Harmonious Coexistence:

Multi-Scale Bird Ecological Corridor Planning in Beijing's Fringe

PROJECT STATEMENT

Urbanization has led to significant habitat loss and fragmentation, posing severe threats to urban biodiversity. Birds, key indicators of ecological health, are central to monitoring urban environments. Beijing, located along the East Asian-Australasian Flyway, boasts the second highest number of bird species among G20 capitals. However, urban sprawl threatens the habitats of these birds in suburban areas, creating conflicts between recreational services and conservation efforts.

This analysis and planning project provides essential insights into balancing bird diversity conservation and human recreational activities in urban fringe areas. Focused on the most conflict-prone regions—Cuihu Wetland, Shahe Wetland, and their surrounding regions—the project aims for harmonious coexistence between humans and birds. It proposes an original strategy that integrates protection and utilization. By understanding birds' ecological habits, a unique three-scale bird ecological corridor protection system was developed. The project identified the spatial distribution of bird habitats and human recreation areas, pinpointing ecological breakpoints in bird flight corridors and conflict zones between birds and humans. It delineated activity spaces for both, proposing harmonious coexistence patterns for their activities. It offers optimized spatial designs that promote harmonious coexistence, achieving dual ecological and social benefits.

PROJECT NARRATIVE AND CONTENTS

01 Project Background

With the acceleration of urbanization, Beijing's urban fringe areas face increasingly severe ecological pressures due to the loss of natural land. These fringe areas are not only crucial for urban biodiversity but also serve as major recreational spaces for citizens. However, habitat loss and fragmentation caused by urban expansion pose significant threats to wildlife, particularly birds. The Second Green Belt of Beijing, as an essential part of the plain ecological security pattern, plays a vital role in maintaining urban ecological stability and enhancing the quality of life for residents. Therefore, achieving a balance between bird conservation and human recreational activities in this area has become an urgent issue.

02 Project Challenges

- Habitat Fragmentation: The project area is at the forefront of urbanization. Development of office and residential areas around the Shahe and Cuihu wetlands has led to the loss of natural vegetation. Bird habitats are being segmented and encroached upon, reducing ecological connectivity, impeding species interaction and migration, and severely threatening biodiversity.
- Human-Bird Conflicts: The project area is one of the most important habitats for birds in Beijing and a popular recreational area for citizens. Human activities often conflict with the needs of bird conservation. The growing density of the population exacerbates this conflict, necessitating solutions for harmonious coexistence.
- Lack of Ecological Corridors: Although the project area serves as a critical stopover for birds between the Yanshan and Taihang mountain ranges, it lacks an effective ecological connectivity network. This limitation hinders bird movement within the area and prevents the formation of a stable ecological connection.

03 Project Objectives

The project aims to achieve harmonious coexistence between bird habitat conservation and human recreational activities in Beijing's fringe areas through scientific planning and reasonable design. Specific objectives include:

- Enhancing Ecological Connectivity: Construct ecological corridors to improve habitat connectivity, facilitating free diffusion and interaction among species.
- Reducing Human Disturbance: Develop recreational activity plans to minimize interference with bird habitats.
- Achieving Harmonious Coexistence: Through rational spatial division and behavioral guidance, provide ecological recreational value while protecting birds.
- Raising Public Ecological Awareness: Enhance public understanding of bird conservation through scientific outreach and ecological education.

04 Project Strategy

Step 1: Selection of Representative Bird Species

The first step of the project involves identifying key bird species and understanding their habitat needs. Data from the China Bird Watching Center shows that approximately 233 bird species (18 orders, 59 families) have been observed in the study area over the past five years. To facilitate classification and research, we categorized these birds into forest birds, water birds, and field birds, with 127, 96, and 10 species respectively.

We established a key protected bird species evaluation system. By applying a graded scoring method, we quantified six indicators: endangered status, protection level, biological representativeness, significance as migratory species, uniqueness to China, and distribution range. This approach identified 8 key protected species and 8 common species within the study area. The ecological habits of these species will provide a scientific basis for subsequent habitat patch identification and conservation strategy development.

Step 2: Macro Scale - Constructing Regional Ecological Network

The project utilizes an innovative research system that determines tasks from macro to micro scales, addressing regional landscape connectivity, bird stopover corridors between Cuihu and Shahe, and habitat patches.

First, we constructed a regional bird ecological network. The core study area was expanded to a 20-kilometer buffer zone, encompassing the Yan and Taihang Mountain ranges and Beijing's urban area. Using land cover data and morphological spatial pattern analysis, we identified regional ecological patches suitable for forest, water and field birds. Next, we developed a landscape resistance surface and calculated the flight resistance patterns for the three bird types using least-cost and Euclidean distances. Applying a circuit theory model, we simulated bird movement and generated current density overlay maps, identifying potential bird ecological networks.

Based on these simulation results, we graded the connectivity of the bird ecological network and ultimately identified the regional ecological corridor system. These corridors, essential for bird mobility and interaction, require protection of existing vegetation and water bodies, crucial for enhancing biodiversity and ecological connectivity.

Step 3: Meso Scale - Bird Stopover Ecological Corridor Analysis

The third step focuses on analyzing bird migration behavior between the two primary ecological sources, Cuihu Wetland and Shahe Reservoir, within the planned area, assessing stopover probabilities and ecological breakpoints.

We first constructed a corridor resistance surface indicator system based on the ecological habits of forest, water, and field birds, and used AHP analysis to determine the weight of each factor. With these weights, we built resistance surfaces and used a circuit model to identify stopover probabilities. Higher current densities indicate greater bird passage probabilities, guiding the establishment of bird flight corridor buffer zones in these high-density areas.

Additionally, using the moving window method, we analyzed ecological breakpoints in bird corridors, simulating land restoration to improve corridor connectivity. This analysis effectively identified barriers to connectivity, providing targeted improvement measures.

Step 4: Micro Scale - Bird Habitat Patch Construction

With the ecological corridors defined, we proceeded to construct bird habitat patches on a micro scale, focusing on the Cuihu-Shahe ecological corridor covering 985.89 hectares.

First, we conducted habitat suitability assessments. Reviewing literature and analyzing representative bird species' ecological habits in feeding, breeding, and nesting, we identified four suitability indicators: food availability, water resources, concealment conditions, and human disturbance. Using AHP analysis to determine weights, we mapped the comprehensive suitability distribution for forest, water, and field birds.

Step 5: Spatial Zoning Management from a Human-Bird Coexistence Perspective

We developed an evaluation system for recreational services in urban fringe areas, identifying areas with high potential for recreational activities. By normalizing and overlaying bird habitats with human recreational density, we delineated three spatial zones: bird-dominated areas, recreation-dominated areas, and human-bird overlapping areas. These divisions will guide precise ecological corridor planning and spatial utilization strategies.

05 Space Construction Strategies

The project aims to achieve harmonious coexistence between bird habitat conservation and human recreational activities in Beijing's fringe areas through scientific planning and reasonable design. Specific objectives include:

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06 Project Vision and Outlook

The project envisions sustainable ecological development in Beijing's fringe areas through scientific planning and effective management, with the following outlook:

- Significant Enhancement of Ecological Connectivity: Building efficient ecological corridors to improve habitats for birds and other wildlife, promoting biodiversity restoration.
- Harmonious Coexistence of Humans and Birds: Rational planning of recreational areas to reduce habitat disturbance, creating a harmonious environment for both humans and nature.
- Increased Public Ecological Awareness: Enhancing citizens' understanding of ecological protection through education and outreach, fostering a community-wide commitment to ecological civilization.
- Healthy Urban Ecosystem Development: Using this area as a model, extending successful experiences and methods to other urban fringe areas for ecological protection and sustainable development.

01 BACKGROUND

Beijing's fringe has an excellent ecological environment different from the city, which is very important for the protection of urban biodiversity. It is planned to take Shahe wetland, an important urban Bird habitat, as an example to carry out the case of harmonious coexistence of humans and bird in city.

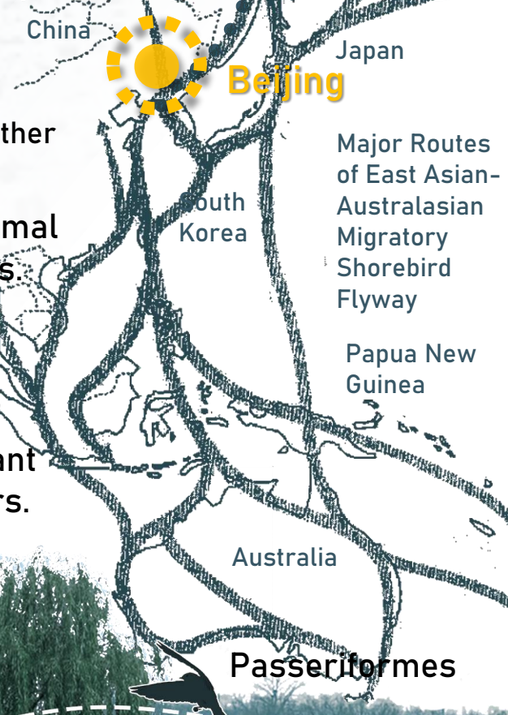
Shahe wetland

Beijing

China

Planning Site

Beijing is the passing point of the East Asian-Australasian Migratory Shorebird Flyway, and the natural wetlands in the plain area, including Shahe wetland, are of great significance to the protection of bird biodiversity.



The number of birds can directly reflect the population status of other species in the urban ecosystem.

2 kind of bird disappears. Reflects 1 kind of mammal disappears.

Birds are the most significant indicator species for urban ecological environment monitoring.

1 kind of bird disappears. Reflects 3 kind of fish disappears. + 35 kind of insect disappears. + 90 kind of plant disappears.

