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# Analysis of Regional Suitable Habitats Based on Remote Sensing and Geographic Information System

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## Abstract

Based on object-oriented remote sensing analysis and GIS spatial analysis, it is effective and easy to carry out rapid, objective and accurate analysis and evaluation of the habitat suitability of ecological environment in rapid and dynamic changes. The result can provide basic scientific basis for animal and plant populations and their living environment planning, protection and management. In this paper, object-oriented image segmentation method is used to extract the bird habitat suitability polygon evaluation unit. Based on the field investigation data, the key environmental factors such as land, vegetation, tide and benthic organisms are analyzed. Qualitative and quantitative relationship between birds and key environmental factors are built. Based on the analysis of GIS spatial analysis methods and techniques, the habitat suitability analysis of the four major bird populations, such as ducks and ducks, pies, herons and gulls, are carried out in the Chongming Island bird reserve. The results show that: (1) The migratory bird habitat of Chongming Island is about 40% of the total area of the protected area; (2) The light beach area and the tidal zone are the geographical areas where birds are suitable for habitat.

## Keywords

*Remote sensing; geographic information; object-oriented; habitat suitability*

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## Introduction

Chongming Island is located in the Yangtze River estuary, located in the eastern part of Shanghai, is an important international estuary beach wetland, in which bird national nature reserve located. As an important ecological sensitive area in the world, it is also an important part of the migration path of the Asia-Pacific birds. It involves the migration routes of the Northeast Asia Crane, the migration routes of the East Asian ducks of the East Asia-Australasia, nearly a million migratory and wintering birds have been interrupted by the area, which is an important migratory pavement and wintering [1-4]. Approximately 80% of Australia's birds recovered from mainland China come from Chongming Island, so it has important international significance in the research and protection of birds.

## Overview of the study area

The island is a silt-type tidal flat, the average annual outburst above 100m, vegetation, at the same time to the corresponding speed to the sea, the widest distribution of vegetation at 2450m. The elevation of the beach is related to the degree of flooding, wind and waves, soil conditions and the degree of terrain scouring. These factors directly

affect the living conditions of various tidal wetland vegetation, and there are obvious gradients in the spatial distribution. Distribution of these characteristics in obvious performance [5].

The large species of freshwater fish and coastal fish were found, such as shellfish etc. In the trench and shallow water area common distribution. The benthic fauna mainly has crustaceans, gastropods, bivalves and so on. The dominant species are mainly in the bivalves and gastropods of crustaceans [6-9], which are mostly distributed in the intertidal zone of the tidal flat, which is an important link of the ecosystem food chain.

## **Basic method**

### *Suitability analysis method flow*

According to the characteristics of National Nature Reserve, it is located in the tidal flat area of the estuary area and has the characteristics of rapid dynamic change of terrain. Combined with remote sensing and geographic information system technology, this paper puts forward the methods and processes of avian suitability analysis. The method and process of the suitability analysis of birds are related to two aspects. First, the theoretical analysis and evaluation model construction, mainly to evaluate the target - the identification of bird groups, according to expert knowledge and experience to identify the impact of bird habitat. The main environmental factors were used to determine the relationship model between bird species and key environmental factors, and the weight of the influence of different key influencing factors on bird suitability was established, and the evaluation matrix between bird and environmental factors was established [10]. On the other hand, it is the process of spatial database construction, model mathematical quantification and habitat suitability index calculation. It mainly involves the selection of spatial geography data, remote sensing data and survey data, remote sensing extraction and geospatial quantification based on common geographic coordinate system. The suitability analysis Habitat geospatial database construction, the object-oriented division of the Habitat Analysis and Evaluation Unit based on the remote sensing data source, and the spatial calculation of the spatial analysis of the GIS by the support of the GIS. The value of the geospatial quantity and the suitability analysis. The evaluation matrix was used to calculate the habitat suitability index of the species. The main process of habitat suitability analysis of birds is shown in Figure 1.

