are developed near the islands in the inner estuary of the Ganghwado Island, as in the nominated property. On the other hand, sand-dominated tidal flats are developed on the coasts of most islands located in the outer area. The Ganghwado Island tidal flat has the most similar characteristics to those of the nominated property. However, since the Korean War, local residents in Ganghwado Island area have suffered from strong restrictions for a long time. For example, Ganghwado Island area has a large military protected area, because this is a border zone that is directly connected to DPRK. And also this area contains a number of nationally designated cultural properties under the Cultural Heritage Protection Act.

Supplied with terrigenous sediments from the rivers, the Garolimman Bay tidal flat is located at the end of the riverine source, and could be a typical semi-enclosed type of Getbol. However, the island-type (archipelagic) tidal flat had been not well developed. This area is a best-suited location for a tidal power plant since Japanese Colonial Period and where the actual development had been planned in earnest by the Ministry of Trade, Industry and Energy from 2005. However, due to more than 10 years of persistent opposition from local residents, the tidal power project was cancelled in 2014 and designated as a Marine Protected Area in 2016. Recently the research and management systems are under way.

The tidal flat developed at the mouth and coast of the Tamjingang River is an estuarine tidal flat formed in a narrow river coast with sediments supplied from the river. There are many islands in the outer part of its estuary, but intertidal flats are not widely developed around the islands. In addition, only narrow mud flats have formed on coasts of the islands in the estuary of the Tamjingang River. Unlike the nominated property, the archipelago in the Tamjingang River estuary does not contain deep and steep tidal channels. Also the area is wave-dominated and is deficient in sediment supply from near streams. Thus, the vertical aggradation of tidal sediments is relatively poor inside the islands.

The Deukryangman Bay tidal flat is affected much by terrigenous sediments from the Geumgang and Yeongsangang rivers. It is a semi-enclosed embayed tidal flat where muddy sediments are moved inwards by tides and accumulate inside the bay. However, the sedimentation pattern associated with islands is not as distinctive as the Boseong-Suncheon Getbol. Also, neither Tamjingang River estuary nor Deukryangman Bay area have any protection systems in place.

Among various islands-type (archipelagic) tidal flats developed in the east coast of the Yellow Sea, the nominated property is representative of the wide tidal flats with the most outstanding geological and ecological characteristics. The components of the nominated property host different depositional systems and unique ecosystems, representative of the island-type tidal flats formed along the southern and western coasts of the Korean Peninsula.

Convincing comparative study with indication, the property can be expanded at a later stage when protection and management is in place.

**Table 3-6.** Comparison with tidal flats formed in the south and west coasts of ROK

| Features | Nominated Property | | | | Ganghwado Tidal Flat | Garolimman Bay Tidal Flat | Tamjingang River Estuarine Tidal Flat | Deukryangman Bay Tidal Flat |
|---|---|---|---|---|---|---|---|---|
| | Seocheon Getbol | Gochang Getbol | Shinan Getbol | Boseong-Suncheon Getbol | | | | |
| Tidal Range | High-macrotidal (7.0 m at spring) | High-macrotidal (7.2 m at spring) | Macrotidal (5.2 m at spring) | High-mesotidal (3.5 m at spring) | High-macrotidal (9.0 m at spring) | High-macrotidal (8.0 m at spring) | High-mesotidal (3.7 m at spring) | Macrotidal (4.2 m at spring) |
| Climate | Temperate | Temperate | Temperate | Temperate | Temperate | Temperate | Temperate | Temperate |
| Type of Tidal Flat | Estuarine | Open-embayed | Open-coast & Archipelagic | Semi-enclosed | Delta-Estuarine | Semi-enclosed | Estuarine | Semi-enclosed |
| Geological Diversity | Mud flat, sand flat, mixed flat, beach, sand dune, dune marsh, rocky substrate, spit, tidal channel | Mud flat, sand flat, mixed flat, sand dune, rocky substrate, chenier | Outer Part: Wave-dominated sand flat Inner Part: Tide-dominated mud flat Mixed flat, gravel beach, rocky substrate, beach, tidal beach, sand dune, dune marsh, spit, narrow salt marsh, tidal channel, tidal gully | Mud flat, rocky substrate, wide salt marsh | Rocky substrate, mud flat, tidal beach, tidal channel, tidal gully, narrow salt marsh | Rocky substrate, mud flat, tidal beach, tidal channel, tidal gully | Rocky substrate, mud flat, tidal channel, tidal gully, narrow salt marsh | Rocky substrate, mud flat, tidal beach, sand dune, tidal channel, tidal gully |
| Primary Production | 37.6-162.1 mg/㎡ | 31.9-215.7 mg/㎡ | 2.9-120.2 mg/㎡ | 10.1-147.7 mg/㎡ | 8.3-277.3 mg/㎡ | 2.4-133.0 mg/㎡ | 14.3-24.0 mg/㎡ | 2.32 mg/㎡ |
| | 81.0 mg/㎡ on average | 67.6 mg/㎡ on average | 52.2 mg/㎡ on average | 66.8 mg/㎡ on average | 36.5 mg/㎡ on average | 34.3 mg/㎡ on average | 17.6 mg/㎡ on average, Attached Algae | Data unavailable |
| Benthic Diatoms | 181 species | 194 species | 224 species | 188 species | 112 species | 46 species | 169 species (Attached Algae) | Data unavailable |
| Marine Macroalgae Diversity (marine macroalgae) | 49 species | 9 species | 144 species | 23 species | Data Unavailable | Data unavailable | Data unavailable | Data unavailable |
| Macrobenthos | 181 species/ 1,736 ind./㎡ | 255 species/ 1,234 ind./㎡ | 568 species/ 594 ind./㎡ | 445 species/ 2,109 ind./㎡ | 236 species/ 2,430 ind./㎡ | 290 species/ 1,680 ind./㎡ | 70 species/ 453 ind./㎡ | 137 species/ 1,670 ind./㎡ |
| Endangered Species (Waterbird) | 85 species/ 147,873 ind. | 90 species/ 41,049 ind. | 90 species/ 54,680 ind. | 99 species/ 40,011 ind. | 89 species/ 28,376 ind. | 67 species/ 12,308 ind. | Data unavailable | 54 species |
| Protection Act | Yes | Yes | Yes | Yes | Partly Yes | Partly Yes | No | No |

# 3.3 Proposed Statement of Outstanding Universal Value

**• Brief Synthesis**

The nominated property is located on the south and west coasts of Republic of Korea, corresponding to the southeastern coast of the Yellow Sea. It is a serial site, encompassing a complex combination of geological, oceanographic and climatic conditions. It displays by world standards a rare and complex coastal sedimentary system with diverse tidal ecosystems; and is made up of Seocheon Getbol, Gochang Getbol, Shinan Getbol and Boseong-Suncheon Getbol. Each component has its own unique and diverse geological and biological features. The area has an OUV that reflects the diversity of the island-type (archipelagic) tidal flat ecosystem and its geological and geomorphological features.

Thousands of islands are scattered across an area of over a thousand square kilometers, like a fishing net spread out to sea. Fast macrotidal currents that change direction every 6 hours run between these islands through channels that are either narrow or wide, short or long, shallow or deep, according to the state of tide. This creates one of nature’s most spectacular coastal phenomena. In addition to this geological complexity, the nominated property is also deeply affected by seasonal changes emanating from the East Asian monsoon. Together, these factors have contributed to the overall diversity found in the property’s tidal flats and habitats.

These macrotidal island-studded tidal flats display a high level of geodiversity in the nominated property. The geodiversity has created a stable equilibrium that has enabled a complex geological environment to evolve and to be maintained. This has resulted in the world's thickest intertidal mud flat sediments deposited during Holocene period.

The high biodiversity and habitat diversity, backed by high primary production in the property, are indicative of its strong ecological sustainability. A distinctive evolution of communities has successfully developed in the property. For example, mud octpuses in muddy flats and waterbirds in sandy flats exist as a keystone species. Especially, the habitat connectivity of the nominated property is an outstanding example that shows the formation of an ecosystem where some waterbirds are seen resting in rocky habitats and feeding in muddy or sandy habitats. The richness of biodiversity and their habitats is supported by the geodiversity that exists in the property.

The nominated property is characterized by its high capacity to support 22 endangered waterbird species, including the spoon-billed sandpiper (CR on the IUCN Red List) on the East Asian-Australasian Flyway (EAAF). The various habitats in the property provide the food and space that is much needed for all waterbirds. This strongly testifies to the essential values embodied by the property.

Should World Heritage inscription be successfully accomplished, then managers of the nominated property will work to add more tidal flats areas in ROK that have similar outstanding attributes to the nominated area. These activities will be conducted as part of the effort to contribute further to the protection of the Yellow Sea Eco-region.

### • Justification for Criteria

Criterion (viii): No other property on the World Heritage List has attributes similar to those found in the nominated property. The area concerned would be the only example of an island-studded tidal flat with a macrotidal range, set in a monsoonal environment. The area has formed within an integrated tectonic, oceanographic, and climatic system. It shows the most complicated, thus the most outstanding on-going geological coastal processes to date.

The nominated property includes various types of tidal flats, namely estuarine type, open-embayed type, archipelago type and semi-enclosed type. It also has high geodiversity with its numerous rocky islands, macrotidal range and seasonal changes. The property has maintained a stable geodiversity for the past 8,500 years and as a result now has the world's thickest Holocene mud sediments. Therefore, the high geodiversity of the tidal flats produced by dynamic ongoing coastal processes is extremely significant and of outstanding value.

Criterion (ix): The nominated property is a representative multi-faceted ecosystem where muddy, sandy and rocky habitats are interconnected in a complex manner. In the various habitats on different substrates biotic communities are found that have gone through exceptional evolutionary processes, and now constitutes a dynamic ecosystem.

In the muddy flats, mud octopus dominates as a top predator and a keystone species, and deposit feeders like Japanese mud crabs, fiddler crabs and polychaetes are dominant species. In the sandy flats, waterbirds are a keystone species, with deposit feeders including Stimpson's ghost crabs, Yellow Sea sand snails, and polychaetes as well as various suspension feeders like clams are dominant species.

Criterion (x): The nominated property plays a critical role in maintaining biodiversity and in supporting internationally endangered species of migratory birds in the Yellow Sea. It hosts one of the most jeopardized flyways amongst the world's three major flyways.

The property is providing for migratory waterbirds, including 22 IUCN Red List species such as spoon-billed sandpipers (critically endangered species), with ideal grounds for feeding, breeding and resting. It thus serves as a core stopover site on the East Asian-Australasian Flyway.

This crucial habitat is supported by the highest primary production and biodiversity of benthic diatoms, marine algae and other benthic organisms among tidal flats under temperate climates worldwide. A total of 2,150 species of flora and fauna are supported in multiple stable ecosystems where the terrestrial, coastal and marine ecosystems are closely connected in the property. The property embraces 375 benthic diatoms, 118 waterbirds, 857 macrobenthos, 152 marine macroalgae, 47 endemic and 5 endangered marine invertebrate species.

### • Statement of Integrity

In setting boundaries for the property, the OUV of the nominated property has been considered. Features that make up the OUV include high geodiversity coming from the sedimentation system, diverse habitats for the endangered species and endemic species, and the tidal flat ecosystem.

Therefore, the property zone includes a) diverse sand flats, mud flats, mixed flats and rocky habitats that support the evolution of the unique ecological communities, b) the high biodiversity of the endangered migratory birds and endemic species, and c) the geological and geomorphological features such as tidal channels and tidal gullies that influence sedimentation.

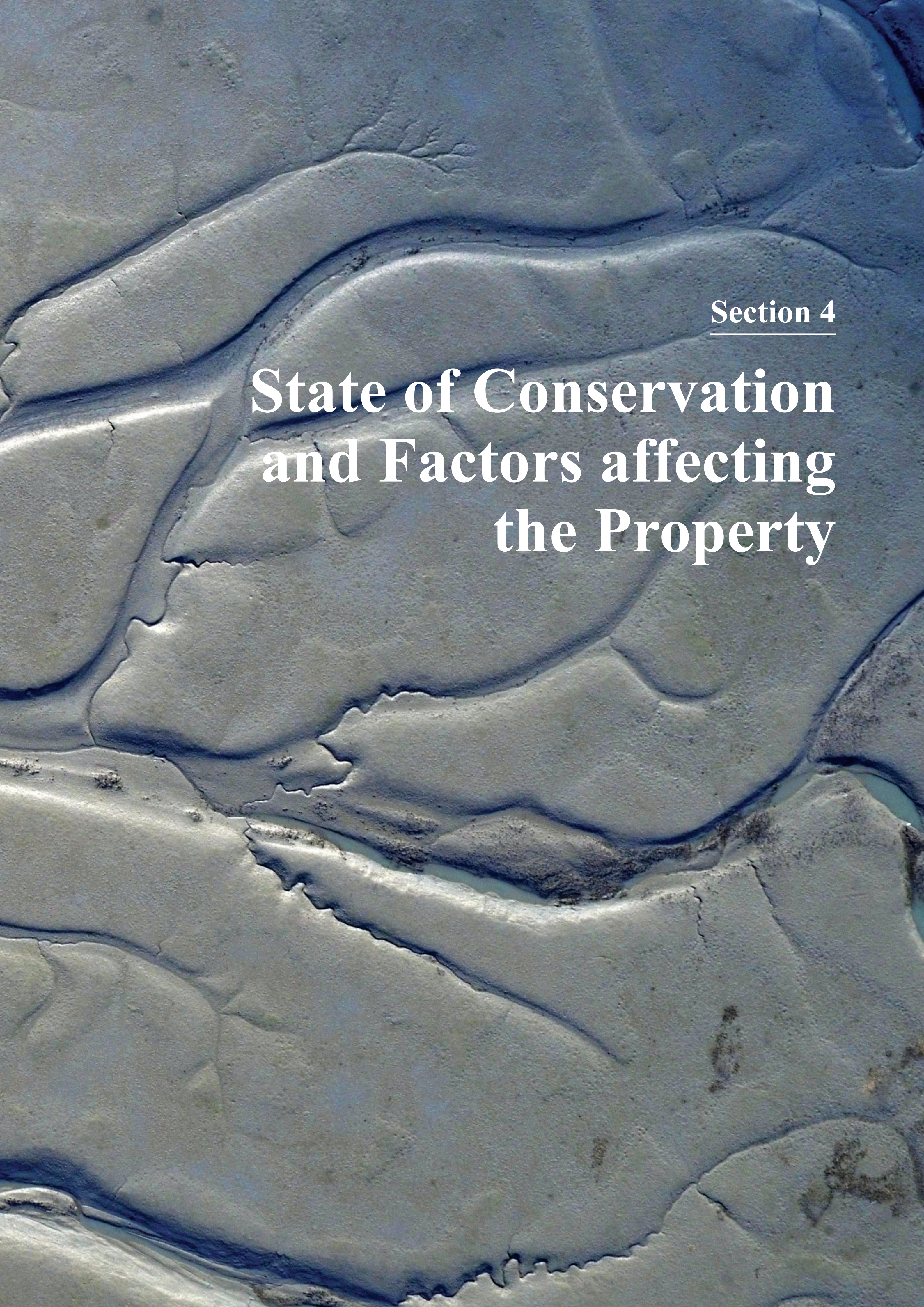
Moreover, the serial sites of the property constitute an independent, single, sedimentary circulation system that includes the source of suspended sediments all the way to the sink. Each component has four different sedimentary systems in four types of Getbol, featuring distinctive tidal circulation and sedimentation patterns, as well as various results of thick mud flat sequences.

In addition, the nominated property sustains its intactness through conservation efforts, where the geological and ecological constituents affected by human activities are naturally restored to their original state by strong monsoons in winter and typhoons in summer.

### • Requirement for Protection and Management

The entire area of the nominated property is designated as Wetland Protected Area (WPA) under the Wetlands Conservation Act (Feb. 8, 1999). Thus, there is a single consistent protection and management system in place. Parts of the property are designated as international protected areas including Ramsar Sites under the Ramsar Convention, Biosphere Reserves under the UNESCO MAB program, and the East Asian-Australasian Flyway (EAAF) habitats network, contributing to the enhancement of global biodiversity. The local municipalities where the property is located have formulated ordinances to further strengthen the protection and management of the property. In addition, the local communities have in place their own traditional tidal flats management system to further support the sustainable protection and management of the property. As such, the property has a multi-layered integrated protection and management system in place.

The ROK government provides the budget for the protection and management plan of the nominated property. By conducting integrated monitoring, the government is working to appropriately respond to any threats to the property and to protect and manage the OUV in a sustainable manner. Following inscription, the Getbol World Heritage Center and the local management offices at each of the components will be established and lead the implementation of the integrated protection and management plan in close cooperation with the central government, local governments, experts, local residents and the NGOs.



Section 4

# State of Conservation and Factors affecting the Property

Section 4

# State of Conservation and Factors affecting the Property

## 4.a Present State of Conservation

Tidal flats, the subject of the nominated property, have not only provided habitat for many species, but have also been used as a place of survival for humans who have lived in the area. There is no doubt that tidal flats provide abundant ecosystem services to humans and other creatures. Tidal flats help to purify and disperse pollutants from the land so that healthy coastal and marine ecosystems can be maintained, and also human wellbeing is enhanced by the aesthetic pleasure derived from vast spreads of tidal flats and intricately developed waterways with interesting geometric forms. Besides, marine products from tidal flats and neighboring coastal areas have had an important role in developing the life of human beings, their economy and even culture.

Interfering behavior of humans has occurred in the nominated property in various traditional ways, with in low-density human activities balanced with nature and, rather, worked as a part of the ecosystem such as top predators. For this reason, the nominated property has maintained good ecological integrity.

Beyond the traditional ways, the nominated property is under multi-layered legal protection including: the Wetlands Conservation Act (1999), the Public Waters Management and Reclamation Act (2010), the National Land Planning and Utilization Act, the Natural Parks Act (1980) and the Cultural Heritage Protection Act (1962) with strict restrictions on any development activities, allowing for robust and sustainable conservation of the property. The fact that most of the property zone has already been designated as Ramsar Sites and UNESCO Biosphere Reserves suggests that the protection and management of the property has been conducted in an international standard (see Table 5-2).

The nominated property has been designated and managed as a Wetland Protected Area under the Wetlands Conservation Act. Limited farming of marine algae and fishing clams in the area are permitted within controlled levels. In addition, any artificial introduction of marine ecosystem disturbing organisms into the area is strictly prohibited to maintain biological integrity and the ecological nature of the property. The Ministry of Oceans and Fisheries (MOF) also forbids any actions that may damage the geologic, geomorphologic or biologic properties, such as reclamation and land filling, based on the Wetlands Conservation Act.

Boseong-Suncheon Getbol and Shinan Getbol are regarded as Provincial Parks subject to the Natural Park Act besides the Wetlands Conservation Act. Based on Article 23 on Permission of Acts of the Natural Parks Act, the Ministry of Environment monitors strictly harmful activities such as new constructions, extension of existing buildings, mining minerals, changing the form and quality of land, reclaiming the surface of the water or land by drainage, and catching wild animals.

Also designated as Scenic Spot, Boseong-Suncheon Getbol is applied by the Cultural Heritage Protection Act in addition to the Wetlands Conservation Act and the Natural Parks Act mentioned above. Article 35 on Matters Subject to Permission of the Cultural Heritage Protection Act stipulates that the Cultural Heritage Administration shall exercise strict control over any attempt to capture, collect or remove animals, plants and minerals.

The public waters, which form the marine buffer zone of the nominated property, must follow the Public Waters Management and Reclamation Act and the Conservation and Management of Marine Ecosystem Act (2007). Article 5 of the Public Waters Management and Reclamation Act prohibits dumping or discharging pollutants on or into public waters and damaging any installations for managing public waters. Article 8 on Occupancy or Use Permit of Public Waters specifies that constructing artificial buildings, excavating or dredging public waters, affecting the depth of waters, extracting minerals, and occupying or using public waters for the purpose not listed on the Act must seek permission from and be managed by the MOF. The Conservation and Management of Marine Ecosystem Act also serves as an effective tool for the strict management of public waters in particular based on Article 23 on Management of Organisms Disturbing Marine Ecosystems, Article 24 on Management of Harmful Marine Organisms, Article 25 on Designation and Management of Protected Marine Areas, Article 27 on Restrictions, etc. on Acts in Protected Marine Areas, Article 30 on Orders for Suspension, etc., and Article 46 on Restoration of Marine Ecosystems all.

Activities in the terrestrial buffer zones of the nominated property are controlled by the National Land Planning and Utilization Act. Constructing buildings or installing structures on, altering the form and quality of, or gathering earth and rocks from these land areas are not permitted without the approval of the concerned municipality in accordance to Article 56 on Standards for Permission for Development Activities of the National Land Planning and Utilization Act.

The Korean national Acts mentioned so far guarantee the retention of the original form and biodiversity in the property and promote a wise and sustainable use. Besides, any project that might affect the nominated property must go through a Strategic Environment Assessment or an Environmental Impact Assessment under the provisions of the Environmental Impact

Assessment Act (1993), or satisfy the Consultation on Utilization of Sea Areas and the Sea Area Utilization Impact Assessment according to the Marine Environment Management Act (2007), depending on the nature and scope prescribed by Act.

These multi-structured systems manage and regulate any possible negative impact on the geological and geomorphological qualities and ecosystems of the Getbols. Despite the multi-layered protection efforts, the nominated property is prone to artificial damage as it stands within or next to areas of human activity. While ecological surveys covering all of the nominated property has been conducted sporadically, regular monitoring that traces changes to the nominated property has been implemented only for the case of waterbirds. An extensive and integrated monitoring system will be developed.

To understand the conservation status of the nominated property, both directly and indirectly, the following data have been utilized: the numbers of species and population of waterbirds, which can be used as an effective indicator of the health and status of the marine and coastal ecosystem, monitoring reports on the numbers of species and individuals of endangered waterbird species on the IUCN Red List, and statistics on species numbers and catch amounts of the fish that use tidal flats as habitats or feeding grounds. The organisms to use the nominated property as habitats or diet areas will increase if the environment and habitats of the property are well protected. In this vein, the fact that biotic communities produced by stable evolution and high biodiversity have been maintained in the property means that the habitats in the property are under proper protection despite various pressures.

## 4.a.i Seocheon Getbol

### • Geographic and Socioeconomic Conditions

Seocheon Getbol is located at the estuary of Geumgang River. The site includes Yubudo Island and Songlim area – major stopover sites of international importance on the East Asian-Australasian Flyway.

The Republic of Korea (ROK) government designated the Seocheon Getbol as a Wetland Protected Area in 2008 (with an extension 2018) and the global community certified it as a Ramsar Site in 2009 and as a Partner of the East Asian-Australasian Flyway Partnership in 2011. The overall protection status is thus excellent.

Man-made structures and human activities, with the flow of time, have impacted the biodiversity and habitats of the property. Yubudo Island, a core site of Seocheon Getbol, used to accommodate only a small number of residents. However, a significant inflow was seen from the 1960s to 1980s when saltpans were built to produce sun-dried salt. The northern part of the island, also a part of the property area, was reclaimed to make land for farming at that time. These saltpans closed down after the 1990s and have become an indispensable habitat for endangered waterbirds.

The buffer zone of Seocheon Getbol borders the Gunsan and Janghang ports. Gunsan Port, which opened in 1899, is a nationally-controlled trade port run by the ROK government, and has seven port units with a total of 184 ㎢ of surface area. Annually, Gunsan Port is used by about 9,000 ships including container ships, industrial ships and chemical ships. Janghang Port, which opened in 1938, is also a nationally-controlled trade port, with a surface area of 4.8 ㎢, and more than 500 ships enter and leave the port every year.

A 7.1 ㎞-long northern training dike off the Gunsan Port is located at the southern boundary of the buffer zone. This dike, built in 1997, blocks sand and waves from drifting into the seaways inside the Gunsan and Janghang ports and calms the waters inside. Interestingly, the dike has contributed to maintaining the geological and geomorphological qualities of the western part of Seocheon Getbol and securing calm waters. Thus, the dike is critical in preserving the biodiversity and securing much-needed habitats necessary for migratory birds at the property.

Like the other components, Seocheon Getbol has some aquaculture activities on its intertidal zones. Within a 5 ㎞ radius of Yubudo Island, 14 aquaculture licenses were granted for aquafarms covering 395 ㏊. Organisms cultured here include clams (corb shells, hard clams, Manila clams, Pacific oysters, hen clams and surf clams) and marine algae such as laver. The aquaculture activities are allowed to the extent that they do not affect the OUV of the property in accordance with the Fisheries and the Fishing Ground Management Acts. Also, concerned municipalities work hard to make their marine ecosystems sustainable by establishing a regular fishery management plan every 5 years, designating Fishing Control Areas, researching fishery environments, leaving a fishing ground fallow, adjusting the size of fishing grounds, and establishing criteria for fishing ground environments by the Ministry of Oceans and Fisheries.

### • Natural and Environmental Conditions

The number of waterbird species and their population in Seocheon Getbol has shown some fluctuation (Figure 4-1). It increased until 2013 but recently began to fall, due to a temporal decline in number of dunlins, bar-tailed godwits and great knots. The number of IUCN endangered species in the nominated property also increased until 2013, then declined for a while before making a steady comeback. The population of bar-tailed godwits and great knots declined in 2014, pulling down the whole population of endangered species visiting Seocheon Getbol. However, their population soared again in 2015, accounting for 45% and 33% respectively. As a result, the total population of endangered species has returned to its 2013 level.

The number of fish species found in Seocheon Getbol has increased continuously from 13 species in 2010 to 23 species in 2015 (Figure 4-2). Although the fish catch slightly diminished, the overall volume has been consistently around 700 tons. Since 2010, fish preying on benthic organisms have grown in both species diversity and catch, proving that the habitats in Seocheon Getbol have been well conserved.

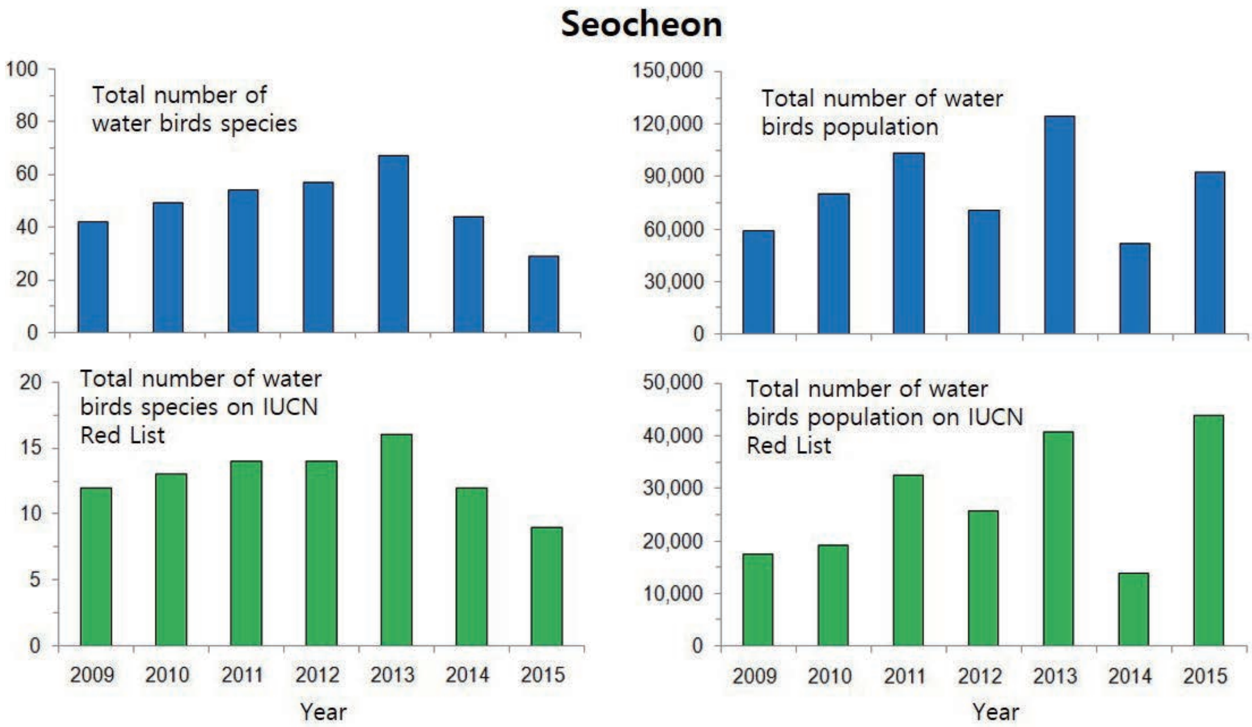



**Figure 4-1.** A trend analysis on the number of waterbirds species and population on the IUCN Red List observed in Seocheon Getbol (SNKS 2013, 2015)

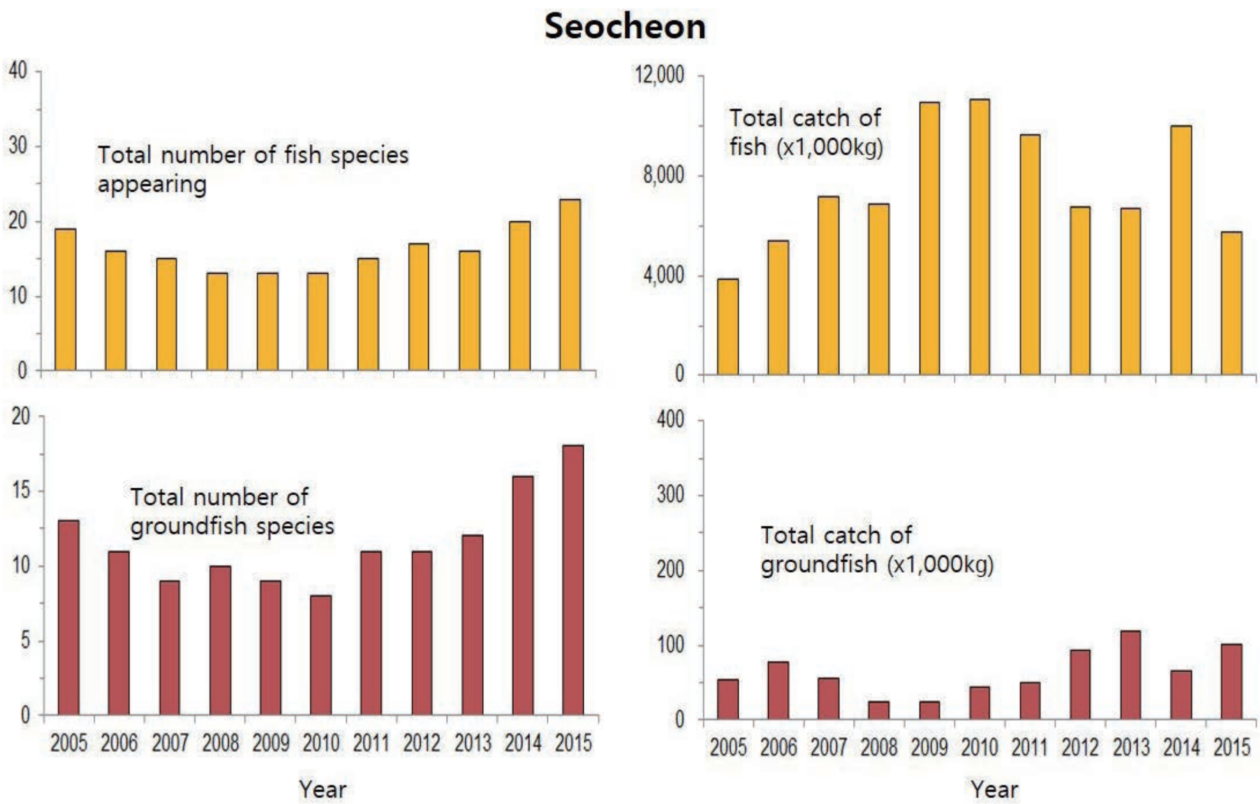



**Figure 4-2.** A trend analysis on the number of fish and groundfish species and catch variation in Seocheon Getbol (Getbol Fisheries Information Portal, http://www.fips.go.kr)

Since the Saemangeum reclamation, Seocheon Getbol, along with Gochang Getbol has been a critical stopover site for migratory birds. Various factors have added up to further support the sound development of habitats for waterbirds. Seocheon Getbol neighbors the large scale ports of Gunsan and Janghang, the training dikes and various aquaculture industries. Yet, the habitats for waterbirds in Seocheon Getbol have been well protected. This is due to the high primary production from a sufficient supply of nutrients from Geumgang River and the calm waters created by the closed saltpans and the northern training dike of the Gunsan Port. Only a small number of people live near Seocheon Getbol due to poor development of the island areas.

Other elements necessary for the sustainable preservation of the property include the central government's wetland management policies and the municipalities' management plans for sustainable fisheries.

## 4.a.ii Gochang Getbol

### • Geographic and Socioeconomic Conditions

Gochang Getbol as a component of the nominated property is formed in the southern and western intertidal area of Gomsoman Bay. The northern outer side of its buffer zone is the Byeonsanbando National Park and the Saemangeum Reclamation Project Region in Buan County, Jeollabuk-do Province. Sinchangcheon Stream flows in on the eastern side and the Galgokcheon and the Jujincheon streams flow in from the south into Gomsoman Bay.

The ROK government designated Gochang Getbol as a Wetland Protected Area in 2008 and it was also registered as a Ramsar Site in 2010 and as a UNESCO Biosphere Reserve in 2013. The overall state of legal protection is thus good.

Yet, the southern terrestrial buffer zone is reclaimed farmland that was made during the Japanese Colonial Period. In addition, there are a total of 45 embankments for fish and shrimp farms that together cover 290 ㏊ along the coastlines of the buffer zone. These farms were established before 1999, at the time when the Wetlands Conservation Act was not in place. But now no additional embankment farms can be added on public waters. Among the existing farms, those in Mandolri and Dueori areas are being rehabilitated to their original, pristine condition under a Tidal Flat Restoration Project by Ministry of Oceans and Fisheries.

As in other components of the nominated property, coastal fishery and aquaculture are active in Gochang Getbol. In the property area, a total of 161 permits were issued for 1,395 ㏊ of aquaculture for Manila clams, corb shells, hard clams and Pacific oysters; 9 for marine algae and laver farms of 246 ㏊; 3 for poly-culture fish farms of 42 ㏊; and 10 for community fisheries of 927 ha. These farms are not allowed to alter and damage the geological or geomorphological features of the property or to harm its biodiversity and must abide by the Wetlands Conservation Act, the Fisheries Act and the Fishing Ground Management Act.

Gochang Getbol is also known for its active tidal-flat experience programs. Three Experience Villages run fishing experience programs in the property area. Every year 60,000 visitors tour within limited areas of Gochang Getbol led by eco-guides and local fishermen. In 2016, the Ramsar Gochang Tidal Flat Center opened, providing education programs for the experience villages and training programs for professional eco-guiders. As such, Gochang Getbol boasts the most well-structured, vigorous tidal-flat education programs in the property.

### • Natural and Environmental Conditions

The number of waterbird species visiting Gochang Getbol has been fairly consistent since 2009, between 51 to 69 species (Figure 4-3). Their total population has also changed little from around 20,000. The population and species of IUCN endangered waterbirds has decreased slightly. However, at least over 5,000 individuals of 10 endangered species come to Gochang Getbol annually.

The number of fish species in Gochang Getbol annually is over 30, with an annual catch of over 200 tons since 2007 (Figure 4-4). The number of fish species preying on benthic organisms on tidal flats has been over 20 since 2005 with a steady catch of over 100 tons per year.

In the wake of the Saemangeum reclamation, Gochang Getbol, together with Seocheon Getbol, has served as an important stopover site for migratory birds. Since 2009, over 20,000 waterbirds have visited Gochang Getbol and it now functions as a stable habitat for endangered species. Clam farming by community fisheries is active within the property area, but fishermen use traditional farming techniques and thus help the nominated property maintain its biodiversity. In addition, the designation as a Wetland Protected Area enabled the geological and geomorphological qualities as well as the biodiversity of Gochang Getbol to be kept intact.

As mentioned above, the artificial coastlines and embankment farms at the northern buffer zone predates the enactment of the Wetland Protected Area. Efforts have been made to recover the damaged coastlines and intertidal zones. The first restoration project (2009-2012) has already been undertaken and the second (2017-2021) is underway. These will be followed by more remedial policies in the years to come to further enhance the overall biodiversity.

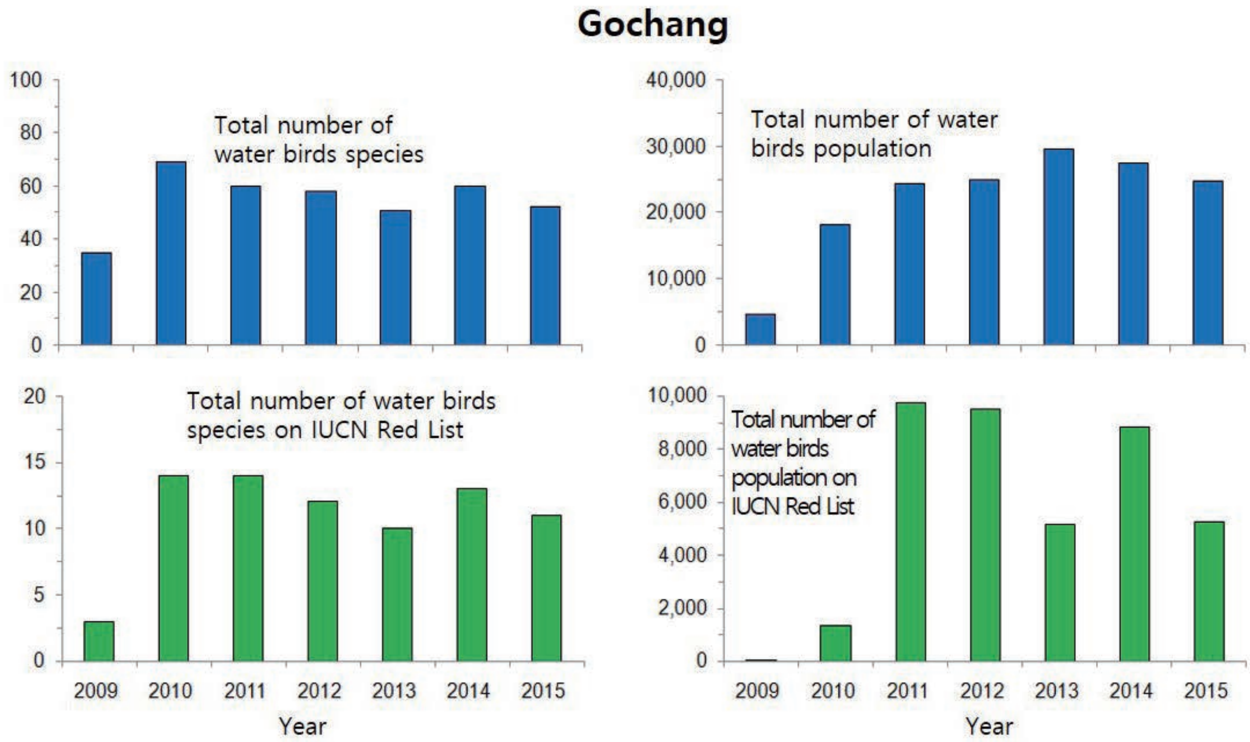



Figure 4-3. A trend analysis on the number of waterbirds species and population on IUCN Red List observed in Gochang Getbol (SNKS 2013, 2015)

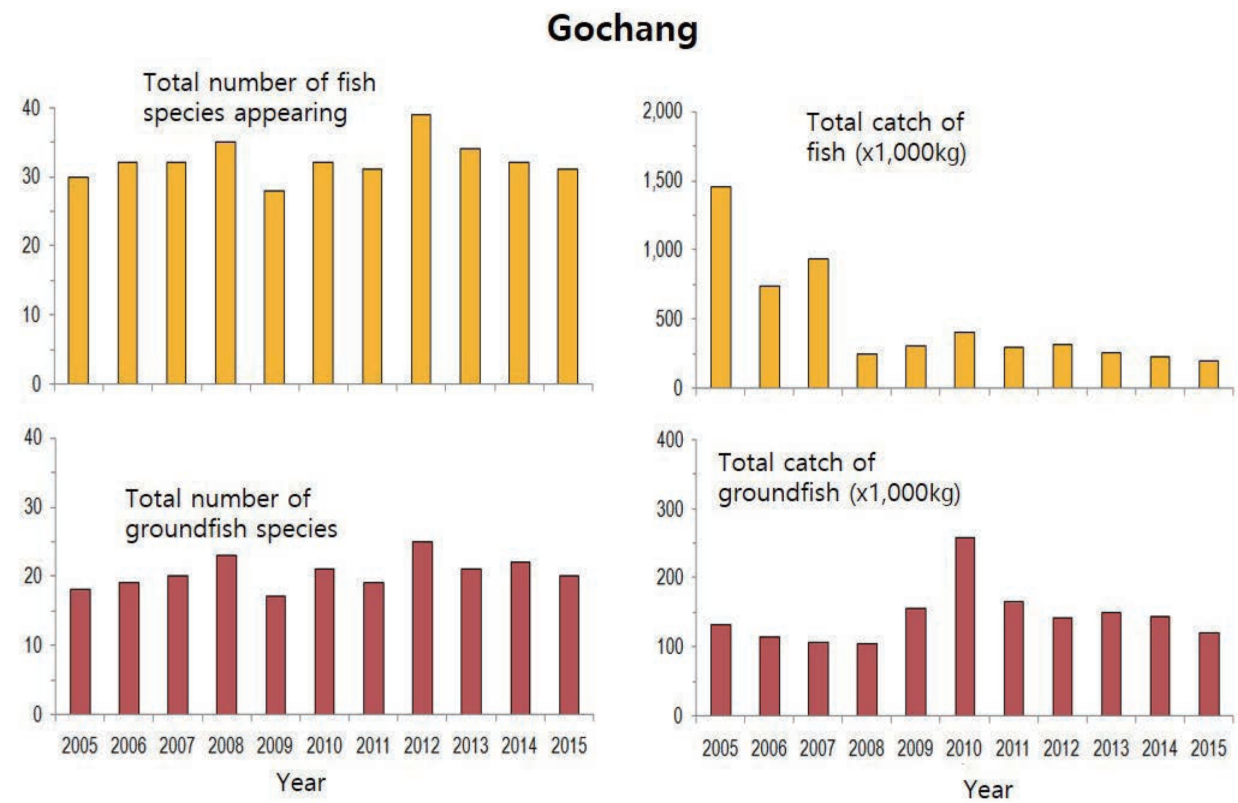



Figure 4-4. A trend analysis on the number of fish and groundfish species and catchment variation in Gochang Getbol (Getbol Fisheries Information Portal, http://www.fips.go.kr)

## 4.a.iii Shinan Getbol

**• Geographic and Socioeconomic Conditions**

Shinan Getbol is formed widely around a number of archipelagic islands including the estuary of Yeongsangang River in the southwest of the Korean Peninsula. Shinan County, where Shinan Getbol is located, is dotted with more than 1,000 islands, and 857 of them are included in the nominated property. The ROK government designated the whole Shinan Getbol as a Wetland Protected Area in 2018 and as a Provincial Park in phases from 2008 to 2017. At the same time, it was designated as a UNESCO Biosphere Reserve in 2009 (extension to the whole County area in 2016) and as a Ramsar Site in 2011. The overall protection status is thus highly sound.

