Kwi-Gon Kim

The Demilitarized Zone (DMZ) of Korea

Protection, Conservation and Restoration of a Unique Ecosystem

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Kwi-Gon Kim
Seoul National University
Seoul
Republic of South Korea

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Foreword

With rapid urbanization and globalization, the balancing act between environmental conservation and socio-economic development in ways that may not endanger the natural resources and stifle opportunities to pursue growth, has become an important concern for policymakers and citizens alike.

As the UN Habitat Agenda indicates, sustainable development is essential for human settlements' development, and thus we need to commit ourselves to the goal of sustainable human settlements in an ever-urbanizing country such as Korea. This can be made possible by developing societies that will make efficient use of resources within the carrying capacity of ecosystems, thereby contributing to the achievement of national sustainable development goals.

The UNDP, through its office in Seoul, has long been a close partner to Korea's governmental and non-governmental endeavors in meeting such national sustainable development goals, as well as in fulfilling the common commitment of the international community to environmental protection. Seoul National University (SNU) and UNDP successfully completed their joint project in conducting a study on an "Environmentally Sound and Sustainable Development (ESSD)" in the Demilitarized Zone (DMZ). The Study was first initiated in 1996, and has since provided valuable assessments and recommendations for the development of the DMZ, which have been critically documented in this book.

The study has especially been important in providing a systematic and comprehensive analysis on the environment in the DMZ, including the Civilian Controlled Zone (CCZ) and, in raising awareness of the value and significance of conserving these areas. The 155 mile (248 km) long DMZ is rich in wildlife and despite political and security issues, the DMZ has become a haven for rare and endangered species of animals and plants. The project successfully compiled extensive records of these ecological features. The protection and permanent preservation of the DMZ ecosystems in South and North Korea hopefully can make a significant contribution to the establishment of a zone of peace between the two Koreas, since the DMZ environment has naturally evolved from the remnants of the Korean War and preserving it is of utmost mutual concern.

Albeit seemingly, environmental issues may be the least considerable concern that would probably break the ice. Nevertheless, this joint effort could gradually build confidence and eliminate the distrust between the two countries, leading to

further collaboration in other fields of common interest like promoting peace in this part of the world. Such concerted effort in biodiversity conservation and in other possible common interests will not only enhance environmental security but ultimately strengthen human security in the Korean Peninsula. It is my sincere hope that this book will contribute not only to the sustainable management of the DMZ and in building inter-Korean cooperative relations, but also in sharing valuable experiences with other countries.

I would like to thank Professor Kwi-Gon Kim of SNU and DMZ National Project Director, and as well as all the contributing experts in Korea and abroad for their significant roles in this project, including the sincere assistance of the military authority, all of whom provided support, guidance, and valuable information about the sustainable management of the DMZ eco-systems, most especially for their selfless contributions to the strengthening of inter-Korean relations.

Anne-Isabelle Degryse-Blateau
Director, UNDP Seoul Policy Center

Preface

The Civilian Controlled Zone (CCZ) and the Demilitarized Zone (DMZ) in Korea are the only one of its kind found throughout the world. These areas provide an opportunity for the conservation of the ecosystem and the stimulation of cooperation between disputing regions. The area has been virtually uninhabited by humans since the Korean War, and its inaccessibility allowed damaged ecosystems to rehabilitate and return to its natural state.

Recently, however, the western part of DMZ has been put under serious developmental pressure. There had been rapid changes in land use and such was the conversion of reed fens and wetlands into agricultural land, particularly in CCZ. If this was allowed to continue, the aftermath would have had tremendous devastating impact on the natural resources of the affected areas. In light of the situation, it was by then imperative to develop mid- and long-term land-use strategies that incorporate Environmentally Sound and Sustainable Development (ESSD) principles.

Based on international recommendations and sustainability criteria, the UNDP, Ministry of Science and Technology (MOST), Seoul National University (SNU), and Korea Land Corporation (KOLAND) formed a partnership to develop an ESSD model for the regions affected by agricultural development. The developed model, in turn, was applied to the western CCZ (Paju) and DMZ area since these areas are the most developed before the division of the Korean Peninsula and, that are still under greatest pressure for development today.

The outcome of this twenty-year study is a long-term plan with an implementation strategy that will allow the central government, Kyonggi province and Paju city to manage the area based on sound local ecosystem principles.

The long-term plan cannot be simply put into practice without support from relevant policies, both domestic and international. Therefore, the strategy offered in this study should be understood and aligned with domestic and international efforts for sustainable development. Those who are involved in natural resources management should participate in setting priority action plans like that of what is being laid out in this study to bring them into action. I firmly believe that the long-term sustainability of CCZ and DMZ will be ensured when new challenges are met with creative solutions from all participants.

To the research staff of the Environment & Ecology Planning Laboratory (EEPL) and to the study team of SNU, in particular, Miss Je-Soon Moon, Mr. Dong-Hyun Lee, Mr. Hoon Lee, Dr. Mi-Yong Park, Professor Chang-Hwan Kim and Mr. Grant Jones, I would like to offer my deepest acknowledgement for being instrumental in preparing this book. I wish to offer special thanks to Miss Tessa Eduave, Dr. Stella Gonzales and Dr. Yong-Hoon Kim for their help by editing and reviewing the manuscript. Equal gratitude is also extended to Miss Anne-Isabel Degryse-Blateau who also made significant contributions to the final outcome. I would like to express my sincerest gratitude to UNDP, UNESCO, MOST, KOLAND, Paju city authorities and the Eco-advisory Group for their cooperation and support. My special thanks must go to the Korean government including Ministry of Environment, Ministry of National Land and Transport and Ministry of Defense. I am indebted to the members of the DMZ Environment & Ecology Research Group commissioned by the Korean government. Finally, I wish to thank all my family for support given throughout the writing process. Without the support from the above personnel and institutions, this book would not have been possible.

