

Landscape Planning for Shiwha Migratory Birds Habitat¹⁾

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ABSTRACT

Shiwha Lake is an excellent example of a body of water restored from a state of heavy pollution to a cleaner and more ecological state. This paper will explore techniques and methods available to landscape planning for the creation of new migratory birds habitats in Shiwha Lake. Because Shiwha lake is located adjacent to a new industrial site on reclaimed land, any planning effort aimed at restoring bird habitats must carefully consider the existing context.

This plan had 3 goals; (1) to restore the coastal environment, (2) to create a habitat for migratory birds, and (3) to administer environmental education programs. To achieve these goals, several objectives were determined and planning criteria were proposed for topology, water environment(fresh, brackish and salt water swamps), zoning(for experts and general visitors), circulations, planting and mounding.

The flora and fauna of the site was surveyed, and 5 alternatives were suggested and compared in several aspects. Planting species were carefully selected considering target birds and habitat requirements. In order to increase bio-diversity of the site, the plan proposed multi-staired mounds and extensive drainage systems. Bird watching facilities with natural materials, and the remote observing system using CCTV and the internet were some of the ecological techniques recommended by the plan. The bird watching trails are divided into two different zones for experts and general visitors.

Key Words : Migratory Birds, Birds Habitat, Reclamation Land, Mud Flat, Shiwha Lake

I. INTRODUCTION

In the wide green network system, it is natural that the ground forests and parks are the main concern and interest, but the rivers and seashores are also

important factors. Our country(the Republic of Korea) is on the Korean Peninsula and has a very long coastline, a lot of seashore and marine resources. The Yellow Sea is especially famous for its large difference of tidal ebb and flow and unique marine eco-system, so the global and international interest has been

1) This plan is the first prizewinner of Shiwha Multi-Techno Valley Competition, which was the turn-key based system held in October 2003 by Korean Water Corporation (KOWACO). The whole plan included not only the landscape planning, but also many other parts such as civil engineering, geology, hydrology, and so on. But this paper was focused on the landscape planning for a migratory birds habitat.

2) Besides the authors, Min-Woo Lee, Hyung-Seok Oh, Shin Kim, and Se-Eun Jeong participated in the landscape planning part. Daelim Industrial Co., Ltd. was the main construction company and Saman Engineering Co., Ltd. was the main engineering company.

increasing.

But, the recent continuing land reclamations on the Yellow Sea have threatened this valuable ecological resource. Among these reclamations, the embankment of Shiwaha Lake became an object of public concern. In 1996, Shiwaha Lake, a former mud flat, was blocked and eventually destroyed all aquatic life. In response, the Korean government spent a lot of money to improve the water quality of Shiwaha Lake and rectify the damages.

At the early stage, there was serious ocean pollution by the rapid discharging of polluted water into the sea, but through the result of continued efforts, the environment of Shiwaha lake has been improving. Nowadays carps and crucians are found around the upriver of the Ansan stream, and fishes and shellfishes also inhabit the seashore of Shiwaha lake again. Consequently, Shiwaha lake has become the habitat for migratory seabirds and today many migratory birds can be found at this area.

There is a plan to prepare the Shiwaha Multi-Techno Valley (Shiwaha MTV), which is the national industrial site, around Jungwang Dong, Shiheung City and Daebodo Dong, Ansan City in Kyunggi Province. This plan is the part of the whole Shiwaha MTV plan and it is for the restoration and creation of the migratory seabirds habitat on the seashore of Shiwaha

Lake. The site of this plan is located in the seashore of the section 3(see Figure 1).

Because the industrial site is planned to be on the Shiwaha lake, it should be conscious, not to damage the ocean environment. The main purpose of this plan is the creation of a sound ocean environment that migratory birds can inhabit.

II. LITERATURE REVIEWS

There is a tendency to recognize mud flats as both biological and recreational resources. Kim(2003) evaluated the resource value of existing mud flats in Jangwha Ri, Kangwha Island, as strategies for ecotourism, using Limits of Acceptable Change(LAC) and Recreation Opportunity Spectrum(ROS). He described strategies for mud flat area management: detection of water quality, resolving problems of equipment, supply of both environmental education programs and guide equipment.