Being comprised of countless islands, Shinan County bridges have been built connecting the islands and the mainland or between the islands to support the daily economic activities of local residents. A total of seven bridges were completed within the property area and additional three are under construction. Among the seven completed bridges, the Jidodaegyo Bridge (2005) connects the island to the mainland, whereas the remaining six connects between islands – the Shinandaegyo Bridge (1989), the Eunamdaegyo Bridge (1996), the Seonammundaegyo (1996), the Jungangdaegyo Bridge (2004), the Jeungdodaegyo Bridge (2007), and the Samdodaegyo Bridge (2017). The three under construction are all island-connecting bridges, namely, the Saecheonnyeondaegyo Bridge, the Imjadaegyo Bridge, and the Anjwado Island-Jarado Island Bridge.

Building island-connecting bridges has proceeded based on the central government's and municipalities' Road Construction and Management Plans and received Strategic Environmental Assessment in accordance to Article 9.1.5 (Plan for construction of roads) of the Environmental Impact Assessment Act; the plan and location of the construction projects were validated through this assessment, followed by the construction companies removing any potential threats to the environment by carrying out the Environmental Impact Assessment.

Following the central government's renewable energy expansion policy, wind power plants are under construction in the coastal areas. The three onshore units of the Shinan Wind Power Plant (completed in 2008, total capacity of 3,000 kW) are currently in operation in Bigeumdo Island and another 20 x 3 MW class onshore units are running on Jaeundo Island. Both areas are in the buffer zone.

These onshore wind power plant development projects must meet the Strategic Environment Assessment and thus they were reviewed based on the Environmental Assessment Guideline for onshore wind power plants before the initiation of the project.

The property area is dotted with coastal fish farms just like other island regions of ROK. The entire Shinan region including Shinan Getbol issued 1,007 permits for fish farms of 17,875 ㏊ in 2015. The permits are distributed as follows: 468 permits were given to marine algae farms, 115 for clam farms, 46 for fish farms, 199 for poly-culture fish farms, and 262 for community fisheries. These fishing farms must comply with the provision of the Fisheries Act which defines requirements for ‘methods of installing facilities in fishing grounds, and methods of cultivation or catching and gathering and, matters concerning fishing vessels and fishing gear.' Some cage aquacultures may need to pass the Evaluation of Fishing Ground Environment as defined in the Fishing Ground Management Act. The central government and municipalities issue permits, educate and control fishermen for the conservation and sustainable use of Shinan Getbol.

The saltpans in the buffer zone of the coastal areas of Shinan Getbol produce sun-dried salt using traditional methods. As of 2015, 944 saltpan farmers have obtained permits for their farms of 2,969 ㏊ in total. These saltpans are environmentally harmless and do not cause any damage to the OUV of the nominated property.

### • Natural and Environmental Conditions

The number of waterbird species coming to Shinan Getbol has increased steadily from 2009, reaching 83 in 2014. The population has been fairly consistent and stable, with more or less 20,000 individuals observed in 2014 (Figure 4-5). The number of IUCN Red List waterbird species has shown a similar pattern to that of waterbirds in general. In 2009, a total of 6 species appeared on Shinan Getbol. The number reached 16 in 2014, then saw a slight decrease in 2015. The entire population of waterbirds and of IUCN Red List birds witnessed a decrease in the same time period.

Although data for shorebirds were not collected and thus not included in the statistics, the current data set sufficiently proves that various endangered waterbird species visit Shinan Getbol (Figure 4-6). The number of fish species using Shinan Getbol and their catch has been consistent from 2005 to 2015. For the same period, about 20 species of fishes feeding on benthic organisms on the tidal flats were caught every year and their annual catch remained steady at 3,000 tons. Despite the continued human interventions including fishing activities, the number of species and the population of endangered waterbirds and of benthos-eating fishes have been steady and it provides evidence that their habitats are well-maintained in a healthy state.

As explained above, Shinan Getbol is armed with multi-layered, overlapping legal protection and management systems regulating man-made structures including bridges and wind power plants, as well as aquaculture activities. All these activities are regulated by conservation and control systems so as to not damage the geological and geomorphological qualities of Shinan Getbol. Locals also know how to stay within traditional practices to keep the balance with nature. Overall, the conservation of Shinan Getbol has been solid.

Additional actions will be taken by the government following the inscription of the nominated property, in particular, on how to collect and manage the inflow of marine trash.

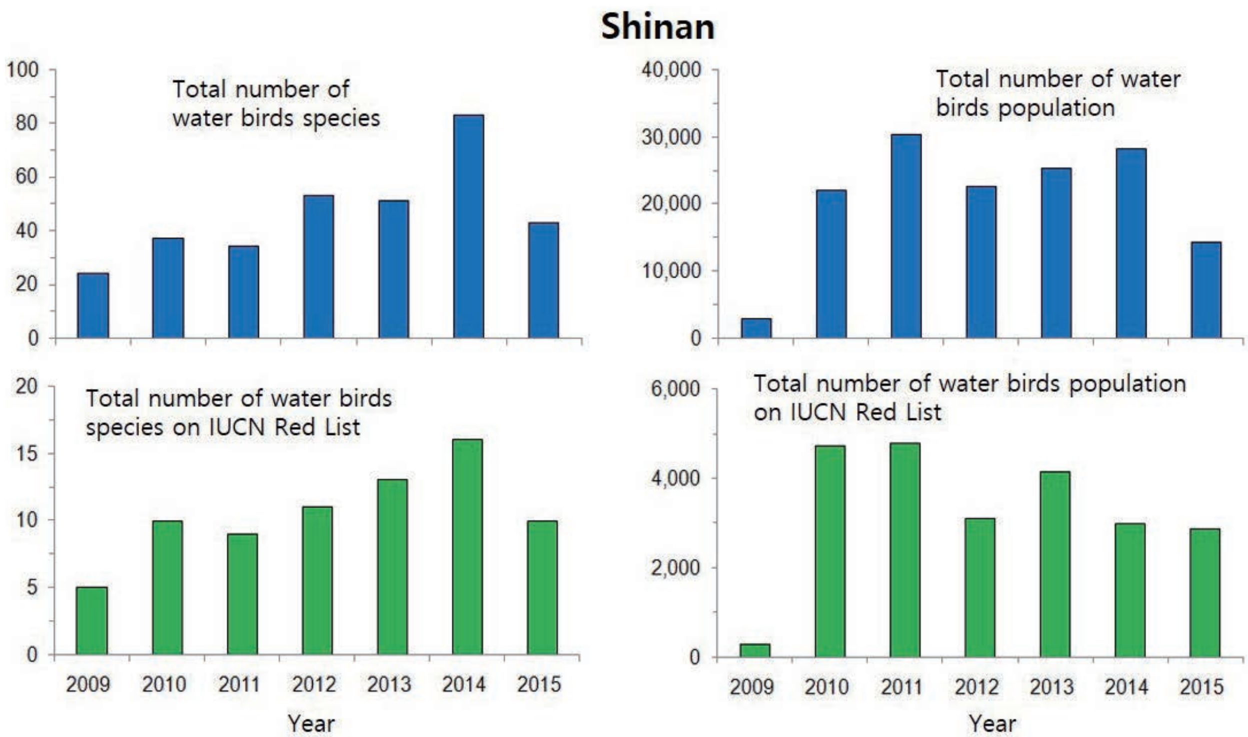



**Figure 4-5.** A trend analysis on the number of waterbirds species and population on the IUCN Red List observed in Shinan Getbol (SNKS 2013, 2015)

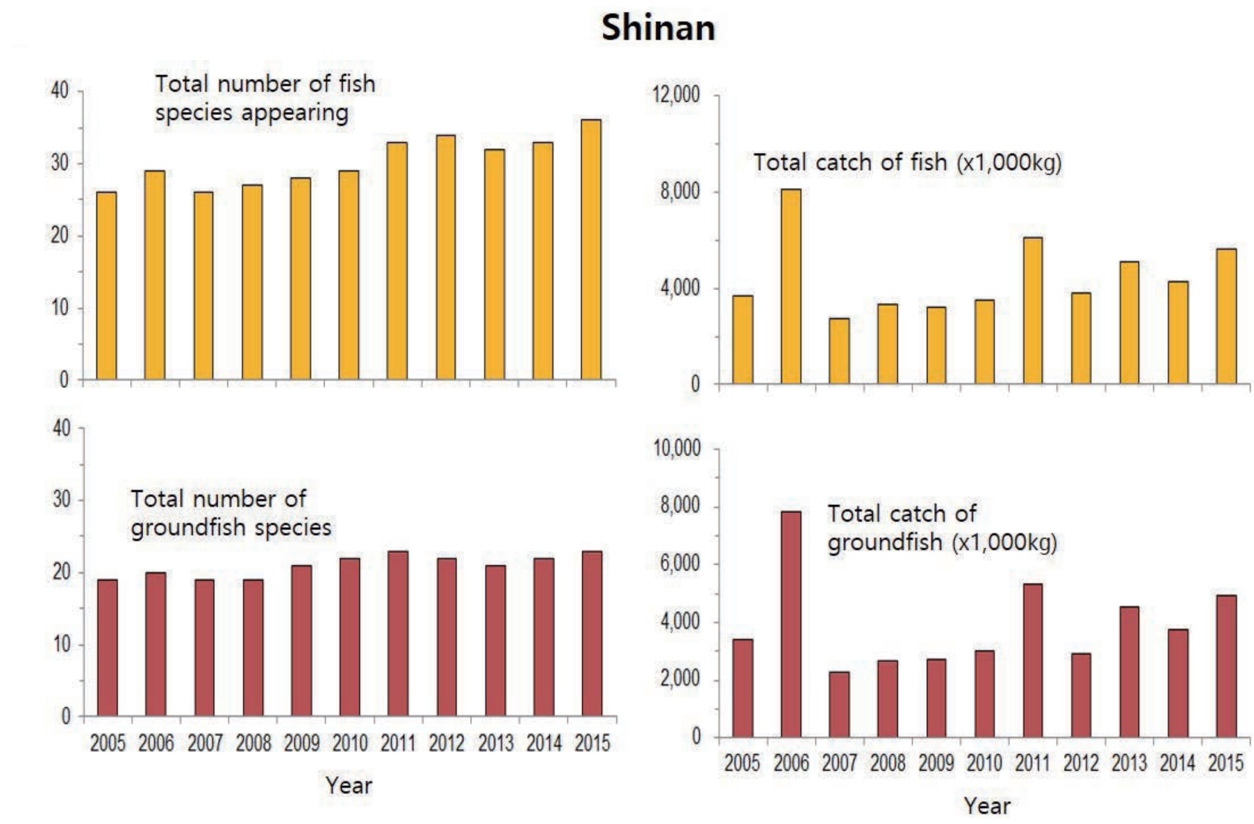



**Figure 4-6.** A trend analysis on the number of fish and ground fish species and catchment variation in Shinan Getbol (Getbol Fisheries Information Portal, http://www.fips.go.kr)

## 4.a.iv Boseong-Suncheon Getbol

### • Geographic and Socioeconomic Conditions

Boseong-Suncheon Getbol can be found at the inner side of Yeojaman Bay. The Boseong and Suncheon Wetland Protected Areas are the central piece of the property area while the boundaries between land and sea as well as the land area of the islands are buffer zones. The Dongcheon Stream, starting from Sangsa Dam in Suncheon, as well as the Seokhyeoncheon and Dongryongcheon streams running along the coasts flow into the northern boundary of Suncheon tidal flat; the Beolgyocheon Stream in Boseong County enters the western boundary of Boseong tidal flat with and Jangdo Island near the southern boundary.

The ROK government designated Boseong-Suncheon Getbol as a Wetland Protected Area in 2003. Suncheonman Bay was chosen as a Scenic Spot in 2008 and Boseong tidal flat as a Provincial Park in 2016. The Ramsar Convention registered them as a Ramsar Site in 2006. In particular, the whole area of Suncheonman City, including Suncheon Bay tidal flats, is newly designated as a UNESCO Biosphere Reserve in July 2018. Accordingly, the overall preservation condition is in good shape. The designation of the Suncheonman Bay as a Scenic Spot under Cultural Heritage Protection Act has the effect of strictly prohibiting any attempt to change the scenic quality of the bay and therefore its geological and ecological features remain intact.

Active aquaculture activities can be seen in Boseong-Suncheon Getbol as in other components of the nominated property. Fishing permits have been given to 32 cockle farms of 991 ㏊, 26 arkshell farms of 683 ㏊ and seven communal razor clam and crab farms of 173 ㏊. Clam and marine algae farming as mentioned above is subject to the Wetlands Conservation Act, the Fisheries Act and the Fishing Ground Management Act; hence all activities that affects the geological and ecological values are strictly forbidden.

The buffer zone of Boseong-Suncheon Getbol has received some of the largest numbers of ecotourism visitors in ROK. The Suncheon Bay Ecological Park located inside the buffer zone attracted 1.9 million visitors in 2016 and some 80,000 participated in Suncheon tidal flat education programs offered in the buffer zone. Suncheon Bay Natural Ecology Center and eight fishing villages are cooperating to provide information on tidal flats and educational and experience programs for many visitors. In particular, educational experience programs in some restricted area of the property and buffer zone are conducted by eco-guiders who are mostly local residents. These on-site educational experiences are recognized as efficient ways for people to understand the heritage values and become the foundation of future education activities in the nominated property.

The buffer zone in the Boseong-Suncheon Getbol, in particular, has the highest visiting pressure among the components of the serial property. Concerns were raised about possible environmental pollution and threat to the habitats, as visitor pressures might exceed the environmental capacity. Recognizing this serious issue, the local officers decided to disperse and redirect visitors throughout the buffer zone. First, they redesigned the layout of the tourism spaces, around the Dongcheon Stream, which connects the Suncheonman Bay to the downtown areas. Secondly, the Suncheon Bay National Garden was opened in the outskirts of the Suncheonman Bay, closer to downtown, aiming to redistribute the visitors. As a result, the hooded crane population started to steadily grow and the socioeconomic benefits from the preservation and wise use of the Suncheonman Bay have spread across the entire Suncheon City.

### • Natural and Environmental Conditions

Over 60 waterbird species stopover at the Boseong-Suncheon Getbol every year and their population has consistently been recorded at over 20,000 (Figure 4-7). The number of IUCN Red List waterbird species spotted in the Boseong-Suncheon Getbol has also been maintained at 15 species every year. It is noteworthy that the population of hooded cranes (*Grus monacha*) and porchards (*Aythya ferina*) has been constantly on the rise. More recently, around 5,000 endangered waterbirds visit the region every year.

The number of fish species in the Boseong-Suncheon Getbol is over 30 and the catch exceeded 2,000 tons except for 2012 (Figure 4-8). The number of fish species enjoying benthic organisms on the tidal flats also is above 20 with an annual average catch of over 500 tons.

The overall species diversity and population of waterbirds and of IUCN Red List endangered birds in the property area has either been maintained or even improved. It attests that the population and biomass of their food, zoobenthos, are abundant in the rich primary production of the property. It also provides evidence that the nature of the nominated property has not been spoiled or artificially modified. The legal protection and institutional systems for the property and its buffer zones are also fully set up and efficiently implemented. Hence, the number of fish species and their catch has been constant and the ecosystem with high biodiversity is maintained in a healthy and strong manner. Against this backdrop, the property becomes an ideal habitat for endangered waterbirds.

The Boseong-Suncheon Getbol is a representative ecotourism site of ROK. It is armed with many protective measures thanks to the designations as Wetland Protected Area, as Provincial Parks and as a Scenic Spot. Therefore, its geologic and geomorphological features and biodiversity are fundamentally safe from any kinds of threats. The primary production is constant and the biological system with high biodiversity is as healthy as ever. The annual visit of over 2,000 hooded cranes is another proof of the health of habitats in the Boseong-Suncheon Getbol. One issue, however, is marine trash. This component of the property is situated furthest from the narrow entrance of Yeojaman Bay. Thus marine trash coming from lands and oceans are trapped in and are being built up, inside Suncheonman Bay. Therefore, a plan must be established to regularly monitor and remove trash (refer to the Marine Trash paragraph of ‘4.b.ⅱ Environmental Pressure’ for details).

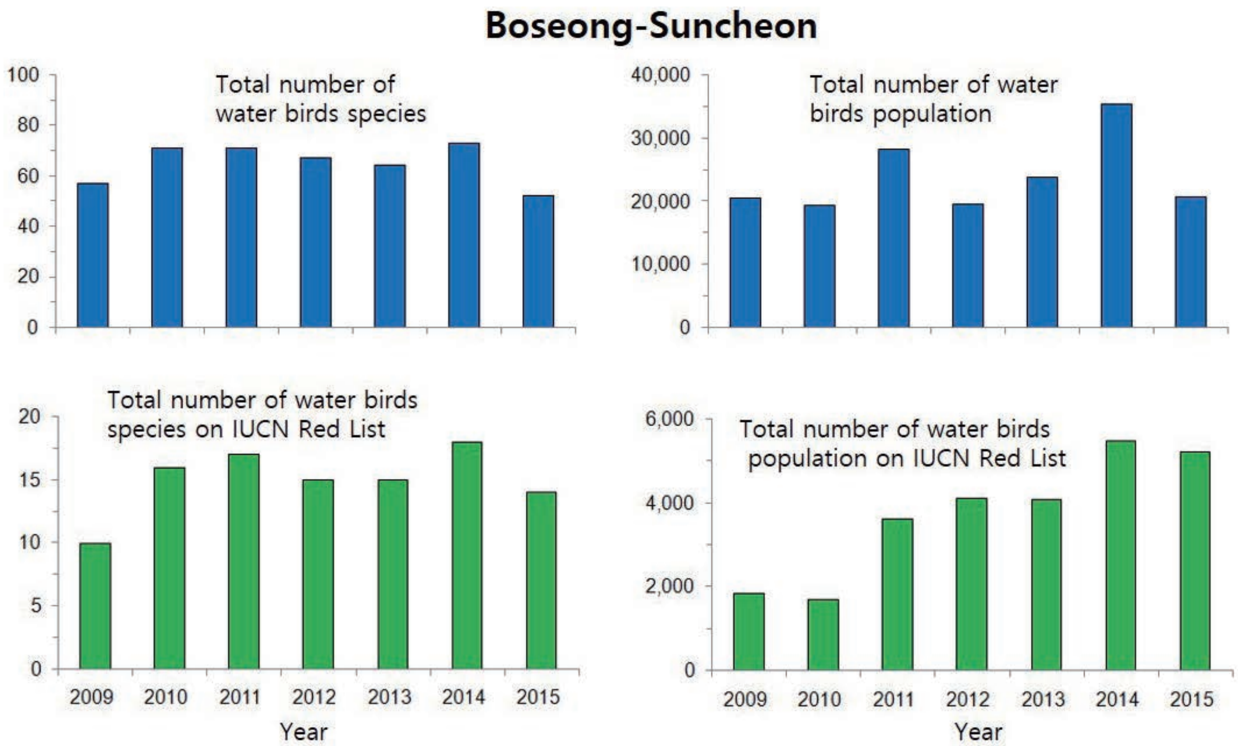



**Figure 4-7.** A trend analysis on the number of waterbirds species and population on the IUCN Red List observed in Boseong-Suncheon Getbol (SNKS 2013, 2015)

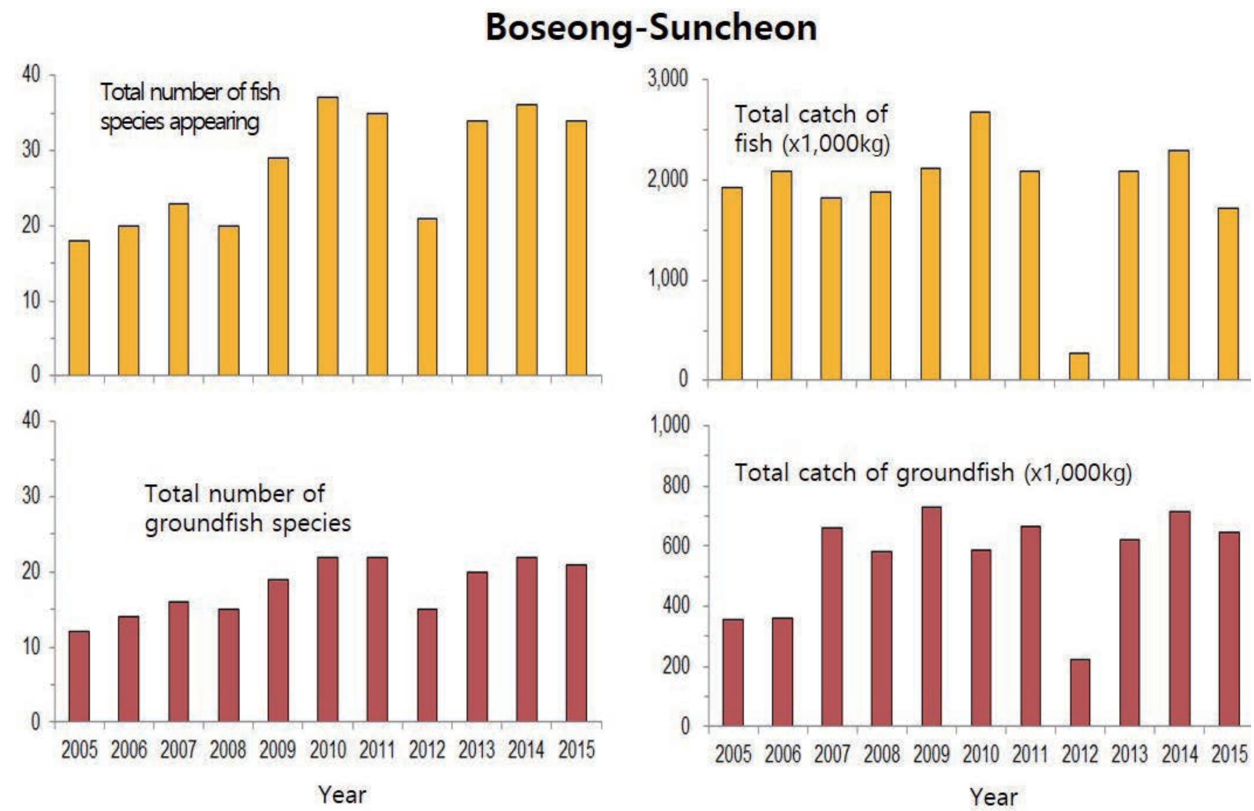



**Figure 4-8.** A trend analysis on the number of fish and groundfish species and catch variation in Boseong-Suncheon Getbol (Getbol Fisheries Information Portal, http://www.fips.go.kr)

# 4.b Factors Affecting the Property

## 4.b.i Development Pressures

All the components of the nominated property are strictly managed as Wetland Protected Area (WPA) under the Wetlands Conservation Act. The Public Waters Management and Reclamation Act and the National Land Planning and Utilization Act apply to the marine and inland buffer zones, respectively. These Acts impose strict restrictions on development projects that can affect the OUV.

In addition, all development plans and projects that may potentially impact the nominated property are regulated under the Environment Impact Assessment Act. A Strategic Environmental Assessment is carried out at the drafting stage of administrative planning, an Environmental Impact Assessment before the project execution phase.

More specifically, Article 13 on Restrictions on Activities of the Wetlands Conservation Act stipulates that those activities of new constructions or extension of artificial structures including buildings, increase of the level or the amount of wetland water, extraction of sands, soils or minerals from wetlands, or artificial introduction of animal and plant species shall not be permitted to preserve ecological qualities of wetlands. However, it should be noted that the Wetlands Conservation Act permits fishing activities performed by locals of the local authorities where the Wetland Protected Area is located or its neighboring regions. Throughout history, the wetlands and the local community have depended on each other and along the way, people have built up time-tested indigenous knowledge and traditional culture. The Wetlands Conservation Act honors this tradition by permitting such fishing activities. Details of the permitted fishing activities are stipulated in the Fisheries Act.

In summary, harmful activities to the geomorphological and geological characteristics such as reclamation or land filling projects are strictly regulated by the National Acts. Also, introduction of species that may disturb marine ecosystem is strictly prohibited. Consequently, any development activity that can potentially damage the OUV of the nominated property is strictly regulated. In addition, Each of development activities carried out in neighboring areas is subject to a strict Environmental Impact Assessment of its impact, based on the Environment Impact Assessment Act. This requirement helps to protect the property from any adverse effects.

Nonetheless, some activities that may undermine the condition of the nominated property are taking place. These potentially harmful activities include dredging of port and sea lanes and wind power plant development plans, land-to-island, island-to-island bridge construction projects, offshore wind power generation development, regional development plans, small-scale reclamation, mining of marine aggregates, introduction of harmful or marine ecosystem disturbing species, and fishing activities of locals.

### • Regional Development Plans

Being a Wetland Protected Area (WPA) in public waters, the nominated property is legally immune to any development activities of any individual that may damage the property's biologic and ecological characteristics, as well as its geological and geomorphological features.

The nominated property is comprised of public waters and islands (some inhabited). Therefore, development projects for basic transportation infrastructures, such as bridges to the mainland or other islands or sea lanes between islands, needed for islanders' daily activities, will continue to be proposed. In this context, the potential impact of ongoing or future regional development plans must be examined.

Possible development projects by the municipalities could include the following: Projects for expansion of wharfs and reinforcement of bank protection facilities near Seocheon Getbol, renewable energy-based power generation projects, land-to-island and island-to-island bridge construction projects, and opening up new sea routes between islands near Shinan Getbol.

These kinds of regional development and infrastructure installment projects are subject to an Environmental Impact Assessment when the projects involve land areas, and to the Sea Area Utilization Impact Assessment Act for sea areas. Any proposed projects must be cleared of any negative impact to the nominated property to receive a green light to proceed. These assessments aim to eliminate harmful impacts to the OUV of the property beforehand.

In particular, the Strategic Environment Assessment stemming from the Environmental Impact Assessment Act mandates a review of locational and planning validity of any project in the property. Therefore, projects, including regional development plans, with possible negative impact on the property can be filtered early in the drafting stages of administrative planning.

In conclusion, development plans possibly harmful to the OUV of the nominated property are all reviewed and sifted out in a proactive environmental assessment system and with reasonable review.

### • Reclamation

Reclamation of tidal flats is the most detrimental factor to the OUV of the property. However, reclamation is strictly banned in the nominated property, designated as a WPA under the Wetlands Conservation Act.

In Republic of Korea (ROK), up to the 1990s, large-scale tidal flat and coastline reclamation projects were undertaken to create agricultural and industrial complexes. Tidal flat area in 1987 stood at 320,400 ㏊. But it decreased by 22% to 248,900 ㏊ in 2010.

However, starting from 1997, NGOs and religious communities in ROK began protesting about the Saemangeum Reclamation Project (SRP), and soon the public began to shun large-scale reclamation projects. Other than the SRP, all government-led large-scale reclamation projects have been suspended.

A prime example of such suspension was Yeongsangang River reclamation project, which had set out to secure 39,040 ㏊ of farmland at the Shinan Getbol. The project was nullified in 1998 due to protests by the local community. In 2007, a reclamation project to build an industrial complex in Seocheon Getbol was also cancelled. Since then the ROK government announced a complete stop to any new large-scale reclamation projects. Due to such changes, the Seocheon and Shinan Getbol became free of reclamation activities and have become the nominated property based on its excellent conservation significance.

In general, the government plans for reclamation of public waters are renewed every 10 years. According to the current Third Public Waters Reclamation Basic Plan (2011-2021), only 232 ㏊ in 53 locations are planned to be reclaimed. Most of these projects were permitted in order to create land for fishing ports, public facilities, or industrial complexes.

According to the current Public Waters Reclamation Basic Plan, one reclamation project will be conducted outside of Seocheon Getbol to create an area for fishing ports. However, the planned reclamation site is only 1.6 ㏊ and is approximately 11 ㎞ away from Yubudo Island. Therefore, it is highly unlikely that the planned project will affect the property.

Also, starting in 2010, the Ministry of Oceans and Fisheries (MOF) has been conducting one tidal flat restoration project a year, working on cleaning up closed saltpans and fish farms and reopening the blocked water paths between isolated tidal flats. To further boost restoration efforts, the ‘Mid-term Plans for Tidal Flat Ecosystem Restoration (2019-2023)’ has been set up. The plan aims for more systematic restoration activities by expanding the restoration target tidal flats, improving the overall project management and increasing the incentives for the restored areas.

Based on this plan, MOF will conduct its tidal flat restoration projects at 23 locations for the next 5 years. By 2023, 14 tidal flat restoration projects will be completed, recovering 3 ㎢ of tidal flats and 3 ㎞ of waterways. The plan includes one location in Seocheon Getbol, two in Gochang, four in Shinan and another three locations in the Boseong-Suncheon Getbol.

### • Mining and Dredging

Mining of marine aggregates can be another factor that impacts the OUV of the nominated property. The property is designated as a Wetland Protected Area, and mining aggregates from ocean beds is prohibited. Collecting aggregates for construction purposes is allowed in the Exclusive Economic Zones to some degree, but this has little influence to the property. Shinan Getbol partially allowed sand mining during the 1990s, but the government withdrew the permission when it was designated as a Wetland Protected Area.

Of the nominated property's components, Seocheon Getbol's buffer zone houses two central ports of ROK, the Gunsan and Janghang ports. The two ports carry out dredging activities periodically to secure enough depth of its waterways for the safety of ships sailing in and out from the ports and for the improvement of its navigational conditions. The Gunsan Regional Office of Ministry Oceans and Fisheries has been supervising the seaway dredging at the Gunsan-Janghang Ports Project (second phase). Initiated in 2013, this project has been ended in 2018 and the amount of dredging is expected to be about 14 million ㎥. The dredging location of the project is outside of Seocheon Getbol and the northern training dike of Gunsan Port separates the project location from the buffer zones. The distance between the two is far enough not to cause damage to the geological features of the nominated property.

### • Fisheries activities

Fisheries activities can be another factor that impacts the OUV of the nominated property. A traditional form of fishery activities is common in tidal flats in the southwest coasts of ROK including the property, usually led by the fishing village cooperatives at the village level. Humans and nature have 'co-existed' and maintained a 'relationship of cooperative competition' for thousands of years. Coastal fishery activities have been regarded as an integral part of ROK's local cultures, and thus a sustainable use of tidal flats has been treasured from generation to generation.

In the nominated property, clam farms growing corb shells, hard clams, surf clams, Manila clams, Pacific oysters, or marine algae farms like laver or sea mustard are active. Seafood take up a significant portion of Korean's diet. The annual seafood consumption of Koreans stands at 54.9 ㎏/person according to the statistics of UN Food and Agriculture Organization (FAO, 2012). This is considerably higher than the world average of 19.2 ㎏/person. Surrounded by sea water on three sides, seafood is an important source of protein for Koreans, accounting for 30% of total food intake. This means that Koreans eat a wide variety of seafood in large quantity, most of which come from tidal flats, such as clams, fishes, marine algae, sea cucumbers, crustaceans, and mollusks.

As mentioned above, an analysis of fisheries catch by different types of fish caught in the nominated property, shows that the number of fish species swarming and their catches have been consistent, except for some temporal changes. It is true that the marine resource has continuously suffered because of compound factors, including overfishing, sea pollution, marine trash and climate change. Even so, those changes are transient in nature and the marine resources have shown strong resilience. It is because nature in tidal flats can cure itself. Local fishermen also have been working hard to boost such natural recovery by discharging spats (seed clams) and young fishes as well as marine clean up activity.

Fishery activities in the nominated property must abide by the Wetlands Conservation Act, the Fisheries Act and the Fishing Ground Management Act. Any action that disturbs the OUV of the property is not allowed.

The Fisheries Act defines requirements for ‘facilities in fishing grounds, culturing methods, capturing and collecting techniques, and types and use of fishing boats and gears’. Article 8 (Fishery License) and Article 41 (Fishery Permit) of the Fisheries Act instruct that the MOF must establish Master Plans for Fisheries every 5 years for the regions with the fishery permit. The concerned municipalities likewise must design its own Master Plans for Fisheries every 5 years and use it to preserve and control the ecosystem of the nominated property in a sustainable manner.

Measures in the Master Plans include: designating sea management areas, research on fishery environments, designating sea management areas for special interests, setting fishery holidays, adjusting fishery areas, and setting standards for fishery environments. Some cage aquacultures may need to pass the Evaluation of Fishing Ground Environment as required in the Fishing Ground Management Act and take necessary actions to improve the conditions of marine environment based on scientific investigations.

In summary, fishing and farming activities in the nominated property, led by the fishing village cooperatives, are regulated by Acts and institutions to a proper level, not to disturb the balance between humans and nature. Therefore, they do not harm the OUV of the property.

## 4.b.ii Environmental Pressures

Global climate change, invasion of exotic species to the region, nationwide shoreline erosion, oil-spills, and marine trash are some of the environmental pressures affecting the nominated property. To each of these issues the Ministry Oceans and Fisheries (MOF) monitors and responds to them consistently and comprehensively. In other words, the environmental pressures to the OUV are properly managed.

### • Pollution

The property is coastal wetland, so it could be affected by terrigenous pollutants or by discharges from ships. The ROK government manages the pollutants by the Sewerage Act. Public and private sewage treatment facilities prevent the pollutants from entering tidal flats in advance. According to a national sewage statistics by the Ministry of Environment, the nationwide distribution rate of sewage was 93.2% in 2016.

The distribution rate in each serial property is 53.1% in Seocheon County, 65.1% in Gochang County, 31.2% in Shinan County, 57.3% in Boseong County, and 91.5% in Suncheon City. The rate varies depending on population and urbanization. So Suncheon City with 283,504 population in 2018 has the high distribution rate with densely populated area. On the other hand, the other components with small-sized area of agricultural and fishing village show the low rate due to lower population than those of urban area; Seocheon County of 54,355 populations, Gochang County 57,205, Shinan County 41,539, and Boseong County 43,031. Regardless of low population in those counties, public sewage treatment facilities are fully equipped in densely populated area and also in case of private resident area, full equipment of the sewage treatment facility is necessary for build permission under the Sewerage Act. With this strong regulation, most of pollutants from inland areas flow to the nominated property after being filtered by various sized sewage processing facilities.

In addition, the Central Government plans to expand and improve the facilities to the property, especially islands and coastal villages for more thorough management of terrigenous pollutants. Besides, main streams and rivers like Geumgang and Youngsangang rivers related with the four components are supervised by national level. Consequently, the terrigenous pollutants which can affect on the OUV are well controlled by proper system.

### • Climate Change

The greatest environmental pressure on the nominated property is climate change and associated sea level rise. Since the 1990s climate change has become a major challenge in natural ecosystem management. ROK, with three sides facing the ocean, and with much of the nominated area being intertidal, is greatly impacted by climate changes and rising sea level. Already, the Korean Peninsula has become like a subtropical zone, with changes being observed in its biodiversity and ecosystem structure. The spread of areas affected by invasive exotic species is also expected. Temperature rise of sea waters induced by climate change will bring in harmful and toxic marine species, cause possible outbreak of diseases and the emergence of new pathogenic microorganisms. In addition, the temperature rise will cause more problems to the intertidal ecosystems: increased volatility in grounds and spawning periods of fishes and clams; habitat and fishing ground alterations of anadromous and sedentary species; mutation of the food chain of marine ecosystem due to ocean acidification; and changes in biodiversity. The rise of sea level will force intertidal biological zones landwards and had been causing coastal erosion.

Therefore, the long term monitoring of the nominated property must address changes in marine and coastal biodiversity and in the cycle of materials. These must be continuously studied along with other variations in the ecosystem. Habitat-based monitoring and change tracking activities must be carried out as well. At the same time, a thorough investigation is needed of coastal erosion caused by climate-change induced sea level rise.

Since 2008, the MOF has set up an Integrated Plan for the oceans and fisheries sector as a countermeasure to climate change. The Ministry has set a vision of protecting the life and property of the people and contributing to mitigation of global warming by responding to climate change-borne marine changes. Under this banner, the following five core strategies were established to minimize the impact of climate change: 1) designing coastal adaptation plans to create a marine environment safe from climate change; 2) drawing up adaptation plans against changes in marine resources in order to secure safe food resources; 3) mapping out green-house gas reduction strategies by developing marine-based renewable energies and storing carbon dioxide with sufficient carbon sinks; 4) strengthening the foundation of marine science to maximize the observation and prediction capability against climate change; and 5) preparing a base for an efficient implementation of policies by upgrading climate change response capabilities.

### • Harmful or Disturbing Organisms

Harmful marine organisms and marine ecosystem disturbing species influence the biodiversity and ecological characteristics of the nominated property. These organisms sneak into ship's ballast waters and can travel between countries and then can be introduced elsewhere by discharge of the ballast water, thus contaminating other waters and ending up disturbing the ecosystem in areas where they settle. The ROK government has been monitoring and trying to control these organisms.

The Conservation and Management of Marine Ecosystems Act defines the term “harmful marine organisms” as organisms causing serious damages to the life or property of people; and the term “marine ecosystems disturbing organisms” as marine organisms coming in from abroad, artificially or naturally, which cause or are likely to cause disturbance to the balance of marine ecosystem.

A total of 17 harmful marine organisms have been listed: Nomura's jellyfish, Portuguese man of war, moon jellyfish, box jellyfish, Japanese sea nettles, Northern Pacific seastars, bat seastars, occidental moss worms, sargassum sea mats, purple sea mats, smooth cordgrass, and English cordgrass. Only one organism disturbing marine ecosystems is included in the list and that is sea squirt (*Ciona* sp.).

The above listed organisms are found in some areas of the property and can possibly disturb the biodiversity or ecologic characteristics. The MOF and the Korea Marine Environment Management Corporation therefore have initiated the National Investigation of Marine Ecosystems to regularly trace, manage, and remove the unwanted listed organisms. Information from the National Investigation of Marine Ecosystem can be found at on the website (http://webgis.ecosea.go.kr).

### • Coastal Erosion

Another environmental pressure experienced in the nominated property is coastal erosion. It can occur for several complex reasons: climate change, sea level rise induced by global warming, mining of marine aggregates to provide construction materials for inland development and urbanization, and negative effects of the installation of artificial structures such as ports and seawalls. ROK displays different geological and geomorphological structures and coastal environments on each side, resulting in different types of coastal erosion. Climate change is expected to continue to induce the sea level rise. Therefore, all types of coastal geological and geomorphic changes in the southwest coasts of ROK, including the nominated property, are being continuously monitored by MOF.

To further address this issue, the MOF will devise a 10-year Basic Plan for Coastal Maintenance for the coastal area preservation. This project will cover a total of 370 locations across the country and the budget will amount to USD 1.83 billion. In fact, an annual monitoring program is already ongoing to study the current erosion status and its causes for the 250 locations. An additional R&D project is also in progress, with a budget of USD 21.3 million to scientifically understand the causes of erosion and to develop efficient technologies for erosion reduction.

According to a 2014 survey of the MOF, 109 out of 250 major coastal locations have shown either ongoing or potential severe erosion. In the west and south coasts of ROK, where the nominated property is located, the number of locations with high erosion risk have dropped by 36.7%, from 79 down to 50 locations. Among the regions of the nominated property, two locations in the Seocheon Getbol (Songlimri beach, Beinmyeon Dasi zone), three locations near the Gochang Getbol (Dongho, Changhori and Gosipo beaches) and another 10 locations at the Shinan Getbol (two on Imjado Island, one on Jeungdo Island, one on Amtaedo Island, five on Jaeundo Island, and one on Anjwado Island) are listed in this nationwide monitoring program. The Boseong-Suncheon Getbol is located inside the Yeojaman Bay, which is closed in, and is therefore not affected by coastal erosion.