The Demilitarized Zone, July 2013 Kwi-Gon Kim

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Introduction

Demilitarized Zone is Life

Ecosystem in the DMZ has its characteristics in various aspects.

First, farming culture has created a large scale of wetland ecosystem. The DMZ was once a cultivated farmland until the Korean War in 1950 and eventually became a vast wetland with high conservation value after its non-cultivation within a period of more than 60 years

Second, DMZ and CCZ areas combined, is four times larger than that of the city of Seoul. Half of the area is wetland. The scale of the wetland in the area is considered as one of the largest conservation areas next to the Amazon forest and the tropical forest of Indonesia.

Third, due to constant forest fires, the area developed its own unique plant succession. In a normal plant succession, coniferous trees would first appear. In the DMZ and CCZ areas, however, young broad-leaved trees appeared first. The broad leaves are well spread and are better tolerant than other forest trees.

Fourth, although materials on genetic diversity are lacking, the area provides a rich repository and living laboratory of natural ecosystems.

Fifth, the DMZ connects two Koreas into one ecosystem.

Approximately 2,000 species of wildlife animals and plants have been identified in the area, and many species have not yet been identified due to landmines. Among the identified species, there are 81 endangered species and protected species. In particular, 14 species which are registered in the IUCN Red List of Threatened Species, including Lutralutra, Hydropotesinermis, Grus japonensis, Eurystomus orientalis, Aix galericulata, Aegypiusmonachus, Platalea minor, Kaloula borealis, and Nannophyapygmaea rambur.

Forest fires have caused the development of mosaic habitats or patches in the river basin.

The area is valuable for providing the following ecological goods and services: Ecological value, Eco-tourism value, and Economic value (as it provides raw materials for medicine and medical supplies). Sovereignty over natural resources and the opportunity for the participation of international programs (the Convention on Biological Diversity, the Climatic Change Convention) has also been provided.

Geographic Information System (GIS) tool was used for spatial data regarding high-conservative-value sites that can be the basis for decision making in land and seascapes. Monitoring and evaluation of the implemented restoration of damaged ecosystem and the initiated replacement ecosystem are based on the principles of restoration ecology. Knowledge regarding diversity of DMZ life and ecosystem services are yet insufficient. Only around two-thirds of DMZ biodiversity and life are known due to the presence of landmines and security issues and, only around 10 % of known species and habitats, status, and trends are documented.

The author once suggested the possibility to apply existing and available information system to DMZ in the international conference regarding Global Biodiversity Information System (GBIS) held in Korea in 2010. Limitation has been identified on the credibility of existing database regarding the protected areas in the DMZ since understanding on ecological process and structure of DMZ ecosystem has yet been in an early stage. The need for acquiring scientifically based knowledge for the establishment and implementation of policies became an important task henceforth. Based on this point of view, DMZ became a "living laboratory" for experts to critically investigate environmental conditions and accumulate enough knowledge on the diversity of life as well as ecosystem services to be used as a strong basis for policymakers to provide a politically friendly environment for DMZ protection, conservation, and sustainable development projects.

One of the uniqueness of the DMZ ecosystem is in the process and formation of its wetland. As a living laboratory, it harbors an ecosystem that triggered the intellectual curiosity of concerned scientists to pilot "ecosystem approaches and wetland sciences." Many wetland studies have been performed in controlled laboratories (en-vitro) but DMZ is a "live" experimental wetlands (en-vivo). In this wetland, ecological studies can be conducted on a spatial and temporal scale that includes most if not all processes of that ecosystem. Studies on the ecosystem of wetlands had been considerably insufficient so far. Thorough and continuous studies are imperative to fully understand and manage wetland ecosystem and ecology. Investigation on its nutrients, function, and role of plants and animals that supplements a fully functional wetland ecosystem must be sought by researchers. Cultural landscapes are also intriguing areas and objects of study. This is again because the ecosystem that developed and flourished in the DMZ had been formed by past agriculture.

Self-organization, self-design, and ecosystem engineering theories and practices such as ecological engineering, adaptive management, and ecosystem modeling are not fully explored in the DMZ. The chapter on wetland contained in this book should be supplemented by scientifically proven concepts and principles, methods and strategies to support the process of data analysis and utilization. It is important to consciously note that the true values of the DMZ wetland are to be continuously explored and understood as the DMZ constantly evolves itself. The uniqueness of DMZ can only be described through long periods of investigation according to scientists and experts on Ecology. Yet even so, from time to time, it continues to amaze and trigger critical curiosity.