Some studies are about the method for creation of biological spaces. Kim and Cho(1999) evaluated the creation techniques of artificial wetlands, by comparing bio-diversities before and after the constructions. Kim et al.(2000) tried to find an approach tool that allows for the consideration of both ecological and visual aspects in the development of an ecological space, and the development of a planting design method considering the correlation between high visual preference and ecological diversity. 20 natural areas and 10 urban areas were selected to survey and analyze visual preference and ecological diversity.

Chang(1997) planed the Junam Reservoir Nature Study Center as a part of the fresh-water wetland conservation program, or habitat conservation for migratory birds. She analyzed characteristics of migratory birds, fresh-water wetland and its application to habitat conservation design. The plan suggested to make a habitat for migratory birds and maintain

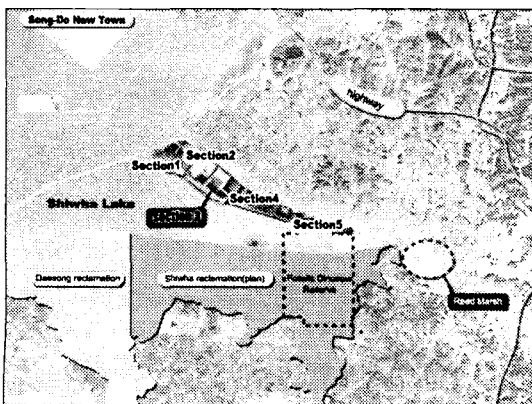


Figure 1. Location of the site

regional environmental conservation, but also to provide for environmental education opportunities.

Chang's study was about the migratory birds habitat, but it was also a plan for the a natural place, as alternative of artificial reclamation. So, the purpose of this paper is to suggest the possibility of a plan for migratory birds in artificially reclaimed land.

III. CASE STUDIES

The cases for the bird watching places were surveyed, including 10 domestic and 5 foreign(Japan) cases(see appendix 1 & 2). The domestic cases were placed around lake or swamp, and were made to appear very natural. They had little interference with the birds, but at the same time, it was difficult and uncomfortable to watch the birds.

Japanese parks were different from domestic ones. They have lots of birds watching facilities for visitors such as observatories, watching posts, and so on. It is very important not only to restore the ocean environment for birds, but also to make watching facilities for visitors and to make efforts to invite birds by planting vegetation and creating habitat, with little disturbance of birds life.

IV. PLAN FOR MIGRATORY BIRDS HABITATS

The progress of the plan is as following(see Figure 2). First of all, the goals and objectives were determined and the site analysis, and the comparison of alternatives followed. After the planning criteria studies and several individual plans(plating, mounding, draining and facilities), the master plan was finally suggested.

1. Goals & Objectives

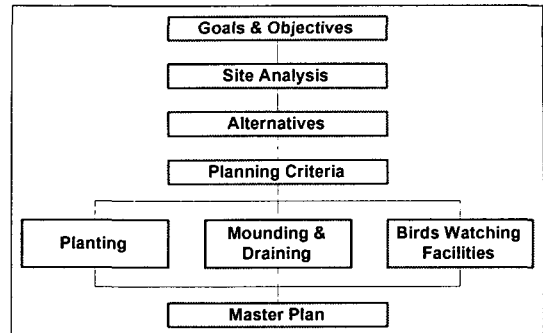


Figure 2. Progress of the plan

GOALS	OBJECTIVES
Restoration of Coastal Environment	<ul style="list-style-type: none"> • various waters : fresh water / brackish water / salt water • curved vegetation : to magnify the edge effect • various planting environment <ul style="list-style-type: none"> : trees - shrubs - transition- salt marsh - mud flat
Creation of Migratory Birds' Habitat	<ul style="list-style-type: none"> • feeding places : perches for birds • resting places : porous materials (rocks and sand island) • mounding : to shield human interferences • brackish area : to connect fresh and salt water
Administration of Environmental Education	<ul style="list-style-type: none"> • visitors center : perches for birds • circulations : to separate the expert and tourist 's path • hidden path : not to disturb birds' life • preliminary education

Figure 3. Goals and objectives of the plan

This plan had 3 goals; to restore the coastal environment, to create a habitat for migratory birds, and to administer the environmental education program making good use of the place. To achieve these goals, several objectives were proposed(see Figure 3).