In 2017, the MOF initiated the 'Coastal Erosion Impact Assessment System.' This system, as part of a reinforced coastal erosion prevention effort, obliges coastal development project owners to prepare erosion-addressing plans through a Preliminary Impact Assessment and to trace any coastline changes. The information on the Ministry's coastal erosion survey status and the history of coastal erosions can be found at on the website (http://www.coast.kr).

### • Oil Spills

Oil spills in the sea is another noteworthy environmental pressure. Seocheon Getbol in particular is close to nationally-important Gunsan and Janghang ports, and vessels regularly sail between islands or between the mainland and the islands at the Shinan Getbol. Although a variety of domestic and international rules for safe navigation are in place, oil spill caused by unexpected accidents can happen in the seas, causing devastating impacts to the biodiversity and ecologic qualities of the nominated property.

Article 14 (Restrictions on Passage of Oil Tankers) of the Maritime Safety Act defines sea areas subject to prohibition against passage of oil tankers. As the volume of oil tanker traffic increases within coastal areas due to growing demand, the Act enforces oil tankers to keep a certain distance from land for safe navigation, preservation of marine ecosystems and protection of coastal fishery industries. A 472-mile long line, 10 to 25 miles away from the mainland, was drawn, stretching from the west coast to the east coast of the Korean Peninsula. The sea areas within this line were classified as a no-entry zone for oil tankers. Oil tankers must sail outside this line, protecting the coastal areas from any possible oil pollution. The oil tankers subject to this regulation are defined as any vessel loaded with more than 1,500 kℓ of oil such as crude, heavy or diesel oils or any ship carrying hazardous liquid materials.

In 2007, the Hebei Spirit oil spill accident occurred near Taean area, Chungcheongnam-do Province, leaking 12,547 kℓ of crude oil into the sea. The spilled oil was carried down to the Chujado Island near the Jejudo Island by the currents of the southwest coasts. Laver farms in

Shinan Getbol were also damaged because of this accident. This tragedy triggered a regulation revision to prohibit any single-hull tankers from entering ports.

In the aftermath of the 2014 'Sewol Ferry Disaster', a national-level incident at sea, measures to prevent accidents in the seas have been further set in place including the Vessel Monitoring System (VMS), Ship Security Alert System (SSAS), the integrated ship-related database, the integrated information sharing system called the General Information Center on Maritime Safety & Security (GICOMS).

### • Marine Trash

Marine trash has also become a severe environmental pressure of concern to the nominated property.

Marine trash can be broken down into two: terrigenous waste and marine waste. Marine waste can be further broken down to trash generated from fishing activities, ships sailing in the sea, or marine facilities. Summer torrential rains usually push a great deal of waste into the ocean through streams, and the nominated property is not an exception.

The MOF and the municipalities responsible for the nominated property established the Second National Marine Trash Basic Management Plan (2014-2018) in accordance with the Marine Environment Management Act. It provides a legal base for a variety of programs and systems including the framework for marine trash prevention, collection and management or education and awareness raising programs with an earmarked budget of USD 344.8 million.

The municipalities also have spent a substantial amount of human and capital resources to collect and dispose of marine trash. The five local governments related to the nominated property invested USD 8.7 million to remove and dispose 23,560 tons of marine waste trash from 2012 to 2016. The locals recognize that marine trash is continuously arriving from both inland and other parts of the ocean, and is a grave concern. Through voluntary activities by the locals and citizen volunteer programs, marine trash in the nominated property is being actively cleaned up.

The MOF, the Ministry of Environment, and the Korean Coast Guard have been jointly responding to marine trash issues at the national level by 1) intensely managing sources of marine trash with a focus on prevention of its inflow; 2) strengthening trash collection programs based on the life cycle of waste producers with a focus on waste collection in coastal areas; 3) upgrading marine trash management frameworks with an emphasis on the invigoration of Marine Trash Management Center; and 4) initiating promotional programs to encourage civilian participation for coastal area purification. Furthermore, the number of offshore marine trash collection stations will increase from 176 to 254 posts by 2018.

Marine trash collection and management programs in the nominated property are a matter of great concern for each municipality and the fishing village community. Getbol World Heritage Center will further bolster the marine trash response effort after inscription to further improve conservation and management of the OUV of the property. It will sign an MOU with local communities to design collection plans, secure sufficient management budget, allocate adequate human resources for trash collection, and operate marine trash collection and management programs, based on the status survey outcome on the marine trash distribution by region.

**Table 4-1.** Marine trash collection status in the nominated property (Units: ton, USD)

| Component | Region | Amount | Total | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|
| Seocheon | Seocheon County | Collected Amount | 4,765 | 934 | 784 | 716 | 807 | 1,524 |
| | | Expenditure | 2,857,401 | 560,718 | 470,683 | 430,000 | 573,000 | 823,000 |
| Gochang | Gochang County | Collected Amount | 773 | 194 | 88 | 154 | 170 | 167 |
| | | Expenditure | 185,406 | 60,000 | 19,281 | 39,280 | 31,677 | 35,168 |
| Shinan | Shinan County | Collected Amount | 14,744 | 3,900 | 2,320 | 1,140 | 4,400 | 2,984 |
| | | Expenditure | 4,692,084 | 1,170,384 | 697,000 | 342,700 | 1,342,000 | 1,140,000 |
| Boseong -Suncheon | Boseong County | Collected Amount | 2,338 | 202 | 300 | 763 | 589 | 484 |
| | | Expenditure | 675,000 | 60,000 | 60,000 | 166,000 | 88,000 | 301,000 |
| | Suncheon City | Collected Amount | 940 | 200 | 200 | 160 | 160 | 220 |
| | | Expenditure | 300,000 | 50,000 | 50,000 | 50,000 | 50,000 | 100,000 |
| Total | | Collected Amount | 23,560 | 5,430 | 3,692 | 2,933 | 6,126 | 5,379 |
| | | Expenditure | 8,709,891 | 1,901,102 | 1,296,964 | 1,027,980 | 2,084,677 | 2,399,168 |

(Data from each County and City)

## 4.b.iii Natural Disasters and Risk Preparedness

The geologic and geomorphologic features of the nominated property are a result of a complex, long-term interaction between erosion and sedimentation. This ongoing dynamic constitutes one of the main characteristics of the nominated property; no natural disaster, even the frequent heavy typhoons every summer, have been formidable enough to remove or destroy the geological and ecological system of the Getbol.

The nominated property, being situated along the track of tropical typhoons, usually witnesses them between June and October as the typhoons are pushed up by high atmospheric pressure from their birthplace near the equator. Typhoon Rusa, formed in 2002, injured 246 people and left 60,000 homeless with an economic loss of USD 6.48 million. These kinds of typhoons of various size strike the Korean Peninsula and its property every year.

ROK responds to natural disasters based on the Framework Act on the Management of Disasters and Safety. In case of an emergency, a 'Si (City)-Gun (County) safety management committee (Article 11)' deliberates on the matter and sets up a 'Central Disaster and Safety Countermeasure Headquarters (Article 16)' if necessary to exercise general control over, and to coordinate matters at the site. Also, a 'Si (City)-Gun (County)-Gu (borough) Safety Control Plans (Article 25)' must be established in connection with a 'Master Plan for National Safety Control (Article 22)' to actively address a disaster. The municipalities responsible for the nominated property also apply this manual as their natural disaster response system.

In the period of high spring tide or supermoon, there are some coastal lowlands that may be flooded by sea level rise combined with climate change. Since 2006, the Korea Hydrographic and Oceanographic Agency (KHOA) has been putting together a 'Coastal Inundation Projection Map', identifying high risk areas so that they can prepare themselves beforehand. High sea water information can be found on the website http://www.khoa.go.kr. Furthermore, KHOA also collects comprehensive information on various coastal disasters. Using the compiled information, KHOA has developed a quantitative grading index to measure how vulnerable a coastal area can be in a disaster with different causes. The GIS based assessment system is used to continue its research on developing preemptive measures against coastal area disasters. More information can be obtained at the website of the Coastal Disaster Assessment System (CDAS; http://www.khoa.go.kr/cdas/pcdas/main/MainPage.do).

In conclusion, the studies and records to-date prove that there are no predictable disasters which may cause irreparable damage to the intactness of the nominated property.

## 4.b.iv Responsible Visitation at World Heritage Sites

The nominated property offers the most active experience and ecotour programs of tidal flats in ROK. Beginning in the 1990s, non-governmental organizations ignited campaigns against large-scale reclamation projects. As part of this effort, tidal flat ecotourism programs were launched to help people better understand the value and importance of tidal flats. Most of these programs were educational in nature, helping participants comprehend the values and benefits of various ecosystem provided by tidal flats. The participants of the program can also enjoy the local ecosystem, culture and culinary art through the program.

Tidal flat ecotourism programs mostly take place in the buffer zones, outside the nominated property or in inland areas; only some fishing experience and tidal flat observation activities are available directly within the property area. The tidal flat observation programs are provided within limited areas through the tidal flat visitor centers and are led by trained guides. The fishing experience programs at the Fisheries Experience Villages are also guided by seasoned fishermen. In both cases, any visitor pressures to the property via tourism activities are under control.

Most of the infrastructure development, tour, and recreational activities related to the nominated property take place outside of the property area. These activities may boost each local economy; however, if the number of tourists exceeds the property's environmental capacity, a negative impact can be expected. It is hard to predict precisely the tourism demand for and environmental capacity of the property. Following the inscription, the Getbol World Heritage Center (GWHC) will work with the municipalities to predict the tourism demand and environmental capacity related to the property. Based on the findings, an additional, sustainable tourism strategy for the property will be designed with thorough preparation, so that a systemic and sustainable tourism can develop. Also, a system is already in place that only allows visitors to access limited areas within the property, so that the tidal flat ecosystem is not disturbed.

In the wake of inscription, the Communication, Education, Participation and Awareness Program will be developed building on the tourism strategy mentioned above. It will enable the nominated property to be better prepared for future tourism pressures. The Center also promotes tour programs that support the conservation of the marine ecosystem and resources with various stakeholders such as local communities and tourism agencies. The programs will raise the local people's and visitors' awareness of the OUV through education and will encourage respect of the indigenous knowledge and traditional culture of people living close to the property. This will enhance the sustainable pursuit of a harmonious co-existence among the marine ecosystem, local people, and the visitors.

### • Passenger Ship Services and their Users in the Nominated Property

Because the region has a rias coastline with many islands, it is seen to frequent trips of passenger ships in the nominated property an important transportation mode for islanders and tourists alike. Among the components of the property, only Shinan Getbol and the Boseong County of Boseong-Suncheon Getbol have regular passenger ship services. The Shinan County encompasses the Shihan Getbol including some 900 islands. Regular transport services for residents living on the 72 inhabited islands and visitors stopping over at the islands of the Shinan County region, including the nominated property, make at most 71 round trips a day. In case of Jangdo Island in Boseong-Suncheon Getbol, only small ships come and go twice a day.

Shinan County, where Shinan Getbol is located, has 72 inhabited and 953 uninhabited islands. Most islanders and visitors come in and out of the island on passenger ships, except where the islands have bridges that connect to other islands or to the mainland. In 2016, about 1.53 million people (including the residents) used passenger ships to travel to and from the 13 inhabited islands in the nominated property.

Passenger ships heading to and from the nominated property are mostly small passenger vessels or car ferries. They always sail along the routes set by Act. Tidal flats in most cases have a shallow water depth and small-scale port facilities and therefore large ships such as cruise ships cannot access them. In other words, the geological impact of the maritime transportation services on the property is almost non-existent.

### • Tourism Infrastructure and Travelers to the Nominated Property

The bulk of tourism infrastructure in the nominated property comprises small-scale lodging facilities and restaurants operated by fishing village communities. Tourist business infrastructure owned by individuals is not accurately tallied. The types of infrastructure that can be built in the island regions are strictly regulated.

Tourism is most active in the Boseong-Suncheon Getbol. The Suncheonman Bay, in particular, has become one of the most popular tourist destinations in ROK, welcoming some 1.9 million tourists a year. But, all tourist activities and visits take place outside the nominated property.

Most of the key infrastructure is located outside the core of the nominated property, with the exception of some decks for tidal flat education and observation purposes inside the property area. Beaches that can be publicly accessed are found only in limited locations at Gochang and Shinan Getbols.

Nine Fishery Experience Villages run by the fishery communities are located in the buffer zone. The number of visitors is around 100,000 annually (refer to Table 4-2). The fishery experience programs are delivered by educated local people at limited sites in the property area. The fishing experience programs, run by experienced fishermen in limited areas, also help to further raise public awareness to protect the OUV of the nominated property.

**Table 4-2.** Number of visitors to experience villages near the nominated property (Unit: Persons)

| Experience Village | | 2015 | 2016 |
|---|---|---|---|
| Seocheon County | Wolhaseong | 25,712 | 17,749 |
| | Seondori | 36,000 | 13,000 |
| Gochang County | Mandol | 27,095 | 29,395 |
| | Hajeon | 24,784 | 31,049 |
| Shinan County | Ujeon | 1,375 | - |
| | Dunjang | 5,964 | 2,528 |
| | Chupo | 1,801 | 1,854 |
| Boseong County | Jangyang | 2,311 | - |
| Suncheon City | Geocha | 4,000 | 5,000 |
| Total | | 129,042 | 100,575 |

(Data from each County and City)

Among the components of the nominated property, the National Marine Biodiversity Institute of Korea and the National Institute of Ecology are the essence of tourism infrastructure in Seocheon Getbol, as they function as research, exhibition, and education centers. These two institutions were originally planned mainly as research organizations. However, the cancellation of the reclamation project to construct the Janghang National Industrial Complex called for a large-scale tourist destination to be developed to vitalize the local economy. The two research institutions were further expanded to encompass education and exhibition functions as well. The National Marine Biodiversity Institute of Korea welcomes 200,000 visitors a year and the National Institute of Ecology is visited by 700,000 a year. In addition, the Seocheon Bird Ecology Exhibition Hall offers education on migratory birds, tidal flats as habitats, along with presenting exhibitions and tourism information. The Janghang Skywalk is an observatory overlooking the tidal flats. Other noteworthy tourism infrastructure includes the Wolhaseong and the Seondori Tidal Flat Experience Villages, which are both operated by local communities. The National Marine Biodiversity Institute of Korea, an affiliated institution of the Ministry of Oceans and Fisheries, collects, conserves, manages, researches, exhibits, and educates about marine biotic resources. It owns a collection of over 7,000 specimens of marine life. The National Institute of Ecology under the umbrella of the Ministry of Environment is the largest ecology exhibition hall in ROK; it provides systematic researches, studies, exhibitions, and educations to conserve and educate about nature and the environment.

The most important tourism asset in Gochang Getbol is the Ramsar Gochang Tidal Flat Center, an education center specializing in tidal flats. In addition, local communities run tidal flat experience villages in various areas with a focus on fishing experiences. Beaches also serve the locals and tourists alike.

When it comes to Shinan Getbol, the Shinan Jeungdo Tidal Flat Ecological Exhibition Hall and the Dochodo Local Environment Education Center are the main tourist sites. They also serve as a main education and exhibition center in Shinan Getbol. Other places worth visiting include Ujeon (Jeungdo Island), Dunjang (Jaeundo Island), Chupodo (Amtaedo Island) Tidal Flat Experience Villages, and the Taepyung Saltpan where visitors can collect salt from the field. Beaches of various size can be found in the 14 different locations on the islands in the nominated property as well.

**Table 4-3.** Number of visitors to the beaches near the nominated property (Unit: Persons)

| Region | 2011 | 2012 | 2013 | 2014[1)] | 2015[2)] |
|---|---|---|---|---|---|
| Gochang County | 157,406 | 120,323 | 124,500 | 255,408 | 63,125 |
| Shinan County | 1,157,203 | 1,298,008 | 1,165,789 | 320,150 | 102,317 |
| Total | 1,314,609 | 1,418,331 | 1,290,289 | 575,558 | 165,442 |

1) School trips and personal trips across the country have been drastically reduced since Sewol Ferry Disaster on April, 2014.

2) Statistics from 2011 to 2013 compiled the entire beach visitors per year, but according to the change in the data aggregation method of the National Statistical Office, only the visitor on the opening period (June 4 to September 15) collected since 2015. Due to this change, the data variation shows a big difference.

In case of Boseong-Suncheon Getbol, the representative tourism infrastructures of the Boseong region is the Jangyang Tidal Flats Experience Village, which is run by the local community. The Suncheon region, on the other hand, boasts the Suncheon Bay Ecological Park and the Suncheonman Eco Museum, which preserve, manage, research, educate, and exhibit about the Suncheonman Bay. The Suncheon Bay National Garden was opened in 2013 to redistribute tourists flooding into the Suncheonman Bay and has become the main tourist spot. Another noteworthy tourist site is the Geocha Tidal Flat Boat Experience Village. Among the components of the nominated property the tourism industry is most active in Boseong-Suncheon Getbol. The periphery regions of the Suncheonman Bay in particular attract over 1.9 million tourists a year, consolidating its position as a representative tourist attraction of ROK. The Suncheonman Bay tidal flats and the Suncheon Bay National Garden clearly demonstrate that conservation of natural resources can go hand in hand with regional development.

Overall, the tourism and recreational activities utilizing various tourism infrastructure in the nominated property mostly take place in inland areas outside of the property or in some buffer zones. Education and experience programs in the property areas are always conducted by professional tour guides and veteran fishermen. Thus, all the possible impacts on the OUV of the nominated property can be prevented through management.

### • Tidal Flat Education and Experience

Tidal flat education and experience programs offered at select locations present visitors with special opportunities to look into the geological, geomorphological, biological, and ecological attributes of the nominated property. Experiencing the unique landscapes and biodiversity, the appearance of endangered species, tidal flat-based fisheries and traditional cultures of fishing villages all serve as precious assets, which raise public awareness of the value and importance of the property.

Tidal flat visitor centers of different sizes welcome visitors in the nominated property, serving as gateways for visitors and taking on a leading role in providing tidal flat education and experience programs.

As explained already, every tidal flat education and experience programs must be guided by tidal flat eco-guides appointed by the Ministry of Oceans and Fisheries (MOF) under Article 22.3 of the Wetlands Conservation Act, in order to contribute to the tidal-flat conservation effort. Tidal flat eco-guides give visitors a chance to experience the value and importance of tidal flats and invigorate the tidal flat tourism industry. Tidal flat eco-guides need to complete a systematic training program. Its curriculum is comprised of theory, training, field trips, and practical on-site training. The main educational objective is to boost the overall understanding of the tidal-flat ecosystem. Furthermore, trainees are taught how to respond to unexpected situations during the educational tour by practicing how to recognize dangerous situations and how to conduct safety measures. The MOF officially entrusted Seocheon County and Suncheon City to train tidal flat eco-guides.

Every year, the 5 tidal flat visitor centers in the nominated property welcome 3,000,000 people and it is safe to say that a considerable number of people have enjoyed a chance to learn the value and importance of the nominated property through the visitor centers. The diverse programs offered at these centers are customized for the different levels of visitor groups such as adults, families, elementary, middle, and high school students, and therefore are very diverse and popular. The program length varies from a half-day classes to overnight stay events, attracting more than a hundred thousand people every year.

Among others, the Suncheonman Eco Museum at Seocheon Getbol, the Ramsar Gochang Tidal Flat Center at the Gochang Getbol, and the Dochodo Local Environment Education Center at the Shinan Getbol are educational institutions specializing in environmental issues. They will be indispensable contributors for developing education programs in the future on the nominated property and for providing focused on tidal flat education to the visitors. The Suncheonman Eco Museum, in particular, has 40 in-house training eco-guides to cover the educational programs that deliver the value and importance of tidal flats to as many audiences as possible. To summarize, the Tidal Flat Visitor Centers are gateways for visitors to the property and mediums of communication which directly convey why the OUV of the property must be preserved. These gateways will play a central role in regulating the tourism pressures onto the property as well.

After inscription, the Getbol World Heritage Center will become the focal point of setting up well-structured education plans for the nominated property. Many new programs and professional guide training courses will be introduced to systematically expand the scale and scope of tidal flat education and experience programs under the supervision of trained staff.

Starting in 2011, the tidal flat visitor center network has been set up to exchange information, pursue joint projects, develop joint programs and support each other's capacity building among the tidal flat visitor centers located in different parts of the tidal flats along the southwest coast. The network actively supports diverse activities to further encourage the local communities and the tidal flat visitor centers to take part in the inscription activities of the property. Thus, the network will also play a vital role as a supporting organization for sustainable education and tourism within the property.

**Table 4-4.** Number of visitors to the tidal flat visitor center near the nominated property

| Category | Name of Tidal Flat Visitor Center | No. of Visitors | | | No. of Education Participants in 3 Years | No. of Eco-guides |
|---|---|---|---|---|---|---|
| | | 2014 | 2015 | 2016 | | |
| Seocheon Getbol | Seocheon Bird Ecology Exhibition Hall | 94,095 | 98,040 | 98,834 | 18,621 | 15 |
| Gochang Getbol | Ramsar Gochang Tidal Flat Center | - | - | 5,000 | 2,440 | 6 |
| Shinan Getbol | Jeungdo Tidal Flat Ecological Exhibition Hall | 54,183 | 50,650 | 37,438 | 1,417 | 3 |
| | Dochodo Local Environment Education Center | 5,136 | 5,699 | 7,491 | 18,326 | 30 |
| Boseong-Suncheon Getbol | Suncheonman Eco Museum | 1,553,870 | 1,939,648 | 1,930,346 | 315,976 | 40 |
| Total | | 1,707,284 | 2,094,037 | 2,079,109 | 356,780 | 94 |

(Data from each County and City)

### • Regulation

Tours to the surrounding regions of the nominated property are being appropriately managed by each component of the nominated property through the Action Plans for Wetland Conservation. It is challenging to gauge the exact environmental capacity of the vast property. Nonetheless, different activities taking place in the property will continue to be controlled by multiple Acts, institutions, and customs including the Wetlands Conservation Act. Also, the tidal flat education and experience programs will always be governed by the tidal flat visitor centers. Its tour and on-site education will be restricted to selected areas and be accompanied by tidal-flat eco-guides. In addition, experience villages run by local communities, rotate selected areas for experience programs to maintain the overall healthiness of its marine resources.

Some of the tidal flat education and experience programs take place inside the nominated property. All other tourism and leisure activities, however, are conducted in the outskirts or the buffer zones of the property, and thereby any actions that could be possibly harmful to the property can be monitored and controlled. Development plans which may negatively impact the property are also controlled through preventive management systems such as Environmental Impact Assessment. Both marine and inland infrastructure development activities near the property are also subject to the Environmental Impact Assessment and are allowed only when no threat is anticipated on the property. Major administrative plans must also pass a Strategic Environmental Assessment if they are related to the property. On top of that, legal instruments including the Wetland Protected Areas, prohibits any development plans that may change the physical properties and disturb the ecology of the property. The management structures explained so far are solid and intricate enough to cut off any possible negative impact beforehand brought about by the increasing visitors to the tourism and recreation sites in the property.

More detailed plans will be set up for additional tourism management strategies, infrastructure development, tourism programs, and professional guides and administrators needed to make the tourism activities in the nominated property even more sustainable. Upon inscription, the Getbol World Heritage Center will coordinate with the municipalities and local communities in the property to discuss what measures should be further added to the existing systems.

## 4.b.v Number of Inhabitants within the Property and the Buffer Zone

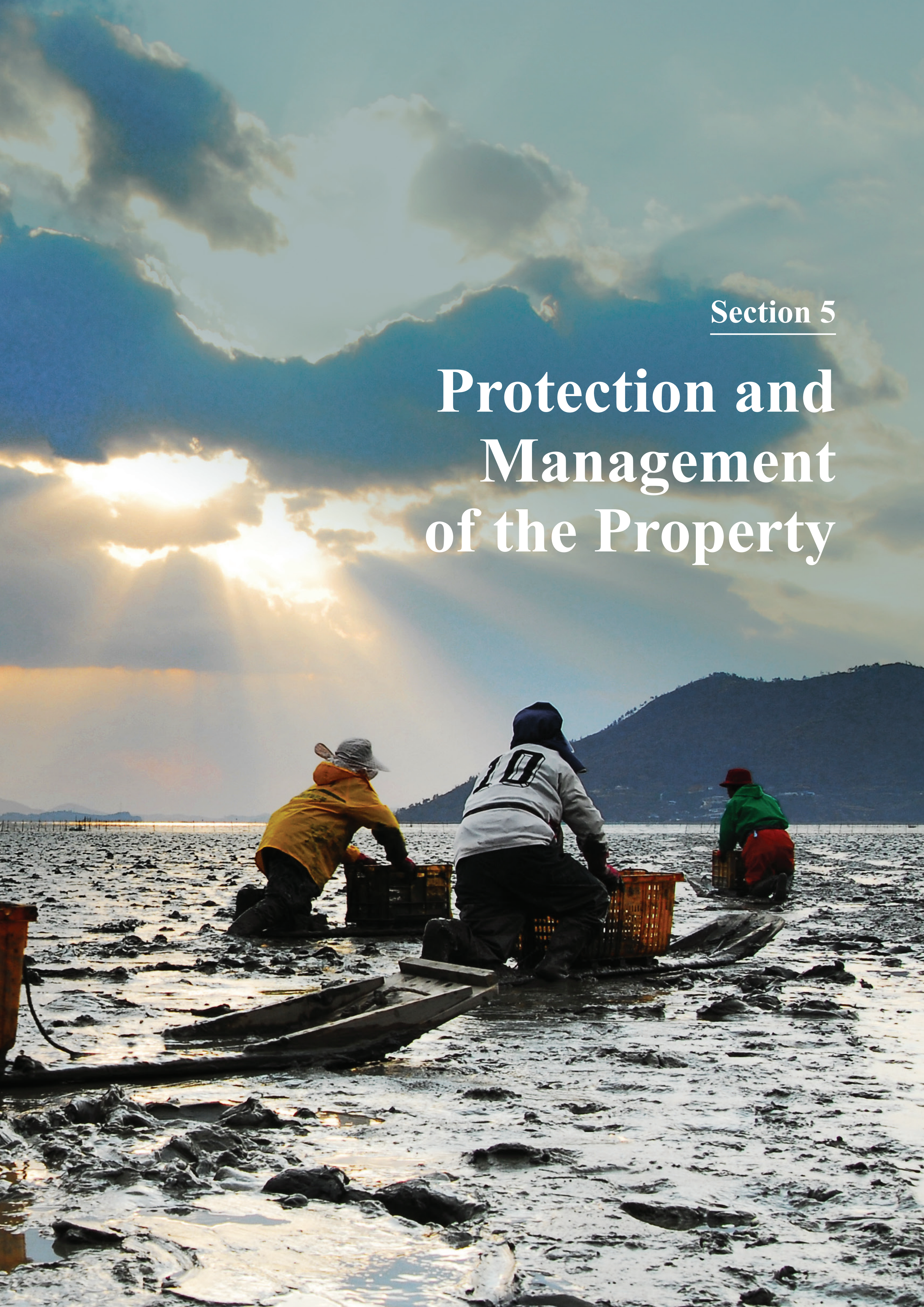
Because the nominated property is categorized as public waters, residing in this area is prohibited in accordance with the Public Waters Management and Reclamation Act. The same applies to the marine buffer zone. The terrestrial buffer zones amount to 58,793 ㏊ and are occupied by approximately 42,300 residents. This translates into 0.719 persons per hectare and indicates that the population density of these regions is extremely low.

**Table 4-5.** Number of residents in the property area and buffer zones of the nominated property (2018) (Unit: Persons)

| Total | Property Area | Buffer Zones | | | | |
|---|---|---|---|---|---|---|
| | | Seocheon | Gochang | Shinan | Boseong-Suncheon | |
| | | | | | Boseong | Suncheon |
| 42,289 | 0 | 100 | 150 | 41,539 | 350 | 150 |

Section 5

# Protection and Management of the Property



# Protection and Management of the Property

## 5.a Ownership

In accordance with Article 2 (Definitions) sub-paragraph 1 of the Public Waters Management and Reclamation Act, the Republic of Korea (ROK) government has 100% ownership of the property area and marine buffer zone of the nominated property. Local municipalities where the property area and buffer zone are situated, are responsible for the daily administration and management. Provided that fishing village fraternities or the individuals intend to use the public waters for fishery, they can be granted from the government temporary and limited rights to use the public waters without assignment of ownership in accordance with the Fisheries Act.

The terrestrial areas of the buffer zone include privately-owned and state-owned lands, as well as land held by local municipalities. Under the National Land Planning and Utilization Act, even privately-owned land inside the buffer zones are designated and controlled as special-purpose areas – Conservation and Control Area and Natural Environment Conservation Area. In the conservation and control area, only buildings less than four stories, detached houses, correctional facilities, elementary schools, facilities for national security and military purpose and specific facilites authorized by 'Urban or County Planning Ordinance' can be built. In the natural environment conservation area, only houses in farming and fishing villages, schools and specific facilites authorized by 'Urban or County Planning Ordinance' that do not cause significant damage to the environment such as quality of water and landscapes are allowed to be built.

Table 5-1. Ownership status within the nominated property (Unit: ㏊)

| Category | | | Seocheon Getbol | Gochang Getbol | Shinan Getbol | Boseong-Suncheon Getbol | Total |
|---|---|---|---|---|---|---|---|
| Property Area | | State-owned | 6,809 | 6,466 | 110,086 | 5,985 | 129,346 |
| Buffer Zone | Sub-total | | 3,657 | 1,785 | 67,254 | 1,801 | 74,497 |
| | Marine Area | State-Owned | 3,257 | 1,403 | 9,932 | 1,395 | 15,987 |
| | Terrestrial Area | Privately-Owned | 384 | 249 | 48,584 | 406 | 49,623 |
| | | Public and State-owned | 16 | 133 | 8,738 | 0 | 8,887 |

# 5.b Protective Designation

The nominated property comprises various protected areas. To protect the property, the whole area is designated as a Wetland Protected Area (WPA) under the Wetlands Conservation Act, a single act that governs the entire property. In the preparatory process for the inscription on the World Heritage List, the ROK government has extended the size of the WPA from 10,762 ㏊ to 129,346 ㏊ in total, covering the whole of the property. This comes as part of the commitment to protect and manage the property in accordance with the Operational Guidelines.

In addition to the national protection system, the majority of the nominated property is recognized by international protected areas and programs. Some parts of all four components in the property are designated as Ramsar Sites under the Ramsar Convention. Following the opportunity of the extension of WPA in 2018, the Ramsar Sites are also expected to expand to cover all WPA. Furthermore, the whole area of Gochang Getbol and Shinan Getbol as well as parts of Boseong-Suncheon Getbol are designated as UNESCO Biosphere Reserves. Partial area of Seocheon Getbol and Boseong-Suncheon Getbol are members of flyway site network of the East Asian-Australasian Flyway Partnership as well.

As a result, parts of or the entire property area are recognized multiply by two or three different international protection systems, pursuing harmonized management as Multi-Internationally Designated Areas (MIDAs).

**Table 5-2.** National and international protected areas in the nominated property (Unit: ㏊)

| Components of the nominated property | National Protected Area | International Protected Area | |
|---|---|---|---|
| | Wetland Protected Area under Wetlands Conservation Act | Ramsar Site by Ramsar Convention (year of designation) | Biosphere Reserves (BR) by UNESCO MAB Program (year of designation) |
| Seocheon Getbol 6,809 | 6,809 | 1,530 (2010) | - |
| Gochang Getbol 6,466 | 6,466 | 4,550 (2010) | Gochang BR 67,152 (2013) |
| Shinan Getbol 110,086 | 110,086 | 3,130 (2011) | Shinan Dadohae BR 323,870 (2016) |
| Boseong-Suncheon Getbol 5,985 | 5,985 | 3,550 (2006) | Suncheon BR 93,840 (2018) |