Scansores

Grallatores

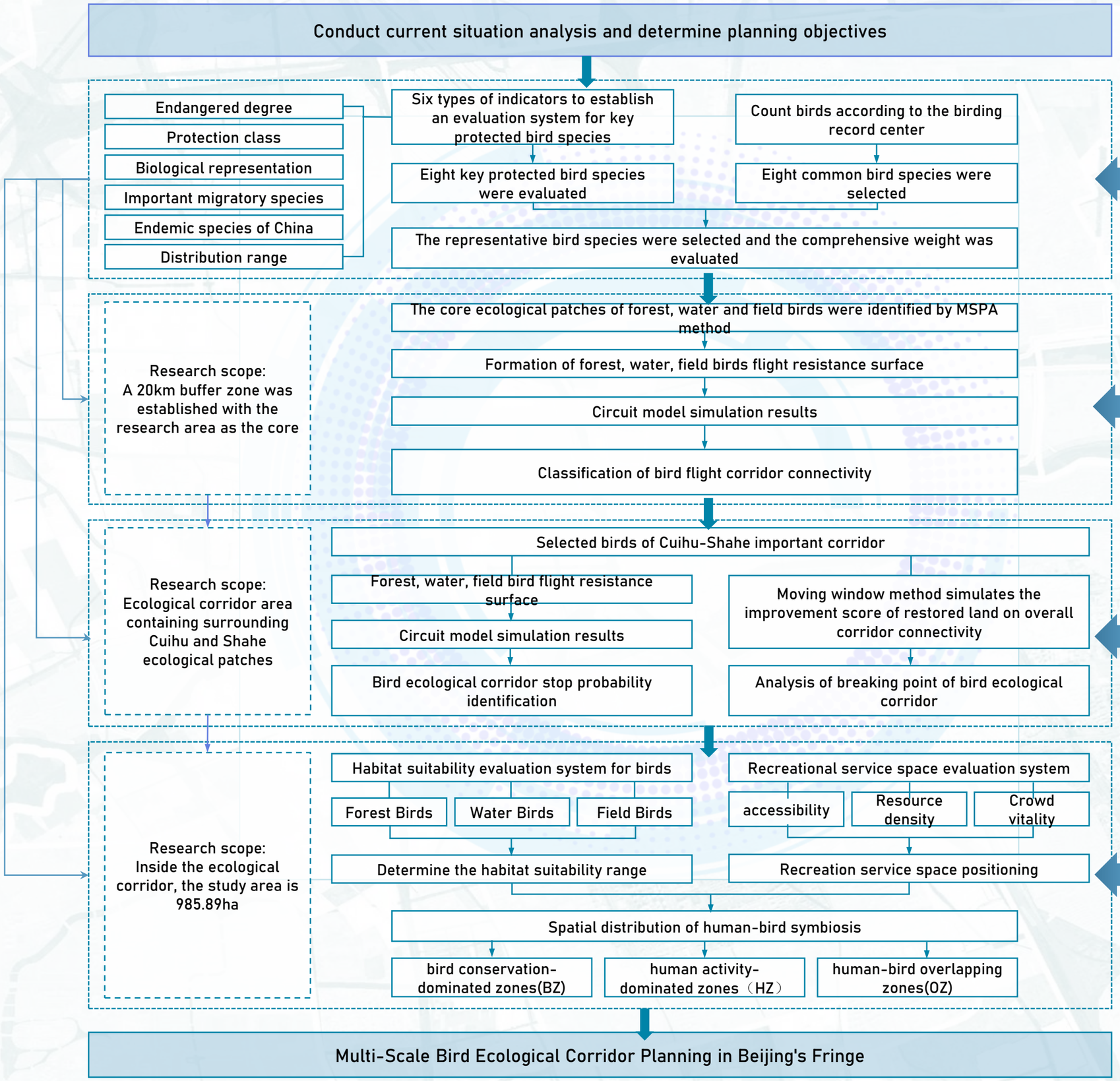
Natatores

Terrestores

Scansores

Passeriformes

02 RESEARCH FRAMEWORK



1

STAGE 1

Selection of representative bird species

2

STAGE 2

【 Macro scale 】
Construction of bird regional ecological network

3

STAGE 3

【 Meso scale 】
Analysis of the ecological corridor of bird transit

4

STAGE 4

【Micro scale】
Construction of bird habitat under human-bird symbiosis space

03 Selection of Bird Species for Research

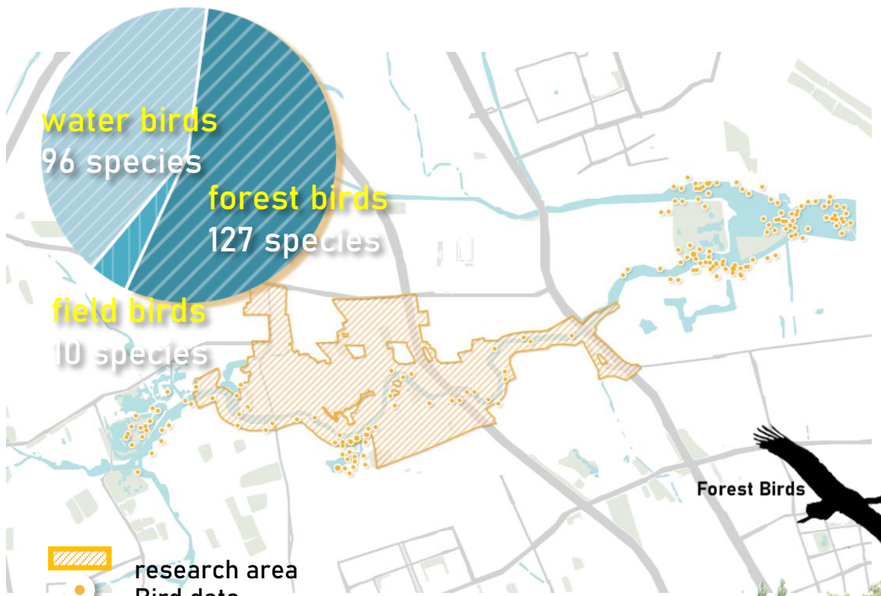
The usual way birds are categorized

- Classification according to type of residence
- Classification according to ecological habits
- Classification according to habitat

With reference to the above categorization, and in conjunction with the type of land use in the study area, birds on the site were classified as **water birds, field birds, forest birds**

Step 1 Selection of birds based on frequency of bird observations in the study area

By crawling the public data of China Birdwatching Center, 8 common bird species of forest birds, water birds and field birds within the study area were obtained respectively

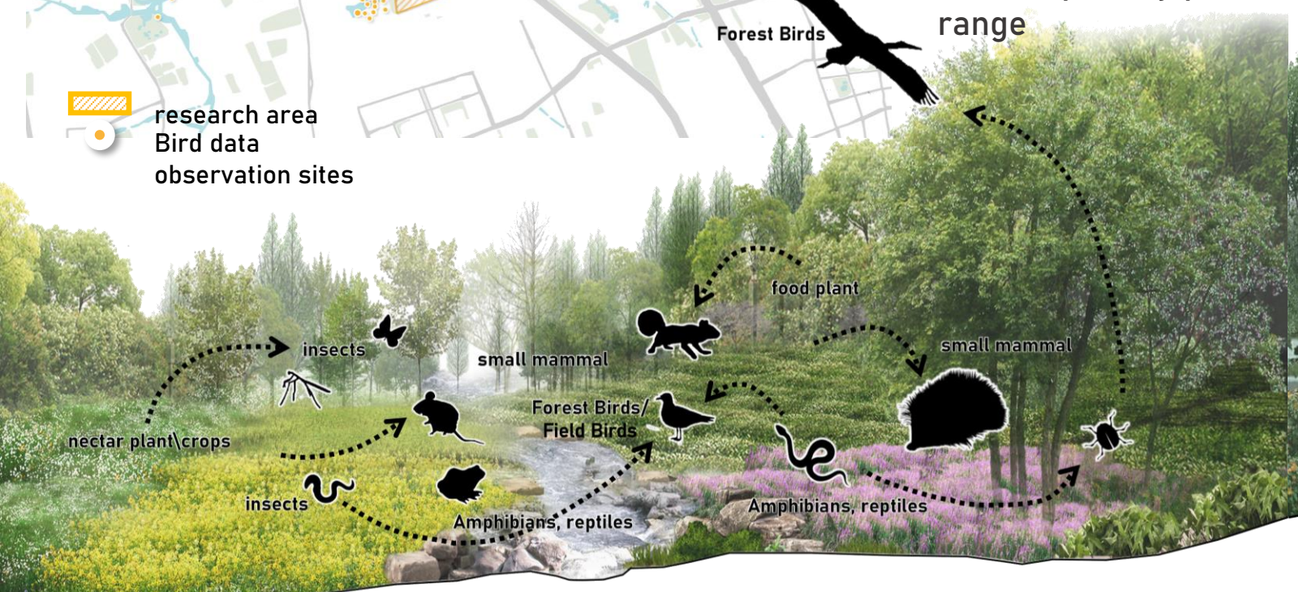


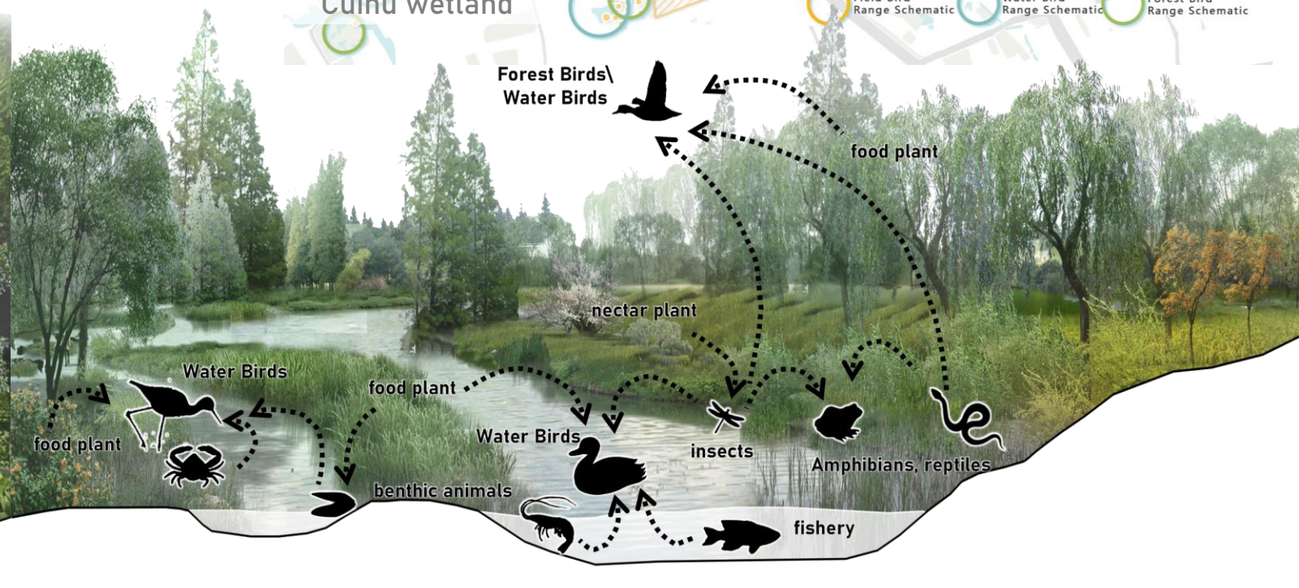
Step 2 Building a scoring system for key conservation species