2. Site Analysis

The site analysis of this plan was mainly focused on the flora(plants) and fauna(animals). There were 135 plant species including 120 species and 15 varieties in 2001(Ministry of Maritime Affairs and Fisheries, 2001). In the on-site survey in 2003, 36 plant species were found around the northern area of Shiwha lake. The diversity of the species had decreased a little, and the dominant species were *Phragmites communis*(Reed), *Salicornia herbacea*, and *Suaeda japonica*.

The Survey of the fauna was emphasized on the



Figure 4. *Calidris alpina* Figure 5. *Haematopus ostralegus*

bird species. There were 15 species in 9 families found in August 2002, and 13 species in 8 families, in April 2003. *Calidris alpina*, *Tringa nebularia*, *Anas crecca*, *Anas platyrhynchos*, and *Haematopus ostralegus* were dominant species. The birds were mostly found along

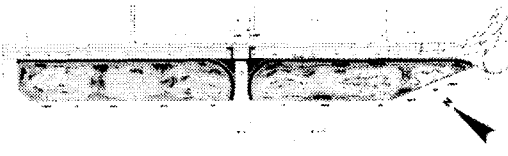

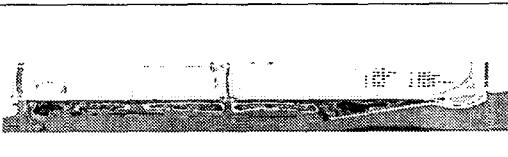
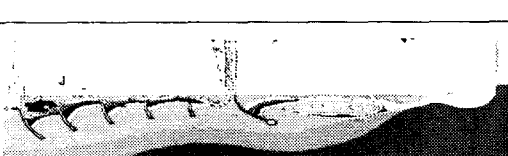
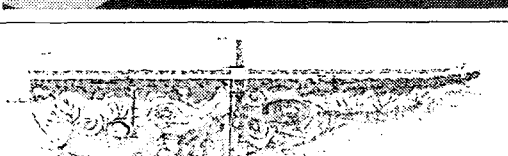

the seashores, islands, and mud flats.

3. Alternatives

5 alternatives for the birds habitat were suggested and compared in the aspects of topographic features, easiness of bird-watching, and variety of the habitat environment. The Table 1 shows the opportunities and constraints of the alternatives.

Each alternative has its own opportunities (the constraints, too). Alt-3 has swamps in the mud flat where birds can rest and feed. Alt-4 can clearly divide the birds' habitat from the area of human

Table 1. Comparison of alternatives

Alternatives		Opportunities(+) & Constraints(-)
ALT-1		<ul style="list-style-type: none"> • little change of current topology • various mounds at the mud flat
ALT-2		<ul style="list-style-type: none"> • various of water environment • maximum of the mud flat
ALT-3		<ul style="list-style-type: none"> • huge artificial structure • bad connection to each mud flat
ALT-4		<ul style="list-style-type: none"> • good for active bird watching • fresh swamp using rainwater
ALT-4		<ul style="list-style-type: none"> • narrow mud flat • conflict between bird's habitat and human activity (bird watching)
ALT-4		<ul style="list-style-type: none"> • clear division of birds habitat and human activity area • various experience by vertical path
ALT-5		<ul style="list-style-type: none"> • too much human activity • structure to interfere eco-system
ALT-5		<ul style="list-style-type: none"> • to make estuary mud flat at the end of the existing stream • various birds' habitat environment
ALT-5		<ul style="list-style-type: none"> • unfavorable for preservation • too much human interference