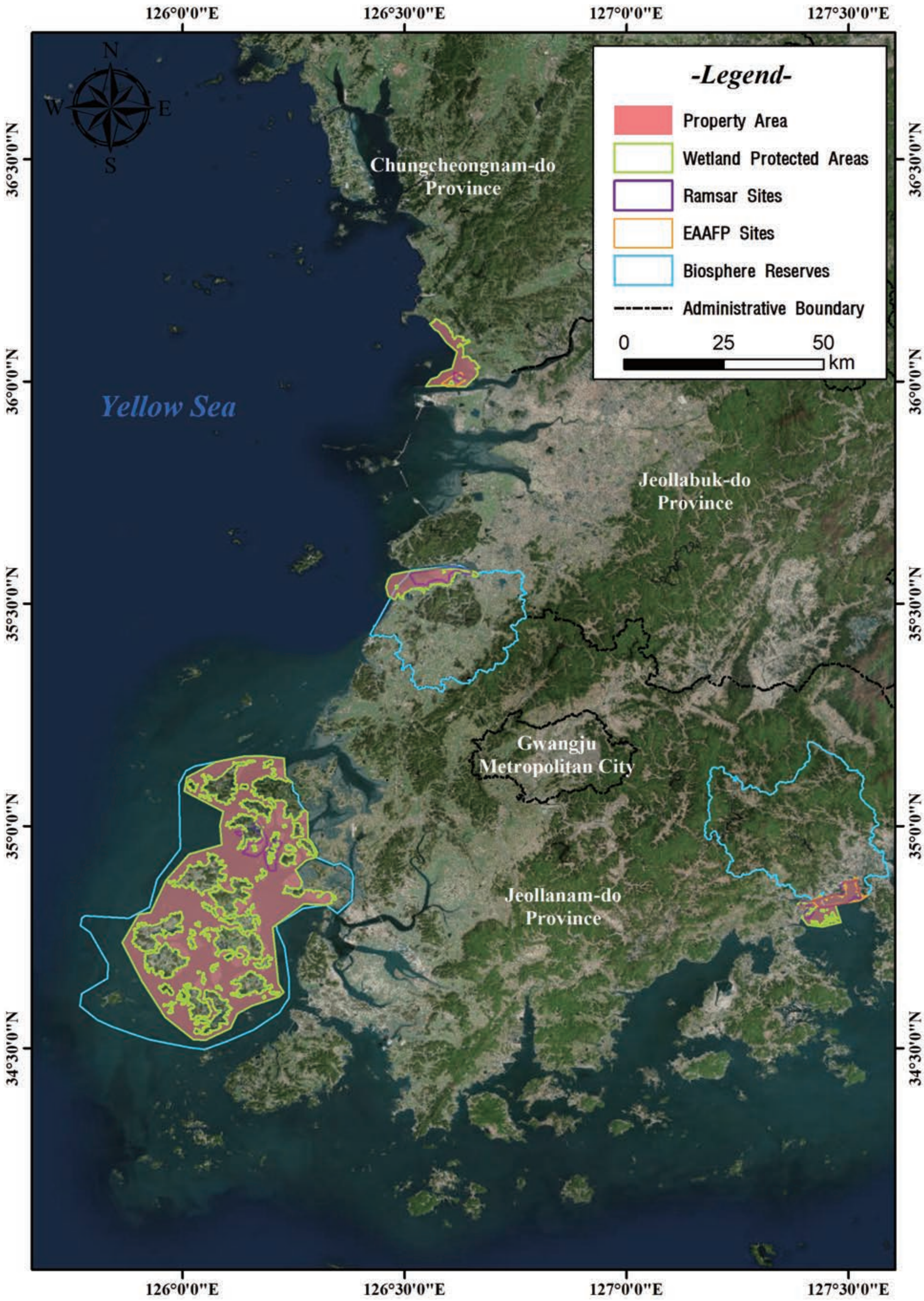



**Figure 5-1.** International and national protected areas in the nominated property

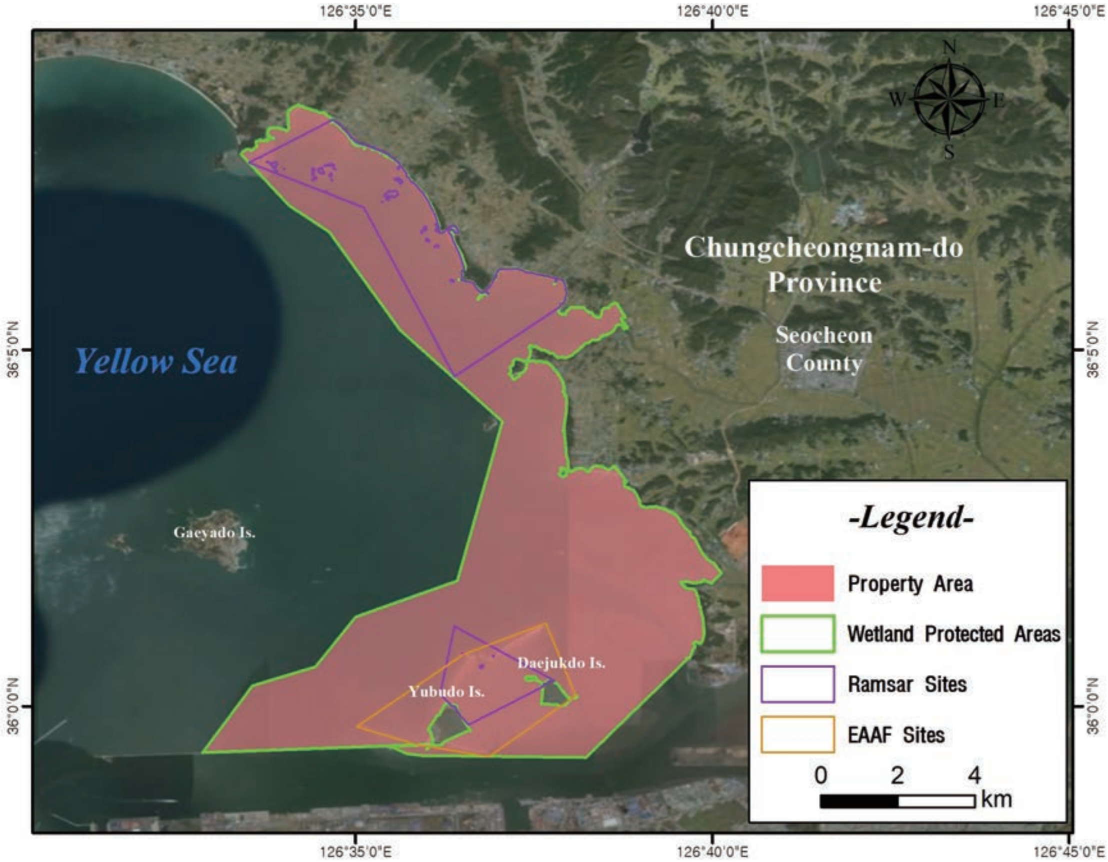



**Figure 5-2.** Boundaries of protected areas in Seocheon Getbol

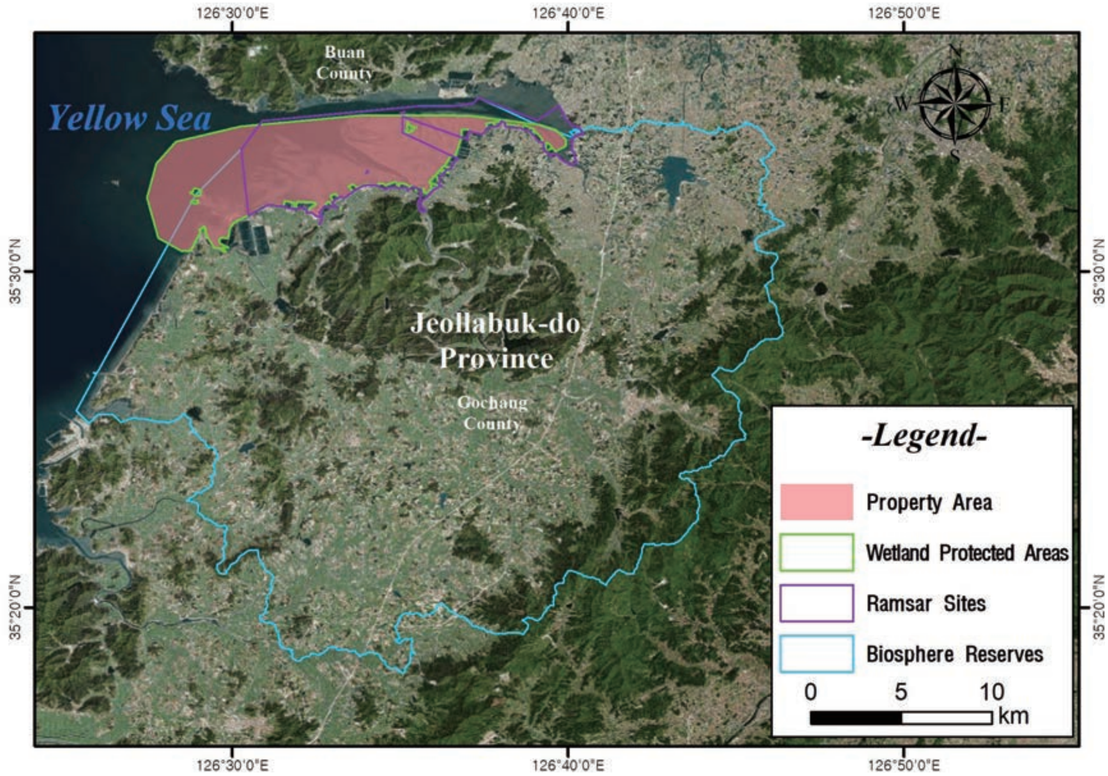



**Figure 5-3.** Boundaries of protected areas in Gochang Getbol

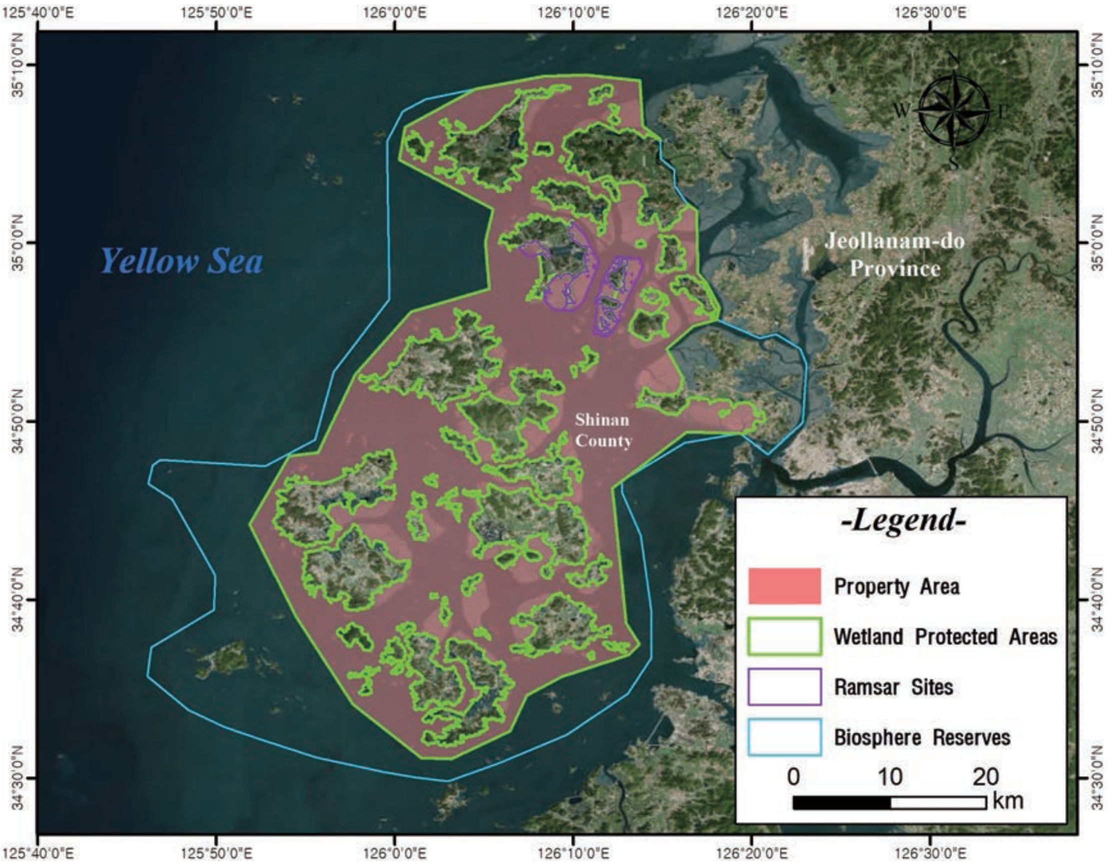



**Figure 5-4.** Boundaries of protected areas in Shinan Getbol

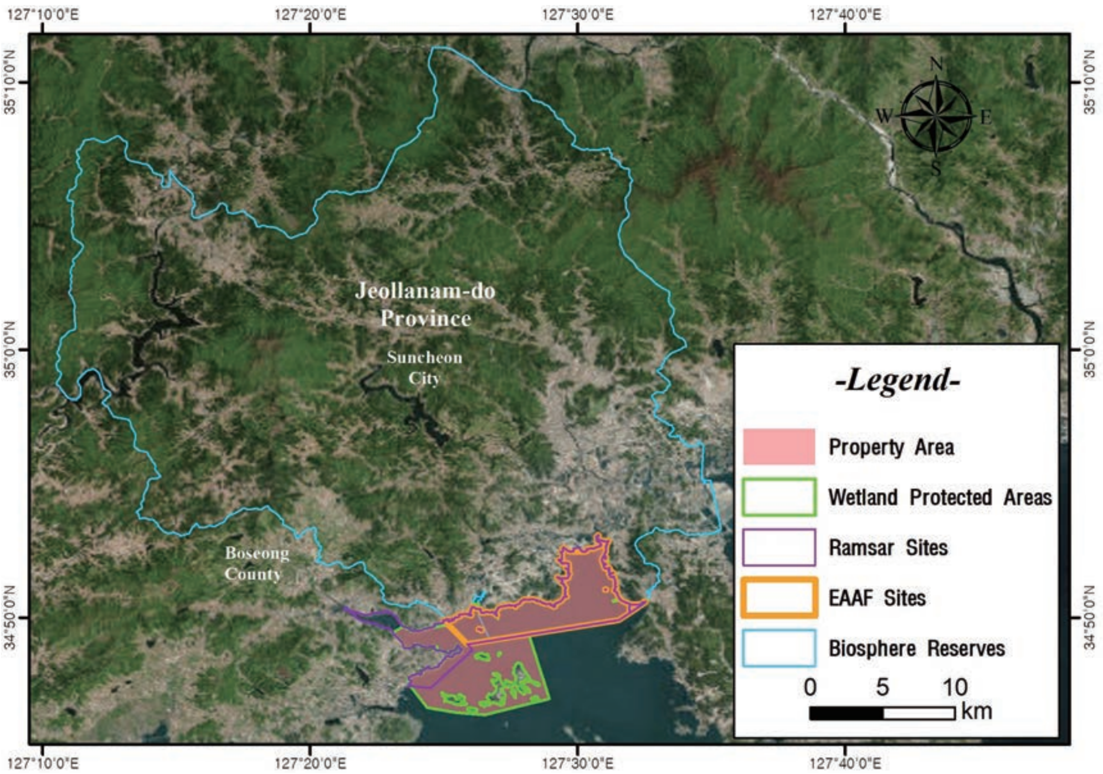



**Figure 5-5.** Boundaries of protected areas in Boseong-Suncheon Getbol

## 5.b.i Designation as National Protected Area

The entire area of the nominated property is designated and managed as a Wetland Protected Area (WPA). The Wetlands Conservation Act has served since its enactment in 1999 as the basic Act to support the conservation of wetlands in ROK and implement the Ramsar Convention nationally. Based on ecosystem-based management, the Wetlands Conservation Act has promoted community-based management with respect to traditional culture and indigenous knowledge of the local residents. The Wetlands Conservation Act, in this sense, clearly reflects the very nature of the nominated property with a long history of harmonious co-existence between nature and humans.

The Wetlands Conservation Act clearly states that the biological, ecological, geomorphological and geological features of tidal flats shall be conserved. In particular, Article 13 of the Wetlands Conservation Act strictly prohibits new construction and extension of artificial structures, extraction of earth, sand and minerals, any activity of increasing or decreasing the level or amount of water in wetlands (reclamation) and introduction of organisms disturbing the ecosystem. Article 12, however, permits installation of the facilities for conservation, management, research and education of WPA. The enforcement of the Wetlands Conservation Act, therefore, plays a significant role in the strong protection of the OUV of the nominated property.

**Table 5-3.** Overview of the Wetlands Conservation Act

| Title of Act | Enactment | Legislative Body | Competent Ministry |
|---|---|---|---|
| Wetlands Conservation Act | 1999 | National Assembly of the Republic of Korea | Ministry of Oceans and Fisheries, Ministry of Environment |

On the other hand, the Wetlands Conservation Act allows fishing activities on tidal flats of the WPA by residents of the local administrative districts where WPAs are located or of adjacent districts. The detailed rules on fishing tools and methods used in fishery activities and taking a fishing right are specified in the Fisheries Act (1953). This again is testimony to the Wetlands Conservation Act being respectful of the nature of the nominated property with a long history of harmonious co-existence between nature and humans. In summary, the Wetlands Conservation Act prohibits any behavior that may artificially damage the natural state of the nominated property or harm the biodiversity and the habitat of any endangered species.

Based on the Wetlands Conservation Act, the ROK government, in the process of preparing for the inscription in World Heritage List, has expanded the WPA from 10,762 ㏊ to 129,346 ㏊ in 2018.

**Table 5-4.** Wetland Protected Area designation status of the nominated property (Unit: ha)

| Components of the Nomitated Property | Area of the component | Area of the Wetland Protected Area | |
|---|---|---|---|
| | | Before expansion | After expansion in 2018 |
| Seocheon Getbol | 6,809 | 1,530 | 6,809 |
| Gochang Getbol | 6,466 | 1,040 | 6,466 |
| Shinan Getbol | 110,086 | 4,362 | 110,086 |
| Boseong-Suncheon Getbol | 5,985 | 3,830 | 5,985 |

## 5.b.ii Designation as International Protected Area

Each component of the nominated property has been recognized, either as a whole or partially, by international protection instruments, such as Ramsar Sites in accordance with the Ramsar Convention, UNESCO Biosphere Reserves and the flyway site network under the East Asian-Australasian Flyway Partnership (EAAFP). All four components of the property are partly designated as Ramsar Sites. The entire areas of Gochang Getbol and Shinan Getbol, as well as parts of the Boseong-Suncheon Getbol are designated as UNESCO Biosphere Reserves, and a partial areas of Seocheon Getbol and Boseong-Suncheon Getbol are members of the flyway site network of EAAFP.

**Table 5-5.** Designation status of international protected areas in the nominated property (Unit: ha)

| Components of the Nominated Property | Ramsar Site by Ramsar Convention | Biosphere Reserves (BR) by UNESCO MAB Program |
|---|---|---|
| Seocheon Getbol | - Name: Seocheon Tidal Flat (2010)<br>- Area: 1,530 | - |
| Gochang Getbol | - Name: Gochang Tidal Flat (2010)<br>- Area: 4,550 | - Name: Gochang BR (2013)<br>- Area: 1,357 of 67,152 in total |
| Shinan Getbol | - Name: Jeungdo Tidal Flat (2011)<br>- Area: 3,130 | - Name: Shinan Dadohae BR (2009, extension in 2016)<br>- Area: 110,086 of 323,870 in total |
| Boseong-Suncheon Getbol | - Name: Suncheon Bay (2006)<br>- Area: 3,550 | - Name: Suncheon BR (2018)<br>- Area: 2,800 of 93,840 in total |

According to the IUCN Protected Area Categories System, the components are classified as Category IV Habitat/Species Management Area. The areas of Category IV are managed to maintain, conserve and restore species and habitats. The ROK government has strengthened various polices on the conservation, management and restoration in the nominated property. Limited areas are used for educational purposes so that the public can learn and appreciate the ecological value and ecosystem services of the nominated property.

All four components of the nominated property have been designated Ramsar Sites in accordance with the Ramsar Convention. The ROK government will take measures to extend the existing Ramsar Site to coincide with the expanded Wetland Protected Area (WPA).

In addition, Gochang Getbol, Shinan Getbol and the Boseong-Suncheon Getbol are included Gochang Biosphere Reserve, Shinan Dadohae Biosphere Reserve and Suncheon Biosphere Reserve, respectively. Backed by the local residents, the Gochang and Suncheon Bioshere Reserves were designated in 2013 and 2018, respectively, covering the entire administrative districts, and the Shinan Dadohae Biosphere Reserve was extended to the whole Shinan County in 2016. In close coordination with relevant policies of the Ministry of Environment, Gochang County, Shinan County and Suncheon City with local residents have been promoting conservation measures and sustainable local economies such as eco-tourism and Biosphere Reserve brand certification and marketing.

Within the nominated property, Seocheon Getbol and Boseong-Suncheon Getbol are members of flyway site network of the East Asian-Australasian Flyway Partnership (EAAFP). Yubudo Island located in the Seocheon Getbol has been a member of EAAFP since 2011. The Yubudo Island serves as an important shelter as a stopover site for 16 internationally important shorebirds including spoon-billed sandpiper, classified as critically endangered (CR), and great knot, and eastern curlew, classified as endangered (EN) by the IUCN Red List. Seocheon County, a municipality responsible for conservation and management of the Yubudo Island has been implementing waterbird protection activities as a member of the EAAFP such as regular collection of marine trash, operation of education programs on tidal flat ecosystems equipped with Seocheon Bird Eco Exhibition Hall, bird-watching hides, eco-trails.

The Suncheonman Bay located in Boseong-Suncheon Getbol was joined as a flyway site network of the EAAFP in 2004. The Suncheon Bay provides optimal habitats to 19 waterbird species. These include species on the IUCN Red List: black-faced spoonbill and far eastern curlew, under the category of endangered species (EN), hooded crane, porchard, Saunders's gull under the category of vulnerable species (VU) and bar-tailed godwit under the category of near threatened species (NT). Various efforts by Suncheon City for conservation and management of the Suncheonman Bay environment are notable: creation of environment-friendly farmland, removal of electric poles, elimination of pollution sources, restoration of tidal flats, fostering of waterbirds monitoring activities, education programs on tidal flat ecosystem operated at the Suncheonman Eco Museum. In order to join protection efforts for internationally endangered waterbirds, Suncheon City has built up a cooperative network with other regions where cranes inhabit, such as signing up a sisterhood relationship with the City of Izumi, Japan in 2012 for crane protection.

The international protected areas in the nominated property differ in characteristics and purposes of their designation mechanisms. As a Multi-Internationally Designated Areas (MIDAs), the nominated property has a complex and connected set of geological, geomorphological, biological, ecological, historical and cultural features, which can be also confirmed in the OUV of the property. In this sense, the international significance of the property has been increasingly recognized together with support from many relevant international organizations on the inscription of the World Heritage List of the property.

The International Tidalites Steering Committee, which works on the subject of tidal sedimentary deposits, held every 4 years under the auspice of the International Association of Sedimentologists, has expressed its fullest support for the inscription of the unique parts of Korean tidal flats as a World Heritage. The East Asian-Australasian Flyway Partnership(EAAFP) also strongly supports the inscription of the tidal flats in the southwestern coast of ROK for World Heritage (refer to Figure 5-6 for their supporting letters).

University of Copenhagen
Department of Geosciences and Natural Resource Management

**Dr. Kyong-O Moon**
Secretary-General / World Heritage Promotion Team
5F, Shinan Community Health Center
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Republic of Korea

23 February 2016

**TO WHOM IT MAY CONCERN**

The International Tidalites Steering Committee wishes to express its fullest support for the effort of having parts of the Korean tidal flats, in particular those of the Shinan Island Archipelago and sites such as Seocheon, Gochang, Boseong and Suncheon, which are truly unique in the world, declared as a UNESCO World Heritage Site.

**Members of the International Tidalites Steering Committee:**

Clark ALEXANDER – Skidaway Institute of Oceanography, Georgia, USA
Jesper BARTHOLDY – University of Copenhagen, Denmark (CHAIRMAN)
Alexander BARTHOLOMÄ – Senckenberg Institute, Germany
José I. CUITIÑO – Centro Nacional Patagónico, Puerto Madryn, Argentina
Robert DALRYMPLE – Queen's University at Kingston, Canada
Poppe L. DE BOER – University of Utrecht, The Netherlands
Burg W. FLEMMING – Senckenberg Institute, Germany
Shu GAO - Nanjing University, China
Yong A. PARK – Seoul National University, Korea
Jean-Yves REYNAUD – University of Lille, France
Roberto SCASSO – University of Buenos Aires, Argentina
Bernadette TESSIER – CNRS, University of Caen, France
Hong WANG – Geological Survey Centre, Tianjin, China
Ping YIN – Qingdao Institute of Marine Geology, China

Dr. Jesper Bartholdy
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EAAFP

9 January 2017

Dear Sir/Madam,

The tidal flats of the southwestern coast of the Republic of Korea are critical for the survival of migratory waterbirds, particularly shorebirds, that depend on this area as a vital refueling refuge on their long journeys, in some cases from Australia and New Zealand all the way to the Russian Arctic and back. The mudflats support important concentrations of Critically Endangered Spoon-billed Sandpiper, Endangered Black-faced Spoonbills and Far Eastern Curlews, as well as internationally significant numbers of many other migratory waterbirds. One site in particular, the Geum Estuary, including Yubu Island, is a globally significant migratory waterbird site, as evidenced by its designation as a Ramsar and EAAFP Network Site. The Yellow Sea, and especially the Republic of Korea, has lost up to 60% of its tidal flats in the last 50 years.
Many migratory species are entirely dependent on the remaining tidal flats in China and the Korean peninsula to be able to continue their migration in future years.

The East Asian-Australasian Flyway Partnership (EAAFP), comprising 35 Partners from 17 countries in the Flyway, strongly supports the nomination of the tidal flats in the southwestern coast of the Republic of Korea for UNESCO World Heritage. Notably, we fully support the inclusion of the important habitats such as tidal flats in Shinan, Seocheon, Gochang, Boseong and Suncheon as these play a critical role in supporting migratory waterbirds in the Flyway.

Yours sincerely

Spike Millington

EAST ASIAN-AUSTRALASIAN FLYWAY PARTNERSHIP
www.eaaflyway.net

**Figure 5-6.** Official Letters to support the inscription of the Getbol for the World Heritage List.

# 5.c Means of Implementing Protective Measures

The Wetlands Conservation Act, which is applied to all components of the nominated property, is the single most important Act to protect the property. As for the buffer zones, the terrestrial areas are managed in accordance with the National Land Planning and Utilization Act, while the marine areas are managed by the Public Waters Management and Reclamation Act.

## 5.c.i Means of Protection and Management of the Nominated Property

The property areas are protected as Wetland Protected Areas (WPAs) under the Wetlands Conservation Act in a consistent manner. Enacted in 1999 and amended in 2016, the Wetlands Conservation Act aims to contribute to the conservation of wetlands and wetland biodiversity and to promote international cooperation by reflecting the purpose of the Ramsar Convention. The Act defines the obligation of the state, provincial and metropolitan city municipalities regarding wetland conservation (Article 3). It also stipulates duties to carry out regular investigations of the ecosystem of wetlands (Article 4), to establish state-level master plans and local-level action plans for wetland conservation every 5 years (Article 5). The Act also defines the establishment and operation of a National Wetland Deliberative Committee as a state-level public-private governance body for wetland protection (Article 5-2); the designation and management of WPA (Article 8); the implementation of the Ramsar convention including registration of wetlands in the List of Wetland of International Importance (Article 9); the formulation and implementation of conservation plans for WPA (Article 11); the restrictions on activities that might harm WPA (Article 13); and the restoration and management of damaged wetlands (Article 17 and 18).

**Table 5-6.** Major implementation means for protecting the nominated property

| Components | Applied Acts | | |
|---|---|---|---|
| | Property Area | Buffer Zones | |
| | Wetland Protected Area | Marine | Terrestrial |
| Seocheon Getbol | Wetlands Conservation Act (1999) | Public Waters Management and Reclamation Act (2010) | National Land Planning and Utilization Act (2002) |
| Gochang Getbol | | | |
| Shinan Getbol | | | |
| Boseong-Suncheon Getbol | | | |

Article 13 of the Wetlands Conservation Act strictly prohibits new construction and extension of artificial structures, a change in the form and quality of land, any activity increasing or decreasing the level or volume of water in wetlands, gathering earth, sand and pebble and stone, extraction of minerals, and artificial introduction of any organism disturbing the ecosystem, thus specifying the conservation of the geomorphological and ecological characteristics of wetlands. Any development pressure to the nominated property is prevented in a consistent manner.

The Act allows fishing on tidal flats of the WPA, and detailed rules are specified in the Fisheries Act. Residents of the regions that host WPA or of other regions adjacent to those hosting regions can engage in fishing activities. This, as mentioned earlier, is testimony to the Wetlands Conservation Act being respectful of the nature of the nominated property with a long history of harmonious co-existence between nature and humans. Thus, this Act plays a vital role in keeping ecological, geological and geomorphological characteristics of the nominated property intact.

Apart from being designated as WPA, different components of the property are also protected by other legal measures, depending on their biological, ecological, geological and geomorphological characteristics. The Shinan Getbol is partly designated as a National Park and Provicial Park under the National Park Act. Boseong-Suncheon Getbol is partly designated as a Scenic Spot under the Cultural Heritage Protection Act and as a Provincial Park under the National Park Act. The multiple layers of protection have contributed to enforce the management of the nominated property.

## 5.c.ii Means of Protection and Management of the Buffer Zone

The buffer zones have been designated to effectively protect the property. The marine buffer zones are governed by Public Waters Management and Reclamation Act, while the National Land Planning and Utilization Act is applied to the terrestrial buffer zones.

### 5.c.ii.1 Public Waters Management and Reclamation Act

The buffer zones of the nominated property are governed under the Public Waters Management and Reclamation Act, enacted in 2010. The purpose of the Act is to promote public welfare and to contribute to improving the quality of life of the people by conserving and managing public waters for their sustainable use and by allowing an efficient use of reclaimed land through environment-friendly reclamation of public waters.

To be specific, the Public Waters Management and Reclamation Act stipulates that the state or a local government that manages public waters shall manages them in an environmentally-friendly manner so that its conservation and sustainable use are made possible (Article 4). Also, the Act states that no person shall perform any action that contaminates the public waters without any justifiable grounds (Article 5). Specifically, the following are strictly prohibited:

- Dumping or discharging wastes, waste oil, wastewater, sewage, excreta, livestock excreta, polluted soil, poisonous substances, animal carcasses, or other pollutants prescribed by Ordinance of the Ministry of Oceans and Fisheries, on or into public waters;
- Opening, closing or damaging any floodgate or installations for managing public waters;
- Abandoning or leaving a ship derelict on public waters

The Act also prescribes that new construction, excavation, dredging, taking sands, growing plants, any activity affecting the depth of the public waters and extracting minerals requires permission from the management agency of public waters (Article 8). The Act defines activities regarding recovery (Article 21).

This Act applies to the entire public waters, and thus these provisions also apply to the waters in the property area and its buffer zones. Any activity that may affect the OUV of the nominated property is controlled in advance.

### 5.c.ii.2 National Land Planning and Utilization Act

The terrestrial buffer zones of the nominated property are governed in accordance with National Land Planning and Utilization Act. With the need to set up a ‘No plan, No development’ system, the Act was enacted in 2002 to formulate comprehensive plans for the management of land nationwide.

The Act stipulated that national land is divided into four special-purpose areas as Urban, Control, Agricultural and Forest, and Natural Environment Conservation Area (Article 36). In accordance with Article 36, the terrestrial areas of the buffer zones are classified as non-urban areas and designated as Conservation and Control Areas, as well as Natural Environment Conservation Areas.

There are restrictions on specific activities, and development activities are allowed only in accordance with the Act (Article 76). To be specific, in cases where the terrestrial areas of the buffer zones of the property are Conservation and Control Areas, only buildings less than four stories including detached houses, correctional facilities, elementary schools, facilities for national security and military purpose and specific facilities authorized by 'Urban or County Planning Ordinance' are allowed to be built. In a Natural Environment Conservation Area, only houses in farming and fishing villages, schools and specific facilities authorized by 'Urban or County Planning Ordinance' that do not cause significant damage to the environment such as quality of water and landscapes are allowed to be built (Article 71).

The Act also states that local municipalities shall formulate urban or county master plans for the terrestrial areas of the buffer zones under their jurisdiction (Article 18). Also, activities regarding construction of buildings or erection of structures, changes in the form and quality of any land, and extraction of earth and stone shall require permission from local municipalities (Article 56) to prevent reckless changes in the form and quality of the buffer zones.

## 5.c.iii Environmental Impact Assessment Act

Policies, plans and development projects that may have environmental impact on the nominated property and buffer zones shall be verified via Environmental Assessment, which consists of a Strategic Environmental Assessment and an Environmental Impact Assessment. These assessment schemes predict, analyze and assess possible environmental impacts that might be induced by policies, plans, programs and projects. The Environmental Assessment is a policy method to prevent environmental destruction and pollution, and to promote Environmentally Sound and Sustainable Development (ESSD), thus establishing and maintaining a healthy environment.

Chapter 2 of the Environmental Impact Assessment Act explains the Strategic Environmental Impact Assessment, which evaluates environmental, economic and social impacts of development projects before formulating high-tier policies and plans. It also assesses whether the policies and plans conform to the relevant environmental conservation plan, develops and analyzes alternatives, and determines the feasibility of the plans and the appropriateness of a site location (Article 2). Strategic Environmental Impact Assessment is applied to 17 different types of master development plans, such as urban development plans, plans for the construction of roads, plans for the development of industrial complexes, plans for the construction of harbors and plans for the development of tourism complexes, 15 policy plans and 85 development basic plans.

Environmental Impact Assessment, explained in Chapter 3 of the Environmental Impact Assessment Act, refers to an assessment conducted to formulate measures for preventing, alleviating, or mitigating harmful environmental impacts by surveying, forecasting, and assessing the environmental impact of a project, when it is intended to permit, authorize, approve, or license an implementation plan or execution plan or to determine whether to implement or execute such plans (Article 2). The Environmental Impact Assessment is conducted for projects in urban development, industrial complex construction, energy sources development, harbor construction, land development and reclamation of the public waters, tourism complex development and projects to extract sand and gravel (Article 22).

Chapter 4 on Mini Environmental Impact Assessment of the Environmental Impact Assessment Act stipulates that measures for environmental conservation shall be formulated by surveying, forecasting, and assessing environmental impacts and the appropriateness of locations of projects when the projects are carried out in areas requiring conservation or planned development, amid concern about reckless development.

As explained, the nominated property and buffer zones are protected via Wetlands Conservation Act, Public Waters Management and Reclamation Act and National Land Planning and Utilization Act. As preventive measures, the Environmental Impact Assessment Act also stipulates that policies, plans and development projects be reviewed in advance. All these legal measures serve as effective tools in protecting the OUV of the property.

## 5.c.iv Other Related Laws and Ordinances

The nominated property and buffer zones are protected via Wetlands Conservation Act, Public Waters Management and Reclamation Act, National Land Planning and Utilization Act and Environment Impact Assessment Act. Additional measures including Marine Environment Management Act, Conservation and Management of Marine Ecosystems Act and other ordinances enacted by the municipal governments serve to protect the OUV of the property.

### 5.c.iv.1 Marine Environment Management Act

The Marine Environment Management Act was enacted in 2007. It manages pollutant sources, including ships, marine facilities and marine spaces. The Act also regulates the emission of marine contaminants such as oil and other harmful fluids. By stipulating the details of measures to prevent, improve, respond to and restore any marine contaminations, the Act aims to promote public health and protect the people’s property and assets.

The Marine Environment Management Act stipulates that occupying or using public waters, license for fishery business, extracting marine aggregates, and the propriety of utilization of marine areas and their impact on the marine environment shall be discussed and evaluated under Article 84 (Consultation on Utilization of Sea Area) and 85 (Sea Area Utilization Impact Assessment). Article 95 (Marine Environmental Impact Surveys) specifies that development activities that may cause impacts on the marine environment shall be surveyed and the results shall be submitted to the management agencies.

Korea Marine Environment Management Corporation (KOEM) which is supporting the Ministry of Oceans and Fisheries, was established under Article 96 of the Marine Environment Management Act and carries out projects for the conservation and management of marine environment and ecosystem, collection and disposal of pollutants and marine environment-related testing, survey, research, design, responding to marine pollution, international cooperation, education and training in accordance with Article 97. KOEM also evaluates implementation of Marine Protected Area management plan and carries out projects to lay a solid foundation for the conservation, sustainable use and management of Marine Protected Areas including the nominated property.

These provisions control any development activities that may impact the nominated property. Also, since the Act provides the legal basis for the KOEM, which conducts the day-to-day conservation and management activities for the marine ecosystem, it also contributes to stable conservation and management of the property.

### 5.c.iv.2 Conservation and Management of Marine Ecosystems Act

The Conservation and Management of Marine Ecosystem Act was enacted in 2006. It aims to protect the marine ecosystem from any artificial damage and to promote sustainable use of marine biological resources. By conducting comprehensive and systematic conservation and management efforts, the Act aims to improve the quality of life of the people and to protect the marine resources.

The Ministry of Oceans and Fisheries governs Marine Protected Areas, including designated protected areas in the sea and the Wetland Protected Areas. Hence, the nominated property which has been designated as a WPA is also included as a Marine Protected Area.

The Conservation and Management of Marine Ecosystem Act stipulates the following:

(Article 7) Establish and operate the marine ecosystem information system to smoothly produce and distribute knowledge and information on marine ecosystems

(Article 8) Formulate joint measures with neighboring countries, in order to conserve and manage marine ecosystems and marine biological resources in a systematic and comprehensive manner

(Article 9) Formulate basic plans on the conservation and management of marine ecosystems every 10 years, to conserve and manage marine ecosystems in a comprehensive and systematic manner

(Article 10) Conduct a national comprehensive investigation into marine ecosystems throughout the nation, referring to a combination of investigations including a basic investigation concerning the marine ecosystem, investigation and observation of Marine Protected Areas, a basic investigation on coastal wetlands based on the Wetlands Conservation Act

(Article 16) Protect the habitats, spawning areas and migratory routes of migratory marine animals and marine mammals for the protection of marine organisms

(Article 18) Take measures necessary to rescue or treat marine animals in distress or wounded

(Article 19) Prepare measures to conserve marine organisms under protection

(Article 23) Management of organisms that disturb marine ecosystems

(Article 25) Designate areas whose marine ecosystems or marine landscape require special protection as Marine Protected Areas

(Article 28) Formulate and implement basic management plans for Marine Protected Areas every 5 years

(Article 34) Support for residents in Marine Protected Areas and adjacent areas

(Article 38) Formulate and implement measures to conserve marine biological diversity for contribution of international agreements including the Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Ramsar Convention

(Article 41) Conclude a contract on the management of marine biological diversity to reimburse actual expenses to any person whose profits from the relevant public waters or land are reduced due to the implementation of such contract

(Article 46) Formulate and implement measures necessary to restore damaged marine ecosystems of high ecological value

(Article 48) Support ecologically sound and environmentally friendly tourism and educational programs

The Conservation and Management of Marine Ecosystems Act, along with the Wetlands Conservation Act, holds an important and effective position in protecting the OUV of the nominated property.

### 5.c.iv.3 Fisheries Act

The purpose of the Fisheries Act, enacted in 1953, is to establish a fundamental system for fisheries to promote the development of fisheries and the democratization of fishery business by comprehensively utilizing and managing fishery resources and waters and consequently enhancing the productivity of fisheries.

Any person who intends to engage in fishery business shall obtain a license from the Minister of Oceans and Fisheries or head of a City / County / Borough (Article 8).

The different types of fisheries activities are categorized as licensed fishery business (Chapter 2), permit-required and reported fisheries business (Chapter 3) and fostering of fish farming (Chapter 4). The Enforcement Decree No. 45 stipulates the size, shape, scale and using methods of fishing gear by the different types of fishing business activities, to regulate the sustainable use of the fisheries resources and adjustments to the fisheries businesses.

Most of the fisheries activities taking place within the nominated property take the form of communal fishing and bare-catch fishery. A license for communal fishing business shall be granted only to fishing village fraternities or fishermen cooperatives located in each district in order to promote the common interests of fishermen who reside in a certain locality. A license for cooperative cultivation business shall be granted only to fishing village fraternities, fisheries partnerships or district fisheries cooperatives. For the west coast, where much of the nominated property is located, waters located up to 1,000 meters away from the coastline at full tide are granted a license to fishing business only for the fishing village fraternities, fisheries partnerships or district fisheries cooperatives (Article 9).

No. 11 of the Regulations on management of fishing permits, etc., stipulates that when catching or collecting marine animals and plants within the fishing grounds for communal fishing, one must use traditional fishing gear such as a sickle, hoe, knife, pick, shovel, seaweed collection tool, rake, fish trap, octopus jar or elastic speargun. Bare-catch fishery is also a common practice within the nominated property and refers to catching fish using one’s hands with the help of a sickle, hoe, seaweed collection tool and other type of rakes (Enforcement Decree No. 29).

The Fisheries Act also stipulates detailed measures to pursue sustainable fisheries activities as seen in the following articles.

(Article 29) Establishing reserves to protect fishery rights for set-net fishery business

(Article 34) Restrictions, etc. on licensed fishery business to meet needs for public interests

(Article 35) Revocation of fishery business licenses

(Article 37) Management of fishing ground by fishing village fraternity, etc.

(Article 38) Fishing ground management covenant

(Article 40) Restricting fishery activities by a mutual agreement if they deem it necessary for proliferation and protection of marine animals and plants as well as maintenance of fishery order.

(Article 64-2) Restricting scale, etc. of fishing gears

Communal fishing and bare-catch fishery is part of the traditional methods of fishing that have been practiced in the nominated property for over a 1,000 years. Such methods have contributed to the ecological circulation of the property and thus have made positive contributions towards the overall marine biodiversity. In conclusion, the Fisheries Act plays a crucial role in protecting the OUV of the property against illegal fishing activities or overfishing.

### 5.c.iv.4 Ordinances of Local Municipalities

Based on Article 22 of the Local Autonomy Act, the local municipalities can enact ordinances regarding their affairs within the scope of statutes. The statute includes Acts, Presidential Decrees, Ordinances of a Ministry, customary laws, general principles of a law, treaties, generally approved international laws and other administrative rules that function as regulations and orders.

For the inscription of the nominated property, local municipalities where the property is located have enacted ordinances to support its protection and management. There are mostly two types of ordinances.

The first type is an ordinance related to the inscription as the World Heritage and conservation and management of the nominated property. These types of ordinances are formulated by the municipal governments of Chungcheongnam-do Province, Jeollabuk-do Province, Jeollanam-do Province and by the local municipalities of Seocheon County, Gochang County, Shinan County, Boseong County and Suncheon City. Their goals are to conserve and manage the property, and also to support the inscription of the nominated property that has OUV to be protected for mankind.

The second type of ordinances is related to the formation and operation of the WPA Management Committee. These ordinances set out to formulate and operate a management committee where various stakeholders take part in the systematic conservation and efficient management of the WPA that has high conservation value and biodiversity. The members of committee is comprised of the local council, local government officers, representatives of local residents, relevant experts and local NGOs. The committee's scope of work is as follows: establish WPA management plans, implement measures for conservation and sustainable use of wetlands, gather the opinion of various stakeholders, encourage understanding and cooperation from the locals, eliminate the barriers that arise in the process of wetland conservation, solve conflicts and disputes related to WPA, and improve overall system, education and PR activities related to the conservation of the WPA. Seocheon County, Gochang County, Shinan County, Boseong County, Suncheon City have all established an ordinance in this regard.

These ordinances are voluntary measures by the local municipalities that have the direct responsibility of managing the property on site. By bringing together the different interest parties, the ordinances greatly contribute to the protection of the nominated property's OUV and raising of awareness.

**Table 5-7.** Local municipalities' Ordinances formulated for the protection and management of the nominated property

| Category | Components | Key Ordinances |
|---|---|---|
| Ordinances relating to the inscription as World Heritage | Seocheon Getbol | Chungcheongnam-do Province Ordinance on the inscription, conservation and management of World Heritage (2011)<br>Seocheon County Ordinance on the establishment of and support for the World Heritage Promotion Team of Korean Tidal Flats (2016) |
| | Gochang Getbol | Jeollabuk-do Province Ordinance on the support, conservation and management of the World Heritage (2011)<br>Gochang County Ordinance on the inscription, conservation and management of the Korean Tidal Flats as World Heritage (2015) |
| | Shinan Getbol | Jeollanam-do Province Ordinance on the inscription, conservation and management for the World Heritage (2013)<br>Shinan County Ordinance on the inscription, conservation and management for World Heritage (2014) |
| | Boseong-Suncheon Getbol | Jeollanam-do Province Ordinance on the inscription, conservation and management for the World Heritage (2013)<br>Boseong County Ordinance on the inscription, conservation and management for World Heritage (2016)<br>Ordinance on Suncheonman Bay Wetland Operations in Suncheon City (2015) |
| Ordinances relating to the formation and operation of Wetland Protected Area Management Committee | Seocheon Getbol | Ordinance on Composition and Operation of the Committee of Wetland Protection in Seocheon County (2010) |
| | Gochang Getbol | Ordinance on Establishment and Operation of the Committee of Coastal Wetland Protection and Management in Gochang County (2012) |
| | Shinan Getbol | Ordinance on Composition and Operation of the Committee of Coastal Wetland Protected Area in Shinan County (2010) |
| | Boseong-Suncheon Getbol | Ordinance on Composition and Operation of the Committee of Wetland Protected Area in Boseong County (2007)<br>Ordinance on Suncheonman Bay Wetland Operations in Suncheon City (2015) |

## 5.c.v Traditional Management by Local Community

Communal fishing businesses employing traditional fishing methods are very active in the nominated property.

The Wetlands Conservation Act has been the primary legal basis to protect the nominated property. The Act permits fishing activities performed by locals living in the regions where the property is located, or their neighboring regions. Details of permitted fishing activities are stipulated in the Fisheries Act. The ROK government's policies for the conservation of coastal wetlands pursue ecosystem-based management and promote a community-based natural resource management system reflecting the importance of traditional culture and indigenous knowledge of the local residents. Throughout history, the nominated property and the local community have depended on each other with a long history of harmonious co-existence between nature and humans. The Wetland Protected Area (WPA) honors this tradition.

Multiple fishing village fraternities have formed in the nominated property and they abide by self-governing rules to manage fishing ground in a sustainable way. They run the communal fishing ground through joint operations and determine the timing, location, amount and size of the catch through discussion.

The local residents who make a living through fishing activities within the nominated property have actively participated in the process of the inscription preparations, including public hearing for WPA designation and many other opinion gathering processes. This has served to promote better understanding of the OUV of the property and its protection and management systems. The local residents have become important stakeholders in the WPA Management Committee that has been set up in each component of the property.

As described, a multi-layered protection system which includes national-level Acts, provincial, city, county-level ordinances, and self-governing rules based on community are all in place. It indicates that the OUV of the nominated property can be protected and managed in a sustainable manner.

# 5.d Existing Plans Related to Municipality and Region in which the proposed property is located

The nominated property is primarily protected and managed by the Wetlands Conservation Act. Additional protection measures based on various other Acts have been in place to conserve and manage the characteristics of the property. With these Acts as the basis, various implementation plans for the practical protection and management of the OUV of the property have been carried out on a regular basis.

The management system of Wetland Protected Area (WPA) applied to the nominated property brings together all relevant organizations. The Ministry of Oceans and Fisheries (MOF) sets the wetlands conservation policy directions and formulates the basic management plans accordingly, while securing the necessary budgets. The local municipalities will formulate action plans in line with the MOF’s basic management plans and conduct on-site execution of the plans at each wetland while securing the necessary budget. The Korea Marine Environment Management Corporation (KOEM) and other specialized institutions support the MOF and local municipalities’ wetlands conservation policies through research, management evaluations, restoration projects, increasing-awareness and international cooperation.

The highest national-level plan related with the property is the 'Basic Plan on Conservation and Management of National Marine Ecosystem', which contains visions, goals, strategies, and action plans for the protection and management of National-level marine ecosystem every 10 years. The plan contains details regarding the following: status of marine ecosystem and current usage; basic directions and major projects for marine ecosystem conservation and management; protection and restoration of the habitat environment and movement routes of the marine organisms; creating a marine ecological axis; research on changes and disturbances of marine ecosystem due to climate change; education and PR; promoting private level cooperation; cooperation between relevant government agencies and the local municipalities; international cooperation and  securing the necessary budget for the projects. The Basic Plan is reviewed and confirmed by the Marine Fisheries Development Committee.

Based on the plan, the 'Basic Plan on National Wetlands Conservation’ is formulated every 5 years, specifying the details for the wetlands. The plan stipulates the following: policy directions for the conservation of wetlands and its sustainable use; securing a scientific management through improving wetlands survey system and strengthening basic information on wetlands; biodiversity conservation by strengthening wetland conservation and management system; education and PR for increasing public awareness; wise-use plan of the wetlands; international cooperation; breakdown of annual budgets for the different projects; and measures to secure the necessary funds. The plan is reviewed and confirmed by the National Wetlands Deliberative Committee.

Based on the national-level management plan, 'WPA Basic Management Plan' in local-level is set up also every 5 years. More site-oriented strategies and action plans are set up at this level, based on specific conservation status and budget plans. The local municipalities where the nominated property is located are responsible for the execution. This plan is reviewed by the WPA Local Management Committee at each component of the property and finalized after the deliberation by the Marine Protected Areas Central Management Committee of the Ministry of Oceans and Fisheries.

The Marine Fisheries Development Committee, National Wetlands Deliberative Committee and Marine Protected Areas Central Management Committee are all policy decision bodies based on private-public governance, where representatives from different stakeholders, including relevant government agencies, experts and NGO participate. The WPA Local Management Committee at each component of the nominated property is also composed of different stakeholders in the region, including the members of the local government council, local government officers, representatives from local residents, relevant experts and local NGOs. Together they discuss and decide on various issues related to the protection and management of the WPA. The committees are comprised to reflect the different voices and opinions and demonstrate that there is an effective and integrated management system in place for the protection and management of the nominated property.

The above-mentioned plans also go through regular evaluations to check if adequate management plans are in place and properly implemented. There is an annual management assessment and a mid-term management effectiveness assessment. The results of the assessment are reflected in the management project of the following year and the WPA Basic Management Plans, set every 5 years.