As the recent UNEP GEO-5 report had advised, sufficient data should be provided in order to establish and implement policies that are premised on scientifically proven theories and methods. Specifically, time-series (quasi experimental studies) data should be provided to establish policies. Discussions regarding policies, plans, and management for DMZ to date have been done and implemented without having been supported by sufficient data. Science-driven priorities for DMZ data are established in this book and the data utilization is based on various types of ecologies. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) was recently established and created four functions namely, Environmental Assessment, Knowledge Generation, Policy Support, and Capacity Building. The environmental evaluation of DMZ and the acquisition of knowledge that can contribute to the development of DMZ Resources Management Policy is the primary focus of this book. Diversity of DMZ life includes: landscape diversity, habitat diversity, species and genes' diversity. Further, it includes other evaluations and measurements of environment such as status, trends and co-relations, the use of theories and methodologies of Conservation and Invasion Ecology, types of habitats, evaluation on interactions that necessitated a balanced policy establishment and performance on DMZ biomass. All are based on theories and methodologies of Landscape Ecology and Life.

Societal responses on the changes of biodiversity, ecosystem services, land use, performances in Environmental Ecology, and in Ecological Engineering are considered. The evaluation and recommendations of researchers and experts, including the author's critical judgment, are significant to the development of programs and initiatives.

Thus, this book was formulated and sought to describe holistically the environmental status of the DMZ and to explore scientific methods and implementing strategies to achieve an ESSD in the Korean Peninsula. As humbling and enabling this DMZ endeavor can be, this book specifically attempted to:

1. Provide science-based assessments and community-based technologies for the management of the DMZ;
2. Foster an environmentally friendly cultural and socio-economic disposition among the many publics the DMZ serves;
3. Provide appropriate methods and approaches for societies to make efficient land use and developmental plans within the carrying capacity of the ecosystems and natural resources;
4. Provide basis for policymaking and priority setting of action plans;
5. Align domestic initiatives with international efforts for sustainable development;
6. Contribute to the improvement of the quality of natural resource management;
7. Build inter-Korean cooperative relations;
8. Contribute to the establishment of peace between the two Koreas;

9. Share valuable experiences with other countries that are having concerns of the same nature; and
10. Enhance human and ecological security.

Significance of the DMZ

Pertinent data continuously documented reveals significant aspects of the DMZ and its implication to human and ecological security not only in Korea but also to the world. Preserving, protecting, and conserving the forest lands and other life-sustaining natural resources in all parts of the world, is an international concern. This common vision does not just apprehend the effects of natural catastrophes brought about by global climate change, but most significantly improves, prevails, and maintains the quality of life of humans as well.

The DMZ corridor has some distinguished features of its own. The land once completely devastated by war, has now become a natural treasure where rare birds and animals inhabit and where succession of plant species occur and thrive. Almost all the ecological features are intact without being shredded by human interference. Here we find a lofty ideal that peace and life can be rediscovered even on the ashes of war. For the Koreans, it is also a place where human agonies and jubilations, heroic stories and sagas remain alive. At the advent of the new millennium, the world starts to shed new light on the DMZ. It is transforming itself from a legacy of the cold war to a symbol of new reconciliation and harmony.

The DMZ Ecosystem regulates Flood and Erosion. Intertidal Habitats such as salt marsh and mudflats provide a buffer system preventing the tidal energy of the ocean to hit the coast. This geological process of the beach plays an important function in protecting the coast. Five rivers running through the DMZ play critical roles in controlling inland floods as well. Grass species along the river tributaries control silts from clogging the rivers while its roots strengthen river banks, thereby preventing erosion.

Water Quality

Wetlands, as natural water purifiers, process water by filtering sediments and absorbing many pollutants in the surface waters. They function as a natural medium for purifying not only surface waters, but also groundwater reserves. Some wetland systems were found to have mechanisms that enhance the quality of groundwater resources.

Habitat for Wildlife

The DMZ ecosystem provides a vital habitat to endangered species. It serves as a flyway for Northeast Asian birds, for many wading species, and waterfowls. It is a stopover for these birds to rest, feed, and build up energy before traveling further.

Global Concern

The DMZ forest is second to the Amazon in value. The Amazon is considered the world's foremost stronghold in controlling climate change. So must DMZ be. The world must realize this, and should help in sustaining this valuable ecosystem because DMZ is a buffering ecology that combats the dreaded effects of global warming.

The collaboration of North and South Korea in the DMZ conservation project is indeed humbling and enabling. It is a clear evident indication that there is a possibility of peace between the two Koreas. This is only the beginning that can open up many doors for partnership, starting with programs of mutual concerns and interests like perhaps in preserving their precious ancestral culture and heritage. The DMZ is humbling because it builds a natural bridge to unify the two countries. Even as they should be independently functioning as two different countries, they can also share their material and human resources, just like friendly neighbors do. The natural healing of the DMZ is an important enabling lesson. It taught the world to allow its wounds to heal naturally and not to nurture the pains caused by them. And to move forward without fear of committing the same mistake that caused such wounds.

Research Value

Environmental Researchers specify their areas for study. It must remain untouched and free from human influence, high impact on human and ecological security, and require collaboration and partnership with international research institutions and agencies. The DMZ is a valuable research that provides a never ending curiosity to the critical researchers and a never ending satisfaction on the results of their advocacy.

Chapter 1
History and Evolution of the DMZ Ecosystem

1.1 Overview of the Past, Present and Future of DMZ

After the Korean War broke out on 25th June 1950, an armistice was established at a deadlock, and North Korea occupied the north of the 38th parallel. Military presence, weapons development and installation of military facilities had been banned in the zone by the armistice pact. In addition, the CCZ was set up to limit civilian entrance in the armistice line areas. Thus, the DMZ and CCZ have formed a boundary belt between the North and South Korea, expanding from the east coast to the west coast, not including the seas.