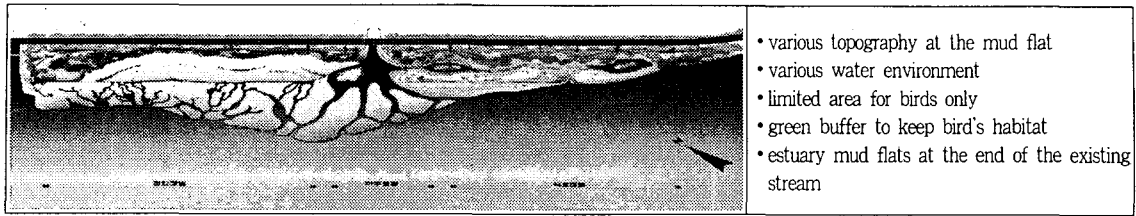


Figure 6. Final plan of Shiwha Birds Habitat (conceptual plan)

activities, and Alt-5 has the merit to use the existing condition and make various habitat environment. The

final plan was composed from these alternatives(see Figure 6).

Table 2. Planning criteria

	<p><i>Topography</i></p> <ul style="list-style-type: none"> • make feeding places at the west mud flat with a gentle slope • make estuary mud flats at the end of the existing stream • make lagoons at the east mud flat with tide channels and salt swamps
	<p><i>Water Environment</i></p> <ul style="list-style-type: none"> • make fresh swamps using rainwater and recycling water • make brackish swamps connecting fresh and salt swamps • prepare porous rocks and sand islands at the mud flat for resting and feeding
	<p><i>Zoning & Facilities</i></p> <ul style="list-style-type: none"> • divide the site into 2 zones, for experts and general visitors • make a observatory at the edge of two zones. • allocate watching posts at each different habitat environment
	<p><i>Circulations</i></p> <ul style="list-style-type: none"> • separate the main path from the bird watching trail • plant trees and make mounds for screening around the watching trails • prepare the place for preliminary education before entrance
	<p><i>Planting & Mounding</i></p> <ul style="list-style-type: none"> • make multi-layered vegetation for various birds' habitat • make various habitat environment (tall trees - shrubs - transition- salt marsh - mud flat) • make multi-staired mounds to hide human activities

4. Planning Criteria

Besides the shape and function of the plan, it is also important to make detailed planning criteria in this project. For example, how to change topography, how to make the water environment, how to divide the areas, and how to plant trees for making better birds' habitat and convenient human uses. Table 2 shows the detailed planning criteria by items.

5. Planting Plan

The planting is one of the most important part of this plan, because the vegetation can perform many functions. It can be the habitat of birds itself and at the same time, the habitat of the prey animals and plants, too. Trees can also hide and screen human activities not to interfere with the birds' life. Thus, planting species should be very carefully selected considering target birds and habitat requirements. Table 3 shows the details.

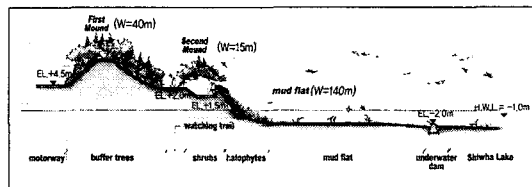


Figure 7. Section of the multi-staired mounds

6. Mounding & Draining Plan

Topological consideration is also important to make various habitat environment of the birds and their preys, such as tidal channels, tide pools, salt swamps, and brackish swamps. Multi-staired mounds can hide human activities from the birds and also can be used as the birds watching trails(see Figure 7).

The mounds with thick forest make a natural ocean landscape and can be a natural buffer from the adjacent industrial site. To make forest on the reclamation, the drainage is essential for the plant growth. The rubble must be layered under the surface soil for drainage(see Figure 8).

Table 3. Plant species selected considering target birds and habitat requirements