- endangeredness
- whether they are endemic to China
- biological representativeness
- whether they are important migratory species
- distribution ranges
- conservation rank

9 bird species were assessed to be in need of priority protection within the range

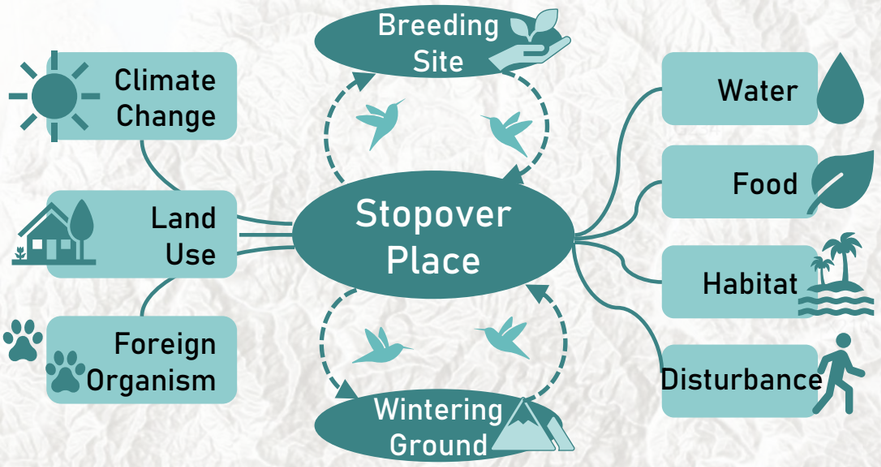
Step 3 Considering the birds selected in steps 1 and 2 together, the final 17 bird species were obtained for the study