**Table 5-8.** Status of protection and management plans in WPA related to the nominated property

<table>
<tr><th colspan="2">Category</th><th>Key Plans</th><th>Agency in Charge</th><th colspan="2">Review Agency</th></tr>
<tr><td colspan="2">National-level Basic Plan</td><td>The Second Basic Plan on Conservation and Management of National Marine Ecosystem (2018-2027)</td><td>Ministry of Oceans and Fisheries</td><td colspan="2">Marine Fisheries Development Committee</td></tr>
<tr><td colspan="2">National-level Basic Plan</td><td>The Third Basic Plan on National Wetlands Conservation (2018-2022)</td><td>Ministy of Oceans and Fisheries, Ministry of Enviornment</td><td colspan="2">National Wetlands Deliberative Committee</td></tr>
<tr><td rowspan="4">Local-level Action Plan</td><td>Gochang Getbol</td><td>Gochang Getbol WPA basic management plan (2013)</td><td>Ministry of Oceans and Fisheries</td><td>Gochang WPA Management Committee</td><td rowspan="4">Marine Protected Areas Central Man-agement Committee</td></tr>
<tr><td>Seocheon Getbol</td><td>Seocheon Getbol WPA basic management plan (2018)</td><td>Ministry of Oceans and Fisheries</td><td>Seocheon WPA Management Committee</td></tr>
<tr><td>Shinan Getbol</td><td>Shinan Jeungdo Tidal Flat WPA basic management plan (2018)<br>Shinan Bigeum-Dochodo Tidal Flat WPA basic management plan (2016)</td><td>Ministry of Oceans and Fisheries</td><td>Shinan WPA Management Committee</td></tr>
<tr><td>Boseong-Suncheon Getbol</td><td>Boseong Beolkyo Tidal Flat WPA basic management plan (2016)<br>Suncheonman Bay Tidal Flat WPA basic management plan (2018)</td><td>Ministry of Oceans and Fisheries</td><td>Boseong-Suncheon WPA Management Committee</td></tr>
</table>

(*WPA: Wetland Protected Area)

Additional conservation and management measures are formulated and implemented for the designated protected areas, reflecting the characteristics of each component of the nominated property. Examples of such plans include management plans for National Parks and Provincial Parks as well as conservation and utilization plan for national designated cultural heritage.

The marine areas nearby Bigeumdo and Dochodo Island of Shinan Getbol are designated as a National Park and conserved and managed in accordance with the Management Plan for National Dadohae Marine Park. The Provincial Parks within Shinan Getbol and in Boseong region of Boseong-Suncheon Getbol are protected and managed in accordance with the Action Plans for Provincial Parks. Suncheonman Bay which is designated as a Scenic Spot is conserved and managed under the Conservation and Utilization Plan for National Scenic Spots of Suncheonman Bay. These plans are regularly reviewed and re-assessed following the management system set by the Ministry of Environment and the Cultural Heritage Administration.

**Table 5-9.** Additional protection and management plans applied to the nominated property

| Category | Key Plans | Agency in Charge |
|---|---|---|
| National-level Basic Plan | The Third Dadohae Marine National Park management plans (2011-2015) | Ministry of Environment |
| Regional-level Basic Plan | Shinan Getbol Provincial Park conservation and management plans (2016-2026) | Jeollanam-do Province |
| | Beolgyo Tidal Flat Provincial Park conservation and management plans (2017-2026) | Jeollanam-do Province |
| Local-level Basic Plan | Conservation and Utilization Plan for National Scenic Spots of Suncheonman Bay (2015) | Suncheon City |

In addition, the Ministry of Oceans and Fisheries has formulated and implemented a Mid-Term Action Plan for the Restoration Project for the Tidal Flat Ecosystem (2019-2023) to restore the value of the tidal flats. The plan sets out measures to expand the target sites for tidal flat restoration projects, to strengthen the overall project management system, and to increase the incentives for the restored areas. According to this plan, of the components in the nominated property, one location in Seocheon Getbol, two in Gochang Getbol, four in Shinan Getbol and three in Boseong-Suncheon Getbol are included in the tidal flat restoration projects. As such, the plan is also vital in maintaining and managing the OUV of the nominated property.

In conclusion, the 10-year national-level Basic Plan on Conservation and Management of Marine Ecosystem, the 5-year national-level Basic plan for wetlands conservation and the 5-year local-level action plans for wetland conservation make up the integrated management system at each component of the nominated property. By inducing the participation of different stakeholders and with clearly designated responsibilities, the protection and management system required to keep the Outstanding Universal Value of the property intact is in place.

# 5.e Property Management Plan or Other Management System

As explained earlier, the nominated property is being protected and managed in a consistent manner, being designated as Wetland Protected Area (WPA) under the Wetlands Conservation Act and utilizing the existing integrated management system already in place. The existing integrated management system has been set by the Ministry of Oceans and Fisheries (MOF) where the protection and management plans are set and necessary budget is secured. The local municipalities are in charge of implementing the plans on-site and also securing any additional budget that is needed. The Korea Marine Environment Management Corporation, with its expertise, works with the MOF and the local municipalities. This is the basic structure for the protection and management of the nominated property.

On top of this, there is also a governance structure in place where diverse stakeholders from government management authorities, marine ecosystem sectorial experts, and NGOs to local residents make up the management committee to review and make joint decisions regarding various plans, projects, organization and budget.

As can be seen, a national-level WPA management system is already in place. But in the inscription process of the nominated property as a World Heritage, the ROK government has formulated the Integrated Management Plan and the necessary framework for the execution of the plan, with the aim of having a more systematic protection and management of the property's OUV. Following the inscription, the integrated management plan and framework will be upgraded according to the government rules and serve as the basis for formulating a more concrete management organization for the property.

The Integrated Management Plan and the framework for the integrated management system are legally backed by the Administrative Consultative Council that has been set up by the Article 152 of the Local Autonomy Act by the Chungcheongnam-do Province, Jeollabuk-do Province, and the Jeollanam-do Province as well as the Seocheon County, Gochang County, Shinan County, Boseong County and Suncheon City.

## 5.e.i Overview of Management Plan

The Integrated Management Plan of the nominated property has been developed following the guidelines for the UNESCO World Heritage Convention and the IUCN protected area management plans. Strict protection and sustainable use, comprehensive management based on scientific research, social consensus based on governance are the principles applied. The nominated property is a representative case where our future generations will benefit significantly from the unique dialogue and cooperation between man and nature that are taking place. The Integrated Management Plan of the property sets as its goals 1) to invite continued participation of the local community to the property and 2) to hand down the unique geological, biological and ecological features and circulation process and its relationship with mankind to our future generations. With these goals, the vision of the integrated management plan of the property is as stated.

### • Vision

"Conservation of the nominated property's OUV, where the past, present and future co-exists, and to achieve sustainable use of the property through cooperation between man and nature."

This vision can be realized through the participation of the local community, protection and management strategy based on the comprehensive development plan, effective integrated management system based on social consensus, effective application of legal measures, stable execution of the necessary budget, and scientific research and monitoring. The mission and strategy of the nominated property are stated below.

### • Mission

1) The nominated property shall contribute to conserving and enhancing the value of geological, geomorphological, biological, ecological and socio-culture characteristics of the property at a global level;

2) The nominated property shall contribute to conserving the habitats and flyways for waterbirds at a global level;

3) The nominated property shall establish best practice cases which promote sustainable development based on ecological, socio-economic conditions observed in the property area, together with cooperation among stakeholders; and

4) The nominated property shall contribute to promoting the value of the World Heritage and cooperative exchanges.

## • Strategies

1) World Heritage perspective: Outstanding Universal Value-based management system set-up

2) National perspective: Ecosystem-based management system set-up

3) Local perspective: Community-based management system set-up

4) Global perspective: Global Network-based management system set-up

## • Detailed Objectives and Action Plans

| Strategy 1 | ① Detailed Objective: Establish a thorough World Heritage Integrated Management Plan and its implementation base |
|---|---|
| World Heritage Perspective: Establish an OUV-based Management System | **<Action Plan>**<br>• Establish a World Heritage Integrated Management Plan<br>- Establish a mid-to-long term World Heritage protection and management road map;<br>- Establish a World Heritage Integrated Management Master Plan (every 5 years)<br>- Establish a World Heritage Integrated Management Execution Plan for each component (every 5 years)<br>• Align the Integrated Management System and management organizations<br>- Align and strengthen relevant organizations and systems for the implementation of the World Heritage Integrated Management Plan<br>- Establish Getbol World Heritage Center as an implementation agency for World Heritage Integrated Management<br>- Establish private-public governance to facilitate participation of various stakeholders<br>• Strengthen on-site management system of the World Heritage<br>- Set up on-site management offices in each component for the implementation of the World Heritage Integrated Management Plan<br>• Align the legal system for the protection and management of the World Heritage OUV<br>- Rearrange existing legal systems to strengthen protection and management of the World Heritage<br>- Develope newly necessary regulations to strengthen protection and management of the World Heritage<br>• Establish an integrated information system for the World Heritage<br>- Establish integrated information system for the World Heritage<br>- Develope online service for providing integrated information |
| Strategy 2 | ② Detailed Objective: Establish monitoring and evaluation system for the World Heritage protection and management of the World Heritage |
| National Perspective: Establish an Ecosystem-based Management System | **<Action Plan>**<br>• Establish an integrated research and monitoring plan for the World Heritage<br>- Establish integrated research and monitoring plan with the OUV perspective<br>- Establish plans for the regular monitoring on different fields<br>- Establish integrated management based on monitoring results<br>• Align and implement a World Heritage monitoring execution system<br>- Reorganize the entire monitoring execution system for the World Heritage<br>- Allocate roles by institutions and strengthen the monitoring execution system<br>- Execute regular monitoring for different fields and threat factors to the World Heritage<br>• Establish an evaluation system for the integrated management of the World Heritage<br>- Execute an evaluation of the World Heritage Integrated Management anually<br>- Conduct mid-to-long term management efficiency evaluation based on the monitoring results<br>• Establish and implement a periodic reporting system for the World Heritage<br>- Establish and implement a write-up system for the periodic reporting for the World Heritage<br>- Hold joint discussion session on the preparation for the periodic reporting among the different stakeholders |

| | |
|---|---|
| Strategy 3 | ③ Detailed Objective: Establish a system for self-governing heritage management and sustainable use by strengthening raising-awareness on World Heritage |
| Regional Perspective: Establish a Community-based Management System | **<Action Plan>**<br>• Establish heritage education programs to raise awareness of the World Heritage<br>- Establish an action plan for World Heritage CEPA (Communication, Education, Participation, Awareness)<br>- Develop and distribute heritage education programs<br>- Establish the World Heritage Visitor Center<br>• Establish a management plan and implementation system for sustainable fishing in the World Heritage<br>- Establish and execute plan to manage marine trash<br>- Establish plan to manage fishing tools<br>- Develop and promote sustainable fishery management programs<br>- Organize a sustainable fishing community network in the Heritage sites<br>- Develop projects to increase local brand value on the World Heritage Site<br>• Establish plan for sustainable tourism in the World Heritage and build an implementation system<br>- Establish strategies for sustainable heritage tourism<br>- Build infrastructure required for heritage tourism and establish management plan for the tourism<br>- Develop heritage tourism programs<br>- Build partnerships with related heritage tourism organizations<br>• Develop human resource and capacity-building for the integrated management of the World Heritage<br>- Execute training program for capacity-building of World Heritage managers<br>- Execute training program for capacity-building of World Heritage researchers<br>- Execute capacity-building and awareness raising programs for the local residents<br>- Train heritage interpreters<br>• Build a public-private-academia governance for sustainable development in the World Heritage<br>- Set up and operate Wetland Protected Areas Local Management Committee Network of the World Heritage<br>- Develop methods to participate in protecting and managing of the World Heritage for local communities and residents<br>- Establish sustainable local development strategies based on the World Heritage<br>• Establish integrated promotion plan for the World Heritage<br>- Establish diverse promotional strategies and plans for expanding awareness of the World Heritage<br>- Execute promotional activities including information board set-up and PR publication |
| Strategy 4 | ④ Detailed Objective: Lay the foundation for international and national cooperation to further expand World Heritage sites and strengthen advanced protection and management system |
| Global Perspective: Establish Global Network-based Management System | **<Action Plan>**<br>• Establish a cooperation basis for further extension of the World Heritage sites<br>- Identify future World Heritage site within ROK and prepare for the extension<br>- Carry out Inter-Korea joint research and projects for the conservation of the West coast tidal flats of Korean Peninsula<br>• Establish a ROK-China cooperation platform and projects to protect the Yellow Sea<br>- Carry out joint research and launch cooperation project in the Yellow Sea<br>• Carry out international joint research and cooperation projects for the World Heritage |

## 5.e.ii Integrated Management System for World Heritage

As mentioned above, a national-level Wetland Protected Area (WPA) management system for the nominated property is already in place. For even more systematic and strict protection and management of the nominated property's OUV, the 'Korean Getbol World Heritage Integrated Management System Framework' has been added.

The Framework will further enhance smooth communication and systematic division of responsibilities between the different organizations that are related to the nominated property to achieve effective and integrated management of the property. This is an important element, since the property is a serial nomination with multiple organization involved in its protection and management.

The specific integrated management system (Figure 5-7) for the nominated property is shown below, with the different responsibilities divided among different organization to ensure the implementation of the integrated management plan (Table 5-10).

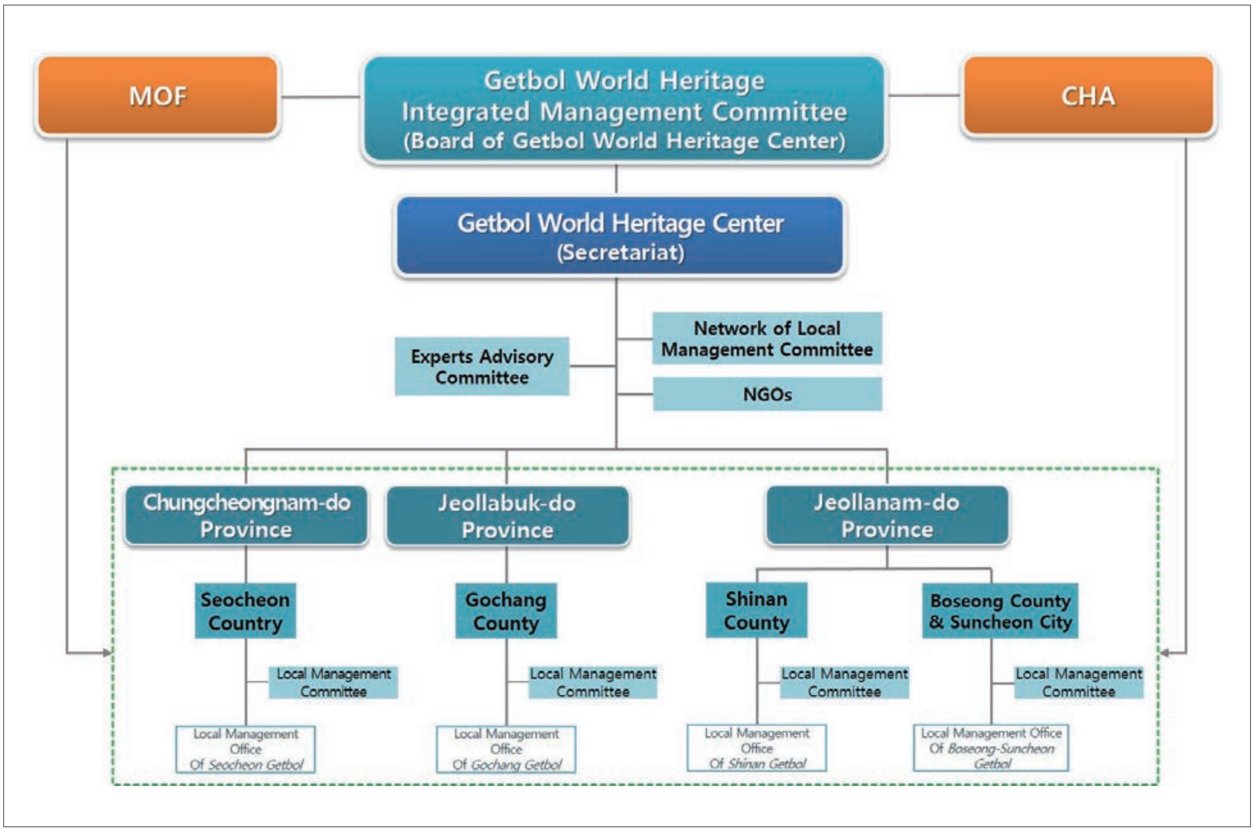



Figure 5-7. Integrated management system framework for the nominated property

The integrated management system instructs the central government and the local municipalities to divide the role and responsibilities for the protection and management of the property. To ensure smooth communication and systematic division of roles and responsibilities and efficient gathering and sharing of information among the different organizations that are involved, a 'Getbol World Heritage Integrated Management Committee' and a 'Getbol World Heritage Center' will be set up. The two bodies will lead the efficient implementation of the integrated management plan. Also, for the strengthened on-site management system for the nominated property, a Local Management Office will be set up in each component of the proposed property.

Getbol World Heritage Integrated Management Committee (Board of Getbol World Heritage Center) is comprised of representatives from diverse organizations that are related to the protection and management of the nominated property and includes the following bodies: Ministry of Oceans and Fisheries, Cultural Heritage Administration, three metropolitan municipalities, five local municipalities, the Getbol World Heritage Center and an experts' advisory committee. This Committee is an integrated decision-making body that discusses and decides on the overall protection and management work for the nominated property and will be in charge of governing the following areas: review of establishment and implementation to the integrated management plan; division of roles and responsibilities; budget for protection and management; Getbol World Heritage Center organization, operation and budgetary decision.

The 'World Heritage Promotion Team of Korean Tidal Flat' has so far been leading the overall activities for the inscription of the nominated property as World Heritage. Upon inscription, this team will be upgraded to the Getbol World Heritage Center (GWHC) as a Secretariat. The GWHC will continue to serve as implementing integrated management body for the Getbol World Heritage of ROK. The GWHC will be comprised of the following divisions: Heritage Research Team, Heritage Protection and Management Team, Heritage Exhibition and Education Team, Heritage Tourism Team, Promotion and PR Team, and Operation Support Team. The GWHC will work on the following areas: protection and management of the nominated property's OUV, research, capacity-building of managers, heritage exhibition, education and PR, heritage tourism, further expansion of inscribed World Heritage, international and national cooperation, collection and sharing of relevant information, and periodic reporting on World Heritage. Basically, the GWHC will provide integrated support to all relevant institutions. The GWHC also leads the executive committee composed of all the central and local municipalities' management officers, experts, local and NGO representatives that are working to review the implementation of the decisions made by the Getbol World Heritage Integrated Management Committee.

For the private-public governance system, the WPA Local Management Committees, already in place at each component of the nominated property, will form a network to bring together all stakeholders including local residents through an open and active communication channel. The experts' advisory committee and NGOs will also actively take part in the governance system to promote scientific and thorough protection and management of the property.

To further strengthen the on-site management system for the nominated property, Getbol World Heritage Local Management Offices will be open in each component of the property. This will further boost the existing local municipalities' WPA on-site management structure in the process of inscription. The relevant departments and divisions scattered in the local municipality will be combined under the umbrella of the Local Management Office, with specialized manpower and systematic management system set in place to further upgrade the on-site integrated management system of the property.

The Local Management Offices will participate in the executive committee of the Getbol World Heritage Center and work on execution of the action plans for the on-site integrated management of the property. Finally, the offices will support the existing WPA Local Management Committee.

The WPA Local Management Committee at each component of the nominated property is composed of different stakeholders in the region, including the members of the local government council, local government officers, representatives of local residents, relevant experts and local NGOs. Together they discuss and decide on various issues related to the protection and management of the WPA. The Local Management Committees are set up at each component of the property and demonstrate that there is an effective and integrated management system in place for the protection and management of the property.

The overall structure and division of roles and responsibilities of the integrated management system at the nominated property are explained in Table 5-10.

**Table 5-10.** Overall structure and division of roles and responsibilities at the nominated property

| Category | Implementation Agency | Role and Responsibilities | Composition |
|---|---|---|---|
| Central Government | Ministry of Oceans and Fisheries (MOF) | • Status: Oversee Wetland Protected Area protection and management in accordance with the Wetlands Conservation Act<br>• Role:<br>- Establish and execute integrated management plan<br>- Implement regular monitoring<br>- Support local management office at each component<br>- Establish Getbol World Heritage Center (GWHC)<br>- Conduct management evaluations<br>- Support to enhance public awareness<br>- Conduct international cooperation<br>- Secure management budget<br>- Reorganize and strengthen management organization and legislation in line with the World Heritage inscription, etc. | - Marine Ecology Division<br>- Daesan / Gunsan / Mokpo / Yeosu Regional Office of Oceans and Fisheries<br>- Korea Marine Environment Management Corporation (KOEM) |
| | Cultural Heritage Administration (CHA) | • Status: Oversee maintenance and improvement of the status of the nominated property following the inscription as World Heritage in accordance with the Cultural Heritage Protection Act<br>• Role:<br>- Submit the periodic report to World Heritage Center<br>- Support relevant utilization and PR projects following the inscription as World Heritage | - World Heritage Division |

| Category | Implementation Agency | Role and Responsibilities | Composition |
|---|---|---|---|
| Integrated Management Body | Getbol World Heritage Integrated Management Committee (Board of GWHC) | • Status: Overarching integrated decision-making body regarding Korean Getbol World Heritage protection and management<br>• Role:<br>- Operate with the participation of heads of all relevant organizations that are involved in the protection and management of the nominated property<br>- Determine organization, operation, work and budget for the GWHC<br>- Review of establishment and implementation to integrated management plan<br>- Coordinate role and responsibilities of different institutions<br>- Discuss and decide on the protection and management budget, etc.<br>• Legal Basis: The Administrative Consultative Council based on Article 152 of Local Autonomy Act | - 20 or so representatives of MOF, CHA, 3 metropolitan municipalities, 5 local municipalities, Getbol World Heritage Center, experts advisory committee |
| | Getbol World Heritage Center (GWHC) | • Status: Integrated management and implementation body following the inscription as World Heritage (Secretariat)<br>• Organization: The World Heritage Promotion Team of Korean Tidal Flat will be transformed to the GWHC following the inscription<br>• Role:<br>- Support other relevant institutions<br>- Research on the nominated property's OUV protection and management<br>- Support capacity-building for relevant institutions and managers<br>- Education, exhibition and PR activities for heritage<br>- Conduct heritage tourism<br>- Promote further inscription of other sites for World Heritage expansion<br>- International and national cooperation<br>- Collect and share relevant information<br>- Conduct regular report on World Heritage, etc. | - Getbol World Heritage Center secretariat<br>- Executive Committee<br>- Wetland Protected Area Local Management Committee Network<br>- Experts Aadvisory Committee<br>- NGOs |
| Integrated Management Body | Getbol World Heritage Center (GWHC) | • Executive Committee: Check on implementation of decisions made by Getbol World Heritage Integrated Management Committee<br>• Detailed organization structure: Heritage Research Team, Heritage Protection and Management Team, Heritage Exhibition and Education Team, Heritage Tourism Team, PR and communication Team, Operation Support Team<br>• Legal Basis:<br>- Decisions made by the Administrative Consultative Council among the institutions in charge of the protection and management of the nominated property based on Article152 of Local Autonomy Act<br>- Ordinance set by metropolitan and local municipalities | |
| Local Governments (On-site management body) | Metropolitan Municipalities | • Status: Metropolitan municipality-level management institution of the nominated property<br>• Role:<br>- Participate at the Integrated Management Committee and the GWHC Executive Committee for decision-making and review of implementation<br>- Support and conduct on-site inspections of protection and management of the nominated property in accordance with the relevant Acts<br>- Secure relevant budget, etc. | - Chungcheongnam-do Province<br>- Jeollabuk-do Province<br>- Jeollanam-do Province |

| Category | Implementation Agency | Role and Responsibilities | Composition |
|---|---|---|---|
| Local Governments (On-site management body) | Local Municipalities (Local management office) | • Status: On-site management institution of the nominated property<br>• Role:<br>- Directly implement the integrated management plan for the nominated property on-site<br>- Participate in the Integrated Management Committee and GWHC Executive Committee for decision-making and review of implementation<br>- Support formation and operation of the Wetland Protected Area Local Management Committee<br>- Establish local management offices in each of the components as an integrated body of all relevant divisions to strengthen on-site management of the nominated property<br>- Secure relevant budget, etc. | - Seocheon County<br>- Gochang County<br>- Shinan County<br>- Boseong County<br>- Suncheon City |
| | Wetland Protected Area Local Management Committee | • Status: Local-level discussion and decision-making body with the participation of all stakeholders<br>• Role:<br>- Approve management plans for the protection, management and restoration of the nominated property<br>- Evaluate the implementation of management projects<br>- Collect different voices of interested parties<br>- Regulate conflicts and arguments<br>- Improve system including ordinance<br>- Participate in Local Management Committee Network, etc. | - 20 or so representatives of member of the local council, local residents, experts and NGOs |
| Governance | Local Management Committee Network | • Status: Opinion-collecting body for the efficient protection and management of the nominated property<br>• Role:<br>- Make suggestions and discuss action plans to the effective implementation of the nominated property integrated management plan (Protection and management, marine trash, sustainable fisheries, promoting local resident's awareness, heritage tourism)<br>- The representatives of network will participate in the GWHC executive committee for review of implementation<br>- Hold a roundtable discussion once a year with all the members of the Wetland Protected Area Local Management Committee<br>- Collect various opinions on the protection and management of the nominated property | - 25 or so including three representatives from Local Management Committee of each component, local municipalities management officers and experts |
| | Experts Advisory Committee | • Status: Advisory board for the scientific and systematic protection and management of the nominated property<br>• Role:<br>- Participate in the Integrated Management Committee and GWHC Executive Committee<br>- Participate in the on-site inspections and decision-making regarding the protection and management of the nominated property<br>- Advice in specialized fields<br>- Conduct research on OUV protection and threat factors | - 20 or so experts |
| | NGOs | • Status: Advisory board for protection and management of the nominated property<br>• Role:<br>- Advisory and surveillance body on the protection and management of the nominated property<br>- Participate in the GWHC Executive Committee<br>- Inspect progress of and provide advice on the protection and management of the nominated property<br>- Participate in various projects for heritage protection and management, etc. | - Relevant NGOs |

As explained in detail, the integrated management plan and co-ordinated management system for the effective protection and management of the nominated property are well in place. In particular, the private-public governance system effectively brings together the diverse stakeholders to participate in a bottom-up policy making process and execution. This further enhances the overall credibility of the protection and management activities at the property.

The framework of the integrated management plan and system for the nominated property will be implemented followed by the central government's procedure after the inscription. It is guaranteed to the legal binding force by an Administrative Consultative Council which consists of the related organizations and takes a role of Getbol World Heritage Integrated Management Committee. The Administrative Consultative Council is a kind of committee to deal with matters that two or more local municipalities jointly related, based on Article 152 of Local Autonomy Act. The jointly decided matters has their legal binding force. The framework of the integrated management plan and system is ensured by the Administrative Consultative Council.

# 5.f Sources and Levels of Finance

## 5.f.i Budgets for Protection and Management

In general, the budget of the ROK government is determined annually by the compilation of the Ministry of Strategy and Finance and the deliberation of the National Assembly of the ROK. The management budget for the nominated property is determined in the same process. The total annual budget of the property as Wetland Protected Area (WPA) was around USD 2.4 to 5.0 million from the Ministry of Oceans and Fisheries. In the process of inscription, the WPA has been extensively expanded. It is therefore expected that the budget will increase accordingly.

A total additional annual budget of USD 2.5 million is required for the protection and management of the nominated property.

The budget will be allocated to the central government and local municipalities in accordance with the relevant regulations. A detailed breakdown of additional budget requirements is listed below.

Table 5-11. Additional budget requirements for the protection and management in the nominated property (Unit: USD $1,000 / year)

| Category | Amount | Annual Total |
|---|---|---|
| Monitoring, surveying, research projects | 800 | 2.5 million |
| Heritage protection and management projects | 500 | |
| Heritage utilization projects (Heritage education, sustainable tourism, PR, etc.) | 400 | |
| Establishment of on-site management systems (Operation of local management committee network and local management offices) | 300 | |
| Operation of the Getbol World Heritage Center | 500 | |

As for the budget required for the establishment of the Getbol World Heritage Center, related institutions will discuss the details of budgets and cost sharing.

## 5.f.ii Execution of Budgets for Protection and Management

From 2013 to 2017, a total of USD 49.6 million was allocated for protection and management at the five existing WPAs included in the nominated property; USD 17 million was borne by the central government, and local municipalities provided the remaining USD 32.6 million.

The central government and local municipalities will continue to provide the management budget. However, in the process of the inscription, the WPA has been extensively expanded. It is therefore expected that the overall budget will increase accordingly.

The following table shows the protection and management budgets for the nominated property. It should be noted that the table only accounts for the budget earmarked for public purposes, namely on-site management of local municipalities where the nominated property is located. It does not reflect any budgets directly executed by the Ministry of Oceans and Fisheries and other institutions. So, budget related to the following items are excluded: establishing of basic management plans, restoration, research and monitoring. Also, budgets for the protection and management measures for some Provincial Parks and Scenic Spots in the nominated property are also not included in the table.

**Table 5-12.** Budget for protection and management projects for WPA in the nominated property (Unit: USD $1,000)

| Year | | 2013 | 2014 | 2015 | 2016 | 2017 | Total |
|---|---|---|---|---|---|---|---|
| Seocheon County | Total | 617 | 464 | 246 | 234 | 229 | 1,790 |
| | Central | 430 | 325 | 170 | 119 | 160 | 1,204 |
| | County | 187 | 139 | 76 | 115 | 69 | 586 |
| Gochang County | Total | 886 | 357 | 214 | 171 | 200 | 1,828 |
| | Central | 620 | 250 | 150 | 120 | 140 | 1,280 |
| | County | 266 | 107 | 64 | 51 | 60 | 548 |
| Shinan County | Total | 286 | 786 | 871 | 857 | 639 | 3,439 |
| | Central | 200 | 550 | 611 | 600 | 447 | 2,408 |
| | County | 86 | 236 | 260 | 257 | 192 | 1,031 |
| Boseong County | Total | 143 | 144 | 143 | 177 | 146 | 753 |
| | Central | 100 | 100 | 100 | 124 | 102 | 526 |
| | County | 43 | 44 | 43 | 53 | 44 | 227 |
| Suncheon County | Total | 6,515 | 6,243 | 7,123 | 11,361 | 10,591 | 41,833 |
| | Central | 1,111 | 1,250 | 1,163 | 4,108 | 3,966 | 11,598 |
| | County | 5,404 | 4,993 | 5,960 | 7,253 | 6,625 | 30,235 |
| Total | | 8,447 | 7,994 | 8,597 | 12,800 | 11,805 | 49,643 |

## 5.f.iii Future Plans of Budgets for Protection and Management

The Ministry of Oceans and Fisheries and the municipal governments together shouldered the budget for the protection and management of the Wetland Protected Area (WPA). Following the inscription of the nominated property, the Cultural Heritage Administration will also allocate their budget, as the Administration is in charge of inscriptions, protection, management and utilization of World Heritage. Additional budget for the protection and management of the property can be secured through joint efforts by the Ministry of Oceans and Fisheries, the Cultural Heritage Administration, metropolitan and local municipalities.

The Ministry of Oceans and Fisheries (MOF) is able to increase the budget for the protection and management of WPA inscribed on World Heritage and also allocate the budget for building Getbol World Heritage Center. If deemed necessary, the Cultural Heritage Administration can allocate the budgets for the heritage utilization and the periodic report to world heritage center.

The budget allocated by the Ministry of Oceans and Fisheries can be used for management projects listed in the following table.

**Table 5-13.** Details of MOF protection and management budget for the nominated property

| Project Type | Project Details |
| --- | --- |
| Research and Monitoring | Establishment of Basic Management Plan |
| | National Investigation of Marine Ecosystem |
| | Citizen Monitoring |
| | Research on conservation and management methods |
| Conservation and Management | Operation of local management committee for Wetland Protected Areas |
| | Honorary rangers (observation, patrol, etc.) |
| | Collection and discarding of marine trash |
| | Removal of environmentally-hazardous facilities |
| | Installation and management of information boards |
| Education and PR | Support programs on enhancing awareness, education and training |
| | Operation of capacity-building and public relation programs |
| | New construction and remodeling of visitor centers, Setting up exhibition materials |
| Local resident support | Purchasing and discharge of marine seed fish |
| | Local resident participatory projects |
| | Marine Protected Areas brand creation projects |
| | Set up and expand convenience facilities for locals and visitors |
| Tidal Flat Restoration | Restoration projects for marine resources, tidal flat waterways and ecosystem improvement |

The entire budget for the protection and management of WPA is generally shared by the central government (70%) and local municipalities (30%), and is operated in a way to emphasize the accountability of local municipalities in the protection and management projects.

# 5.g Sources of Expertise and Training in Conservation and Management Techniques

Sharing expertise and education programs about the protection and management of the nominated property is done in various ways. The Ministry of Oceans and Fisheries, Cultural Heritage Administration and the Getbol World Heritage Center (GWHC) will work closely with local municipalities to run various programs to nurture the necessary human resources for the management of the property.

In additon, the institutions will develop and run practical programs on World Heritage educaion courses for tidal flat eco-guiders, along with the existing tidal flat eco-guide training courses.

The Korea Marine Environment Management Corporation (KOEM), a specialized marine environment management agency, together with universities and research institutes located in the regions, plan to share their expertise and experience for the protection and management of the property.

Following the inscription of the nominated property, the GWHC plans to develop education and training programs which cover the OUV of the property.

The 'Visitor Center Network for Local Marine Protected Areas' connects the 17 visitor centers and relevant institutions at the tidal flats nationwide and runs programs to enhance the capacity-building of managers that operate the visitor centers and to promote their activities. NGOs which engage in activities to conserve the tidal flat ecosystem, including the nominated property, will also share their knowledge and experiences on protection and management.

**Table 5-14.** Present training courses for tidal flat eco-guiders

| Course | Category | Training Topic | Contents |
|---|---|---|---|
| Basic Course | Environmental Awareness | Environmental and Ecological Philosophy and Ethics | • Environmental and biological philosophy and environment<br>• Environmental and biological environment crisis<br>• Environmental and biological value and human life |
| | Methods of Environmental Guide | Environmental Guide Technique | • Emergence of environment guide and social and historical progress<br>• Concept, definition, purpose, meaning and characteristics of environment guide<br>• Basic principles, techniques and application of environment guide<br>• Practice of environment guide and on-site application |
| | Understanding of Ecosystem | Ecology 101 | • Basic principles and theories of ecology |
| | | Understanding of Tidal Flat Ecosystem | • Understanding of tidal flat ecosystem's characteristics, structure, components and interactions between the components |

| Course | Category | Training Topic | Contents |
|---|---|---|---|
| Basic Course | Understanding of Tidal Flat | Earth-Science Understanding of Tidal Flats | • Understanding of the tidal flat formation process and changing process (sedimentation, water flow, topography, etc.) |
| | | Cultural Understanding of Tidal Flat | • Understanding of the relation between the tidal flat ecosystem and traditional culture (tangible and intangible) developed via the relation between human life and the tidal flat |
| | | Value of Tidal Flats | • Understanding of economic, disaster prevention, environment purification and aesthetic value of the tidal flat |
| | Tidal Flat Resource Guide (Biological Resource) | Benthos | • Studying inhabitation types and biological characteristics of benthos and major indicator organisms |
| | | Plants | • Studying inhabitation types and biological characteristics of plants and major indicator organisms |
| | | Birds | • Studying inhabitation types and biological characteristics of birds and major indicator organisms |
| | Safety Education | Safety Education and Management (First Aid included) | • Accident prevention education<br>• Establishing priorities to remove risk factors<br>• Recognizing risk factors during outdoor activities in tidal flats and how to respond to the risk factors<br>• Safe response to unexpected situations |
| Intensive Course | Environmental Awareness | Environmental and Ecological Philosophy and Ethics | • Human and environment<br>• Environmental determinism and environmental possibilism<br>• The necessity of the protection and conservation of the environment |
| | Understanding of Ecotourism | Ecotourism 101 | • Emergence of ecotourism and historical and social progress<br>• Concept, definition, purpose, meaning and characteristics of ecotourism<br>• Types of ecotourism<br>• Case studies of ecotourism |
| | Practice of Environment Explanation | Planning of Environment Guide Program | • Concept and definition of environment explanation programs<br>• Practical principles and factors in each stage from planning to assessment of environment explanation programs |
| | | Practice of Tidal Flat Program Planning | • Learning practical techniques for each stage<br>• Practice of planning tidal flat explanation programs after choosing location, period, target audience.<br>• Field practice with tidal flat explanation programs |
| | | Group Guidance Theory and Practice | • Self-expression and relationship build-up training for communication with target audiences<br>• Understanding of the formation process of a small group composed of target audiences, personalization, position and roles, and barriers to group formation and practice of group guidance |
| | Tidal Flat Monitoring | Tidal Flat Monitoring Method | • Meanings of monitoring and cautions<br>• Monitoring methods for tidal flat organisms (benthos, plants, birds) |
| | | Tidal Flat Monitoring Practice | • Practice how to keep a record<br>• Practice how to establish a photo record (photo monitoring)<br>• Practice how to make a pictorial (miniature) record<br>• Practice monitoring methods in tidal flats<br>• Practice how to record tidal flat monitoring |
| | Understanding of Local Community | Understanding of the Environment of Local Community | • Having a better understanding of the natural environment of local communities regarding the tidal flat and giving more detailed explanations on the tidal flat |

| Course | Category | Training Topic | Contents |
|---|---|---|---|
| Intensive Course | Understanding of Local Community | Understanding of Social Mores and History of Local Community | • Develop competencies to interpret tangible and intangible history, culture and social environment of local communities with the natural environment |
| Intensive Course | Tidal Flat Resource Guide | Tidal Flat Biological Resource | • Intensive learning of ecological characteristics of benthos and fishes inhabiting the tidal flat and observation techniques<br>• Intensive learning of habitat types and ecological characteristics of Halophytes<br>• Learning measures to conserve and manage birds, including migratory birds |
| Intensive Course | Tidal Flat Resource Guide | History of Tidal Flat and Cultural Resource | • Develop competencies to interpret history, culture and resources of the tidal flat with the adaptation to the natural environment |

**Table 5-15.** World Heritage education courses for tidal flat eco-guiders

| Course | Category | Training Topic | Training Contents |
|---|---|---|---|
| Heritage Education Course | World Heritage Recognition | Meaning and Value of Heritage | • Concept and value of World Heritage<br>• Understanding of systems including the World Heritage Convention<br>• Understanding of OUV |
| Heritage Education Course | World Heritage and Outstanding Universal Value (OUV) | Topographical and Geological Diversity and Biodiversity | • Current topographical and geological status of the nominated property and management plan for habitat<br>• Current biodiversity status of each region of the nominated property and management measures<br>• Current endangered species status of each region in the nominated property and management measures |
| Heritage Education Course | Heritage Environment | Environmental Characteristics of the Nominated Property | • Understanding of characteristics of Island-type tidal flat<br>• Education of similarities and differences between regional environments<br>• Measures to maintain the OUV and environment in a sustainable manner |
| Heritage Education Course | Heritage Tourism | Sustainable Heritage Tourism | • Analyzing the concept of sustainable heritage tourism and case studies<br>• Tourism strategy as a way to protect and manage heritage<br>• Measures to analyze heritage tourism infrastructure and establish plans |
| Heritage Education Course | Heritage Protection and Management | Understanding of Local Community and Participation | • Understanding of the importance and characteristics of a community-based protection and management<br>• Visiting to local communities<br>• Understanding of characteristics of Getsallim (sustainable life in tidal flats) and regional and traditional cultures and the dynamics between those characteristics and tidal flat ecosystem |
| Heritage Education Course | Planning and Practice | Planning Heritage Tourism Program | • Planning a program to visit heritage sites which will be run by tidal flat visitor centers<br>• Demonstrating a program to visit heritage sites which will be run by tidal flat visitor centers<br>• Learning from heritage-based tourism cases and field trips to understand the current status of regions |

# 5.h Visitor Facilities and Infrastructure

## 5.h.i Visitor Facility

To prevent any damage to the environment in the nominated property, visitors' indiscreet access to the nominated property is managed by local municipalities and communities. Visitors can take part in tidal flat experience programs in limited areas of the property areas or access the property by going to tidal flat visitor centers located in the buffer zone.

The number of visitors to the regions where the nominated property is located is growing. Accordingly, more convenience and management facilities are being built in the buffer zone for exhibitions, education, information purposes as well as visitor centers, public restrooms and parking lots. Visitors are able to enjoy the tidal flats experiences at the fishing villages. Benches, drinking fountains and foot washing stations are set up for rest. Eco-trails along the tidal flats, observatories, and pedestrian walking decks are also for observation. Information facilities are mainly sign boards for general information, facility, road and warning information.