Vegetation Type		Target Birds	Habitat Requirements	Selected Plant Species
Trees		<i>Parus major</i> , <i>Emberiza cioides</i> , <i>Gorsachius goisagi</i> , <i>Ardea cinerea</i> , <i>Casmerodius albus</i>	<ul style="list-style-type: none"> resting & hiding places multi layered vegetation open water 	<i>Pinus thunbergii</i> , <i>Celtis sinensis</i> , <i>Sophora japonica</i> , <i>Quercus acutissima</i> , <i>Cornus controversa</i> , <i>Styrax japonicus</i> , <i>Euonymus alatus</i>
Shrubs		<i>Parus major</i> , <i>Emberiza cioides</i> , <i>Casmerodius albus</i> , <i>Gorsachius goisagi</i> , <i>Ardea cinerea</i>	<ul style="list-style-type: none"> restriction of human activity shrubs with fruits or berries for birds feeding habitats for insects 	<i>Zanthoxylum schinifolium</i> , <i>Ligustum obtusifolium</i> , <i>Spiraea prunifolia</i> , <i>Euonymus alatus</i> , <i>Callicarpa japonica</i> , <i>Rosa rugosa</i>
Fresh Water Swamp		<i>Tadorna tadorna</i> , <i>Gallinula chloropus indica</i> , <i>Tachybaptus ruficollis</i>	<ul style="list-style-type: none"> habitat for water insects and fishes for birds feeding sands, gravels, pebbles, mud 	<i>Phragmites communis</i> , <i>Typha orientalis</i> , <i>Monochoria korsakowii</i> , <i>Nymphaea var. angusta</i> , <i>Hydrocharis dubia</i> , <i>Trapa japonica</i> , <i>Myriophyllum verticillatum</i> , <i>Ruppia maritima</i>
Mud Flat	brackish swamp	<i>Gallinago solitaria</i> , <i>Haematopus ostralegus</i>	<ul style="list-style-type: none"> habitat for benthos (starfish, oysters, clams) 	<i>Phragmites communis</i> , <i>Ruppia maritima</i>
	rocks & sand island	<i>Haematopus ostralegus</i> , <i>Gallinago solitaria</i>	<ul style="list-style-type: none"> spawning ground non planting area 	<i>Salicornia herbacea</i> , <i>Suaeda japonica</i> , <i>Phragmites communis</i>

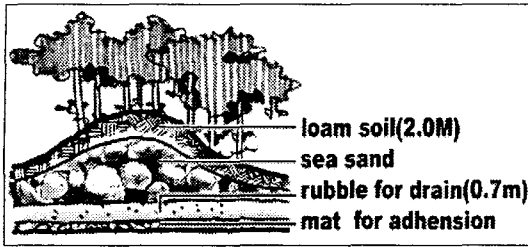


Figure 8. Rubble layer for drain

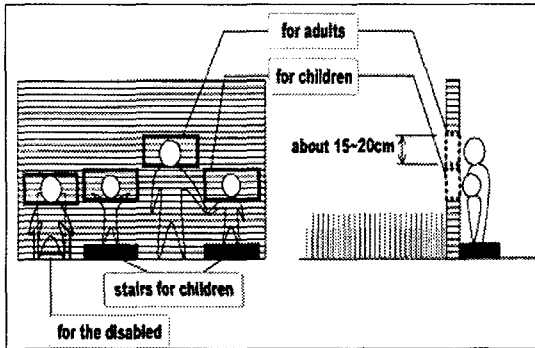


Figure 9. Rubble layer for drain

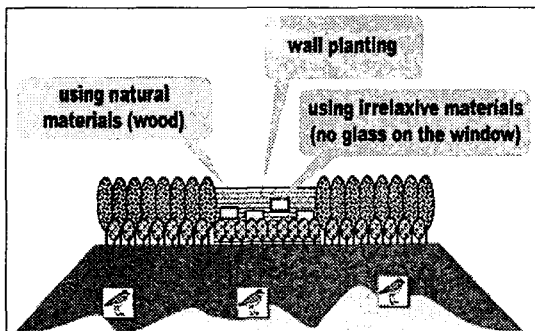
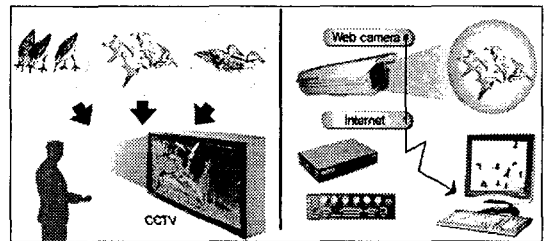