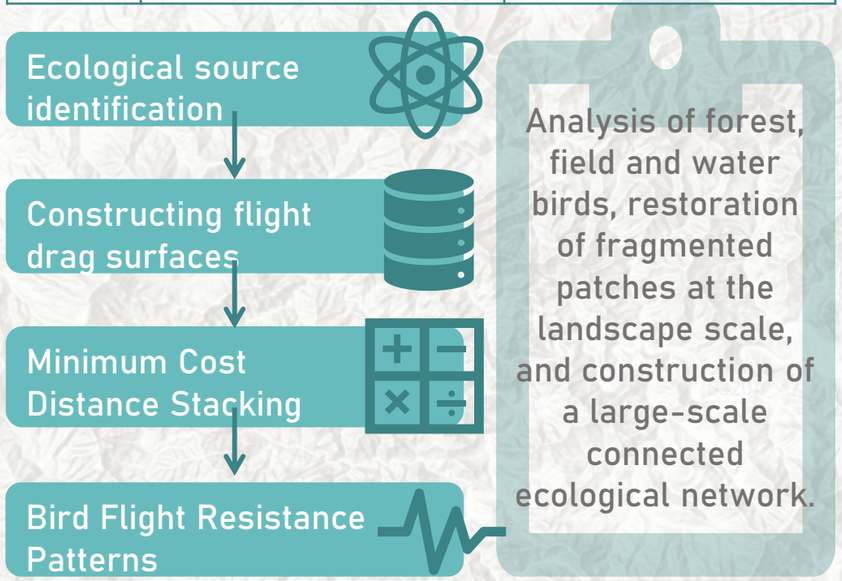


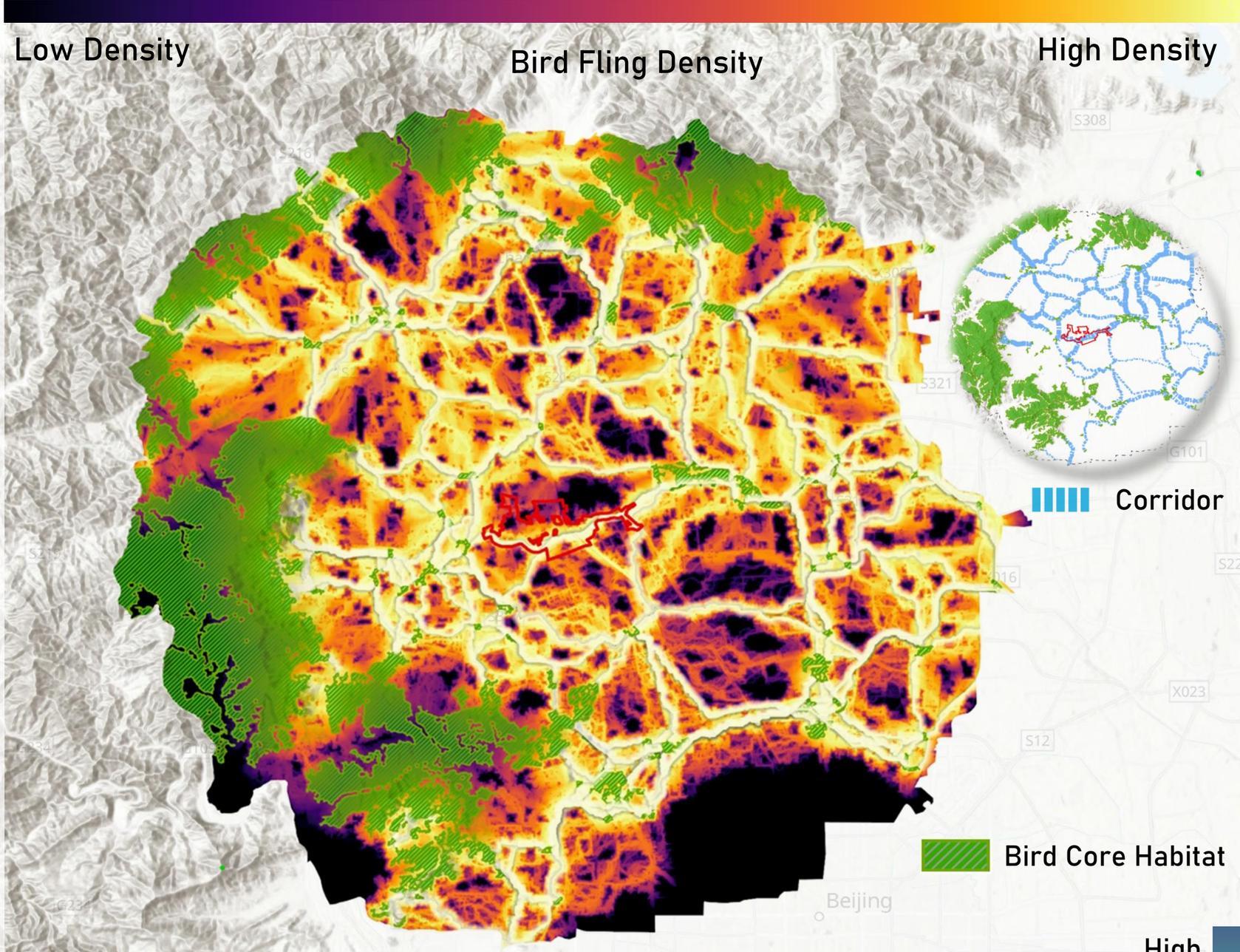
04 MACRO SCALE

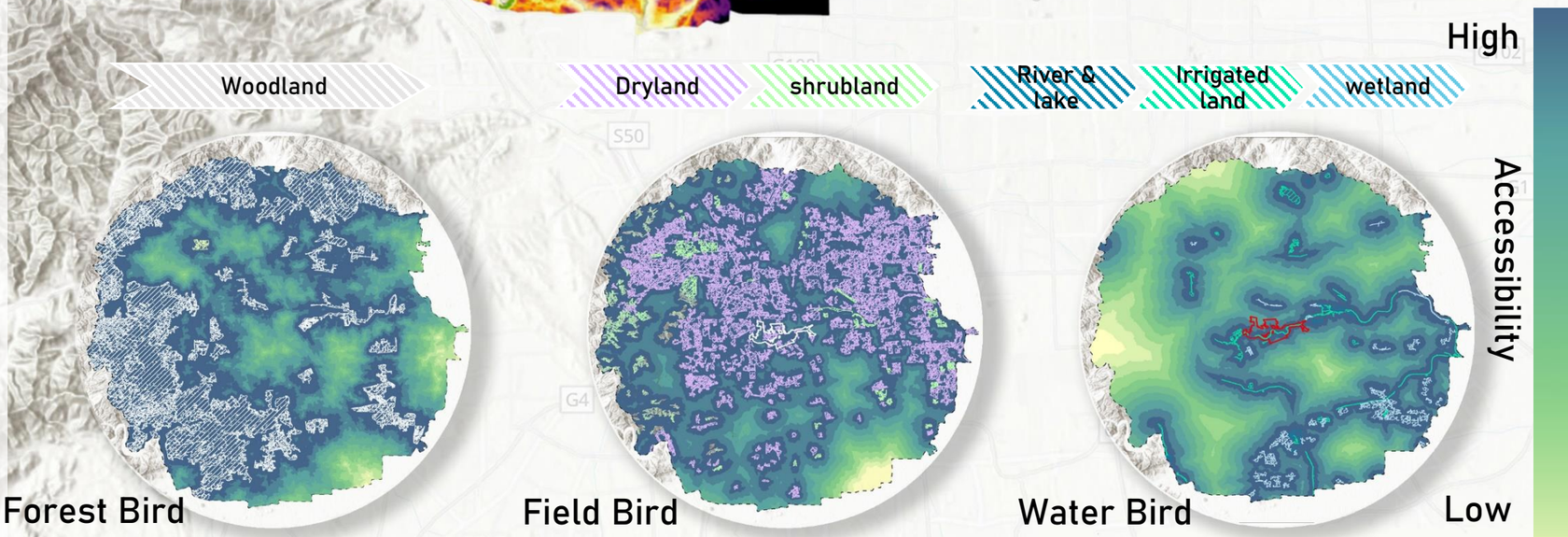
Landscape Scale ····· Local Scale



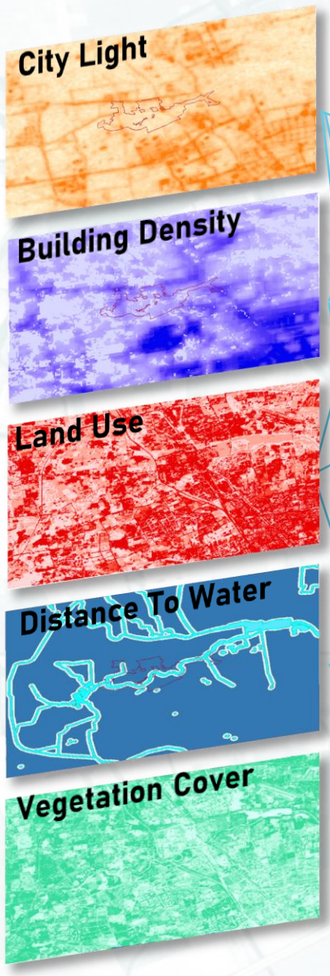
Factor	Impact	Habitat Requirements
Food Resources	Crucial for migration timing and stopover points, influenced by availability and foraging strategies.	Food quantity, quality, and accessibility tailored to different stopover needs.
Stopover Area	Size and distribution of habitats dictate migration strategies; land type conversion affects bird populations.	Minimum 10 ha of green space with longer perimeters preferable.
Stopover Vegetation	Diversity and integrity impact population size; habitat loss and fragmentation decrease waterbird numbers.	Regional vegetation diversity supports various bird needs.