**Table 5-16.** Current status of visitor facilities in the nominated property

| Category | | Seocheon Getbol | Gochang Getbol | Shinan Getbol | Boseong-Suncheon Getbol |
|---|---|---|---|---|---|
| Observation Facility | Exhibition Hall or Visitor Center | Yes | Yes | Yes | Yes |
| | Tidal Flat Eco Trail | Yes | Yes | Yes | Yes |
| | Observatory | Yes | Yes | Yes | Yes |
| | Pedestrian Walking Deck | Yes | Yes | Yes | Yes |
| | Stair and Slope | Yes | Yes | Yes | Yes |
| Experiential Facility | Experience Learning-Purpose Fishing Village | Yes | Yes | Yes | Yes |
| | Experience Learning-Purpose Tidal Flat | Yes | Yes | Yes | Yes |
| Convenience Facility | Tourism Information Service | Yes | Yes | Yes | Yes |
| | Public Restroom | Yes | Yes | Yes | Yes |
| | Parking Lot | Yes | Yes | Yes | Yes |
| | Bench | Yes | Yes | Yes | Yes |
| | Drinking Fountain | Yes | Yes | Yes | Yes |
| | Foot Washing Station | Yes | Yes | Yes | Yes |
| Information Facility | General Information Board | Yes | Yes | Yes | Yes |
| | Facility Information Board | Yes | Yes | Yes | Yes |
| | Road Information Board | Yes | Yes | Yes | Yes |
| | Warning Information Board | Yes | Yes | Yes | Yes |

## 5.h.ii Information Provision to Visitors

Multiple organizations have been providing information through different systems. The Cultural Heritage Administration provides visitors with information related to World Heritage and the nominated property on its website. Visitors also can go to 'Integrated Information System of Marine Ecosystem (www.ecosea.go.kr)' of the Ministry of Oceans and Fisheries to find information on Wetland Protected Area (WPA) in the nominated property, as well as information on the entire marine protected areas in ROK. Furthermore, the five local municipalities provide comprehensive information about the property via their websites as well as through education and promotional materials. All the information regarding the entire process of inscription of the nominated property, the OUV, regional characteristics and results of various research activities can be obtained from the website of the Promotion Team (http://www.ktidalflats-heritage.com).

Digital information about the nominated property is also available on the culture and tourism websites of local municipalities where the property is situated. Visitors can place orders for promotional materials which are available on-site by mail or phone in advance. Tidal flat visitor centers in Seocheon Getbol, Gochang Getbol, Shinan Getbol and Boseong-Suncheon Getbol provide information about the property on their respective websites.

Table 5-17. Websites providing information about the nominated property

| Type | | Website | Management Organization |
|---|---|---|---|
| Central | World Heritage | http://www.cha.go.kr | Cultural Heritage Administration |
| | Wetland Protected Area | http://www.ecosea.go.kr | Ministry of Oceans and Fisheries |
| Common | | http://www.ktidalflats-heritage.com | World Heritage Promotion Team of Korean Tidal Flat |
| Component | Seocheon Getbol | http://seocheon.go.kr/tour.do | Department of Tourism and Festival, Seocheon County |
| | | www.bird.seocheon.go.kr | Seocheon Bird Eco Exhibition Hall |
| | Gochang Getbol | http://gochang.go.kr | Department of Culture, Heritage and Tourism, Gochang County |
| | | http://www.gotidalflat.modoo.at | Ramsar Gochang Tidal Flat Center |
| | Shinan Getbol | http://tour.shinan.go.kr | Department of World Heritage, Shinan County |
| | | http://goo.gl/dJZXOq | Shinan Jeungdo Tidal Flat Ecological Exhibition Hall |
| | Boseong-Suncheon Getbol | http://tour.boseong.go.ke | Department of Culture and Tourism, Boseong County |
| | | http://www.suncheon.go.kr/tour | Department of Culture and Art, Suncheon City |
| | | www.suncheonbay.go.kr | Suncheonman Eco Museum |

# 5.i Policies and Programmes Related to the Presentation and Promotion of the Property

A wide variety of activities are now being carried out to raise the public awareness of the nominated property. Many education programs on the conservation and wise use of the property have been developed. The key objective of the education programs is to help the public gain a better understanding of the OUV of the property and to achieve social consensus on the necessity of protection activities and how to use the property in a sustainable manner. Delivering education and promotion programs to future generations is one of the major promotional strategies. Education courses on geomorphology, geology, biology, ecology, biodiversity and endangered species will motivate children and adolescents to actively engage in the protection and management of the property in the long term.

Tidal flat visitor centers in the property carry out various education programs for students, families, tourists and local residents. The objectives of the education programs regarding the property include:

- Increasing visitors and local residents' awareness of the conservation of the marine environment by helping them have a better understanding of the value and importance of the property via on-site education programs on the tidal flat;

- Laying the foundation for sustainable education on the property by training specialists and developing well-organized education programs; and

- Laying the foundation for international cooperation and nationwide support by carrying out education programs and raising-awareness activities to promote the inscription and to increase the public awareness of the property.

Tidal flat visitor centers hold exhibitions about the property and run education programs. The exhibitions and programs cover a variety of topics including the formation and evolution of the tidal flats, migratory birds, organisms in tidal flats, fishing businesses, and fishing village culture in each region. Furthermore, customized education programs are available to the different groups of preschoolers, elementary, middle and high school students, families and general tourists.

The following table shows the list of exhibitions and education programs provided by the tidal flat visitor centers.

**Table 5-18.** Exhibition and education programs of tidal flat visitor center in each component

<table>
<tr><th colspan="2">Category</th><th>Seocheon Getbol<br>(Seocheon Bird Eco Exhibition Hall)</th><th>Gochang Getbol<br>(Ramsar Gochang Tidal Flat Center)</th><th>Shinan Getbol<br>(Shinan Jeungdo Tidal Flat Ecological Exhibition Hall)</th><th>Boseong-Suncheon Getbol<br>(Suncheonman Eco Museum)</th></tr>
<tr><td colspan="2">Regular and Special Exhibition</td><td>· Miniature models of migratory birds observed in the Geumgang River estuary and habitats<br>· Video clips on the Seocheon Getbol<br>· Exhibition hall of migratory bird flyway<br>· Bird school and Bird house (experience education hall)<br>· Bird documentary experiential hall<br>· 4D video experiential hall<br>· Special exhibition of the Yubudo Island</td><td>· Tidal flats and culture of Gochang County<br>· Functions and value of the tidal flat<br>· Tidal flat culture<br>· Bird migration and its meaning<br>· Tidal flat restoration<br>· Marine Protected Area special exhibition<br>· Tidal flats and people in Gochang County<br>· Special exhibition of marine waste</td><td>· Tidal flats in Shinan County<br>· Migratory birds observed in Shinan County<br>· Fishing culture<br>· Tidal flat plants<br>· Tidal flats and saltpans</td><td>· Formation and evolution of the tidal flat<br>· Characteristics of the Suncheonman Bay tidal flat and comparison with other tidal flats<br>· Marine and fisheries culture of the Suncheonman Bay<br>· Tidal current in the Suncheonman Bay<br>· Hooded cranes (Grus monacha)<br>· Video clips on bird watching</td></tr>
<tr><td rowspan="5">Education Program</td><td>Preschooler</td><td rowspan="4">· Learning the ecosystem of the Geumgang river estuary<br>· Birdwatching programs<br>· Yubudo Island clean volunteers<br>· Fostering guides on the nature and environment<br>· Fostering tidal flat eco guides</td><td>· Seagull puppet show<br>· Watching video clips on the tidal flat<br>· Create miniature models of tidal flat organisms</td><td rowspan="5">· Experience education on island ecosystem<br>· Island ecosystem academy<br>· Island ecosystem expert training courses<br>· Ecological experience camp<br>· Experience traditional culture</td><td rowspan="2">· Education on the ecosystem of Suncheonman Bay<br>· Tidal flat junior ranger</td></tr>
<tr><td>Elementary School Student</td><td>· Lectures and video clips on the tidal flat<br>· Create miniature models of tidal flat organisms<br>· Field trip to the tidal flat</td></tr>
<tr><td>Middle School Student</td><td>· Marine waste<br>· Education on the ecology of the Yellow Sea<br>· Observation of tidal flat organisms<br>· Field trip to the tidal flat</td><td>· Ecosystem of the Suncheonman Bay</td></tr>
<tr><td>Family</td><td>· Field trip to the tidal flat<br>· Create miniature models of tidal flat organisms<br>· Make tidal flat organism-shaped cookies</td><td>· Tidal flat eco guide training<br>· Hooded cranes (Grus monacha) monitoring</td></tr>
<tr><td>General toursim</td><td>· Birdwatching in Geumgang River<br>· Ecological education in Seocheon Getbol</td><td>· Field trip to the tidal flat<br>· Birdwatching in tidal flat</td><td>· Natural ecology interpretation education<br>· Astronomical observation</td></tr>
</table>

Educational and experience programs regarding the nominated property all serve to enhance the general awareness of the public on the OUV of the property. This helps to further secure support for sustainable conservation and wise use of the property. With the education programs, local municipalities have been promoting the property and invigorating local economies directly and indirectly. As described, education and promotion activities can lay the foundation for a virtuous cycle which enhances the protection and management for the property. This is why the Ministry of Oceans and Fisheries and local municipalities continuously devise support systems for them.

Importantly, the Visitor Center Network for Local Marine Protected Areas has provided various capacity-building support programs. Those programs include training managers of visitor centers and tidal flat eco-guides, co-hosting exhibition on the property, co-developing education programs and learning materials, educating local residents and establishing campaign strategies for conservation and sustainable use.

The Getbol World Heritage Center plans to work with Visitor Center Network for Local Marine Protected Areas, local environmental NGOs and related organizations so that they can carry out education and promotion activities more actively.

## 5.j Staffing Levels and Expertise

Management organizations of the nominated property consist of governmental and non-governmental agencies. The governmental organizations include the Ministry of Oceans and Fisheries, Cultural Heritage Administration, regional offices of the Ministry of Ocean and Fisheries, Korea Marine Environment Management Corporation (KOEM), metropolitan municipalities and local municipalities responsible for the property. These organizations have expertise and experience in administrative work required for the management of the property, applicable Acts and regulation as well as site management.

KOEM is a marine environment management-dedicated agency. It has experience and know-how in the protection and management of Marine Protected Areas and has established a scientific knowledge base for research on the marine ecosystem. Korea Maritime Institute is a research body with expertise and experience and is responsible for introducing rules and policies regarding the protection and management of Marine Protected Areas. National Institute of Fisheries Science is responsible for the management of fishery resources and fishing grounds and has specialty and experience in fishery resources in the nominated property and sustainable fishing.

Universities and research institutes located in the nearby property area carried out research on marine sedimentation and biology of the nominated property with experience and expertise for a long time. They have conducted research and survey on geomorphological, geological, biological, and ecological characteristics of the property to demonstrate its OUV. These institutions have surveyed indigenous knowledge of fishing village cooperatives used in the property and traditional practices including 'Getsallim'. Getsallim means sustainable life in the tidal flat along with tidal flat organisms, waterbirds and humans. With the results of the survey, the institutions have built expertise in the unique cultural and ecological value of the property.

Utilizing the research outcome of specialized research institutes, the central and municipal governments are also accumulating expertise on the unique geological, geomorphological, biological, ecological, historical and cultural values of the nominated property. Environmental NGOs related to the property also have expertise and experience in the local community-based management of Marine Protected Areas, education and ecotourism.

Each tidal flat visitor center at the component sites has 5-20 staffs and about 10-40 tidal flat eco-guides. The centers regularly provides its staffs and eco-guides with capacity-building programs.

And the 'Visitor Center Network for Local Marine Protected Areas', established in 2011, connects the 17 tidal flat visitor centers and relevant instutions at the tidal flats nationwide and run programs to enhance the capabilities of managers that operate the visitor centers and to promote their activities. The secretariat of the Network is created by the recommendation and approval of its member organizations. The secretariat is currently being operated by an NGO since 2015. The Network engages in diverse support activities to provide information so that the tidal flat visitor centers and local communities within the nominated property can actively participate in the process of the inscription of the World Heritage. In this context, the Network is also considered a vital organization with key expertise in the protection and management of the nominated property. In addition, many environmental NGOs and volunteers join in protecting the nominated property.

The Getbol World Heritage Center (GWHC), to be established after the inscription, will be composed of public officials dispatched from the local municipalities and newly hired experts. The GWHC will hire more experts required to efficiently and systematically carry out projects – management and protection of the OUV of the nominated property, heritage tourism and education – to raise the public awareness. The local management offices in each components of the property will also be hiring experts to carry out thorough and diverse on-site management programs.

Table 5-19. Current manpower status of management organizations of the nominated property

| Organization | Departments | Composition |
|---|---|---|
| Cultural Heritage Administration | World Heritage Division | Administrator:1 Staff: 8 |
| World Heritage Promotion Team of Korean Tidal Flat | Teams of Administrative and Research Support | Administrator:1 Staff: 6 |
| Ministry of Oceans and Fisheries | Marine Ecology Division | Administrator:1 Staff: 10 |
| Regional Office of Oceans and Fisheries | Daesan Regional Office of Oceans and Fisheries<br>Gunsan Regional Office of Oceans and Fisheries<br>Mokpo Regional Office of Oceans and Fisheries<br>Yeosu Regional Office of Oceans and Fisheries | Administrator:1 Staff: 2<br>Administrator:1 Staff: 2<br>Administrator:1 Staff: 2<br>Administrator:1 Staff: 2 |
| Chungcheongnam-do Province | Division of Culture, Sports and Tourism | Administrator:1 Staff: 2 |
| Jeollabuk-do Province | Division of Culture, Sports and Tourism | Administrator:1 Staff: 2 |
| Jeollanam-do Province | Division of Tourism, Culture and Sports | Administrator:1 Staff: 2 |
| Seocheon County | Department of Tourism and Festival<br>Department of Marine and Fisheries | Administrator:1 Staff: 8<br>Administrator:1 Staff: 8 |
| Gochang County | Department of Culture, Heritage and Tourism<br>Department of Marine and Fisheries | Administrator:1 Staff: 8<br>Administrator:1 Staff: 5 |
| Shinan County | Department of World Heritage<br>Department of Marine and Fisheries | Administrator:1 Staff: 4<br>Administrator:1 Staff: 5 |
| Boseong County | Department of Culture and Tourism<br>Department of Marine and Fisheries | Administrator:1 Staff: 13<br>Administrator:1 Staff: 2 |
| Suncheon City | Department of Culture and Arts<br>Department of Suncheonman Bay Conservation | Administrator:1 Staff: 19<br>Administrator:1 Staff: 53 |

Table 5-20. Specialized organizations involved in the nominated property

| Organization | Departments and Teams | Composition |
|---|---|---|
| Korea Marine Environment Management Corporation | Marine Protected Area Management Team<br>Marine Ecosystem Management Team | Administrator:1 Staff:7<br>Administrator:1 Staff:17 |
| Korea Maritime Institute | Headquarter of Marine Research | Administrator:1 Staff:30 |
| National Institute of Fisheries Science | Tidal Flat Research Center of West Coast Marine Research | Administrator:1 Staff:5 |
| Visitor Center Network for Local Marine Protected Areas | Secretariat: Eco-Horizon Institute | Administrator:1 Staff:6 |

**Table 5-21.** Plans for hiring of experts for the protection and management of the nominated property

<table>
<tr><th colspan="2">Organization</th><th>Departments and Teams</th><th>Composition</th></tr>
<tr><td colspan="2">Getbol World Heritage Center</td><td>Research Team, Protection and Management Team, Exhibition-Education Team, Tourism Team, Public Relations Team, Operation Support Team</td><td>Administrator:1 Staff:20</td></tr>
<tr><td rowspan="4">Local Management Office in each Component</td><td>Seocheon Getbol</td><td>Seocheon Getbol World Heritage Administration Office</td><td>Administrator:1 Staff:19</td></tr>
<tr><td>Gochang Getbol</td><td>Gochang Getbol World Heritage Administration Office</td><td>Administrator:1 Staff:19</td></tr>
<tr><td>Shinan Getbol</td><td>Shinan Getbol World Heritage Administration Office</td><td>Administrator:1 Staff:19</td></tr>
<tr><td>Boseong-Suncheon Getbol</td><td>Boseong-Suncheon Getbol World Heritage Administration Office</td><td>Administrator:2 Staff:62</td></tr>
</table>

Section 6

# Monitoring

# Monitoring

## 6.a Key Indicators for Measuring State of Conservation

The monitoring activities for the nominated property have the following goals: 1) evaluating the condition of and changes to tidal flat ecosystems and geoheritage values associated with habitats, thereby producing basic scientific evidence and baseline data; 2) assessing the potential impact of environmental change and implications for conservation of the property; and 3) designing and implementing conservation strategies and establishing effective management plans based on the scientific evaluations and interpretation regarding the property.

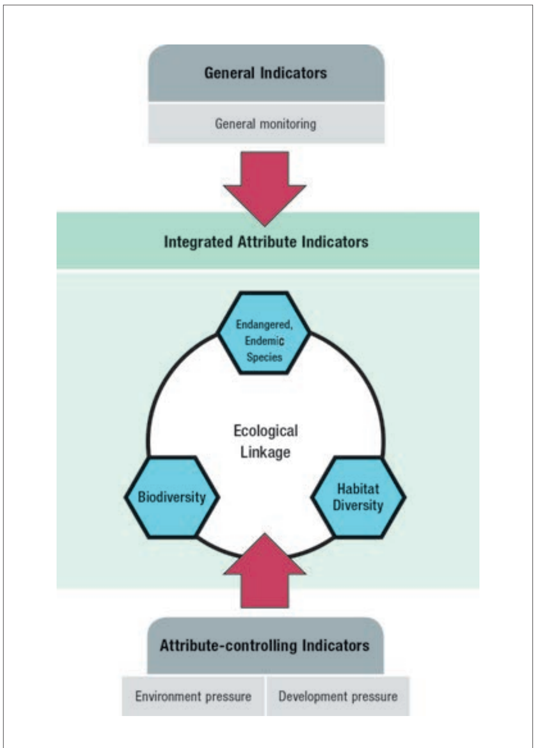



Figure 6-1. Monitoring indicators for the nominated property

The monitoring will be conducted on various aspects of the OUV of the nominated property and important parameters to check its short- and long-term changes. To sustain the OUV of the property, various controlling factors that have influenced the property will be analyzed and any changes will be tracked. By interpreting any changes to the natural environment of the property, we are in a better position to anticipate future changes and to set up necessary responding measures.

The monitoring item of the property is conducted on the anticipated changes caused by various factors and can be categorized in four ways: natural environmental change, environment pressure, development pressure and visitor pressure.

Changes to the natural environment will be scrutinized by monitoring long-term changes of natural process in the whole property. Recent circumstances in global warming and climate change are also viewed as changes to the natural environment. Also included are changes to the physical parameters, geological, geomorphological and ecological systems. Fishing activities also have a direct impact on the ecosystem, and therefore changes to the ecosystem by fishing activities are also included with the changes of the natural environment. Changes to the ecosystem refers to measuring any observed variation in living organisms in the tidal flats. In particular, monitoring of endangered species is conducted in detail by species tracking and measurement. Moreover, any changes to the geological environment that makes up the habitats of endangered species of birds or invertebrates will also be monitored, linking that with any change to the ecosystem as a whole.

For changes caused by environmental and artificial pressure, the factors responsible for the changes will be investigated. Sediments, physical attributes of sea water, nutrients and levels of toxic elements are included in this category of monitoring. Changes in the ecosystem caused by oil spills or trash, any changes to fishing zones and saltpans caused by climate-driven factors, geological, geomorphological and ecological system changes caused by fish farms are also included.

Changes caused by development pressure refer to social and ecological system changes caused by artificial facilities. Changes caused by visitor pressure refers to the monitoring of visitor numbers and to any changes to the ecosystem caused by the visitors.

These monitoring activities will be conducted by the Getbol World Heritage Center (GWHC), Cultural Heritage Administration, Korea Marine Environment Management Corporation and each local management office. Depending on the specifics of each monitoring indicator, the timing of the monitoring, and the agency in charge, the monitoring frequency will differ. Details are presented in Table 6-1.

The monitored data is collected at the GWHC and stored in a web digital archive (http://www.ktidalflats-heritage.com/archive/) that is already in place. The archived documents, photos and video materials will be available to the public and experts in digital form. In addition, authentic materials to be exhibited will be rented to local visitor centers. The results of the monitoring will be published quinquennially in a report. Annually accumulated monitoring results will be shared and discussed by policy makers, on-site managers, experts, NGOs, and local people at an integrated symposium held every 3 years in order to synthesize information for the periodic report to the World Heritage Center. Final results from these symposia, after scientific review, will be used in the preparation of subsequent management plans.

**Table 6-1.** Monitoring categories and parameters for the nominated property

<table>
<tr><th colspan="3">Major Monitoring Parameters for the Nominated Property</th></tr>
<tr><td rowspan="4">Natural Environment</td><td>Geologic Parameters</td><td>Biologic Parameters</td></tr>
<tr><td>• Sediments and sedimentation<br>• Sedimentary bodies by natural event<br>• Hydro-mechanical properties<br>• Evolution of sediment layers and tidal channels</td><td>• Phytoplankton and primary production<br>• Marine algae and halophytes<br>• Zoobenthos<br>• Fishes<br>• Migratory birds<br>• Marine mammals<br>• Microorganisms</td></tr>
<tr><td>Habitat Parameters</td><td>Target Parameters</td></tr>
<tr><td>• Salt marshes<br>• Tidal beaches and sand dunes<br>• Mud, sand and mixed flats<br>• Rocky habitats<br>• Tidal channels and gullies<br>• Oxidized layers</td><td>• Endangered species<br>• Invasive species</td></tr>
<tr><td rowspan="2">Pressures</td><td>Environmental Parameters</td><td>Human Activity Parameters</td></tr>
<tr><td>• Water quality and nutrients<br>• Heavy metals in sediments<br>• Organic matter in sediments<br>• Microplastics</td><td>• Fishery<br>• Tourism and recreational activities<br>• Artificial change of coastal area<br>• Energy development plans<br>• Marine trash<br>• Oil spills</td></tr>
<tr><td rowspan="2">General Parameters</td><td>General Parameters</td><td></td></tr>
<tr><td>• Hydrology<br>• Weather condition<br>• Land use<br>• Geomorphology<br>• Temperatures of water and sediment</td><td></td></tr>
</table>

**Table 6-2.** Detailed list of monitoring indicators for the nominated property

| Parameter | Monitoring Item | | Frequency | Target Area | Implementation Organizations & Archives |
|---|---|---|---|---|---|
| Geology | Basic | Sedimentological characteristics (sedimentary facies, organic matter, SS) | Quinquennial | Entire area | KOEM |
| | | Geomorphology (topography, flat altitude, coastline change) | Quinquennial | Entire area | GWHC |
| | Advanced | Event influence (storm, typhoon) | Quinquennial / after event | Entire area | GWHC |
| | | Long term change of sediment (evolution, dynamics) | Quinquennial | 1 lateral line per component | GWHC |
| Biology | Basic | Biodiversity and primary production (benthic diatoms, marine algae, halophytes) | Quinquennial | Entire area | KOEM |
| | | Biodiversity, density, and biomass (macrobenthos, meiobenthos, fishes) | Quinquennial | Entire area | KOEM |
| | | Biodiversity and population of waterbirds | Annual | Entire area | KOEM |
| | | Biodiversity and population of sea mammals | Annual | Entire area | KOEM |
| | Advanced | Oxidized layers (depth, zoobenthos) | Quinquennial | 2 lateral lines per component | GWHC |
| | | Microorganisms | Quinquennial | Selected points | GWHC |
| | | Habitat biodiversity (rocky habitats, salt marshes) | Quinquennial | Entire area | KOEM / GWHC |
| | | Keystone species | Annual | Selected points | KOEM |
| | | Dissolution of nutrient from sediment | Quinquennial / seasonal | Representative area | GWHC |
| | | Food chains | Quinquennial | Representative area | GWHC |
| Habitat | Basic | Effect of climate change | Quinquennial | Entire area | GWHC / KOEM |
| | Advanced | Geological and geomorphological habitats (tidal flat, tidal channel and gully, sand dune, tidal beach, event body) | Quinquennial | Entire area | GWHC / KOEM |
| | | Biological habitats and communities | Quinquennial | Entire area | GWHC |
| Target | Basic | Invasive species and organisms | Annual | Entire area | KOEM |
| | Advanced | Endangered species and food chains | Annual | Entire area | GWHC |
| General | Basic | Natural features (hydrology, weather condition) | Annual | Entire area | KOEM / Meteorological Administration Agency |
| | | Water (inner and outer areas) and sediment temperatures | Annual | Selected points | KOEM / GWHC |
| | | Geomorphological features (dike, flood gate, fresh water discharge, polluted material) | Annual | Entire area | KOEM |

＊KOEM, Korea Marine Environment Management Corporation
＊＊GWHC, Getbol World Heritage Center

**Table 6-3.** Monitoring of development, environment, and tourism pressures on the nominated property

| Pressure | | Monitoring Item | Frequency | Evaluation | Organization |
|---|---|---|---|---|---|
| Development | Influence from artificial structure | Influence from dyke and coastline change, and from old reclamation project | Quinquennial | Environmental assessment | KOEM |
| | | Influence from coastal roads and seawalls | Quinquennial | Environmental assessment | GWHC |
| | Fishery | Comparison on sediments and species between aquaculture and non-aquaculture areas | Annual | Changing status | GWHC |
| | | Density changes of organism by bare-catch fishery | Annual | Changing status (population/㎡) | KOEM |
| | | Amount of catch by bare-catch fishery | Quinquennial / seasonal | Changing status (㎏/person) | KOEM |
| | | Changes in production by fish species | Quinquennial / seasonal | Changing status (tons) | GWHC |
| Environment | Marine trash / waste | Amount and type of marine trash, source, changes of amount and type | Quinquennial / seasonal | Changing status (tons) | GWHC / Each Municipality |
| | Climate change | Seasonal variations in fish species and catch, density changes | Quinquennial / seasonal | Changing status (tons) | GWHC |
| | Oil pollution / oil spill | Ecological impacts | Quinquennial | Changing status by routes (%) | GWHC |
| | Invasive species | Investigation of invasive species in marine ecosystem | Annual | Changing status | KOEM |
| | Healthiness of water and sediment | Indicators for healthy tidal flat sediment (heavy metals, pH, Eh, water quality) | Quinquennial | Changing status by causes (%) | GWHC |
| Tourism | | Visitor number (age, nationality, group tour, etc.) and types | Annual / seasonal | Person | Each Municipality |
| | | Visitor satisfaction | Annual / seasonal | Good / Normal / Bad | GWHC / Each Municipality |
| | | Visitor pressure | Quinquennial | Change | |
| | | Safety of infrastructure | Annual | Change | |
| | | Pollution by visitors | Annual / seasonal | Change | |
| | | Infrastructure capacity (parking, food, etc.) | Quinquennial | N/A | |
| | | Trash from visitors | Annual / seasonal | Change | |
| | | Density changes of biology and habitats | Biennial | Changes in species diversity and abundance | |
| | | Resiliency of organisms | Triennial | Changing status (species diversity and population density) | |

* KOEM, Korea Marine Environment Management Corporation
* * GWHC, Getbol World Heritage Center

# 6.b Administrative Arrangements for Monitoring Property

Monitoring on the nominated property will be carried out by different institutions at different times depending on the characteristics of the monitoring indicators and their details. General indicators are used by the Ministry of Oceans and Fisheries (MOF) and Korea Marine Environment Management Corporation (KOEM) in the National Investigation of Marine Ecosystem; integrated indicators are used by the Getbol World Heritage Center (GWHC); indicators about controlling the attributes are used by different marine related organizations and local municipalities conducting relevant monitoring.

The GWHC will work with all relevant agencies with close consultation and cooperation so that all monitoring activities for preserving the nominated property's OUV are carried out in a comprehensive manner. Should inscription be achieved, the protection and management system of the property will be further reinforced with additional monitoring indicators and systems.

The evaluation of designing and implementing protection and management plans along with the natural scientific monitoring is also needed. The MOF and KOEM will conduct annual Management Evaluation and mid- and long-term Management Effectiveness Evaluation to assess how well the nominated property is protected and managed. But, the MOF and KOEM evaluations cover other Marine Protected Areas as well and are not specified for just the nominated property. Therefore, the Republic of Korea will set up a separate protection and management evaluation system dedicated for the nominated property.

All monitoring and evaluation results of the nominated property will be delivered to the municipalities in each component of the property, so that it can be reflected in the future plans and projects for the property.

Since multiple institutions are performing monitoring and management programs for the nominated property, there needs to be a platform open for regular communication and cooperation among the relevant organizations. Through the platform, different agencies will be able to efficiently divide their work scope and exchange monitoring outcomes. After inscription, regular symposia will be held to check the progress of the management effort for the OUV and to discuss the future plan and division of work among relevant institutions. Participants in these symposia will include relevant agencies, other subject matter experts, non-governmental organizations and local residents. The symposia will serve as a basic platform for the production of regular reports after inscription and will be conducted by GWHC.

In addition, all reports produced for the protection and management of the nominated property will be gathered in an online archive available to the public, which will be operated by the GWHC.

**Table 6-4.** Information concerning agencies responsible for monitoring of the nominated property

| Category | Organization | Department | Address |
|---|---|---|---|
| Integrated Management Organization | Cultural Heritage Administration | World Heritage Division | 189, Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea |
| | Ministry of Oceans and Fisheries | Marine Ecology Division | 94, Dasom 2-ro, Sejong, 30110, Republic of Korea |
| | Korea Marine Environment Management Corporation | Department of Marine Conservation | 28, Songpa-daero 28-gil, Songpa-gu, Seoul, 05718, Republic of Korea |
| | Getbol World Heritage Center | Research and Management Team | 2, Oryong 3-gil, Samhyang-eup, Muan-gun, Jeollanam-do, 58564, Republic of Korea |
| Cooperation Organization | Korea Hydrographic and Oceanographic Agency | Oceanographic Observation Division | 351, Haeyang-ro, Yeongdo-gu, Busan, 49111, Republic of Korea |
| | National Institute of Fisheries Science | Tidal Flat Research Center of West Coast Marine Research | Institute 14, Seonnyeobawi-ro, Jung-gu, Incheon, 22361, Republic of Korea |
| | National Marine Biodiversity Institute of Korea | Fundamental Research Division | 75, Jangsan-ro, 101beon-gil, Janghang-eup, Seocheon-gun, Chungcheongnam-do, 33662, Republic of Korea |
| Metropolitan Municipality | Chungcheongnam-do Province | Division of Culture, Sports and Tourism<br>Division of Marine and Fisheries | 21, Chungnam-daero, Hongbuk-eup, Hongseong-gun, Chungcheongnam-do, 32255, Republic of Korea |
| | Jeollabuk-do Province | Division of Culture, Sport and Tourism<br>Division of Agriculture, Livestock and Food | 225, Hyoja-ro, Wansan-gu, Jeonju-si, Jeollabuk-do, 54968, Republic of Korea |
| | Jeollanam-do Province | Division of Tourism, Culture and Sports<br>Division of Ocean and Fishery | 1, Oryong-gil, Samhyang-eup, Muan-gun, Jeollanam-do, 58564, Republic of Korea |
| Local Municipality | Seocheon County | Department of Tourism and Festival<br>Department of Marine and Fisheries | 57, Guncheong-ro, Seocheon-eup, Seocheon-gun, Chungcheongnam-do, 33638, Republic of Korea |
| | Gochang County | Department of Culture, Heritage and Tourism<br>Department of Marine and Fisheries | 245, Jungang-ro, Gochang-eup, Gochang-gun, Jeollabuk-do, 56428, Republic of Korea |
| | Shinan County | Department of World Heritage<br>Department of Marine and Fisheries | 1004, Cheonsa-ro, Aphae-eup, Sinan- gun, Jeollanam-do, 58827, Republic of Korea |
| | Boseong County | Department of Culture and Tourism<br>Department of Marine and Fisheries | 165, Songjae-ro, Boseong-eup, Boseong-gun, Jeollanam-do, 59455, Republic of Korea |
| | Suncheon City | Department of Culture and Arts<br>Department of Suncheonman Bay Conservation | 30, Jangmyeong-ro, Suncheon-si, Jeollanam-do, 57956, Republic of Korea |

# 6.c Results of Previous Reporting Exercises

## 6.c.i Reports for Protection and Management at the International Level

In the nominated property, the Yubudo Island tidal flat of Seocheon Getbol, part of Gochang Getbol, the Jeungdo Island tidal flat of Shinan Getbol and part of Boseong-Suncheon Getbol are all Ramsar Sites. The Conference of the Contracting Parties on the Ramsar Convention is held triennially and a national report on the implementation of the Ramsar Convention and an inspection of the Ramsar site is also submitted every 3 years from each member state. The following Table 6-5 shows the national reports which have been submitted to date.

For the UNESCO Biosphere Reserve, Gochang Getbol was designated in 2013 and expanded to the entire Shinan Getbol in 2016. Suncheon area in Boseong-Suncheon Getbol was also designated in 2018. Periodic Report on UNESCO Biosphere Reserve are released every 10 years. As it has been less than 10 years since Gochang, Shinan Getbol and Suncheon area in Boseong-Suncheon Getbol were designated as UNESCO Biosphere Reserve, the three have not yet been included in the UNESCO MAB's Periodic Report.

Table 6-5. A list of national reports on the nominated property submitted to the Ramsar COP

| Title | Year Published | Relevant Components | Webpage URL |
|---|---|---|---|
| COP10 National reports: Republic of Korea | 2008 | Boseong-Suncheon Getbol | http://ramsar.rgis.ch/pdf/cop10/cop10_nr_repkorea.pdf |
| COP11 National reports: Republic of Korea | 2012 | Seocheon Getbol<br>Gochang Getbol<br>Shinan Getbol<br>Boseong-Suncheon Getbol | https://www.ramsar.org/sites/default/files/documents/pdf/cop11/nr/cop11-nr-rep-korea.pdf |
| COP12 National reports: Republic of Korea | 2015 | Seocheon Getbol<br>Gochang Getbol<br>Shinan Getbol<br>Boseong-Suncheon Getbol | https://www.ramsar.org/sites/default/files/documents/library/cop12_nrf_republic_of_korea.pdf |

## 6.c.ii Reports for Protection and Management at National Level

The Ministry of Oceans and Fisheries (MOF) and Korea Marine Environment Management Corporation (KOEM) have been conducting basic costal wetland research every 5 years since 1999. The monitoring categories include sedimentary environment, macrobenthos, tidal flat health condition, socioeconomic status and awareness, and economic value assessment. From 2015, multiple research avenues and surveys that had been conducted separately came together under one big umbrella study, titled the 'National Investigation of Marine Ecosystems'.

The new diagnosis and evaluation presented through this biannual research enable the authorities to respond to the changed conditions of the marine ecosystem in a timely manner. Table 6-6 shows the list of the published reports.

The overall outcomes are published and uploaded on the Marine Ecosystem Web GIS (Geographic Information System) of 'Integrated Information System of Marine Ecosystem (http://www.ecosea.go.kr)', allowing easy public access.

The MOF and the KOEM have been carrying out the protection and management evaluation of the entire Marine Protected Area, including the nominated property, which has been a Wetland Protected Area since 2008. Table 6-7 presents a list of management evaluation reports of Marine Protected Areas. Table 6-8 shows the results of monitoring conducted at the local level during the inscription promotion process.