Figure 10. Materials for the observatory



Figure 11. Downward lighting



(a) via Closed-circuit television (b) via Internet

Figure 12. Remote observing systems

7. Bird Watching Facilities

The facilities for bird watching are necessary in this project and the facilities should be carefully designed not to interfere with the birds life. The birds observatory must be made of irreflexive materials and able to hide visitors. The fences can be made of natural material like wood, and the lightings must illuminate downwards to minimize the ecological

	fresh water swamp	mud flat	estuary mud flat
activity	vivid bird watching from observatory (using Camera and Telescope)	bird watching in the observatory and watching post with minimum interference	bird watching in the watching post
facility	observatory, watching hide, CCTV	first post, watching hide, second post, third post	third post
instrument	CCTV, camera, telescope	camera, telescope	camera, telescope
target	<i>Anas formosa</i> , <i>Tadorna ferruginea</i> , <i>Camarda sinensis</i>	<i>Callinago subitans</i> , <i>Larus argentatus</i> , <i>Corvus corax</i>	<i>Actitis macularia</i> , <i>Larus argentatus</i> , <i>Larus argentatus</i>

Figure 13. Materials for the observatory

disturbance.

V. SUMMARY

Shiwaha Lake is an excellent example of a body of water restored from a state of heavy pollution to a cleaner and more ecological state. This paper will explore techniques and methods available to landscape planning for the creation of new migratory birds habitats in Shiwaha Lake. Because Shiwaha lake is located adjacent to a new industrial site on reclaimed land, any planning effort aimed at restoring bird habitats must carefully consider the existing context.

This plan had 3 goals: (1) to restore the coastal environment, (2) to create a habitat for migratory birds, and (3) to administer environmental education programs. To achieve these goals, several objectives were determined and planning criteria were proposed for topology, water environment(fresh, brackish and salt water swamps), zoning(for experts and general visitors), circulations, planting and mounding.

The flora and fauna of the site was surveyed, and 5 alternatives were suggested and compared in several aspects. Planting species were carefully selected considering target birds and habitat requirements. In order to increase bio-diversity of the site, the plan proposed multi-staired mounds and extensive drainage systems. Bird watching facilities with natural materials, and the remote observing system using CCTV and the internet were some of the ecological te-

chniques recommended by the plan. The bird watching trails are divided into two different zones for experts and general visitors.









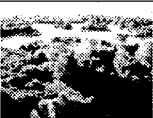

This paper is about the landscape planning of the whole plan, and suggests some fundamental ideas and plans. This plan is still in progress at the phase of construction drawings. Thus, many details must be continuously developed and various researches studied to make a ecological birds habitat. There should be a lot of effort to minimize bad environmental impact until the whole completion.