The length of DMZ from the end of the west to the end of the east is about 248 km (approximately 155 miles), while the width from the south to north is 4 km, covering a total of 907 km^2 as a whole. In addition, the CCZ—the northern area of the civilian controlled line was set with the width of 5–20 km from south boundary line of the DMZ and the total area is 1,369 km^2. As the Borderland Promotion Act took effect in 2000, some parts of the southern area of the CCZ were set as borderlands. As a result, the total area became 7,678 km^2. If borderlands are not counted, the total area of the ecosystem treasure which crosses the Korean Peninsula is 2,276 km^2 as shown in Fig. 1.1.

1.1.1 The Past of DMZ

DMZ and CCZ, hereto referred as "DMZ", are the political products from the past. Many areas in the DMZ, including Panmunjeom and Cheorwon fields in particular, contain a large farmland where Korean people had farmed and resided in the past. The remains of such farming and residing activities were observed during the survey. One example was the Jangdanmyeon town office in the Paju DMZ area which indicates that the surrounding area was a large district with the town office serving as a central zone. Also, the area was an important transport terminal of the Gyeonggi railroad. The Fig. 1.2 shows some of the remaining evidence of the past.

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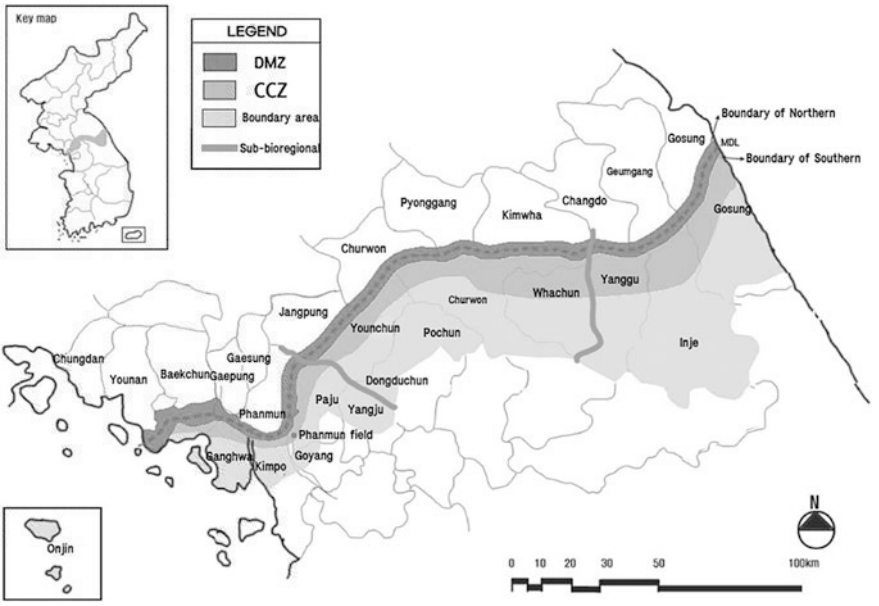

Fig. 1.1 Location of the DMZ and CCZ

Further, Cheorwon DMZ area is a flatland which was mostly used as farmland. In this particular area lies the places where Goguryeo ruled in year 829–936 and Gung Ye who ruled in 901–918, with the remains of their residences indicated the glory of their times. Some of the remains in the Cheorwon DMZ area are shown in Fig. 1.3.

Having different environmental features from previously described Paju and Cheorwon, the DMZ of Goseong was an area where people inhabited. *Pseudosasa japonica*, poplar (*Populus deltoids*) and tombs, are unique characteristics of villages formed in those areas that were observed during the on-site survey. Specific views of the area are presented in Fig. 1.4.

1.1.2 The Present of DMZ

Being a residential and agricultural area in the past, DMZ area has been changed to wildlife habitat today. After the Korean War in 1950 and ceasefire line on the 38th parallel as the armistice pact was signed, the DMZ has remained 'a no-man's land' for the past 60 years. The military left mine fields in many areas while the border is known to be the most heavily armed in the world. Under such circumstances, the farmlands and villages left by its inhabitants had time to naturally vegetate and undergo ecological succession, a process of natural change. The farmlands, in particular, became wetlands and wildlife habitats. Many abandoned rice paddies

Fig. 1.2 Remains of past residence in Paju DMZ area. **a** Janndanmyeon town office. **b** Remain of Gyeonggi railroad

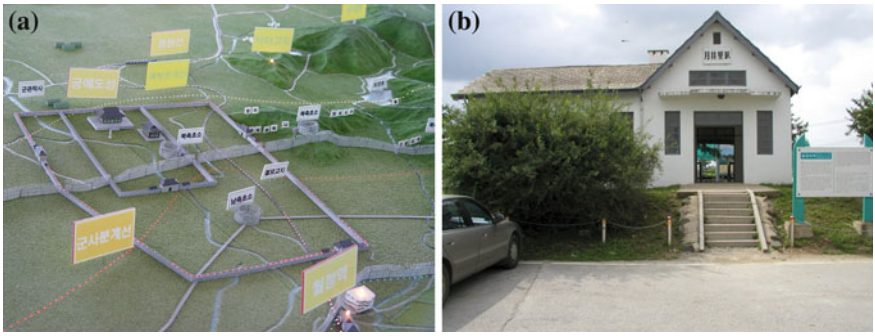

Fig. 1.3 Remains of human residences in the Cheorwon DMZ area. **a** Model of capital in Cheorwon DMZ area. **b** Woljeong-ri station in Cheorwon DMZ area