Table 6-6. A list of monitoring reports on the tidal flat ecosystem published at the national level

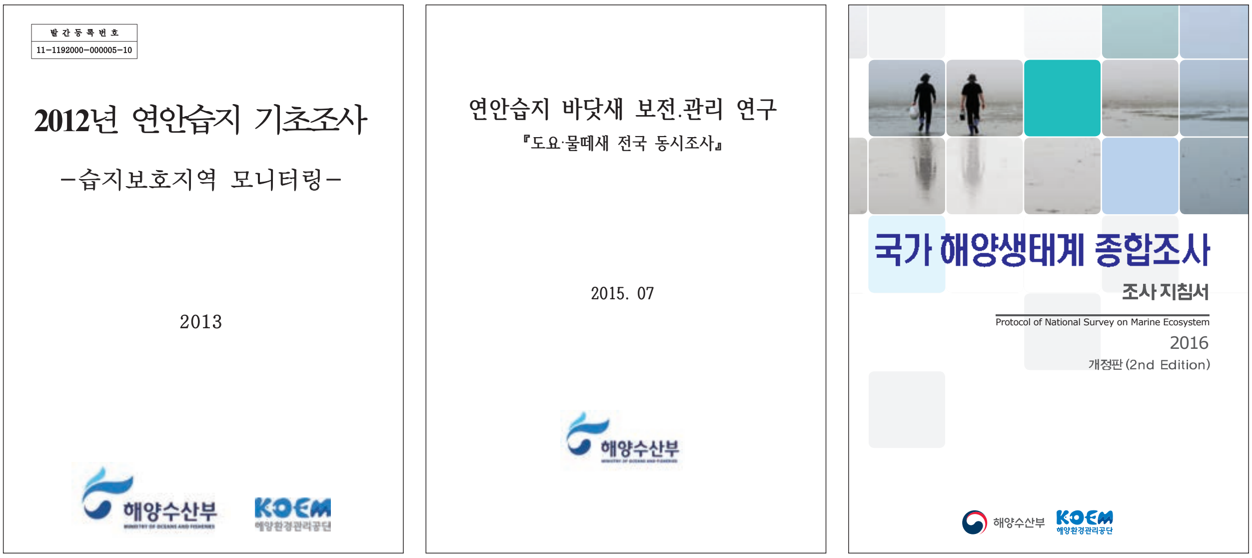
| Title | Year Published | Webpage URL |
|---|---|---|
| 2012 Basic Investigation of Coastal Wetlands and Wetland Protected Area Monitoring | 2013 | http://www.ecosea.go.kr/cwbs_report/datacenter/doc/datacenter01.do |
| 2013 Basic Investigation of Coastal Wetlands | 2014 | http://www.ecosea.go.kr/cwbs_report/datacenter/doc/datacenter01.do |
| 2014 Basic – Emergency Investigation of Coastal Wetlands | 2014 | http://www.ecosea.go.kr/cwbs_report/datacenter/doc/datacenter01.do |
| 2013 Basic Investigation of Coastal Wetlands: the inventory of tidal flats in ROK | 2014 | http://www.ecosea.go.kr/cwbs_report/datacenter/doc/datacenter01.do |
| 2015 National Investigation of Marine Ecosystems (I. the Tidal Flat Ecosystem) | 2015 | http://www.ecosea.go.kr/ecbs_synreport/datacenter/doc/datacenter08.do |
| 2015 National Investigation of Marine Ecosystems (II. the Coastal Ecosystem) | 2015 | http://www.ecosea.go.kr/ecbs_synreport/datacenter/doc/datacenter08.do |
| 2015 National Investigation of Marine Ecosystems (Emergency Investigation) | 2015 | http://www.ecosea.go.kr/ecbs_synreport/datacenter/doc/datacenter08.do |
| Research on the Conservation and Management of Waterbirds in Coastal Wetlands – Nationwide Investigation of shorebirds | 2015 | http://www.ecosea.go.kr/cwbs_report/datacenter/doc/datacenter01.do |
| 2016 National Investigation of Marine Ecosystems (I. the Tidal Flat Ecosystem) | 2017 | http://www.ecosea.go.kr/ecbs_synreport/datacenter/doc/datacenter08.do |
| 2017 National Investigation of Marine Ecosystems (I. the Tidal Flat Ecosystem) | 2018 | http://www.ecosea.go.kr/ecbs_synreport/datacenter/doc/datacenter08.do |

Table 6-7. List of management evaluation reports of Marine Protected Areas

| Title | Published Year | Webpage URL |
|---|---|---|
| 2011 Marine Protected Area Management Project Assessment | 2011 | http://www.ecosea.go.kr/mpainfo/datacenter/doc/datacenter06.do |
| 2012 Marine Protected Area Management Assessment | 2012 | http://www.ecosea.go.kr/mpainfo/datacenter/doc/datacenter06.do |
| 2013 Mid to Long-term Management Effectiveness Evaluation of Marine Protected Area | 2013 | http://www.ecosea.go.kr/mpainfo/datacenter/doc/datacenter06.do |
| 2014 Marine Protected Area Management Assessment | 2014 | http://www.ecosea.go.kr/mpainfo/datacenter/doc/datacenter06.do |
| 2015 Marine Protected Area Management Assessment | 2015 | http://www.ecosea.go.kr/mpainfo/datacenter/doc/datacenter06.do |
| 2016 Marine Protected Area Management Assessment | 2016 | http://www.ecosea.go.kr/mpainfo/datacenter/doc/datacenter06.do |

Table 6-8. List of the results of monitoring carried out by local municipalities

| Title | Published Year | Implementation Organization |
|---|---|---|
| The Establishment of Basic Research Direction of the Shinan Getbol and Basic Monitoring Plan for the Jeungdo Getbol | 2010 | Shinan County |
| Monitoring Report on the Shinan Archipelago Tidal Flat | 2013 | Shinan County |
| The 3rd Korea-Wadden Sea Joint Research on Tidal Flats – Comparative Study on Tidal Flat Monitoring | 2013 | Mokpo National University, Jeollanam-do Province, Ministry of Land, Transport and Maritime Affairs |
| Monitoring of Seasonal Changes in Topography and Geography of the Subtidal Zones of Island-type tidal flats during Winter | 2014 | Shinan County |




Left: Basic Research on Coastal Wetland-Monitoring on Wetland Protected Area (2013)
Middle: Research on Conservation and Management of Sea Birds in Coastal Wetland-National-Wide Census on Shorebirds (2015)
Right: Protocol of National Survey on Marine Ecosystem (2016)

**Figure 6-2.** Front covers of the reports on the tidal flat ecosystem monitoring results published at the national level


**Figure 6-3.** Marine Protected Areas management effectiveness evaluation (From left, 2011; 2012; 2016)

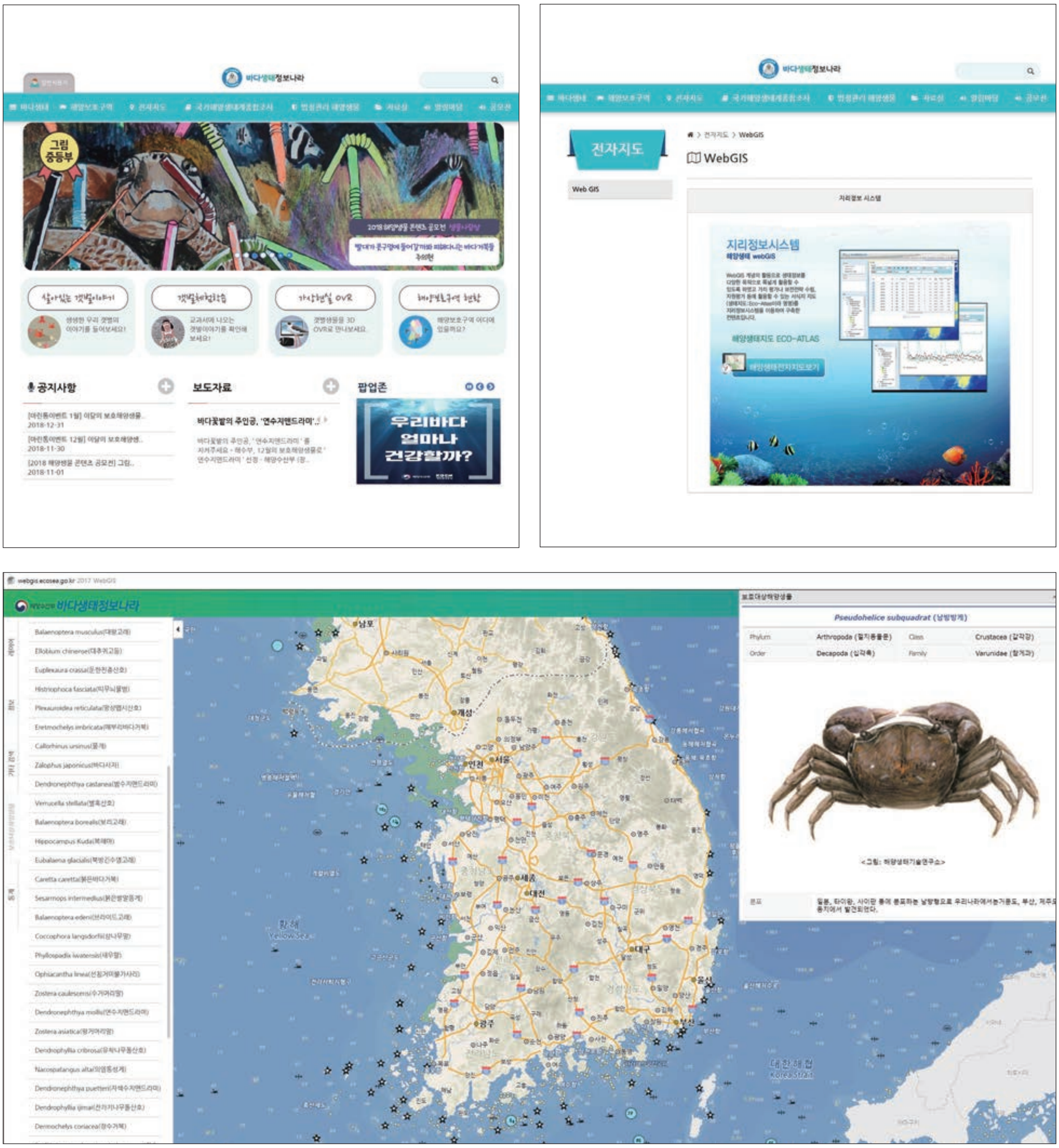



**Figure 6-4.** Web-GIS providing the result of the National Investigation of Marine Ecosystems

## Section 7

# Documentation

# Documentation

## 7.a Photographs and Audiovisual Image Inventory and Authorization Form

Table 7-1. The following table is a list of photographs and audiovisual images used or inserted in this nomination

| ID No. | Format | Caption | Year of Production | Author | Copyright Owner | Owner Contact | Non Exclusive Cession of Right |
|---|---|---|---|---|---|---|---|
| 2-1 | JPG | Representative scenery of the inner part of rocky island-type (archipelagic) mud flat in the nominated property (Shinan Getbol) | 2010 | World Heritage Promotion Team of Korean Tidal Flat | World Heritage Promotion Team of Korean Tidal Flat | World Heritage Promotion Team of Korean Tidal Flat | Approved |
| 2-19 | JPG | Mud octopus, keystone species, in muddy habitat | 2017 | Lim Hyun-sig | Muan County | Promotion Team | Approved |
| 2-23 | JPG | Dunlin (*Calidris alpine*) running with just-caught polychaete worm | 2015 | Park Dae-yong | Promotion Team | Promotion Team | Approved |
| 2-24 | JPG | Cockle (*Tegillarca granosa*) harvest in Boseong-Suncheon Getbol | 2014 | Boseong County | Promotion Team | Promotion Team | Approved |
| 2-25 | JPG | Fortunate scavenging mud snails (*Reticunassa festiva*) feed on full moon jelly fish (*Aurelia aurita*) during low tide | 2015 | Lim Hyun-sig | Promotion Team | Promotion Team | Approved |
| 2-26 | JPG | Polychaete worms dwelling in aerobic and anaerobic layer of the sediment | 2015 | Lim Hyun-sig | Promotion Team | Promotion Team | Approved |
| 2-30 | JPG | Common reed and *Suaeda japonica* community in Boseong-Suncheon Getbol | 2017 | Promotion Team | Promotion Team | Promotion Team | Approved |
| 2-31 | JPG | *Enteromorpha* growing abundantly on a rocky habitat in Gochang Getbol | 2014 | Lim Hyun-sig | Promotion Team | Promotion Team | Approved |
| 2-32 | JPG | Eurasian oystercatcher on Seocheon Getbol | 2014 | Jun Hung-tae | Promotion Team | Promotion Team | Approved |
| 2-34 | JPG | Spoon-billed sandpiper, critically endangered species (CR) on the IUCN Red List | 2014 | Go Gyung-nam | Promotion Team | Promotion Team | Approved |
| 2-35 | JPG | Milky fiddler crab (*Uca lactea*), endangered species in the nominated property | 2016 | Go Gyung-nam | Promotion Team | Promotion Team | Approved |

| ID No. | Format | Caption | Year of Production | Author | Copyright Owner | Owner Contact | Non Exclusive Cession of Right |
|---|---|---|---|---|---|---|---|
| 2-36 | JPG | Tiger crab (*Orithyia sinica*), an endemic species in the Yellow Sea | 2017 | Go Gyung-nam | Promotion Team | Promotion Team | Approved |
| 2-39 | JPG | A scenery of Yubudo Island intertidal flat in the Seocheon Getbol from the south. Wide mud flats are distributed in the inner part which are surrounded by spits and small islands. | 2017 | Promotion Team | Promotion Team | Promotion Team | Approved |
| 2-42 | JPG | A scenery of the northern Yubudo Island intertidal flat in Seocheon Getbol showing multiple swash bars and spits connected with islands. These are mostly used by migratory waterbirds as places for feeding and resting. | 2017 | Promotion Team | Promotion Team | Promotion Team | Approved |
| 2-44 | JPG | Eurasian oystercatcher, keystone species and NT on IUCN Red List, flying up after resting and feeding in Seocheon Getbol | 2017 | Promotion Team | Promotion Team | Promotion Team | Approved |
| 2-45 | JPG | Spoon-billed sandpiper (*Eurynorhynchus pygmeus*) in Seocheon Getbol | 2017 | Go Gyung-nam | Promotion Team | Promotion Team | Approved |
| 2-48 | JPG | A scenery of outer part in Gochang Getbol showing a curved chenier formed on the upper most tidal flat. Two islands of Daejukdo (right) and sojukdo are shown in the upper center | 2017 | Promotion Team | Promotion Team | Promotion Team | Approved |
| 2-50 | JPG | Lamp shell (*Lingula anatina*), living fossil in Gochang Getbol | 2016 | Lim Hyun-sig | Promotion Team | Promotion Team | Approved |
| 2-51 | JPG | Oriental stork (*Ciconia boyciana*), EN on IUCN Red List, in Gochang Getbol | 2013 | Go Gyung-nam | Promotion Team | Promotion Team | Approved |
| 2-56 | JPG | A picture of a sand-gravel string developed on Shinan Getbol. The second island from left side in Galwooseom Island from which the formation of snad-gravel string seem to be started. | 2016 | Shinan County | Promotion Team | Promotion Team | Approved |
| 2-57 | JPG | A scenery of Shinan Getbol, showing archipelagic feature and tidal channels near Aphaedo and Goido islands | 2013 | Promotion Team | Promotion Team | Promotion Team | Approved |
| 2-58 | JPG | Various and complicated patterns of tidal gully networks on the inner mud flats of Shinan Getbol | 2013 | Shinan County | Promotion Team | Promotion Team | Approved |
| 2-60 | JPG | Various shapes of tidal gullies in the inner part of Shinan Getbol | 2017 | Promotion Team | Promotion Team | Promotion Team | Approved |
| 2-61 | JPG | Marshfire glasswort (*Salicornia europaea*) community in Shinan Getbol | 2017 | Promotion Team | Promotion Team | Promotion Team | Approved |
| 2-62 | JPG | An inner mud flat with a small sand spit and ebb-tide road in Jeungdo Island of Shinan Getbol | 2017 | Shinan County | Promotion Team | Promotion Team | Approved |

| ID No. | Format | Caption | Year of Production | Author | Copyright Owner | Owner Contact | Non Exclusive Cession of Right |
|---|---|---|---|---|---|---|---|
| 2-63 | JPG | School of Japanese mud crab (*Macrophthalmus japonica*) on mud flat habitat in Shinan Getbol | 2013 | Go Gyung-nam | Promotion Team | Promotion Team | Approved |
| 2-64 | JPG | Chinese egret (*Egretta eulophotes*), EN on IUCN Red List, in Bigeumdo and Dochodo islands of Shinan Getbol | 2014 | Go Gyung-nam | Promotion Team | Promotion Team | Approved |
| 2-65 | JPG | Great knot (*Calidris tenuirostris*), EN on IUCN Red List in Jeungdo Island of Shinan Getbol | 2013 | Go Gyung-nam | Promotion Team | Promotion Team | Approved |
| 2-68 | JPG | Tidal gullies and salt marshes in Boseong-Suncheon Getbol | 2017 | Promotion Team | Promotion Team | Promotion Team | Approved |
| 2-69 | JPG | Salt marsh and common reed community in Suncheon area | 2015 | Suncheon City | Promotion Team | Promotion Team | Approved |
| 2-71 | JPG | Hooded crane (*Grus monacha*), VU on IUCN Red List, in Boseong-Suncheon Getbol | 2014 | Suncheon City | Promotion Team | Promotion Team | Approved |
| 2-73 | JPG | Joint harvesting by local residents through fishing village cooperative | 2006 | Go Gyung-nam | Promotion Team | Promotion Team | Approved |
| APP 1-2 | JPG | 「Getbol, Korean Tidal Flat」 World Heritage Inscription, Protection and Management MOA Signing | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 000-001 | JPG | Seocheon Getbol | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 000-002 | JPG | Yubudo Island, Seocheon Getbol (1) | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 000-003 | JPG | Yubudo Island, Seocheon Getbol (2) | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 001-001 | JPG | Daejukdo Island, Gochang Getbol | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 001-002 | JPG | Gochang Getbol | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 001-003 | JPG | Jukdo Island, Gochang Getbol | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 002-001 | JPG | Sunset at Shinan Getbol | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 002-002 | JPG | Okdo Island, Shinan Getbol | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 002-003 | JPG | Hauido Island, Shinan Getbol | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 002-004 | JPG | Daegwang sand beach in Imjado Island, Shinan | 2015 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 002-005 | JPG | Galwooseom Island tidal flat, Shinan Getbol | 2015 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 003-001 | JPG | Jangdo Island, Boseong | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 003-002 | JPG | Boseong-Suncheon Getbol | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |

| ID No. | Format | Caption | Year of Production | Author | Copyright Owner | Owner Contact | Non Exclusive Cession of Right |
|---|---|---|---|---|---|---|---|
| ADD. 003-003 | JPG | Spring in Suncheonman Bay | 2014 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 003-004 | JPG | Summer in Suncheonman Bay | 2014 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 003-005 | JPG | Autumn in Suncheonman Bay | 2014 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 003-006 | JPG | Winter in Suncheonman Bay | 2014 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 004-001 | JPG | Complex tidal gullies in the nominated property | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 004-002 | JPG | Getbol's vitality during Winter (1) | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 004-003 | JPG | Getbol's vitality during Winter (2) | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 004-004 | JPG | Wild waves of typhoons in summer (1) | 2014 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 004-005 | JPG | Wild waves of typhoons in summer (2) | 2014 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 005-001 | JPG | Spoon-billed sandpiper | 2016 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 005-002 | JPG | Black-faced spoonbill | 2015 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 005-003 | JPG | Great knots and Bar-tailed godwits | 2015 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 005-004 | JPG | Dance of Great knots, Bar-tailed godwits and Gray plovers | 2015 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 005-005 | JPG | Sandpipers and Plovers (Far eastern curlew, Eurasian oystercatcher) | 2015 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 005-006 | JPG | Community of East Asian seepweed and Hooded cranes | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 005-007 | JPG | Sanderling hunting for worms | 2016 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 005-008 | JPG | Mud hopper and Japanese mud crab | 2014 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 005-009 | JPG | Japanese mud crab | 2014 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 005-010 | JPG | Halophytes (1) | 2015 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 005-011 | JPG | Halophytes (2) | 2015 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 006-001 | JPG | Traditional catchment of Mud octopus | 2012 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 006-002 | JPG | Macroalgae catchment in rocky substrate | 2012 | Promotion Team | Promotion Team | Promotion Team | Approved |
| ADD. 007-001 | MP4 | Introduction video clip of the nominated property | 2018 | Promotion Team | Promotion Team | Promotion Team | Approved |

# 7.b Texts Relating to Protective Designation, Copies of Property Management Plans or Documented Management Systems and Extracts of Other Plans Relevant to the Property

### Acts

- Wetlands Conservation Act, Ministry of Environment, 1999
- Public Waters Management and Reckamation Act, Ministry of Ocean and Fisheries, 2010
- National Land Planning and Utilization Act, Ministry of Land, Infrastructure and Transport, 2002
- Environmental Impact Assessment Act, Ministry of Environment, 1993
- Natural Parks Act, Ministry of Environment, 1980
- Cultural Heritage Protection Act, Cultural Heritage Administration, 1962
- Marine Environment Management Act, Ministry of Ocean and Fisheries, 2007
- Conservation and Management of Marine Ecosystems Act, Ministry of Ocean and Fisheries, 2007

### Plans Set by Acts

- The First Basic Plan for Marine Ecosystem Preservation and Management (2009-2018), Ministry of Ocean and Fisheries, 2009
- The Second Basic Plan for Wetlands Conservation (2013-2017), Ministry of Environment and Ministry of Ocean and Fisheries, 2012
- The First Plan for Dadohae Marine National Park Conservation and Management (2013-2022), Ministry of Environment, 2012
- Action Plan for Shinan Getbol Provincial Park (2016-2026), Jeollanam-do Province, 2016
- Action Plan for Beolgyo Getbol Provincial Park (2017-2026), Jeollanam-do Province, 2016

- The Preservation Plan for the Tidal Flats in the Jeungdo Island, Shinan County, 2011
- The Preservation Plan for the Wetland Protected Areas in Bigeumdo/Dochodo islands, Shinan County, 2016
- The Preservation Plan for the Wetland Protected Areas in the Seocheon Tidal Flat, Seocheon County, 2009
- The Plan to Conserve the Wetland Protected Areas in the Gochang Tidal Flat, Gochang County, 2013
- The Preservation Plan for the Wetland Protected Areas in Boseong County, Boseong County, 2016
- The Management Plan for Wetland Protected Areas in Suncheonman Bay Tidal Flat, Suncheon City, 2005
- The Plan for scenic spots (Suncheonman Bay) Preservation and Management, Suncheon City, 2015

## Municipal Ordinances

- Ordinance on the Establishment and Operation of the Committee of the Wetland Protected Area Conservation and Management, Seocheon County, 2010; Gochang County, 2010; Shinan County, 2012; Boseong County, 2007
- Ordinance on Support of Nature and Environment Interpreter, Seocheon County, 2013
- Ordinance on the Conservation and Management for Suncheonman Bay Wetland and Relevant Support Projects, Suncheon City, 2014
- Ordinance on Suncheonman Bay Wetland Operations, Suncheon City, 2015

# 7.c Form and Date of Most Recent Records or Inventory of Property

Table 7-2. Category and released year of recent records

| Title | Year | Category | Language |
|---|---|---|---|
| The Basic Survey of Coastal Wetland (2008-2012) | 2008 | Report | Korean |
| The Basic Plan for the Inscription of Tidal Flats and Salt Ponds on the South and West Coast of ROK into the World Heritage List | 2012 | Report | Korean |
| The Comparative Survey of the Outstanding Universal Value of Tidal Flats on the South and West Coast of ROK, Heritage Area and Heritage Type Confirmation | 2012 | Report | Korean |
| Halophytes and Vegetation in Wetland Protected Area in Seocheon Getbol | 2013 | Report | Korean |
| Monitoring on Seasonal Changes in the Topography and Geology of Subtidal Zones of Island Flats during Winter – Division Setting of Management Regions and Development of Survey Station System | 2014 | Report | Korean |
| National Investigation of Marine Ecosystem (the West Sea and the West of the South Sea) | 2015 | Report | Korean |
| The Report of Domestic Academic Symposium on the Inscription of Tidal Flats on the South and West Coast of ROK into the World Heritage List | 2015 | Report | Korean |
| The Report of International Academic Symposium on the Inscription of Tidal Flats on the South and West Coast of ROK into the World Heritage List | 2015 | Report | Korean |
| The Ecological Study on the Preservation and Management of the Tidal Flat Ecosystem | 2009 | Academic Thesis | Korean |
| The Current Environmental and Ecologic Status of the Coast of the Suncheonman Bay and the Analysis of World Heritage Inscription Criteria | 2013 | Academic Thesis | Korean |
| The Study on the Protection and Management System for Tidal Flats on the South and West Coast of ROK to be Inscribed into the World Heritage List | 2015 | Academic Thesis | Korean |
| The Chance of the Inscription of Tidal Flats on the South and West Coast in ROK into World Natural Heritage | 2016 | Academic Thesis | Korean |
| The Analysis of the Conservation and Management System of Tidal Flats on the South and West Coast of ROK and Development Direction | 2012 | Academic Sourcebook | Korean |
| The International Comparative Study for the Inscription of Tidal Flats on the South and West Coast of ROK into the World Heritage List | 2012 | Academic Sourcebook | Korean |
| The Academic Sourcebook of International Symposium on the Inscription of Tidal Flats on the South and West Coast in ROK into the World Heritage | 2013 | Academic Sourcebook | Korean |
| Comparative Analysis of Tidal Flats | 2015 | Academic Sourcebook | Korean / English |

| Title | Year | Category | Language |
|---|---|---|---|
| The Academic Sourcebook of Domestic Symposium on the Inscription of Tidal Flats on the South and West Coast in ROK into the World Heritage | 2015 | Academic Sourcebook | Korean |
| The Academic Sourcebook of International Symposium on the Inscription of Tidal Flats on the South and West Coast in ROK into the World Heritage | 2015 | Academic Sourcebook | Korean |
| The Biodiversity of Shinan Tidal Flat and Yubudo Island Tidal Flat | 2015 | Academic Sourcebook | Korean / English |
| The Community-based Protection and Management of World Heritage | 2015 | Academic Sourcebook | Korean / English |
| The Efforts to Inscribe the Shinan Archipelago Tidal Flat on the World Heritage List | 2015 | Academic Sourcebook | Korean / English |
| The New Understanding of the Tidal Flat and its Culture | 2015 | Academic Sourcebook | Korean / English |
| The Preservation and Utilization Case of the Suncheonman Bay | 2015 | Academic Sourcebook | Korean / English |
| The Protection and Management of Tidal Flats on the South and West Coast of ROK and Future Roadmap | 2015 | Academic Sourcebook | Korean / English |
| The Study on Topography and Geology of Shinan Getbol and Yubudo Island Tidal Flat | 2015 | Academic Sourcebook | Korean / English |
| The Topographic and Geologic Survey of the Island Tidal Flats for the Inscription on the UNESCO World Heritage List | 2015 | Academic Sourcebook | Korean / English |
| The Academic Sourcebook of 2016 International Symposium on the Inscription of Tidal Flats on the South and West Coast in ROK on the World Heritage List | 2016 | Academic Sourcebook | Korean |
| The Intertidal Zones of the Yellow Sea within the East Asian-Australasian Flyway as an Important Bottleneck Site for Migratory Birds | 2016 | Academic Sourcebook | Korean / English |
| The Outstanding Universal Value of Tidal Flats on the South and West Coast of ROK and its Chance to be Inscribed on the World Heritage List | 2016 | Academic Sourcebook | Korean / English |
| The Topographic and Geologic Comparison between Tidal Flats in the Wadden Sea and Korean Tidal Flats | 2016 | Academic Sourcebook | Korean / English |
| The Topographic and Geologic Outstanding Universal Value (OUV) of Tidal Flats on the South and West Coast of ROK | 2016 | Academic Sourcebook | Korean / English |
| The Value of Tidal Flats on the South and West Coast of ROK as World Heritage site and its Biodiversity | 2016 | Academic Sourcebook | Korean / English |

# 7.d Address where inventory, records and archives are held

| Organization | Department | Address |
|---|---|---|
| Cultural Heritage Administration | World Heritage Division | Government Complex-Daejeon, 189, Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea<br>Tel: +82-42-481-3180 |
| World Heritage Promotion Team of Korean Tidal Flat | | 4F, Jeollanam-do Business Agency, 2 Oryong-3gil, Samhyang-eup, Muan-gun, Jeollanam-do, 58564, Republic of Korea<br>Tel: +82-61-246-3356 |
| Ministry of Oceans and Fisheries | Marine Ecology Division | Sejong Government Complex, 94, Dasom 2ro, Sejong, 30110, Republic of Korea<br>Tel: +82-44-200-5310 |
| Korea Marine Environment Management Corporation | | 28, Songpa-daero 28-gil, Songpa-gu, Seoul, 05718, Republic of Korea<br>Tel : +82-2-3498-8715 |
| Korea National Park Service | | 22, Hyoksin-ro, Wonju-si, Gangwon-do, 26466, Republic of Korea<br>Tel: +82-33-769-9300 |
| Chungcheongnam-do Province | Division of Culture, Sports and Tourism | 21, Chungnam-daero, Hongbuk-myeon, Hongseong-gun, Chungcheongnam-do, 32255, Republic of Korea<br>Tel: +82-41-635-2450 |
| Jeollabuk-do Province | Division of Culture, Sports and Tourism | 225, Hyoja-ro, Wansan-gu, Jeonju-si, Jeollabuk-do, 54968, Republic of Korea<br>Tel : +82-63-280-3150 |
| Jeollanam-do Province | Division of Tourism, Culture and Sports | 1, Oryong-gil, Samhyang-eup, Muan-gun, Jeollanam-do, 58564, Republic of Korea<br>Tel: +82-61-286-5310 |
| Seocheon County | Department of Tourism and Festival | 57, Guncheong-ro, Seocheon-eup, Seocheon-gun, Chungcheongnam-do, 33638, Republic of Korea<br>Tel: +82-41-950-4470 |
| Gochang County | Department of Culture, Heritage and Tourism | 245, Jungang-ro, Gochang-eup, Gochang-gun, Jeollabuk-do, 56428, Republic of Korea<br>Tel: +82-63-560-2441 |
| Shinan County | Department of World Heritage | 1004, Chunsaro, Aphae-eup, Shinan-gun, Jeollanam-do, 58827, Republic of Korea<br>Tel: +82-61-240-8174 |
| Boseong County | Department of Culture and Tourism | 165, Songjae-ro, Boseong-eup, Boseong-gun, Jeollanam-do, 59455, Republic of Korea<br>Tel: +82-61-850-5200 |
| Suncheon City | Department of Culture and Art | 30, Jangmyeong-ro, Suncheon-si, Jeollanam-do, 57956, Republic of Korea<br>Tel: +82-61-749-6788 |

# 7.e Bibliography


Allard, M., Fortier, R. and Seguin, M.K., 1992, The thermal regime of intertidal permafrost, George River estuary, Ungava Bay, Quebec, Canada, Journal of Earth Science, v.29, p.249-259.

Amos, C.L. and Long, B.F.N., 1980, The sedimentary character of the Minas Basin, Bay of Fundy, In: McCann, S.B. (Eds.), The coastline of Canada, Can. Geol. Surv., Paper 80-10ß, p.153-180.

Baek, Y.S. and Chun, S.S., 2004, Depositional characteristics and seasonal change of surface sediment and sedimentary structure on the Doouri tidal flat, southwestern coast of Korea, Korean Journal of Petroleum Geology, v.10, p.10-17.

Baek, Y.S. and Chun, S.S., 2008, Thick summer mud-flat and winter sand-flat dominancy controlled by monsoonal waves on the open-coast Doowoori tidal flat, Korea, Proceedings of 7th International Conference on Tidal Environments, Sept. 25-27, 2008, Qingdao, China, p.55-56.

Baek, Y.S. and Chun, S.S., 2010, Preliminary Study on the Formation of Fluid-Mud Layer during summer in the Doouri Open-coast Tidal Flat, Southwestern Korea, Journal of the Geological Society of Korea, v.46, p.291-303.

Baek, Y.S., Chun, S.S. and Shin, S.J., 2009, Seasonal Variation of Sedimentary Structures and Ichnofacies in the Doouri Open-coast Tidal Flat, Southwestern Korea, Journal of the Geological Society of Korea, v.45, p.187-208.

Baek, Y.S., Chun, S.S., Chang, T.S. and Kim, J.K., 2018, The role of fluid mud in the formation of extensive mud sheets during summer on the Duuri macrotidal flat, west coast of Korea, Geosciences Journal 1, v.22, p.19-22

Baek, Y.S., Kim, J.K. and Chun, S.S., 2010, Seasonal sedimentation of intertidal flat revealed by distribution of ichnofacies: Southern tidal flat (Yeochari) of Gangwha Island, Journal of the Geological Society of Korea, v.46, p.661-674.

Baek, Y.S., Kim, J.K. and Chun, S.S., 2016, Spatio-temporal zonation by ichnocoenoses combined with sedimentary facies in the Yeochari tidal flat (Ganghwa Island), the Han River estuary of Korea, Geosciences Journal, v.20, p.295-309.

Bai, Q. Q., Chen, Y. and Choi, C. Y., 2012, Southward migration phenology and impacts of aquaculture on shorebirds at the Dandong Yalu Jiang Estuarine Wetland National Reserve, Liaoning, China, Oriental Bird Club Conservation Grant Final Report, p.1-33.

Baptist, M.J. 2015. The comparative analysis for the Getbol-Advice on methodology, The 2nd International Workshop for World Heritage, Seocheon, Korea, May 1-2, 2015, Proceedings, p.115-130.

Bartsch-Winkler, S., Ovenshine, A.T., 1984, Macrotidal subarctic environment of Turnagain and Knik Arms, Cook Inlet, Alaska: sedimentology of the intertidal zone, J. Sediment. Petrol., v.54, p.1221-1238.

Beeftink, W.G., 1977, The coastal salt marshes of Western and Northern European ecological and phytosociological approach, In Wet Coastal Ecosystem, V.J. Chapman (Eds.), Elsevier, Amsterdam, p.109-155.

Bettina, S. and Gerd, L., 2012, Microphytobenthic dynamics in a Wadden Sea intertidal flat – Part II: Seasonal and spatial variability of non-diatom community components in relation to abiotic parameters, Eur. J. Phycol., v.47(2), p.120-137.

Bird, E.C.F., 1985, England and Wales, In: Bird, E.C., Schwartz, M.L. (Eds.), The World's Coastline, Van Nostrand Reinhold, New York, p.359-369.

BirdLife, "Sundarbans", http://datazone.birdlife.org/site/factsheet/18464

Brabets, T.P., 1997, Geomorphology of the lower Copper River, Alaska, Denver: U.S. Geological Survey Professional Paper, p.89.

Cadee, G.C. and Hegeman, J., 1974, Primary production of the benthic microflora living on tidal flats in the Dutch Wadden Sea, Neth. J. Sea Res., v.8, p.260-291.

Carlson, R.J., Baichtal J.F., ,2015, A predictive model for locating early Holocene archaeological sites based on raised shell-bearing strata in southeast Alaska, USA, Geoarchaeology, v.30, p.120-138.

Chang, D.J. and Kim, D.A., 2003, Characteristics by the Behavior and Habits of the Common Octopus (*Octopus minor*), J. Kor. Fish. Soc., v.36(6), p.735-742.

Chang, J.H., Chun, S.S., Kwon, S.J., Shin, D.H., Han, S.J. and Park, Y.A., 1993, Sedimentary Characteristics and Evolution History of Chenier, Gomso-bay Tidal Flat, Western Coast of Korea, The Journal of the Oceanological Society of Korea, v.28, p.212-228.

Chang, T.S. and Chun S.S., 2012, Micro-characteristics of sustained, fine-grained lacustrine turbidites in the Cretaceous Hwangsan Tuff, SW Korea, Geosciences Journal, v.16(4), p.409-420.

Chang, T.S., Flemming B.W., Tilch, B.E., Bartholomae, A. and Ralf W., 2006, Late Holocene stratigraphic evolution of a back-barrier tidal basin in the East Frisian Wadden Sea, southern North Sea: transgressive deposition and its preservation potential, v.52, p.329-340.

Chang, T.S., Ha, H.J. and Chun, S.S., 2015, Factors controlling mud accumulation in the Heuksan mud belt off southwestern Korea, Geo-Marine Letters, v.35, p.461-473.

Chang, T.S., Hong, S.H., Chun, S.S. and Choi, J.H., 2017, Age and morphodynamics of a sandy beach fronted by a macrotidal mud flat along the west coast of Korea: a lateral headland bypass model for beach-dune formation, Geo-Marine Letters, v.37, p.361-371.

Chapman, V.J., 1942, The new perspective in the halophytes, Quart. Rev. Biol., v.17, p.291-311.

Chapman, V.J., 1964, Coastal vegetation, McMillan Co., New York, p.245.

Chapman, V.J., 1977, Wet coastal ecosystems, Elsevier Scientific Publishing Co., New York, p.428.

Chevane, C.M., Penven, P., Nehama, F.P.J. and Reason, C.J.C., 2016. Modelling the tides and their impacts on the vertical stratification over the Sofala Bank, Mozambique, Africa, Journal of Marine Science, v.38, p.465-479.

Chonnam National University, 2008, Investigation of damage of fishery right by Construction of expressway Beolgyo Bridge, Process Report, p.263-273.

Choudhury, A., Bhunia, A.B. and Nandi, S., 1984, Preliminary Survey of Macrobenthos of Prentice Island, Sundarbans, West Bengal, Rec. Zool. Surv., India, v.81(3&4), p.81-92.

Chough, S.K., 2013, Geology and Sedimentology of the Korean Peninsula, Elsevier, p.363.

Chough, S.K., Lee, H.J. and Yoon, S.H., 2000, Marine Geology of Korean Seas, Elsevier, p.313.

Chough, S.K., Lee, H.J., Chun, S.S. and Shinn, Y.J., 2004, Depositional processes of late Quaternary sediments in the Yellow Sea: a review, Geosciences Journal, v.8, p.211-264.

Chowns, T.M., 2006, Quaternary stratigraphy and depositional environments: Jekyll island and the golden isles parkway, 41st Annual Field Trip of the Georgia Geological Society, p.108.

Chun, S.S., 2003a, Sedimentation and Holocene evolution of macrotidal-flat depositional system in the southwestern coasts of Korean Peninsula, Invited Special Talk in 1st symposium of Sedimentological Society of Japan, Tokyo, Japan, Apr. 26-28, 2003, Proceedings, p.14-18.

Chun, S.S., 2003b, Sedimentation and Holocene evolution of macrotidal-flat depositional system in the southwestern open coasts of Korean Peninsula, Workshop on Sedimentation in the Yellow Sea Coasts, Seoul, Korea, Oct. 30-31, 2003, Proceedings, p.281-300.

Chun, S.S., 2004, The importance of salt marsh-lessons from artificial salt marshes and dykes, Journal of Korean Wetlands Society, v.6, p.10-17.

Chun, S.S., 2005, Characteristics of tidal flats and their active conservation way in the western coast of the Korean Peninsula, International Symposium for Hosting 2008 RAMSAR COP10, Changwon, Korea, Oct. 17-18, 2005, Proceedings, p.135-159.

Chun, S.S., 2006a, Monsoonal sedimentation on an open-coast macrotidal flat, southwestern Korea: summer tidal flat - winter shoreface, The 5th International Symposium on Terrestrial Environmental Changes in East Eurasia and Adjacent Areas, Nagoya, Japan, Dec. 5-9, 2006, Abstract, p.8-9.

Chun, S.S., 2006b, Tidal flats in the western coast of Korea: open-coast, embayed and estuarine intertidal flats, International Symposium on Regional Wetland Issue in Asia and Preparation of the Ramsar COP10, Nov. 30-Dec. 1, 2006, Changnyeng, Korea, Proceedings, p.67-80.

Chun, S.S., 2007, Monsoonal sedimentation and sequential pattern on an open-coast macrotidal flat, southwestern Korea, The 7th International Symposium on the Marine Sciences of the Yellow Sea and East China Sea, Incheon, Korea, Oct. 12-14, 2007, Proceedings, p.151-153.

Chun, S.S., 2008a, Sedimentation and Holocene evolution of sequential pattern on an open-coast macrotidal Flats, southwestern Korea, 2008 World Wetland Day: Commemorative International Symposium, Korean Wetland Society, Seocheon, Korea, Feb. 1, 2008, Proceedings, p.3-19.

Chun, S.S., 2008b, Short Thinking about Targets and Direction of Tidal-Flat Restoration in Korea, International Symposium, Recent Progress on the Coastal Wetland Restoration, Sept. 8-9, 2008, Seoul, Korea, Proceedings, p.59-80.

Chun, S.S., 2008c, The coasts of the Korean Peninsula, In: Asia-Pacific Coasts and Their Management, Springer, p.262-268.

Chun, S.S., 2011a, Depositional Characteristics and Long-term Change of the Western Tidal Flats of Korea, The 3rd Wadden Sea - Korea Joint Monitoring, Sept. 26-27, 2011, Mokpo, Korea, Proceedings, p.173-196.

Chun, S.S., 2011b, Sedimentology and Geomorphology of Korean Tidal Flats, The 3rd Wadden Sea - Korea Joint Monitoring, Sept. 26-27, 2011, Mokpo, Korea, Proceedings, p.123-156.

Chun, S.S., 2013, Geological Characteristics of Tidal Flats along the Southwestern Coast of Korean Peninsula, Geoheritage International Workshop, Sept. 14-15, 2013, Mokpo, Korea, Proceedings, p.129-158.

Chun, S.S., 2018, The macrotidal flats in the southwestern coast of Korea: classification, characteristics and uniqueness, 2018 Western Pacific Sedimentology Meeting, Gwangju Korea, March 19-20, Proceedings, p.1-8.

Chun, S.S. and Kim, J.K., 2004, Depositional processes and evolution of open-coast macrotidal settings in the southeastern coast of Yellow Sea, 2nd Symposium on Geological and Geophysical Feature of Yellow Sea (China-Korea), Beijing, China, Sept. 15-16, 2004, proceedings, p.26-33.

Chun, S.S. and Kim, J.K., 2006, Environmental change in coastal area by the longest dyke in the world, 17th International Sedimentological Congress, Fukuoka, Japan, Aug. 27-Sept. 1, 2006, v.B., S-077, p.31.

Chun, S.S. and Kim, J.K, 2013, Depositional characteristics and long-term change of the Macrotidal Flats, Korean Yellow-Sea Coast, 4th China-Korea Symposium on Ocean Science and Technology, Qingdao, China, Aug. 29, 2013, Proceedings, p.8-10.

Chun, S.S. and Lee, H.J., 1998, Transgressive, coarsening-upward sequences of wave-dominated macrotidal flat in the southwestern coast of Korea: role of landward migrating sand ridges on the Holocene evolution, 15th International Sedimentological Congress, Alicante, Spain, Apr. 12-17, 1998, Proceedings, p.256-257.

Chun, S.S. and Lim, H.S., 2009, Korean Getbol Monitoring and its Relation to the Policy Formation, The 1st Joint Workshop, Memorandum of Understanding Wadden Sea-Korea, Ministry of Land, Transport and Maritime Affairs and Common Wadden Sea Secretariat, Mokpo, Korea, Oct. 19-20, 2009, Proceedings, p.133-150.

Chun, S.S. and Yang, B.C., 1998, Mud-flat sedimentation on the wave-dominated macrotidal flat in the southwestern coast of Korea: long- and short-term processes related to both sea-level rise and monsoon, The 5th International conference on cohesive sediment transport, Seoul, Korea, May 26-30, 1998, Proceedings, p.10-11.

Chun, S.S. and Yang, B.C., 2004, Sedimentation and Holocene evolution of wave-dominated, macrotidal-flat depositional system in the southwestern open coasts of Korean Peninsula, Journal of Sedimentological Society of Japan, No.58, p.65-83.

Chun, S.S., Baek, Y.S. and Jang D.G., 2010, Transport behavior of spring-summer high concentration suspended sediment and formation of summer mud flat in the Doouri open-coast tidal flat, Southwestern Korea, 18th International Sedimentological Congress, Mendoza, Argentina, Sept. 26-Oct. 1, 2010, Proceedings, p.799.

Chun, S.S., Kim, J.K. and Baek, Y.S., 2007, Sedimentological characteristics and long-term change of Korean tidal flats, International Symposium on Improved Coastal Wetland Management, Suncheon, Korea, May 29-30, 2007, Proceedings, p.21-33.

Chun, S.S., Kim, J.K. and Choi, S.J., 2006, Comparison of Seasonal and Long-term Sedimentation between Mankyung River Estuary and Gomso-Bay Embayed Tidal Flat, South Korea, International Conference on Deltas, Darussalam, Burnei, Jan. 13-18, 2006, Abstracts, p.8.

Chun, S.S., Kim, J.K., Baek, Y.S. and Choi, K.S., 2007, Tidal flats in the Western Coast of Korea: Open-coast, Embayed and Estuarine Intertidal Flats, 2007 KSRG/KSPG Field Guide Book, Korean Sedimentology Research Group, p.158.

Chun, S.S., Kim, J.K., Baek, Y.S., Yang, B.C., Choi, K.S. and Dalrymple, R.W., 2006, Tidal flats in the Western Coast of Korea: Open-coast, Embayed and Estuarine Intertidal Flats, ISC-2006 Guide Book, Field Trip FE-A16, International Association of Sedimentologists, p.85.

Chun, S.S., Kim, J.K., Moon, K.O., Woo, K.S., Son, C.S., Yoon, H.H. and Chang, D.., 2015, Sedimentation and Holocene evolution of archipelago tidal flats in SW Korea, Tidalites 2015, 9th International Conference on Tidal Sedimentology, Puerto Madryn, Argentina, Nov. 17-20, 2015, Proceedings 35-37.

Chun, S.S., Kim, J.K., Yang, B.C., Baek, Y.S. and Dalrymple, R.W., 2004, Summer-Typhoon Deposits on the Baeksu Open-coast Tidal Flat: Comparison in Sedimentary Facies, Size and Preservation Potential with Winter-Storm Deposits, 6th Int'l. Con. on Tidal Sedimentology, Copenhagen, Denmark, Aug. 2-5, 2004, Proceedings, p.36-37.

Chun, S.S., Lee, H.J., Ryu, S.O. and Yang, B.C., 1998, Seasonal and local variation of sedimentation on the wave-dominated tidal flats, southwestern coast of Korea: comparison between inner-bay and open tidal flats, 15th International Sedimentological Congress, Alicante, Spain, Apr. 12-17, 1998, Abstracts, p.257.

Chun, S.S., Lee, H.J., Shin, D.H., Yoo, H.R. and Han, S.J., 1992, Sedimentological implications of vertical and lateral facies changes in the modern, non-barred macrotidal flats of the west coast of Korea, 3rd Int'l. Res. Sym., Tidal Clastics 92, Willhelmshaven, Germany, Cour. Forsch.-Inst., Senckenberg, v.151, p.16-18.

Chun, S.S., Yang, B.C. and Dalrymple, R.W., 2002a, Seasonal change of sedimentation and Preservation Potential in the Open-coast Intertidal Flats, Southwestern Coast of Korea: Summer Tidal Flat and Winter Shoreface, Int'l. Conf. on Tidal Dynamics and Environment, Hangzhou, China, Aug. 8-13, 2002, Proceedings, p.12-13.