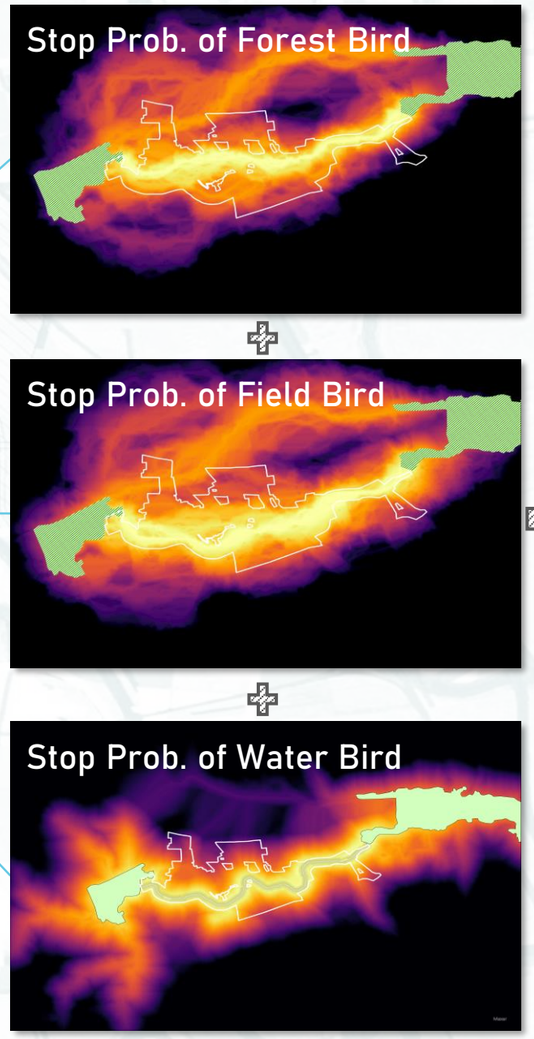


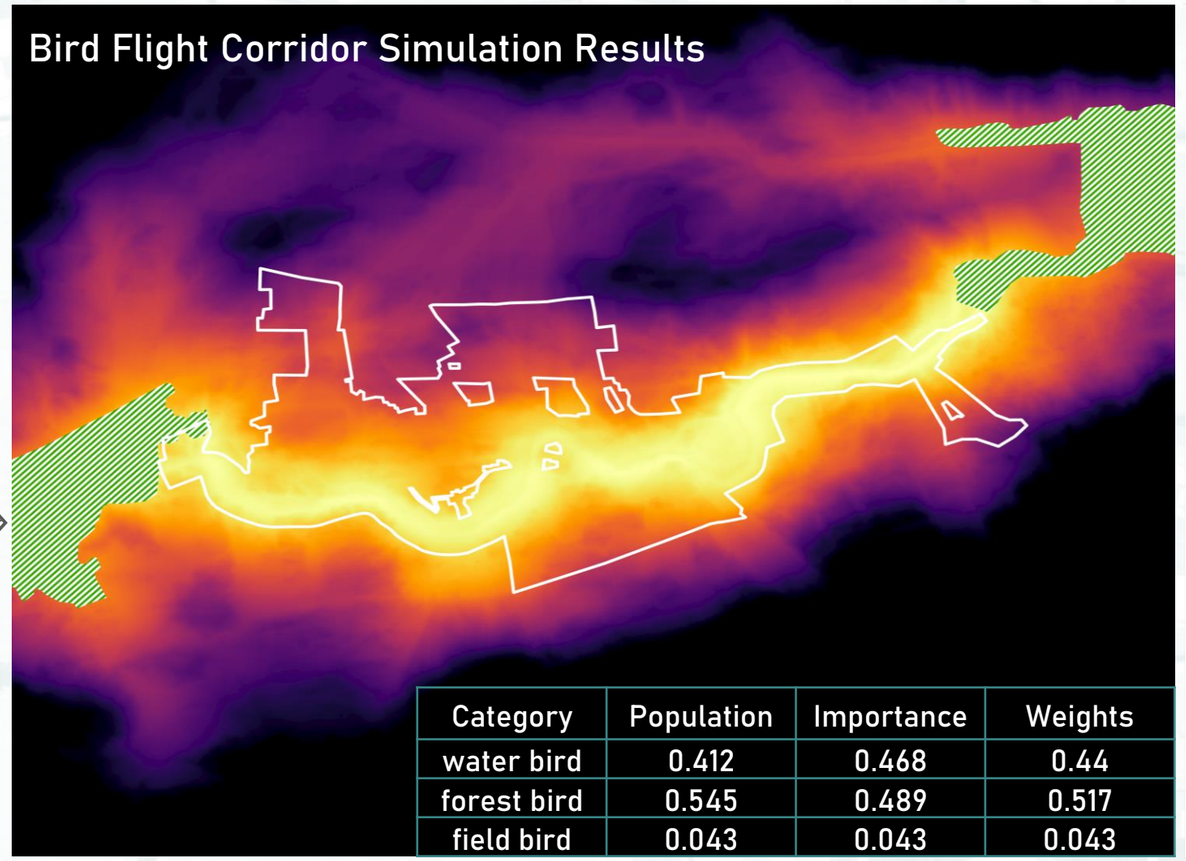




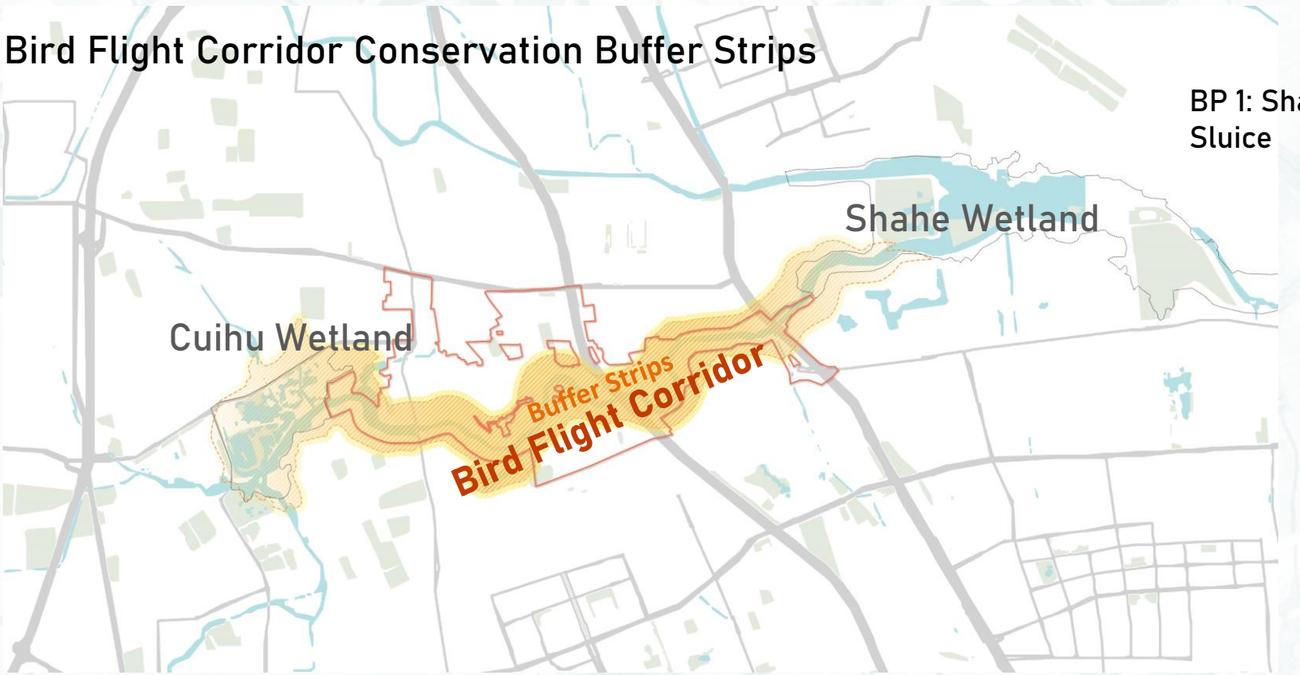
05 MESO SCALE

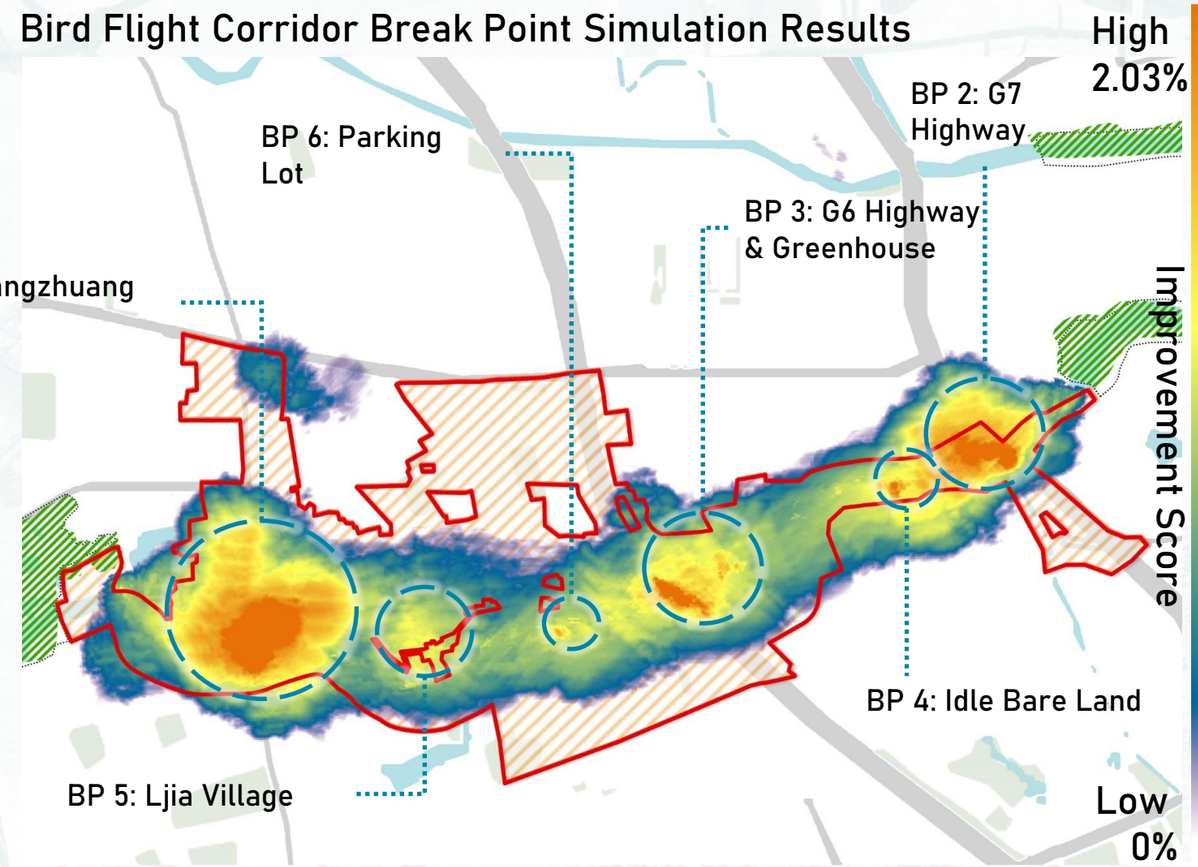






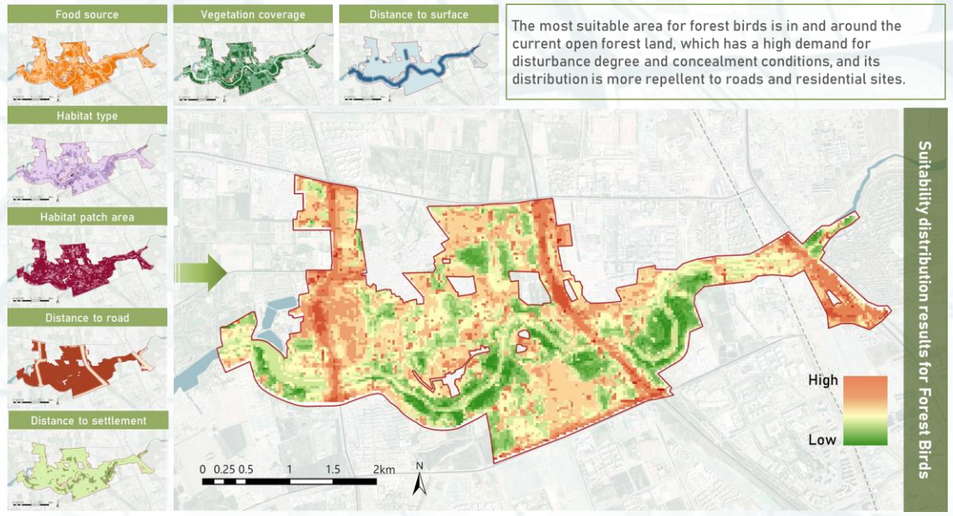
Category	Population	Importance	Weights
water bird	0.412	0.468	0.44
forest bird	0.545	0.489	0.517
field bird	0.043	0.043	0.043



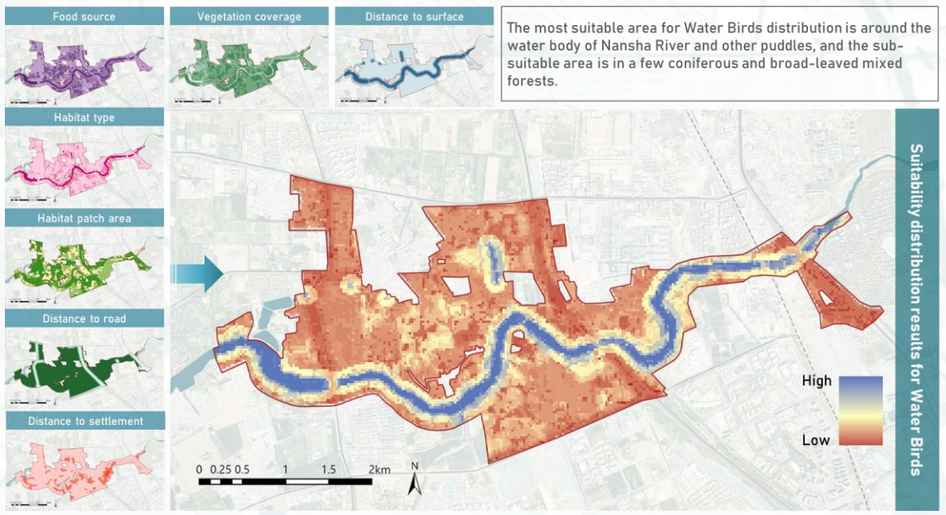


06 MICRO SCALE

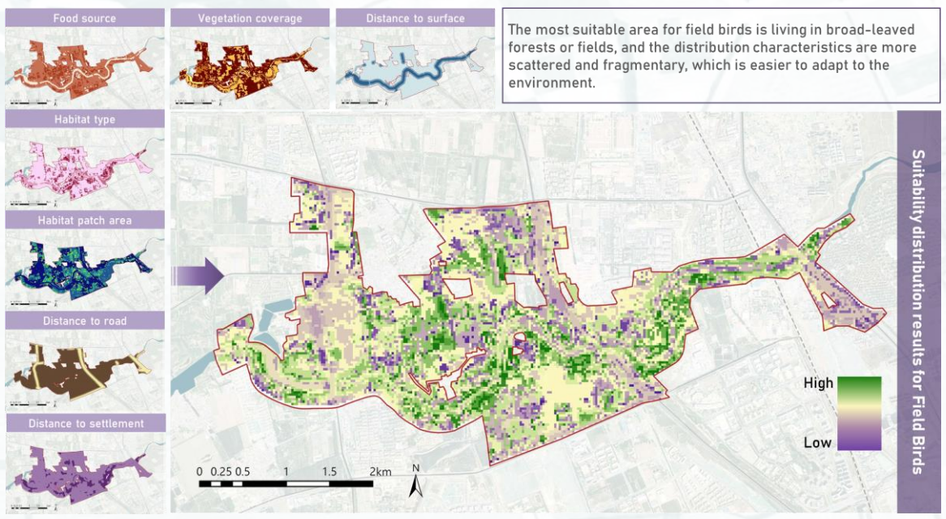
Results of habitat suitability of Forest Birds