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Appendix

Appendix 1. The cases of domestic birds watching places

Location	Habitat Type	Habitable Birds	Remarks
Kangwha Island 	natural wetland	<i>Anser fabalis</i> , <i>Tadorna tadorna</i> , <i>Platalea leucorodia</i> , <i>Casmerodius albus</i> , <i>Gallinago solitaria</i> , <i>Haematopus ostralegus</i> , <i>Larus saundersi</i>	natural mud flat environment
Chunsoo Bay 	reclamation wetland	<i>Anser fabalis</i> , <i>Anas platyrhynchos</i> , <i>Anas poecilorhyncha</i> , <i>Mergus serrator</i> , <i>Tachybaptus ruficollis</i> , <i>Gallinago solitaria</i> , <i>Haematopus ostralegus</i>	features of reclamation
Youngrang Lake 	accumulated natural tide land	<i>Cygnus columbianus</i> , <i>Anas platyrhynchos</i> , <i>Anas formosa</i>	waterfront space (ongoing)
Kumkang Estuary Dyke. 	estuary swamp mud flat	<i>Platalea minor</i> , <i>Cygnus cygnus</i> , <i>Larus saundersi</i> , <i>Circus cyaneus</i> , <i>Accipiter nisus nisosimilis</i> , <i>Falco tinnunculus interstinctus</i> , <i>Haematopus ostralegus</i> .	bird observatory
Soonchun Bay 	estuary reed marsh	<i>Larus saundersi</i> , <i>Ciconia boyciana</i> , <i>Grus vipio</i> , <i>Grus monacha</i> , <i>Platalea minor</i> , <i>Gallinago solitaria</i>	eco-park planning (ongoing) : including birds habitat and watching facilities
Junam Reservoir 	artificial swamp	<i>Cygnus cygnus</i> , <i>Anser fabalis</i> , <i>Aythya ferina</i> , <i>Anas platyrhynchos</i> , <i>Anas poecilorhyncha</i> , <i>Mergus merganser</i> , <i>Gallinago solitaria</i> .	famous eco-tour place (for watching birds)
Wooipo Swamp 	natural swamp	<i>Gallinula chloropus indica</i> , <i>Anser fabalis</i> , <i>Platalea leucorodia</i> , <i>Anas platyrhynchos</i> , <i>Anas crecca</i> , <i>Cygnus cygnus</i> , <i>Casmerodius albus</i> , <i>Ardea cinerea</i>	birds watching trail, conserved marsh by Ramsar Convention(1998)
Ulsook Island 	deposit of mud estuary mud flat reed marsh	<i>Larus ridibundus</i> , <i>Gallinago solitaria</i> , <i>Haematopus ostralegus</i> , <i>Mergus serrator</i> , <i>Tachybaptus ruficollis</i> , <i>Phalacrocorax capillatus</i> , <i>Casmerodius albus</i>	the designated natural monument (1996)
Bam Island (in Han River) 	accumulated island in Han River	<i>Mergus albellus</i> , <i>Oriolus chinensis diffusus</i> , <i>Ninox scutulata</i> , <i>Haliaeetus albicilla</i> , <i>Falco tinnunculus interstinctus</i> , <i>Asio flammeus flammeus</i>	eco-preservation zone (1998)
Daeho Embankment 	reclamation farmland, fresh swamp	<i>Cygnus cygnus</i> , <i>Haematopus ostralegus</i> , <i>Gallinula chloropus indica</i> , <i>Podiceps cristatus</i> , <i>Charadrius alexandrinus</i> , <i>Charadrius dubius</i> , <i>Anser fabalis</i>	features of reclamation

Appendix 2. The cases of Japanese birds watching places

Location	Habitat Type	Habitable Birds	Remarks
Tokyo Wildbird Park 	landfill, fresh water, salt swamp, forest	<i>Gallinago solitaria</i> , <i>Casmerodius albus</i> , <i>Corvus corone</i> , <i>Haematopus ostralegus</i> , <i>Phalacrocorax carbo</i> , <i>Tadorna tadorna</i>	natural waterside with vegetation, seawater channel
Yonago Seabird Park 	tideland, lake, reclamation, reed marsh	<i>Haematopus ostralegus</i> , <i>Tadorna tadorna</i> , <i>Ardea cinerea</i> , <i>Cettia diphone borealis</i> , <i>Alcedo atthis bengalensis</i> , <i>Phalacrocorax capillatus</i> , <i>Aythya ferina</i> , <i>Anas acuta</i>	observatory, watching post, reed marsh, water filtration system
Osaka Wildbird Park 	fresh swamp, salt swamp, mud flat	<i>Tadorna tadorna</i> , <i>Gallinago solitaria</i> , <i>Ardea cinerea</i> , <i>Haematopus ostralegus</i> , <i>Larus saundersi</i> , <i>Strix aluco</i> , <i>Saxicola torquata stejnegeri</i>	embankment, seawater pipes, fresh swamp, salt swamp, reed marsh, observatory
Kasai Sea Park 	Park on the reclamation, artificial mud flat	<i>Tadorna tadorna</i> , <i>Gallinago solitaria</i> , <i>Larus saundersi</i> , <i>Casmerodius albus</i>	sand bank, mud flat, fresh swamp, brackish swamp
Kirarahama Natural Park 	artificial salt lake, fresh swamp, brackish lake, reed marsh	<i>Larus saundersi</i> , <i>Platalea leucorodia</i> , <i>Phoenicurus aureus aureus</i> , <i>Grus monacha</i> , <i>Anser fabalis</i> , <i>Tadorna tadorna</i> , <i>Gallinago solitaria</i>	observatory, parking, tideland, fresh swamp