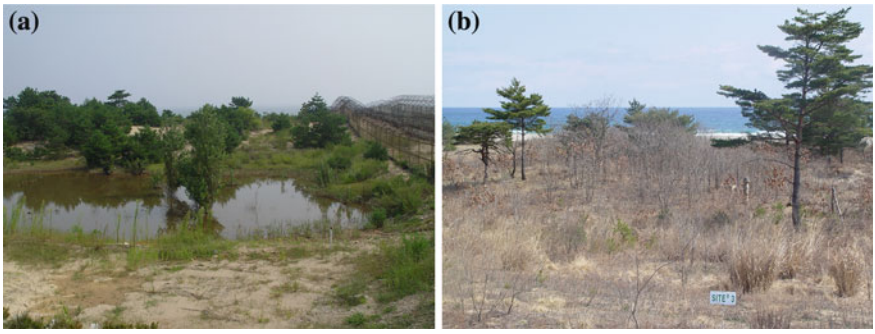

Fig. 1.4 Villages of the DMZ of Goseong area as a ground of life in the past. **a** Poplars in the area of Goseong DMZ. **b** Tombs in the area of Goseong DMZ

and farmlands in Panmunjom—a joint Security Area then, became a sanctuary of birds including the white egret, cattle egret and, the common heron and white heron. This is shown in Figs. 1.5, 1.6 and Table 1.1.

The DMZ in Cheorwon has also been transformed into habitats for birds as the farmland areas in the past was abandoned and transformed into wetlands. Particularly in Cheorwon DMZ area, virtually no farmland could be seen anymore and abundant reeds developed instead, covering the wetlands (Fig. 1.7).

Costal dune was widely developed in Goseong DMZ area brought about by the sands swept away from the coastline. As the DMZ area has been conserved, widely spread alluvial land used as farmlands in the past have been transformed into wetlands where willows and alder trees thrived (Fig. 1.8).

The peaceful utilization of the DMZ areas has been raised in accordance with South–North reconciliation mood since the South–North joint Declaration has been signed on June 15, 2000. Construction works started and completed in 2002 at country level. In addition, as a number of development plans were implemented in the DMZ areas, the habitats changed. The wetlands where meadows of reeds and *Miscanthussacchariflorus* grew and widely thriving, were damaged and affected by the construction works (Figs. 1.9, 1.10 and 1.11).

Fig. 1.5 Abandoned rice paddies of Panmun field in Paju transformed into forested wetlands

Fig. 1.6 Birds found at abandoned rice paddies that transformed into forested wetland in the Panmun field. **a** Some white herons and their breeding. **b** Egrets' multiplication

Table 1.1 The current status of specially protected species in the DMZ

Classification	Endangered species designated by Ministry of Environment	Red data	Natural monument species	Indigenous species	Total
Vegetation	–	–	–	–	0
Mammals	Small-eared cat	Chinese water deer, small-eared cat	–	–	2
Birds	Golden eagle, Red-crowned crane, white-naped crane, marsh harrier, swan goose, einereous vulture, common buzzard, goshawk, bean goose	Red-crowned crane, white-naped crane, hooded crane, einereous vulture, swan goose	Red-crowned crane, white-naped crane, golden eagle, goshawk, marsh harrier, kestrel, swan goose	–	10
Amphibians and reptiles	–	–	–	–	0
Insects	–	–	–	–	0
Fishery	Common Korean bitterling	–	–	Korean rose bitterling, Squalidusgracilismajimae, Abbottinaspringeri Banarescu et Nalbant, Korean spotted sleeper	5
Total	–	–	–	–	17

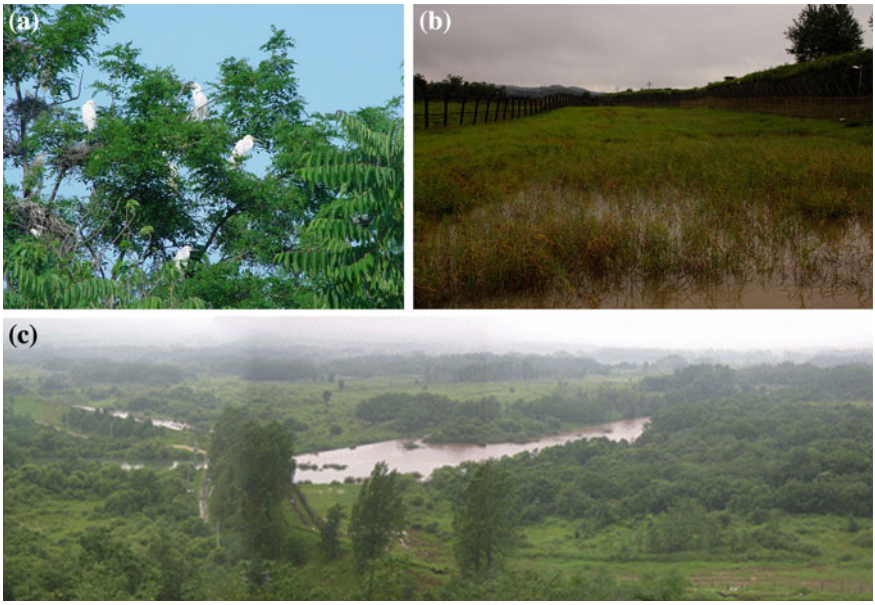

Fig. 1.7 Abandoned rice paddy field transformed into wetlands in Cheorwon DMZ area. **a** Wetland area transformed from abandoned rice paddy field in Panmun field in Paju. **b** Wetland in the DMZ area at the inside of Weoljeongri station. **c** Wetlands in Cheorwon DMZ area viewed from the victory observatory