Habitat suitability results for Water Birds



Habitat suitability results for Field Birds



Identify birds in the study area

↓

Constructing habitat evaluation index system

↓

Locate the regional distribution of suitability

↓

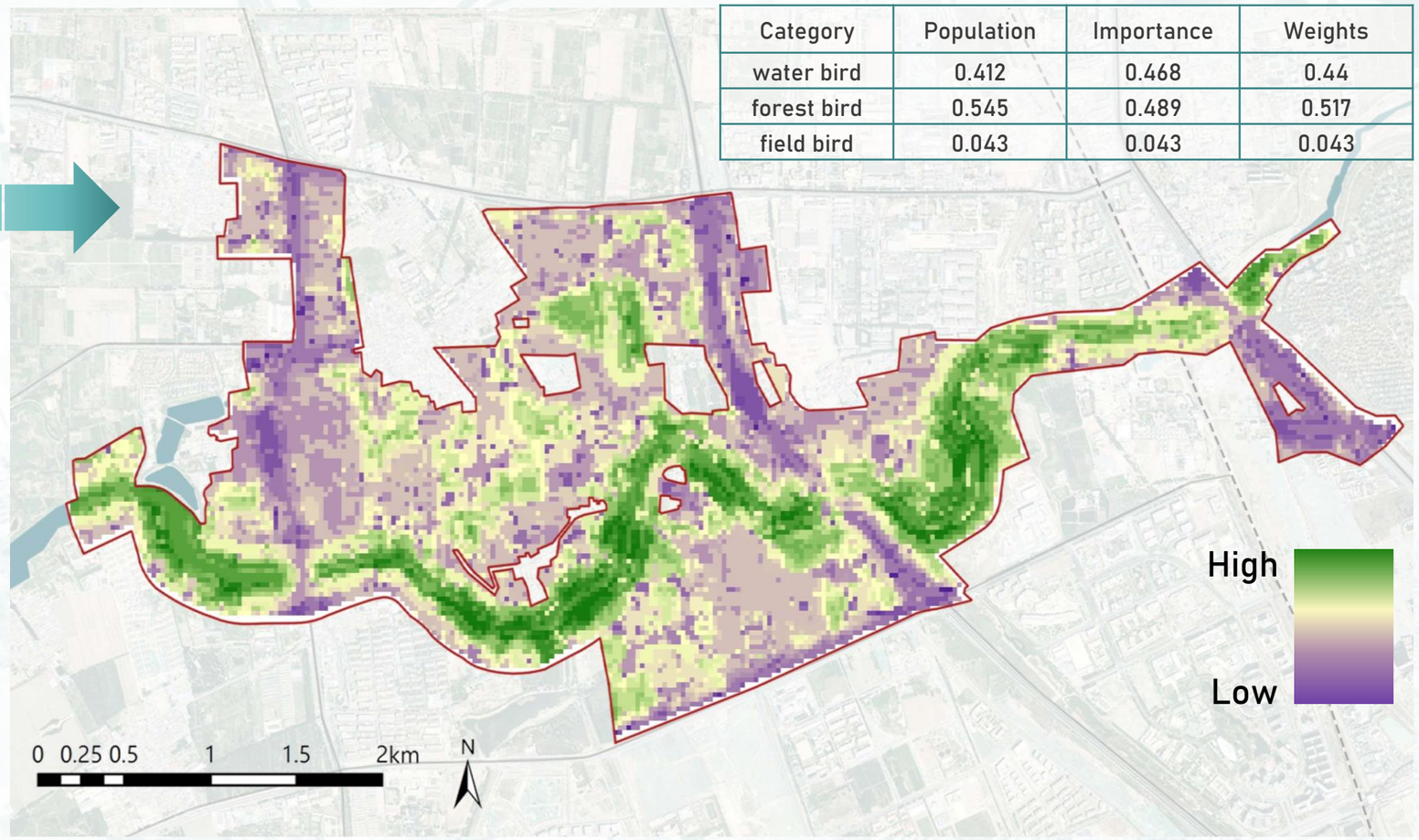
Control the intensity of planning zones

According to the food availability, water resources, hiding conditions and human disturbance, the habitat suitability distribution results of forest, water and field birds were obtained.

Target layer	Criterion layer	Index level
	Environment variable	Index
Habitat suitability assessment for birds	Availability of food	Food source
		Vegetation coverage
	Water resources	Distance to surface
	Concealment condition	Habitat type
		Habitat patch area
	Human interference	Distance to road
		Distance to settlement

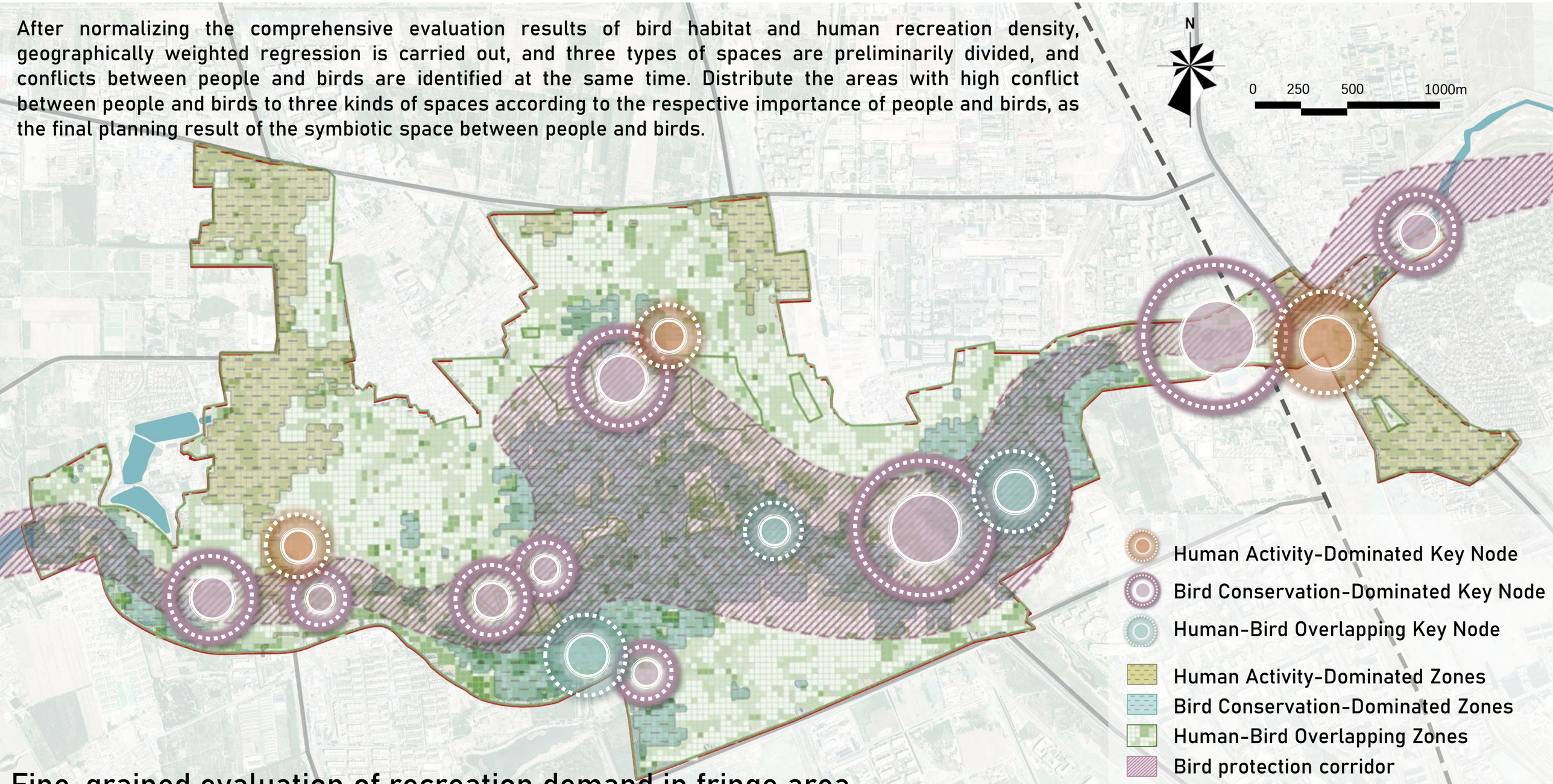
Integrated habitat suitability distribution of birds

Category	Population	Importance	Weights
water bird	0.412	0.468	0.44
forest bird	0.545	0.489	0.517
field bird	0.043	0.043	0.043



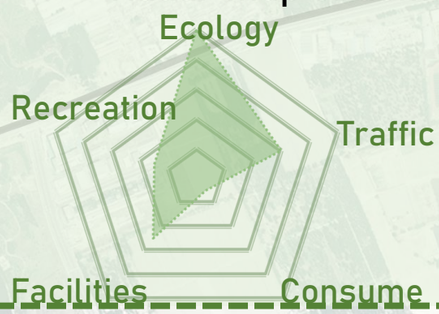
07 HUMAN-BIRD CONFLICT IDENTIFICATION

After normalizing the comprehensive evaluation results of bird habitat and human recreation density, geographically weighted regression is carried out, and three types of spaces are preliminarily divided, and conflicts between people and birds are identified at the same time. Distribute the areas with high conflict between people and birds to three kinds of spaces according to the respective importance of people and birds, as the final planning result of the symbiotic space between people and birds.



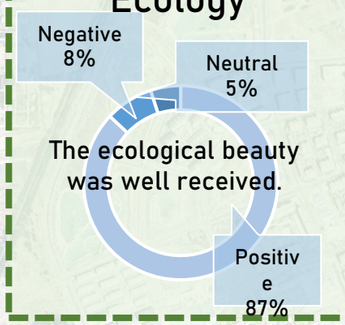
Fine-grained evaluation of recreation demand in fringe area

Radar map of demand concern

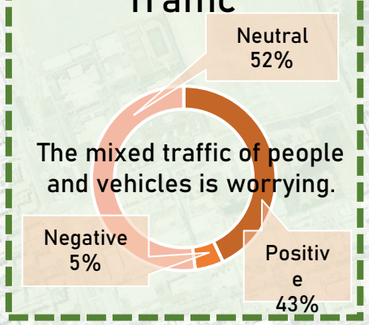


In the demand for recreation, people pay the highest attention to the ecological environment and facilities.

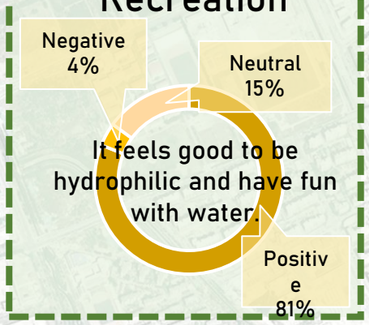
Ecology



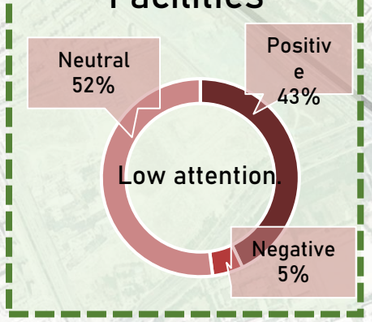
Traffic



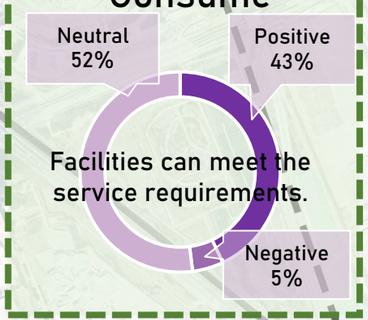
Recreation



Facilities



Consume

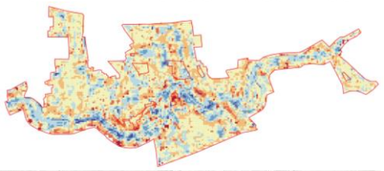


08 MASTER PLAN: Ecological Corridor Planning

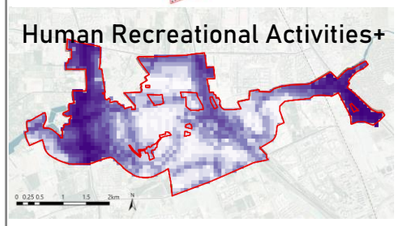
1 Spatial division of coexistence of humans and bird.