### *Brief analysis of the relationship between bird groups and habitats*

The relationship between bird species and habitat analysis mainly analyses the temporal and spatial relationship between the number and type of birds and habitats. Only by fully investigating the relationship we can effectively select the key habitat influence factors and establish the suitability analysis and evaluation model matrix.

Chongming Island's rich vegetation and beach wetland resources for birds foraging, habitat and breeding provides excellent conditions. According to the distribution of waterfowl communities in different habitat types, the light beach and community are the most important habitats of waterfowl, and are far higher than those of reed and interspersed in terms of species or quantity of waterfowl grass community. The food chain of wetland ecosystem is the scallions and the habitat of wintering habitat. Crane and Little Swan are the staple food of is the staple food. In recent years, they have rapidly spread through the wetland through artificial introduction and natural diffusion, and excludes local indigenous species reed, which changed the structure of plant community and produced great influences.

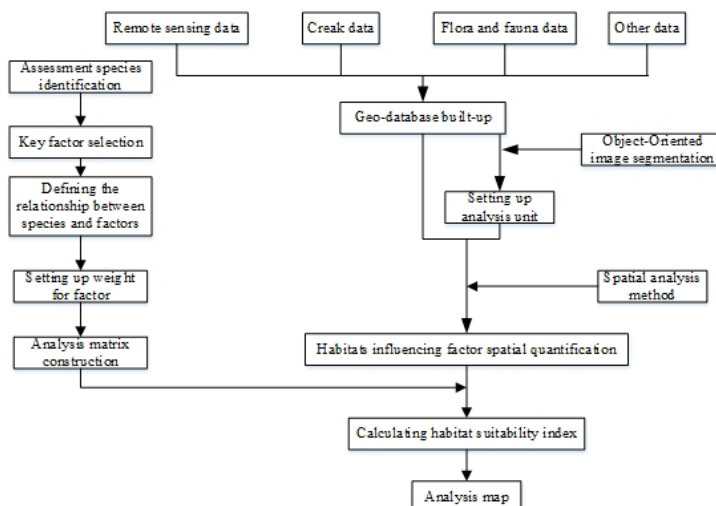


FIG. 1 THE WORK FLOW CHART FOR BIRD HABITAT SUITABILITY ANALYSIS IN NATURE RESERVE

Chongming Island is a variety of important economic fish and crustacean habitat, there fish is mainly in the perch-shaped fish. Benthos are mainly crustaceans, gastropods, bivalves, hairy, etc. They live in the intertidal zone, which is an important part of the biological chain. Studies have shown that, this island owned the benthic animal species less but the unit area of the estuary of the biomass is very high. The highest biomass in autumn and autumn is the lowest in summer and the biomass in spring and winter is comparable, and between autumn and summer, its abundant benthic fauna and fish resources are an important reason to attract large numbers of birds to stop here. According to the observation and analysis, pepper is mainly composed of gastropods, bivalves, crustaceans and animal foods. The wild ducks are omnivorous and the proportion of plant foods is larger. The gulls and herons. The class of food is completely animal food, located in the trench and shallow water within the region of fish, benthic animals is its main source of food.

According to the tide tide change, intertidal zone is divided into high tide beach, tidal flat and low tide beach. The tidal flat height is between 2.7 and 3.4 m, the vegetation type is mainly reed, and the benthic fauna is dominated by crab shrimp. The tidal flat in the tidal flat is between 2.0 and 2.7 m, and the natural vegetation is in the order of Scylla, mainly benthic animals to shellfish mollusc; low tidal flat elevation of roughly 2.0m below, characterized by light mud beach, plants are mainly salt algae, benthic animals to bivalves, lord, it is an important area for animal feeding birds to feed.

**Suitability analysis index system**

Based on the above principles, a comprehensive analysis of bird habitat, suitability analysis of the main selection of surface types, vegetation index, benthic organisms/fish, tide, human activities, interference in five categories, combined with the existing on environmental factors of the research results, the indicators and then subdivided to establish the bird habitat main influencing factors index system (see in Table 1).