1.1.3 The Future of DMZ

Ocular surveys revealed that the wetlands nearby DMZ were damaged and succinctly affected by development. Efforts for restoration and management had been made to minimize the effect. A joint survey team for ecological environment has been established to minimize the devastating effect on the ecological system of the highly sensitive ecological areas that arises from the construction of Gyoenggi Line, Donghae Line and North–South connecting road inside the DMZ. The joint survey team for ecological environment played an important role in these areas. The team identifies specific ecological changes by periodically monitoring the area and, provides appropriate conservation strategy for the damaged habitats by enforcing the restoration and maintenance policy. They accelerated and prompted the execution of the conservation and restoration plan by introducing a 'Fast Track' system as a first priority of the national government. The activities of the joint survey team for ecological system are shown in Fig. 1.12.

The reduction and restoration for the damaged areas nearby DMZ had been accomplished through the decisions and actions made by the joint survey team for ecological environment. Their epitomic accomplishments are the construction of ecological bridge and the replacement wetlands. The features after the habitat restoration are shown in Figs. 1.13, 1.14, 1.15. They tried the ecological links by

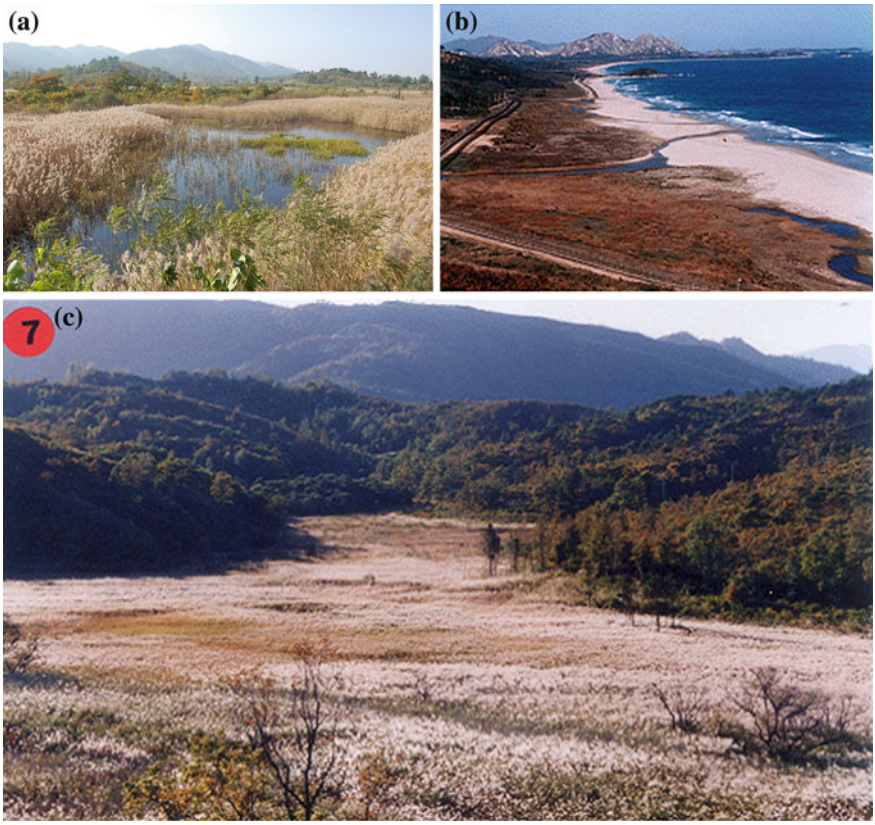

Fig. 1.8 Estuarine wetlands and abandoned rice paddy field transformed into wetlands in Goseong DMZ area. **a** Marsh wetlands developed in Goseong DMZ. **b** Widely developed coastal dune wetlands at the inside of barbed wire in Goseong DMZ area. **c** Alluvial valley wetlands developed in Goseong DMZ area

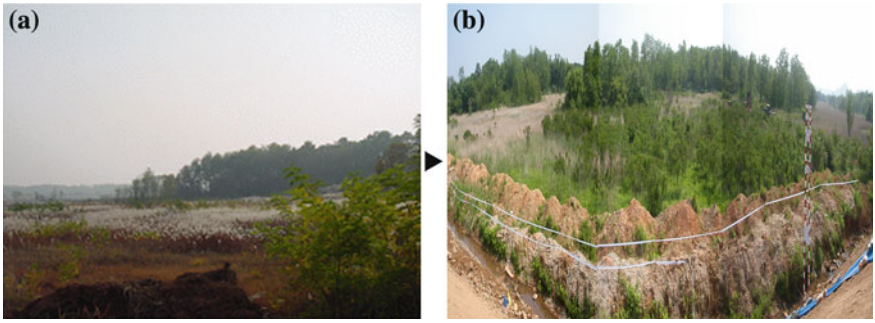

Fig. 1.9 Changes in habitats due to the construction of the road connection of South–North Korea in Paju. **a** Before the road construction. **b** Habitats affected by the road construction