Combine the results of the human-bird spatial analysis to delineate the three spatial categories of human activity-dominated zones (HZ), bird conservation-dominated zones(BZ), and human-bird overlapping zones(OZ)

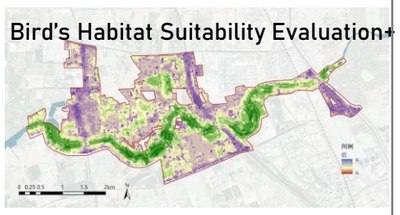
Human-Bird Conflict Area+



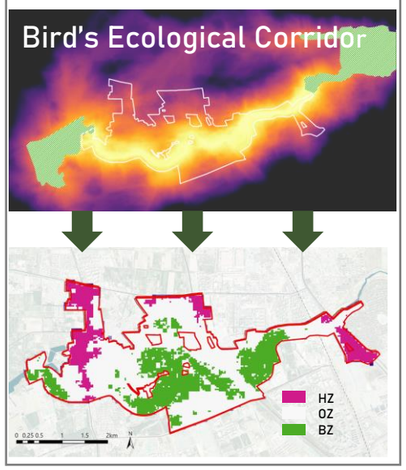
Human Recreational Activities+



Bird's Habitat Suitability Evaluation+



Bird's Ecological Corridor



2 Planning Goals and Strategies

Status quo issues: Habitat buffering between humans and birds & Fragmentation of Humans and Nature

Goals: Building a Demonstration area of the Second Green Belt for the harmonious coexistence of humans and birds

Creating Habitats for birds

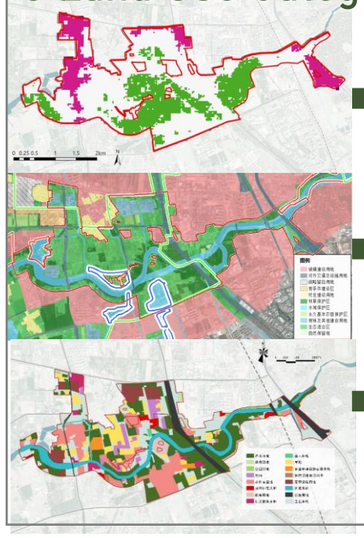
+

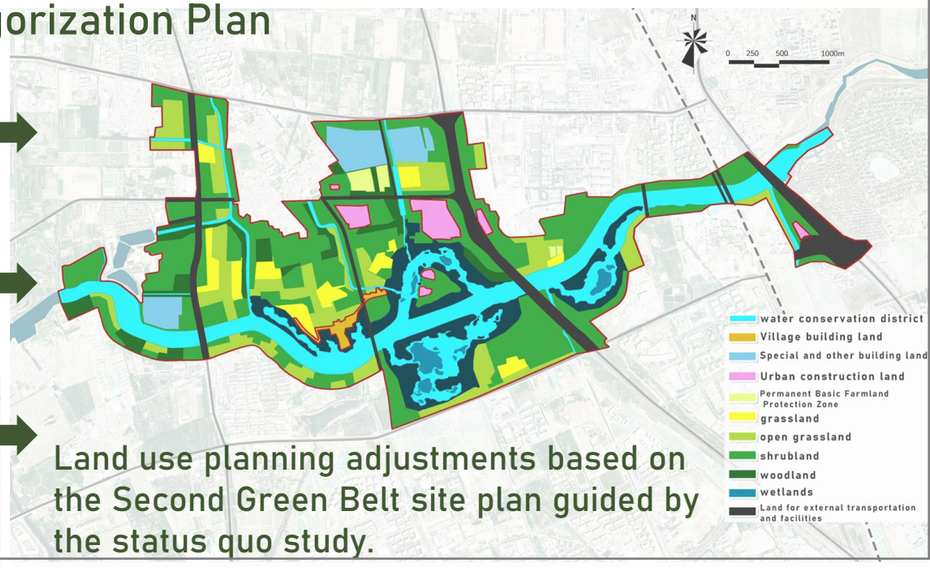
Creating a paradise for mankind

+

Creating a harmonious home

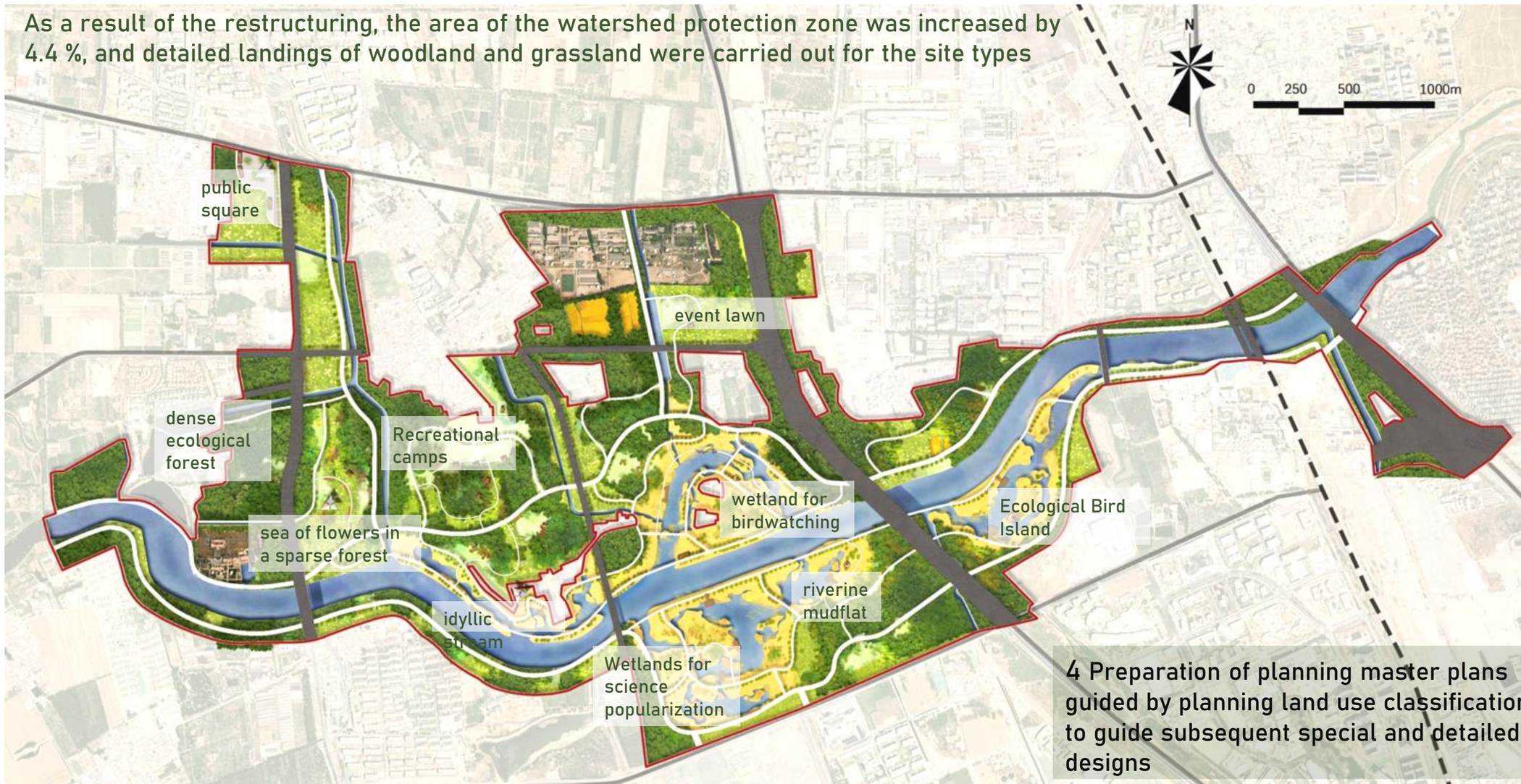
3 Land Use Categorization Plan





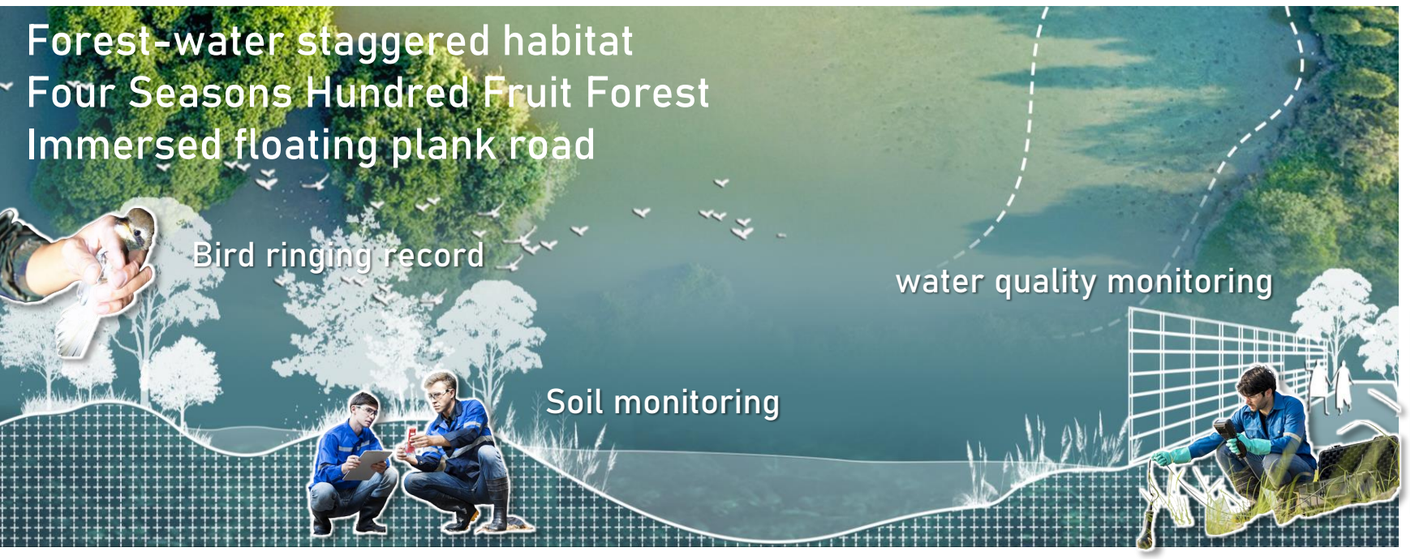
Land use planning adjustments based on the Second Green Belt site plan guided by the status quo study.