Chun, S.S., Yang, B.C. and Dalrymple, R.W., 2002b, Seasonal change of sedimentation on the Baeksu open-coast intertidal flat, southwestern coast of Korea: summer tidal flat and winter shoreface, 16th International Sedimentological Congress, Johannesburg, South Africa, July 8-12, 2002, Proceedings, p.65.

Chun, S.S., Yang, B.C., Dalrymple, R.W., and Kim, J.K., 2008, Consistent Variation of Sedimentation and Sequential Pattern within a Macrotidal Embayed Tidal Flat, Gomso Bay, Korea, 7th International Conference on Tidal Environments, Qingdao, China, Sept. 25-27, 2008, Proceedings, p.23-24.

Chun, S.S., Yang, B.C., Kim, J.K. and Baek, Y.S., 2004, Comparison in depositional characteristics and preservation potential between winter storm and summer typhoon deposits in the open-coast tidal-flat setting, 5th Int'l. Conf. on Asian Marine Geology and IGCP-475 Delta Map, Bangkok, Thailand, Jan. 13-18, 2004, Proceedings, p.37-38.

Chun, S.S., Yang, B.C., Lee, I.T. and Lee, H.J., 2000, Non-barred, open macrotidal flats strongly influenced by wave action, Gomso Bay and Baeksu coast, southwestern Korea: depositional processes, seasonal evolution and transgressive stratigraphy, Tidalite 2000 - 5th International Conference on Tidal Environments, Seoul, Korea, Field Trip B2 Guide Book, June 12-14, 2000, p.101.

Chung, S.O., Cho, Y.S., Choi, H.D., Jeung, J.H. and Han, H.K., 2015, Spatio-temporal microalgal and environmental variation of the Hajeonri tidal flat, Gochang, Korea, Korean J. Environ. Ecol., v.29(5), p.743-752.

Conway, K.W., Barrie, J.V., Picard, K. and Bornhold, B.D, 2012, Submarine channel evolution: active channels in fjords, British Columbia, Canada, Geo-Mar. Lett., v.32(4), p.301-312.

Cook, P.J. and Mayo, W., 1977, Sedimentology and Holocene history of a tropical estuary, Broad Sound, Queensland, BMR Geol. Geophys., Bull., v.17, p.206.

Cruz, O., Coutinho, P.N., Duarte, G.M., Gomes, A. and Muehe, D., 1985, Brazil In: Bird, E.C., Schwartz, M.L. (Eds.), The World's Coastline. Van Nostrand Reinhold, New York, p.85-91.

Cummings, D.I., Dalrymple, R.W., Choi, K.S. and Jin, J.H., 2016, The tide-dominated Han River delta, Korea, Elsevier, p.376.

CWSS (Common Wadden Sea Secretariat), 2009, Macrozoobenthos, Thematic Report, 10, p.1-27.

CWSS (Common Wadden Sea Secretariat), 2012, The Wadden Sea, Extension Denmark and Germany – Volume tow – ANNEXES, p.1-450.

Daesan Regional Office of Oceans and Fisheries, 2009, Marine Protected Area Citizen Monitoring Service Report.

Daesan Regional Office of Oceans and Fisheries, 2010, Marine Protected Area Citizen Monitoring Service Report.

Daesan Regional Office of Oceans and Fisheries, 2011, Marine Protected Area Citizen Monitoring Service Report.

Daesan Regional Office of Oceans and Fisheries, 2012, Marine Protected Area Citizen Monitoring Service Report.

Daesan Regional Office of Oceans and Fisheries, 2013, Marine Protected Area Citizen Monitoring Service Report.

Daesan Regional Office of Oceans and Fisheries, 2014, Marine Protected Area Citizen Monitoring Service Report.

Dalrymple, R.W., Makino, Y. and Zaitlin, B.A., 1991, Temporal and spatial patterns of rhythmite deposition on mud flats in the macrotidal Cobequid Bay – Salmon River estuary, Bay of Fundy, Canada. In: Smith, D.G., Reinson, G.E., Zaitlin, B.A., Rahmani, R.A. (Eds.), Clastic Tidal Sedimentology, Can. Soc. Petrol. Geol. Mem., v.16, p.137-160.

Dalrymple, R.W., Yang, B.C. and Chun, S.S., 2006a, Distinguishing sandy open-coast tidal flats from shorefaces: observations from the southwestern coast of Korea, 17th International Sedimentological Congress (ISC 2006), Fukuoka, Japan, Aug. 27-Sept. 1, 2006, v.B., p.180, p.231.

Dalrymple, R.W., Yang, B.C., and Chun, S.S., 2006b, Sedimentation on a wave-dominated, open-coast tidal flat, southwestern Korea: summer tidal flat–winter shoreface–reply, Sedimentology, v.53, p.693-696.

Dionne, J.C., 1988, Characteristic features of modern tidal flats in cold regions, In: de Boer, P.L., van Gelder, A., Nio, S.D. (Eds.), Tide-influenced Sedimentary Environments and Facies, D. Reidel Publ. Co., Dordrecht, p.301-332.

Diop, E.S., 1985, Guinea-Bissau and Republic of Guinea. In: Bird, E.C., Schwartz, M.L. (Eds.), The World's Coastline, Van Nostrand Reinhold, New York, p.561-567.

Diop, S., Fabres, J., Pravettoni, R., Barusseau, J.P., Descamps, C. and Ducrotoy, J.P., 2014, The western and central Africa land-sea interface: a vulnerable, threatened, and important coastal zone within a changing environment. In: Diop, S. et al. (Eds.), The land/ocean interactions in the coastal zone of West and Central Africa, Estuaries of the World, Springer, Berlin, p.1-8.

Du, G. and Chung, 2007, Spatio-temporal variation of intertidal microphytobenthos in the Nakdong Estuary, J. Korean Soc, Oceanography, v.12, p.186-190.

Eisma, D., 1985, Vietnam. In: Bird, E.C., Schwartz, M.L. (Eds.), The World's Coastline, Van Nostrand Reinhold, New York, p.805-811.

Eisma, D., Augustinus, P.G.E.F. and Alexander, C., 1991, Recent and subrecent changes in the dispersal of Amazon mud, Neth. J. Sea Res., v.28, p.181-192.

Espinosa, M.A. and Isla, F.I., 2015, Modern diatom assemblages in surface sediments from meso-macrotidal estuaries of Patagonia, Argentina, Pan-Am, J. Aquat. Sci., v.10, p.29-43.

Fan, D., 2012, Open-coast tidal flats, R.A. Davis, Jr. and R.W. Dalrymple (Eds.), Principles of Tidal Sedimentology, 187, Springer Science+Business Media B.V.

Fang, J., Z. Wang, S., Zhao, Y., Li, Z., Tang, D., Yu, L., Ni, H., Liu, P., Xie, L., Da, Z. and Zheng, C., 2006, Biodiversity changes in the lakes of the Central Yangtze, Front. Ecol. Environ., v.4(7), p.369-377.

Filatov, N., Pozdnyakov, D., Johannessen, O.M., Pettersson, L.H. and Bobylev, L.P., 2005, The White Sea – Its Marine Environment and Ecosystem Dynamics Influenced by Global Change, Springer, Berlin, and Praxis Publ., Chichester, p.476.

Flemming, B.W., 2005, Tidal environments. In: Schwartz, M. (Eds.), Encyclopedia of Coastal Science, Springer, Berlin, p.1180-1185.

Flemming, B.W., 2011, Geology, Morphology, and Sedimentology of Estuaries and Coasts, In: Wolanski, E. and McLusky, D.S. (Eds.), Treatise on Estuarine and Coastal Science, v.3, Waltham: Academic Press, p.7-38.

Flemming, B.W., 2012, Siliciclastic Back-Barrier Tidal Flats. In: Davis, R.A. Jr., Dalrymple, R.W. (Eds.), Principles of Tidal Sedimentology, Springer, Dordrecht, p.231-267.

Galloway, R.W., 1985, Northern Territory. In: Bird, E.C., Schwartz, M.L. (Eds.), The World's Coastline, Van Nostrand Reinhold, New York, p.949-956.

Gao, S., 2013, Holocene shelf-coastal sedimentary systems associated with the Changjiang River: An overview, Acta Oceanol. Sin., v.32, p.4-12.

Gochang County, 2007, Coast Wetland Protected Area Designation Plan of Gochang tidal flat, Gochang Report, p.99-126.

Gonzáles-Bonorino, G., Bujalesky, G., Colombo, F. and Ferrero, M., 1999, Holocene coastal paleoenvironments in Atlantic Patagonia, Argentina, J. S. Am. Earth Sci., v.12, p.325-331.

Greenway, H. and Murrs, R., 1980, Mechanisms of salt tolerance in non-halophytes, Ann. Rev. Pl. Physiol., v.31, p.149-190.

Guilcher, A., 1985, France. In: Bird, E.C., Schwartz, M.L. (Eds.), The World's Coastline, Van Nostrand Reinhold, New York, p.385-396.

Gunsan Regional Office of Oceans and Fisheries, 2015, Management scheme research on Marine Protected Area of Julpo Bay, p.89-111.

Guo, X. and Yanagi, T.J., 1998, Three-dimensional structure of tidal current in the East China Sea and the Yellow Sea, Journal of Oceanography, v.54, p.651-668.

Ha, H.J., Chun, S.S. and Chang T.S., 2013, Distribution Pattern, Geochemical Composition, and Provenance of the Huksan Mud Belt Sediments in the Southeastern Yellow Sea, The Journal of the Korean Earth Society, v.34(4), p.289-302.

Hayes, M.O., 1979, Barrier island morphology as a function of tidal and wave regime, In: Leatherman, S.P. (Eds.), Barrier islands, Academic Press, New York, p.1-27.

Hayes, M.O. and Ruby, C.H., 1994, Barriers of Pacific Alaska. In: Davis, R.A. Jr. (Eds.), Geology of Holocene barrier island systems, Springer, Berlin, p.395-433.

Heywood, V.H., 1995, Global biodiversity assessment, UNEP, Cambridge University Press, p.1140.

Hong, S.H., Chun, S.S. and Un, J.A., 2015, The 2009-based detailed distribution pattern and area of Phragmites communis-dominant and *Suaeda japonica*-dominant communities on the Suncheon-bay and Beolgyo estuarine wetlands, Journal of Korean Wetlands Society, v.17(1), p.26-37.

Hong, S.H., Chun, S.S., Chang, T.S. and Jang, D.G., 2017, Contrasting sedimentation patterns in two semi-enclosed mesotidal bays along the west and south coasts of Korea controlled by their orientation to the regional monsoon climate, Geo-Mar Lett., v.37, p.385-395.

Hong, W.S., 1956, Study on the coastal vegetation in west coast of Korea I, Korean J. of Biological Society, v.1, p.17-24.

Hopeley, D., 1985, Queensland. In: Bird E.C., Schwartz M.L. (Eds.), The World's Coastline, Van Nostrand Reinhold, New York, p.957-967.

Hori, K., Saito, Y., Zhao, Q., Cheng, X., Wang, P., Sato, Y. and Li, C., 2001, Sedimentary facies and Holocene progradation rates of the Changjiang (Yangtze) delta, China, Geomorphology, v.41, p.233-248.

Isla, F.J., Vilas, F., Bujalesky, G.G., Ferrero, M., Gonzáles-Bonorino, G. and Arche, A., 1991, Gravel drift and wind effects on the macrotidal San Sebastian Bay, Tierra del Fuego, Argentina, Mar. Geol., v.97, p.211-224.

Isobe, A., 2008. Recent advances in ocean-circulation research on the Yellow Sea and East China Sea shelves, Journal of Oceanography, v.64, p.569-584.

IUCN, IUCN Red list, http://www.iucnredlist.org/

Iversen, J., 1936, Biologische Pflanzentypen als Hilfsmittel in der Vegetationsforschung, Dissertation, Medd. fra Skalling laboratoriet, Copenhagen.

Jefferson, T.A. and Hong, S.K., 2004, *Neophocaena phocaenoides*, Mamm. sp., v.746, p.1-12.

Jennings, J.N. and Coventry. R.J., 1973, Structure and texture of a gravely barrier island in the Fitzroy estuary, Western Australia, and the role of mangroves in the shore dynamics, Mar. Geol., v.15, p.145-167.

Jeonnam Province, 2010, Research Service for Sustainable Use of Jeollanam-do Tidal Flat: focusing on tidal flat Provincial Park, p.277.

Kang, C. K., Lee, Y. W., Choy, E. J., Shin, J. K., Seo, I. S. and Hong, J. S., 2006, Microphytobenthos seasonality determines growth and reproduction in intertidal bivalves, Mar. Ecol. Prog. Ser., v.315, p.113-127.

Kang, S.K., Foreman, M.G.G., Lie, H.J., Lee, J.H., Cherniawsky, J., Yum, K.D., 2002. Two-layer tidal modeling of the Yellow and East China Seas with application to seasonal variability of the M2 tide, J. Geophys. Res. 107, 6-1–6-19.

Kang, S.L., Ryang, W.H. and Chun, S.S., 2015, Characteristics of Surface Topography Variation on the Gochang Beach, Southwestern Coast of Korea, The Journal of the Korean Earth Society, v.36(6), p.533-542.

Kapaln, P., 1985, Pacific USSR. In: Bird, E.C., Schwartz, M.L. (Eds.), The World's Coastline, Van Nostrand Reinhold, New York, p.857-871.

Kim, D.S., 2004, Studies on Reproductive Ecology, Growth and Variation of Local Populations of *Octopus minor*, Ph.D Thesis, Mokpo National University, Jeollanam-do, Korea, p.153.

Kim, D.S. and Kim, J.M., 2006, Sexual Maturity and Growth characteristics of *Octopus minor*, J. Kor. Fish. Soc., v.39(5), p.410-418.

Kim, D.S. and Kim, J.M., 2007, Spawning and Hatching of *Octopus minor*, J. Kor. Fish. Soc., v.40(4), p.243-247.

Kim, J.K. and Chun, S.S., 2006, Sedimentation in the deltaic to estuarine intertidal flat, Ganghwa Island, western coast of Korea, 17th International Sedimentological Congress (ISC 2006), Fukuoka, Japan, Aug. 27-Sept. 1, 2006, Proceedings A, p.58.

Kim, J.K. and Chun, S.S., 2008, Sedimentation and Holocene Evolution of Ganghwa Intertidal Flat, Gyonggi Bay, South Korea, 7th International Conference on Tidal Environments, Qingdao, China, Sept. 25-27, 2008, Proceedings, p.28-29.

Kim, J.K. and Chun, S.S., 2013, Architectural interpretation of the Ganghwa intertidal flat, Gyeonggi Bay, South Korea- Preservation of intertidal deposits under small-scale transgression during Late Holocene, Western Pacific Sedimentology Meeting (2013 WPSM), Taoyuan, Taiwan, May 13-14, 2013, Proceedings, p.53-54.

Kim, Y.H. and Chung, S.C., 1990, Studies on the Growth and Molting of the Tiger Crab, *Orithyia sinica* (Linnaeus), Bull. Korean Fish. Soc., v.23(2), p.93-108.

Kim, J.K., Chun, S.S., Baek, Y.S., Chang, E.K. and Shun, S.J., 2006, Importance and Application of Ichnology, Korean Journal of Petroleum Geology, v.12, p.34-42.

Kim, Y.H., Lee, H.J., Chun, S.S. and Chough, S.K., 2000, Holocene Transgressive Stratigraphy of a Macrotidal Flat in the Gomso Bay, Korea, Tidalite 2000 - 5th International Conference on Tidal Environments, Seoul, Korea, June 12-14, 2000, Proceedings, p.73-75.

Kim, Y.H., Lee, H.J., Chun, S.S., Han, S.J. and Chough, S.K., 1999, Holocene transgressive stratigraphy of macrotidal flat, Yellow Sea, Journal of Sedimentary Research, v.69, p.328-337.

Koh, C.H. and Khim, J.S., 2014, The Korean tidal flat of the Yellow Sea: Physical setting, ecosystem and management, Ocean and Coastal Management, v.102, p.398-414

Korea Hydrographic and Oceanographic Agency, 2016, Ocean information, p.228.

Korea Meteorological Administration, National Climate Data Service System website (https://data.kma.go.kr/cmmn/main.do)

Korea Meteorological Administration, National Typhoon Center, 2011, Typhoon White Book, p342.

LaMoreaux, H.K., Brook, G.A. and Knox, J.A., 2009, Late Pleistocene and Holocene environments of the Southeastern United States from the stratigraphy and pollen content of a peat deposit on the Georgia Coastal Plain, Palaeogeography, Palaeoclimatology, Palaeoecology, v.280, p.300-312.

Larsonneur, C., 1994, The Bay of Mont St. Michel: a sedimentation model in a temperate macrotidal environment. In: Flemming, B.W., Hertweck, G. (Eds.), Tidal flat and barrier systems of continental Europe: a selected overview, Senckenbergiana Maritima, v.24, p.3-63.

Lauriol, B. and Gray, J.T., 1980, Processes responsible for the concentration of boulders in the intertidal zone of Leaf Basin, Ungava. In: McCann, S.B. (Eds.), The coastline of Canada, Can., Geol. Surv., Paper 80-10ß, p.281-290.

Lee, C.B., 2003, Coloured Flora of Korea II. Hyangmunsa, Seoul.

Lee, H.J., Chun, S.S., Chang, J.H. and Han, S.J., 1994, Landward migration of isolated shelly sand ridge (chenier) on the macrotidal flat of Gomso Bay, west coast of Korea: controls of storm and typhoon, Journal of Sed. Res., v.A64, p.886-893.

Lee, H.Y., 2002, Comparison of the effects of physico-chemical factors on the zonation and vertical distribution of benthic microalgae communities in the tidal flats of southwest Korea, p.529-535.

Lee, I.T. and Chun, S.S., 2001, Role of Sand Shoal in the Intertidal Flat Sedimentation, Gomso Bay, Southwestern Korea, The Journal of the Korean Earth Society, v.22(2), p.120-129.

Lee, I.T., Chun, S.S., Sohn, C.S., Ryu, J.H. and Won, J.S., 2000, Role of Sand-shoal Migration for the Sedimentation in the Gomso Bay Intertidal Flat, Southeastern Korea, Tidalite 2000 - 5th International Conference on Tidal Environments, Seoul, Korea, June 12-14, 2000, Proceedings, p.88-90.

Lee. S.W., 2000, Feeding ecology of migratory waders in relation to the preys on the southern tidal flat of Kanghwa Island in the west coast of Korea, Ph. D. Thesis, Kyung Hee University, Seoul, Republic of Korea, p.191.

Lee, Y.G., Kim, S., Lee, H.W. and Mee, M.B., 2008, Chemical Properties of Sediment and Increase of Reed (*Phragmites australis*) Stands at Suncheon Bay, Journal of Korean Wetlands Society, v.10(3), p.9-26.

Lee, Y.W., Choi, E.J., Kim, Y.S. and Kang, C.K., 2009, Seasonal Variations of microphytobenthos in Sediments of the Estuarine Muddy Sand flat of Gwangyang Bay: HPLC Pigment Analysis, Journal of Korean Society of Oceanography, v.14(1), p.48-55.

Li, X., Fan, X., Han, L. and Lou, Q, 2002, Fatty acids of some algae from the Bohai Sea, Phytochemistry, v.59, p.157-161.

Lim, H.S., Cho, Y.B. and Lee, J.Y., 2017, Characteristic of Seasonal and Spatial Variation of Macrobenthos in Garolim Bay, West Sea, The Korean Society of Oceanography Spring Symposium, Busan, Korea, Apr. 19-20, 2017, Poster session, BP31.

Liu, J.P., Milliman, J.D., Gao, S. and Cheng, P., 2004, Holocene development of the Yellow River's subaqueous delta, North Yellow Sea, Marine Geology, v.209, p.45-67.

Liu, W., Zhang, J., Tian, G., Xu, H. and Yan, X., 2013, Temporal and vertical distribution of microphytobenthos biomass in mangrove sediments of Zhujiang (Pearl River) estuary, Acta Oceanol. Sin., v.32, p.82-88.

Lorenzen, C.J., 1967, Determination of chlorophyll and Phaeopigments; Spectrophotometric equations, Limnol. Oceanography, v.12, p.343-346.

Luternauer, J.L., 1980, Genesis of morphologic features on the western delta front of the Fraser River. In: McCann, S.B. (Eds.), The Coastline of Canada. Can., Geol. Surv., Paper 80-10, p.381-396.

Martin, L. and Williams F.E., 1924, An ice-eroded fjord: The mode of origin of Lynn Canal, Alaska, Geographical Review, v.14, p.576-596.

Martinez, J.O., Gonzales, J.L., Pilkey, O.H. and Neal, W.J., 1995, Tropical barrier islands of Colombias's Pacific coast, Journal of Coastal Researches, v.11, p.432-453.

McCallie, S.W., 1911, Geology of the Coastal Plain of Georgia, Geological Survey of Georgia, Bulletin, No. 26, 466p.

McCann, S.B., 1985, Atlantic Canada. In: Bird E.C., Schwartz M.L. (Eds.), The World's Coastline, Van Nostrand Reinhold, New York, p.235-240.

McLusky, D.S. (Eds.), 1987, Symposium on the Natural Environment of the Estuary and Firth of Forth, Proc. Roy. Soc., Edinburgh, 93B, p.567.

Ministry of Environment, 1988-2014, Technical Reports.

Ministry of Land, Infrastructure and Transport, 2008-2012, Survey Reports.

Ministry of Ocean and Fisheries, 2000-2015, survey Reports.

Mobley, C.M. and McCallum, W.M., 2001, Prehistoric intertidal fish traps from central southeast Alaska, Canadian Journal of Archaeology, v.25, p.28-52.

Muan-gun, 2015, 2014-2015 Monitoring Research Service of Muan tidal flat ecosystem, Muan Ecological Tidal Flat Center, p.119.

National Institute of Biological Resources, 2009-2016, Survey Reports of waterbirds or endemic species of Korea.

NEINS, Indigenous species list, http://www.neins.go.kr/etr/ecology/doc01b.asp

National Institute of Environmental Research, 2001-2012, Survey Report on uninhabitable islands.

NIE, 2014a, National Uninhabitable islands Natural Environment Survey (Gochang, Buan Area), p.268.

NIE, 2014b, National Uninhabitable islands Natural Environment Survey (Seocheon, Hongseong Area), p.305.

Ng, P.K.L., Guinot, D. and Davie, P.J.F., 2008, Systema Brachyurorum: Part I, An Annotated Checklist Of Extant Branchyuran Crabs Of The World, The Raffles Bulletin Of Zoology, v.17, p.1-286.

Oh, T.Y., Kim, J.I., Seo, Y.I., Lee, S.K. and Choi, M.S., 2012, Distribution characteristic of *Octopus minor* in the Tando Bay on the southwest coast of Korea, J. Kor. Soc. Fish. Tech., v.48(4), p.370-378.

Owens, E.H. and Harper, J.R., 1985, British Columbia. In: Bird, E.C.F., Schwartz, M.L. (Eds.), The World's Coastline, Van Nostrand Reinhold, New York, p.11-15.

Pan, B.Z., Wang, H.J., Liang, X.M. and Wang, H.Z., 2009, Factors influencing chlorophyll-*a* concentration in the YANGTZE-connected lakes, Fresenius Environmental Bulletin, v.18(10), p.1894-1900.

Park, G.B., 1987, Whaling history of Korean peninsula, Taehwa Press, p.562.

Park, K.A., Park J.E., Choi, B.J., Lee, S.H., Shin, H.R., Lee, S.R., Byun, D.S., Kang, B. and Lee, E., 2017, Schematic Maps of Ocean Currents in the Yellow Sea and the East China Sea for Science Textbooks Based on Scientific Knowledge from Oceanic Measurements, The Sea, Journal of Korean Society of Oceanography, v.22, p.151-171.

Park, K.I., Choi, K.S., Chun, S.S., Lee, I.T. and Lim, H.S., 2002, Survey on the mortality of the Manila clam *Ruditapes philippinarum* using cage in Gomso Bay, Korea, World Aquaculture 2002, Bejing, China, Apr. 23-27, 2002, Proceedings, p.584.

Park, K.J., 2006, Population ecological characteristics and stock assessment of finless porpoise, *Neophocaena phocaenoides* in the western sea of Korea, Ph.D Thesis, Pukyung National University, Busan, Korea, p.174.

Park, K.J., Kim, Z.G., and Chang, I.Z., 2007, Abundance Estimation of the Finless Porpoise, *Neophocaena phocaenoides*, Using Models of the Detection Function in a Line Transect, J. Kor. Fish. Soc., v.40(4), p.201-209.

Park, K.J., Lee, S.Y., An, Y.R., Kim, H.W., An, D.H., Kim, D.N., and Kim, Y.H., 2014, Reappearance and Distribution Tendency of Finless Porpoises *Neophocaena asiaeorientalis* after their Mass Mortality in the Saemangem Dyke, Kor. J. Fish. Aquat. Sci., v.47(6), p.978-982.

Piccolo, M.C. and Perillo, G.M.E., 1999, Estuaries of Argentina: a review. In: Perillo, G.M.E., Piccolo, M.C., Quivira, P. (Eds.), Estuaries of South America: their geomorphology and dynamics, Springer, Berlin, p.101-132.

Poljakoff-Mayber, A. and Gale, J., 1975, Plants in saline environments, Springer-Verlag, New York, Heidelberg, Berlin, p.213.

Reid, F.A., Fehringer, D., and Kempka, R.G., 2016, Copper River delta, Alaska. In: The Wetland Book, Springer, Heidelberg, p.1-8.

Reimold, R.J. and Queen, W.H., 1974, Ecology of halophytes, Academic Press, New York, p.605.

Ritchie, W., 1985, Scotland. In: Bird, E.C., Schwartz, M.L. (Eds.), The World's Coastline, Van Nostrand Reinhold, New York, p.371-376.

Ryu, J.H., Cho, W.J., Won, J.S., Lee, I.T., Chun, S.S., Suh, A.S. and Kim, K.L., 2000, Intertidal DEM Generation using waterline extracted from remotely sensed data, Journal of Kor. Soc., Remote Sensing, v.16(3), p.221-233.

Ryu, J.H., Kim C.H., Lee, Y.K., Won, J.S., Chun, S.S. and Lee, S., 2008, Detecting the intertidal morphologic change using satellite data, Estuarine Coastal and Shelf Science, v.78, p.623-632.

Ryu, S.O., You, H.S. and Chun, S.S., 1997, Distribution Pattern and Characteristics of the Surface Sediments in Hampyong Bay, the Southwestern Coast of Korea, The Journal of the Korean Earth Society, v.18, p.367-378

Satpati G.G., Barman, N. and Pal, R., 2012, Morphotaxonomic account of some common seaweeds from Indian Sundarbans mangrove forest and inner island area, J. Algal Biomass Utln., v.3(4), p.45-511.

Schizas N.V. and Shirley T.C., 1996, Seasonal changes in structure of an Alaskan intertidal meiofaunal assemblage, Marine Ecology, Progress Series, No.133, p.115-124.

Schnack E.J., 1985, Argentina. In: Bird, E.C., Schwartz, M.L. (Eds.), The World's Coastline, Van Nostrand Reinhold, New York, p.69-78.

Shinan-County, 2013, Shinan Jeungdo Tidal Flat Monitoring Report.

Shinan-County, 2014a, Shinan Archipelago Island Tidal Flat Monitering and Study on utilization of Island Tidal Flat to Improve Resident Income.

Shinan-County, 2014b, Shinan Jeungdo Tidal Flat Monitoring Report.

Shinn, Y.J., Chough, S.K. and Hwang, I.G., 2010, Structural development and tectonic evolution of Gunsan Basin (Cretaceous-Tertiary) in the central Yellow Sea. Mar Petrol Geol 27:500-514.

Shorebird Network Korea Secretariat (Shinan County), 2013, Shorebird Monitoring Report of Korea (2011-2012), p.3-193.

Shorebird Network Korea Secretariat (Shinan County), 2015, Shorebird Monitoring Report of Korea (2014), p.3-117.

Sitoe, A.A., Mandlate, L.J.C. and Guedes, B.S., 2014, Biomass and carbon stocks of Sofala Bay mangrove forests, Forests, v.5, p.1967-1981.

Smithson, P., Addison, K. and Atkinson, K., 2002, Fundamentals of the Physical Environment (3rd Eds.), Routledge, London, p.627.

Son, C.S., Baek, Y.S. and Chun, S.S., 2002, Comparison of Depositional Characteristics between Gomso-bay and Yumsan Open-coast Intertidal Flats, Southwestern Coast of Korea, Int'l. Conf. on Tidal Dynamics and Environment, Hangzhou, China, Aug. 8-13, 2002, Proceeding B, p.48-49.

Son, C.S., Flemming B.W., Bartholomae, A. and Chun, S.S., 2012, Long-term changes in morphology and textural sediment characteristics in response to energy variation on shoreface-connected ridges off the East Frisian barrier-island coast, Southern North Sea, Journal of Sedimentary Research, v.82, p.385-399.

Steers, J.A., 1964, The Coastline of England and Wales, Cambridge University Press, Cambridge.

Steers, J.A., 1973, The Coastline of Scotland, Cambridge University Press, Cambridge.

Stewart, P.L., Pocklington, P. and Cunjak, R.A., 1985, Distribution, abundance and diversity of benthic macroinvertebrates on the Canadian continental shelf and slope of southern Davis Strait and Ungava Bay, Arctic, v.38, p.281-291.

Stocker, O., 1929, Eine Feldmethode zur Bestimmung der momentanen Transpirations und Evaporationsgroesse, Ber. dt. bot. Ges., v.47, p.126-136.

Suncheon City, 2010, 2009, Korea and Japan Joint Symposium on Biology of Tidal Flat, p.449.

Swinbanks, D.D. and Murray, J.W., 1981, Biosedimentological zonation of Boundary Bay tidal flats, Fraser River Delta, British Columbia, Sedimentology, v.28, p.201-237.

Ta, T.K.O., Nguyen, V.L., Tateishi, M., Kobayashi, I., Tanabe, S. and Saito, Y., 2002, Holocene delta evolution and sediment discharge of the Mekong River, southern Vietnam, 21:1807-1819.

Thom, B.G., Wright, L.D. and Coleman, J.M., 1975, Mangrove ecology and deltaic estuarine geomorphology: Cambridge Gulf-Ord River, Western Australia, Journal of Ecology, v.63, p.203-232.

Tinley, K.L., 1985, Mozambique. In: Bird, E.C., Schwartz, M.L. (Eds.), The World’s Coastline, Van Nostrand Reinhold, New York, p.669-677.

Van Tri, T., Thạnh, T.D., Waltham, T., An, L.D. and Anh, L.H., 2003, The Ha Long Bay World Heritage: Outstanding geological values, Journal of Geology, Series B, v.22, p.1-18.

Vilas, F., Arche, A., Ferrero, M. and Isla, F., 1999, Subantarctic macrotidal flats, cheniers and beaches in San Sebastian Bay, Tierra del Fuego, Argentina, Mar. Geol., v.160, p.301-326.

Vilas, F., Arche, A., Ferrero, M., Bujalesky, G.G., Isla, F.J. and Gonzáles-Bonorino, G., 1987, Esquema evolutivo de la sedimentación reciente en la Bahia San Sebastian, Tierra del Fuego, Argentina, Thalassas, v.5, p.118-134.

Waisel, Y., 1972, Biology of halophytes Academic Press, New York, p.395.

Walling, D.E. and Webb, B.W., 1983, Patterns of sediment yield. In: Gregory, K.J. (Eds.), Background to Palaeohydrology, Wiley, Chichester, p.69-95.

Wells, J.T. and Coleman, J.M., 1981, Periodic mudflat progradation, northeastern coast of South America: a hypothesis, Journal of Sediment Petrol., v.51, p.1069-1075.

West, R.C., 1956, Mangrove swamps of the Pacific coast of Colombia, Annals of the American Association of Geographers, v.46, p.98-121.

Wignsma, G., Wolff, W. J., Meijboom, A., Duiven, P. and Vlas, J. D., 1998, Species richness and distribution of benthic tidal flat fauna of the Banc d' Arguin, Mauritania, Oceanologica Acta, v.22(2), p.233-243.

Wilson, E. O. and Peters, F. M. (Eds.), 1988, Biodiversity, National Academy Press, Washington DC.

Witkowski, A., LI, C., Zglobicka, I., Yu, S. X., Ashworth, M., Dabek, P., Qin, S., Tang, C., Krzywda, M., Ruppel, M., Theriot, E. C., Jansen, R. K., Car, A., Plocinski, T., Wang, Y. C., Sabir, J. S., Daniszewska-Kowalczyk, G., Kierzek, A. and Hajrah, N.H., 2016, Multigene Assessment of Biodiversity of Diatom (Bacillariophyceae) Assemblages from the Littoral Zone of the Bohai and Yellow Seas in Yantai Region of Northeast China with some Remarks on Ubiquitous Taxa, Journal of Coastal Research, v.74, p.166-195.

Woods, P.J., Webb, M.J. and Eliot, I.G., 1985, Western Australia. In: Bird, E.C., Schwartz, M.L. (Eds.), The World's Coastline, Van Nostrand Reinhold, New York, p.929-947.

World Heritage Promotion Team of Korean Tidal Flats, 2016, Annual report of World Heritage Promotion on Korean tidal flats, p.1-324.

Wright, L.D., Coleman, J.M. and Thom, B.G., 1973, Geomorphic variability, northwestern Australia, University of Sydney, Coastal Studies Bulletin, v.7, p.35-64.

Wu N., Cai, Q. and Fohrer, N., 2014, Contribution of microspatial factors to benthic diatom communities, Hydrobiologia, v.732(1), p.49-60.

WWF, KORDI, KEI, 2008, Biological assessment report of the Yellow Sea Ecoregion, Ecologically important areas for the Yellow Sea Ecoregion's biodiversity.

Yancheva, G., Nowaczyk, N. R., Mingram, J., Dulski, P., Schettler, G., Negendank, J. F.W., Liu, J., Sigman, D. M., Peterson, L. C. and Haug, G. H., 2007, Influence of the intertropical convergence zone on the East Asian monsoon, Nature, v.445, p.74-77.

Yang, B.C. and Chun, S.S., 1999, Seasonal Evolution of Surface Sedimentary Facies and Depositional Processes in the Baeksu Intertidal Flat, Southwestern Coast of Korea, Fourth International Conference on Asian Marine Geology, Qingdao, China, Oct. 14-18, 1999, Abstracts, p.169.

Yang, B.C. and Chun, S.S., 2000, New Sedimentological Meanings of Mud Balls in the Baeksu Intertidal Flat, Southwestern Coast of Korea. Tidalite 2000 - 5th International Conference on Tidal Environments, Seoul, Korea, June 12-14, 2000, Proceedings, p.165-169.

Yang, B.C. and Chun, S.S., 2001, A seasonal model of surface sedimentation on the Baeksu open-coast intertidal flat, southwestern coast of Korea, Geosciences Journal, v.5(3), p.251-262.

Yang, B.C., Chun, S.S. and Dalrymple, R.W., 2002, Intertidal sedimentation on a wave-dominated, open coast tidal flat, SW Korea: Summer tidal flat and winter shoreface, Advances in Earth Science Res. Conf. 2002, Sedimentology and Stratigraphy, Ottawa, Canada, Mar. 8, 2002, Proceedings, p.56-58.

Yang, B.C., Chun, S.S., Chang, T.S. and Baek, Y.S., 2000, Seasonal Evolution, Depositional Processes and Preservation Potential of the Intertidal Deposits in the Baeksu Coast, Southwestern Korean Peninsula, Tidalite 2000 - 5th International Conference on Tidal Environments, Seoul, Korea, June 12-14, 2000, Proceedings, p.170-173.

Yang, B.C., Dalrymple, R.W. and Chun, S.S., 2005a, Recognition of intertidal storm deposits and stratigraphic reconstruction using wavelength of hummocky cross-stratification: observation and deductions from Korean tidal flats, AAPG 2005 Annual Convention, Calgary, Canada, June 19-22, 2005, Abstracts A, p.157

Yang, B.C., Dalrymple, R.W. and Chun, S.S., 2005b, Sedimentation on a wave-dominated, open-coast tidal flat, southwestern Korea: summer tidal flat - winter shoreface, Sedimentology, v.52(2), p.235-252.

Yang, B.C., Dalrymple, R.W. and Chun, S.S., 2006, The significance of hummocky cross-stratification (HCS) wavelengths: evidence from an open-coast tidal flat, South Korea, Journal of Sedimentary Research, v.75, p.2-8.

Yang, B.C., Dalrymple, R.W., Chun, S.S. and Baek, Y.S., 2004, Tidally Modulated Storm Deposits on the Open Coast Tidal Flats, Southwestern Coast of Korea: Risingand Falling-Tide Successions, 6th Int'l. Conf. on Tidal Sedimentology, Copenhagen, Denmark, Aug. 2-5, 2004, Proceedings, p.196-199.

Yang, B.C., Dalrymple, R.W., Chun, S.S. and Lee, H.J., 2006, Transgressive sedimentation and stratigraphic evolution of a wave-dominated macrotidal coast, western Korea, Marine Geology, v.235, p.35-48.

Yang, B.C., Dalrymple, R.W., Chun, S.S., Johnson, M. and Lee, H.J., 2008, Tidally modulated storm sedimentation on open-coast tidal flats, southwestern Korea: Distinguishing tidal-flat from shoreface storm deposits, SEPM Special Publication No.90.

Yang, B.C., Dalrymple, R.W., Chun, S.S., Kim, J.K. and Jang, K.S., 2004, Stratigraphic Evolution in the Open-Coast Tidal Flats, Southwestern Coast of Korea: The Holocene Transgression, 6th Int'l. Conf. on Tidal Sedimentology, Copenhagen, Denmark, Aug. 2-5, 2004, Proceedings, p.200-203.

Yang, B.C., Dalrymple, R.W., Gingras, M.K., Chun, S.S. and Lee, H.J., 2006, The characteristics of sediment facies and ichnology in a mixed-energy Gomso-bay Estuary, western coast of Korea, 17th Int'l. Sedi. Con. (ISC 2006), Fukuoka, Japan, Aug. 27-Sept. 1, 2006, Proceedings, vol. B, p.220.

Yang, B.C., Dalrymple. R.W., Gingras, M.K., Chun, S.S. and Lee, H.J., 2007, Up-Estuary Variation of Sedimentary Facies and Ichnocoenoses in an Open-mouthed, Macrotidal, Mixed-Energy Estuary, Gomso Bay, Korea, Journal of Sedimentary Research, v.77, p.757-771.

Yang, H. Y., Chen, B., Barter, M., Piersma, T., Zhou, C. F., Li, F. S. and Zhang, Z. W., 2011, Impacts of tidal land reclamation in Bohai Bay, China; ongoing losses of critical Yellow Sea waterbird staging and wintering sites, Bird Conservation International, v.21, p.241-259.

Yi, S., 2011, Holocene vegetation responses to East Asian monsoonal changes in South Korea, In: Climate Change- geophysical foundations and ecological effects, p. 157-178, InTech publishing (intechopen.com).

Yuan, D., Zhu, J., Li, C., Hu, D., 2008. Cross-shelf circulation in the Yellow and East China Seas indicated by MODIS satellite observations. J. Mar. Syst. v.70, p.134-149.

Zenkovich, V.P., 1967, Quaternary Coastlines of the Pacific Ocean, Nauka Press, Moscow.

Zenkovich, V.P., 1985, Arctic Russia. In: Bird, E.C., Schwartz, M.L. (Eds.), The World's Coastline, Van Nostrand Reinhold, New York, p.863-871.

Zhang, C.I., Park, K.J., Kim, Z.G., and Sohn, H., 2004, Distribution and Abundance of Finless Porpoise (*Neophocaena phocaenoides*) in the West Coast of Korea, J. Kor. Fish. Soc., v.37, p.129-136.

Zhang, F. J., Tong, C. F., Zhang, H. and Lu, J. J., 2007, Community Structure of Macrobenthic Fauna in Subtidal Areas of the Yangtze River Estuary in Spring, Zoological Research, v.28(1), p.47-52.

Zhou, H. and Liu, X., 2007, Changes in the shelf macrobenthic community over large temporal and spatial scales in the Boha Sea, China, Journal of Marine Systems, v.67, p.312-322

Section 8

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### Local Governments

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| Marine Biodiversity Institute of Korea | 75, Jangsan-ro, 101 beon-gil, Janghang-eup, Seocheon-gun, Chungcheongnam-do, 33662, Republic of Korea | +82-41-950-0600 |
| Seocheon Bird Eco Exhibition Hall | 916, Jangsan-ro Maseo-myeon, Seocheon-gun, Chungcheongnam-do, 33657, Republic of Korea | +82-41-950-4002 |
| Ramsar Gochang Tidal Flats Center | 320, Aehyanggaetbeol-ro, Simwon-myeon, Gochang-gun, Jeollabuk-do, 56401, Republic of Korea | +82-63-560-2638 |
| Suncheonman Eco Museum | 513-25, Suncheonman-gil, Suncheon-si, Jeollanam-do, 58027, Republic of Korea | +82-61-749-6052 |
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## Section 9

# Signature on behalf of the State Party

Section 9

# Signature on behalf of the State Party

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