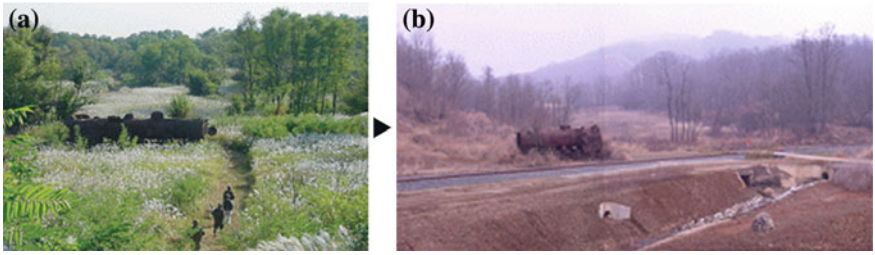

Fig. 1.10 Changes in habitats due to the construction of the Gyeonggi Railroad line, Paju. **a** Before the construction of the railroad. **b** Damaged state after the construction of the railroad

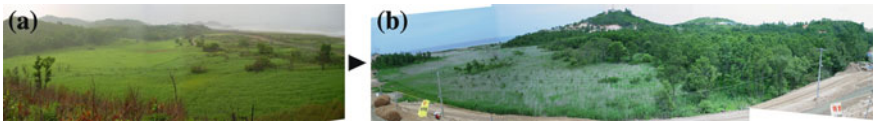

Fig. 1.11 Changes in habitats due to the construction of Donghae Railroad line and the road that connects South Korea to North in Goseong. **a** Before the construction of the railroad. **b** Habitats affected by the construction of the railroad

Fig. 1.12 Photos on the activities of a joint survey team for ecological environment led by the author. **a** Scene for installation of survey plots. **b** A view for ecological survey

means of connecting the mountainous habitats through the building of an ecological bridge in the isolated habitats and damaged areas. The functions of nature can be maintained by nurturing the replacement wetlands which perform the roles and forms the structures similar to the damaged wetlands.

The wetlands, forest and other habitats are restored through the ecological restoration process at the DMZ area. Such features help explore ways to save the DMZ natural ecology from constant development pressure. A model for continuous land use with attached natural conservation plan should be applied in DMZ area. Guaranteeing future environmental sustainability and maintenance of the

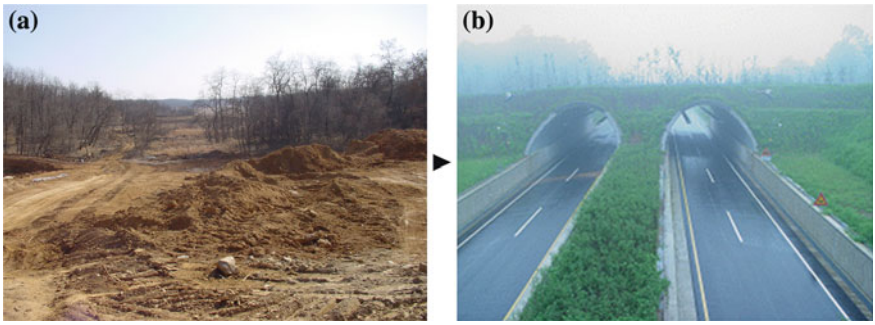

Fig. 1.13 The view of the constructed ecological bridge at the DMZ in Paju. **a** The damaged habitats in road construction. **b** The restoration habitat after the construction of the ecological bridge

Fig. 1.14 The view of the constructed replacement wetland in new Gyoenggi line at Paju. **a** The damaged area after the railroad construction. **b** The restored habitat by construction of a replacement wetland

Fig. 1.15 The effect of the constructed bridge along Goseong line, Donghae line and North–South road. **a** The habitat damaged by the railroad construction. **b** The effect was minimized by construction of a eco-bridge

DMZ must be given sincere consideration and that such responsibility must be inculcated to the present generation and the generations to come.

The DMZ is currently under the pressure of development. The discussion on the joint cooperative development project of North and South Korea in utilizing DMZ is gaining force. It was pointed out that a model on the conservation and continued use of DMZ for the cooperation between North and South is urgent and a national task. The Panmun field where the Gyoenggi Line and roads cross is located at the west of DMZ is highly evaluated in many respects as the areas of the model suggested for North and South cooperation with the opportunity and potentiality to draw out the future vision of the proximities at North–South border line. In biological and geographic points of view, the Panmun field is a link to the ecological system developed in a wider range at the estuary of Sacheon River which

originated from Kaesung city and flowing into Imjin river. However, it is identified as the most feasible area for the integrated management of estuary and land use by the North–South. The author would like to suggest a few proposals which would help the development of a model for North–South cooperation in their joint project at the Panmun field of DMZ.