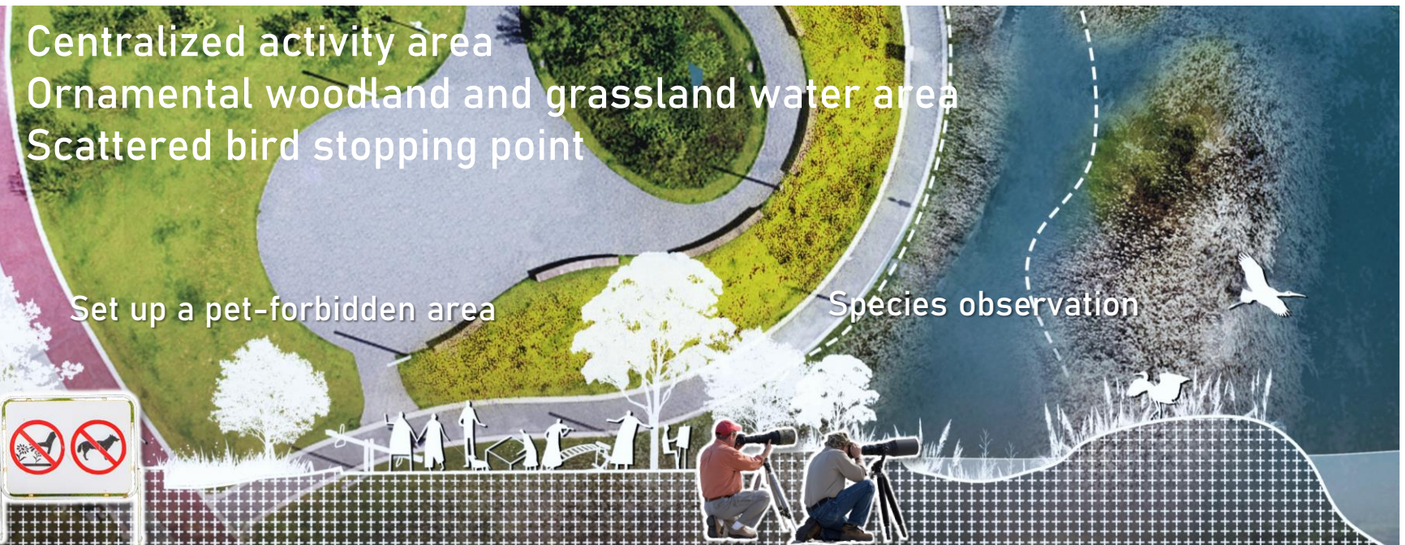
As a result of the restructuring, the area of the watershed protection zone was increased by 4.4 %, and detailed landings of woodland and grassland were carried out for the site types

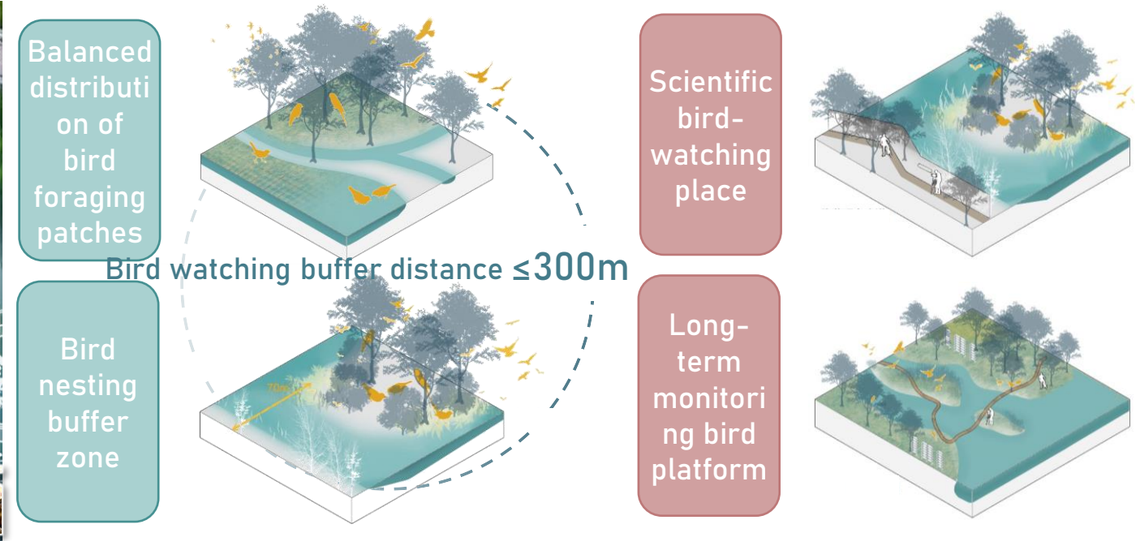


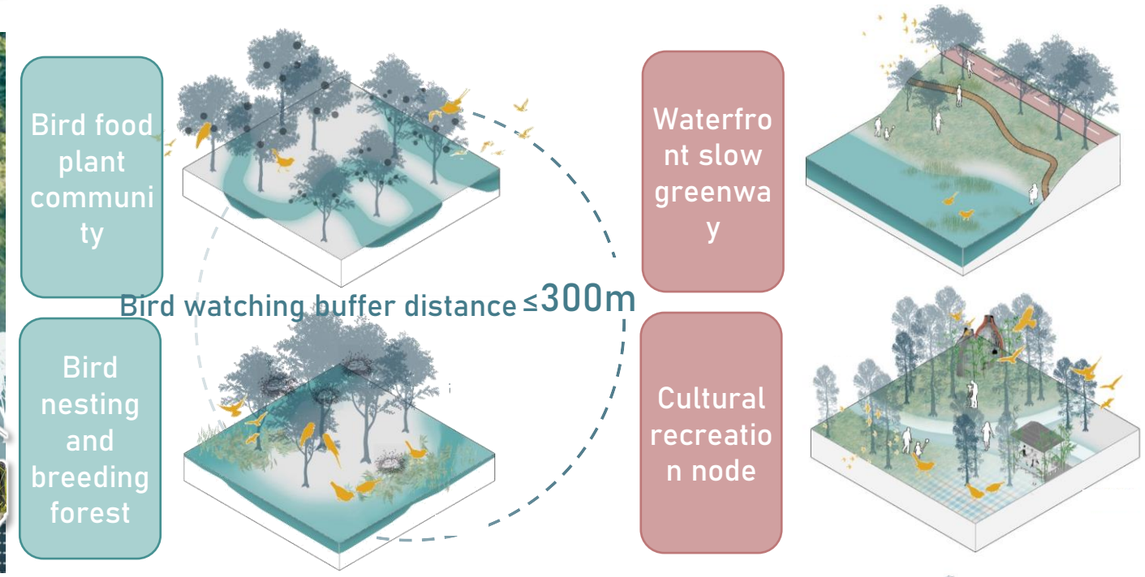
4 Preparation of planning master plans guided by planning land use classifications to guide subsequent special and detailed designs

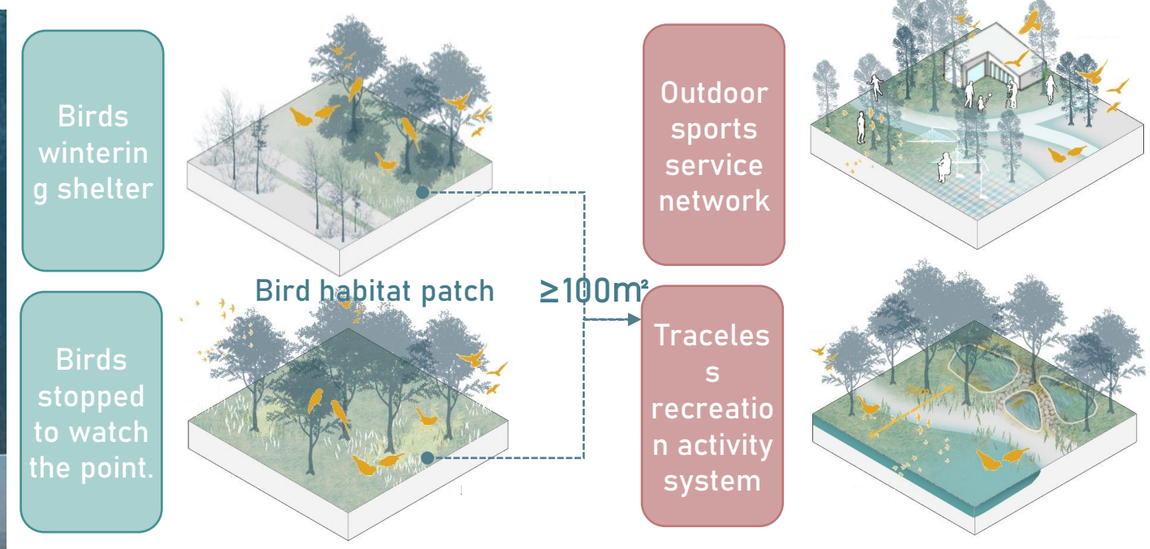
09 CONSERVAYION STRATEGY: Living Habitat Construction











10 Social Values: Harmonious Coexistence of Humans and Bird

◆ Develop and implement a code of practice for the Harmonious Coexistence of Humans and Bird

Production of the Harmonious Coexistence of Humans and Bird sensitization brochures

Designing of the Harmonious Coexistence of Humans and Bird online applet

Planning of an exhibition to publicize the code of the Harmonious Coexistence of Humans and Bird

birdwatching hut

shallow mudflat food source for birds

shrubbery food source for birds

Undisturbed Bird Island

Bird science popularization system

tree plant communities

shrubby plant community

aquatic plant community

herbaceous plant community

Constructing a complex community hierarchy of “trees - shrubs - herbs - wet plants - aquatic plants”.

With our planning and design, we expect a 34.6% lift in bird numbers and a 55.1% decrease in Human-Bird Conflict area.