First, provide a model for North–South environmental cooperation. It may include a model for the management of wetlands and rivers, model for its designation as a nature reserve, and the model for information generation. North Korea released a survey report on the ecological system after declaring the Panmun field as a nature reserve area. According to the report, 15 orders, 38 families, 149 species of birds live in the area. The white-naped and hooded cranes were included. The ecological survey, led by the author, on the southern part of Panmun field has been conducted through the permission of the United Nations Command since 1996. During the survey, four dead bodies of eagles were found at the proximities of JSA inside DMZ. These eagles are designated as Natural Treasure No. 243. These dead eagles were handed over to the College of Veterinary, Seoul National University where the prescribed investigation was performed in order to find out the cause of death. It was presumed then that dead eagles can also be found at the northern part of DMZ since these birds thrive and cover the same environment as to those in the immediate south. However, it is difficult to establish the cause of death of these eagles because information is not shared.

Second, develop a model for the cultural buffer region. The suggestion to develop a model for the recovery of cultural identity with the cooperation of both North–South is feasible in Panmun field even before as well as after the unification. The native towns at the Panmun field areas can be fostered as the ecological peace zone of North–South and as the cultural buffer area. Designating Kaesung city as the world cultural heritage complex of UNESCO will be helpful for the recovery of cultural identity.

Third, develop the model of special region for North–South eco-tourism. It will be the best of both worlds if the water path from Yeomhwa river of Incheon, through the estuary of Han river, to the Sacheon river and to the proximities of Panmun field is developed for eco-tourism. The Gyoenggi Railroad and the roads near the DMZ can be launched as a sightseeing course for ecology enthusiasts. This opportunity for eco-tourism at the Panmun field of DMZ will suggest a term-based, comprehensive integrated model that boasts the features of the DMZ to the world can eventually boost the collaborative economic future of North–South. The models to be developed here cover the total area of Northern and Southern parts of the DMZ, hence can initiate a significant road map for North–South partnership and hopefully contributes to the eventual peace in the Korean peninsula.

1.2 Environmental Description of DMZ

1.2.1 Introduction

There will be no peace and life in the DMZ without the strong conviction and common efforts of government and non-government agencies to conserve its natural resources—a unique biosphere in the world, and paralleled with the collaborative efforts of the public.

1.2.1.1 DMZ

The DMZ is a strip of land running across the Korean Peninsula, which served as a buffer zone since the ceasefire between North and South Korea in 1953. It is 155 mile long and 2.5 mile wide along the military demarcation line (MDL) where civilians' pass is strictly restricted. It has been untouched ever since and is now considered as a precious natural habitat, a rich source of flora nowhere else found in other parts of the country. Lots of efforts are being made to preserve its biodiversity and to transform this zone into a sanctuary of nature, life and peace.

1.2.1.2 Scars of Tragic History

Since the ceasefire between the two Koreas in 1953, there had been various provocative actions from North Korea. One critical provocation was the four underground tunnels the North Korean army built. It was evidently designed for an invasion of the south. When discovered by the south, North Korea insisted that it was designed by South Korea for a surprise attack on the north. North Korea's allegation was proven untrue as evidenced by the direction of blasting inside the tunnels that were obviously going towards the south. Since the thawing tide of the cold war however, attention and great interest from various sectors had been concentrated in the area.

1.2.2 Topography

Steep mountains cover the eastern part of the DMZ, which made it a very good forest ecosystem and a favorable habitat for birds and mammals. Vast plains cover the central part of the DMZ with lush forests where rare migrant birds, including cranes, refuge here in winter time. The western DMZ features lowlands and various types of wetlands creating high biodiversity. It is inhabited by various rare animals and plants. The conservation value of the DMZ is high with its excellent ecosystem. For the same reason, people's access to the area has been controlled for the past six decades.

1.2.3 Functions of DMZ Ecosystem

The DMZ ecosystem has many functions even though there are needs for more studies to describe functional response.

Habitat for wildlife: The DMZ ecosystem provides vital habitat to endangered species. It serves as flyways of North-east Asian birds, for many wading species and waterfowls, a stopover to rest, feed and build up energy before traveling further.

Protection against flood: Five rivers running through the DMZ play critical roles in controlling flood as well as providing water resources.

Research value: Environmental researchers specify their areas for study. It must remain untouched and free from human influence, high impact on human and ecological security and, require collaboration and partnership with international research institutions and agencies.

1.2.4 Ecosystem in the Western DMZ

In the western area of DMZ, a large area of wetland expands around Jangdan peninsula, Imjin and Sacheon river, where an estuary is running into the West Sea then conjoined with Imjin and Han river. These areas serve as intermediate landing spots for migratory birds that are flying over the western coastal area and, provides a winter home for many water birds as well.

A variety of wetland ecosystems can be seen conjoining with the estuarine and coastal wetlands. That is why winter migratory birds designated as Korean natural treasures like the Swan Goose and Brent Goose, the Red-crowned Crane among other rare birds are found here. Natural wetlands provide wildlife habitats not only for birds but also for insects such as *Nannophyapygmaea*, reptilia and as well as *Elapheschrenckii* species.

Necessity for protecting and restoring the Western DMZ ecosystem

The DMZ ecosystem is expected to be subjected to high potential environmental degradation arising from high demand of development. These conditions attract tremendous concerns especially when the Gyoenggi railroad was restored. It was an area that required regional and international partnership for its restoration and conversation. We should conserve the DMZ wetlands along with the equally important Donghae (East Sea) wetlands, as they are part of the critical flyway for water birds.