TABLE 1 CATEGORY SYSTEM OF BID HABITAT SUITABILITY INDEX IN NATURE RESERVE

Factor level	Level one	Level two	Level three	
Bird HIS category system	Land use type	Water	Channel	
			Shallow water	
			Deep water	
	NDVI	Vegetation	-	
	Creek	Benthos/fishes	Destiny	-
			Fractal index	-
			Biomass	-
	Disturbance of human activity		Diversity	-
			Seawall	-
			Herding and fishing	-
			-	

In the calculation and analysis of the suitability of birds, taking into account the actual situation of mathematical model and spatial geography quantification, according to the empirical knowledge of experts, we mainly select the spatial geo-habitat indicators, namely, the surface type (NDVI), benthic biomass, tidal density, and so on.

**Habitat suitability evaluation matrix model construction**

The construction of bird habitat suitability evaluation matrix is mainly to establish the correspondence relationship between habitat impact factor and suitability index and the contribution value of each influencing factor to the total suitability index of target species. In the analysis of the suitability of birds, qualitative data and quantitative data such as biomass, tidal density and so on are used. Considering the standardized and unified calculation of qualitative data and quantitative data, 0~100), and the suitability index is divided into four grades. That is to say, the best fit (100~75), good fit (75~50), suitability (50~25), poor suitability (25~0) and other four levels.

For the qualitative habitat impact factors, such as the type of ground, according to the actual survey of birds and the existing research results, through expert analysis of the various types of birds on the suitability of the level of the number of standardized value. The median of the suitability classification interval is used. The sea triangular is the most suitable for wild ducks and ducks, then the sea for wild and duck habitat suitability score of 87. In the construction of the suitability matrix model of qualitative factors, the assessment grade of various birds should be treated according to the habits and seasonal changes of various birds. The time of remote sensing data used in this study is November, so the bird suitability analysis is mainly in autumn. The evaluation model of suitability of birds in type is shown in Table 2. For the quantitative factors of quantitative habitat, the subordinate linear model was used to calculate the suitability index. On the basis of the local survey, the empirical analysis and the numerical analysis, the quantitative factors corresponding to the four adaptive interval sections were obtained. Bird habitat suitability analysis of each quantitative factor suitability evaluation in Table 3.

TABLE 2 VALUE FOR BIRD HABITAT SUITABILITY AT DIFFERENT LAND USE TYPE IN NATURE RESERVE

Bird category	Reed	Bare tide flat	Shallow water	Deep water
Heron class	Fair	Good	Best	Poor
Gulls	Poor	Best	Best	Good
Ducks	Fair	Poor	Good	Poor

TABLE 3 ASSESSMENT CRITERIA FOR BIRD HABITAT SUITABILITY ANALYSIS IN NATURE RESERVE

Indicator	Best	Good	Fair	Poor
NDVI	0.2~0.5	0.5~1	0~0.3	<0.1
Biomass of benthos (g/m <sup>2</sup> )	>110	>45	>15	>0.2
Destiny of creeks/ (m/m <sup>2</sup> )	>4500	3000~4500	1000~3000	0~1000

The influence degree of each influencing factor on bird habitat suitability is different, and the measure of importance degree is the contribution value or weight of each influence factor to habitat suitability index. According to the comprehensive analysis of expert knowledge, the different degree of importance of each habitat influence factor in suitability analysis is given, and the weight value of each influencing factor is given respectively. The determination and distribution of weights is a very important step in the analysis of suitability of birds. Its objectivity and authenticity play an important role in the evaluation of habitat suitability of birds. In the analysis of suitability of avian habitat, the weight determination method adopts the factor relative importance method. To ducks and ducks, for example, it is the main vegetable food, the benthic biomass index weight value is higher than the animal food-based heron class is lower. The weight of the benthic biomass is the main value, and the vegetation index, which reflects the vegetation composition, accounts for the lower weight value. The weight of each habitat impact factor of the last established bird group (see in Figure 2).

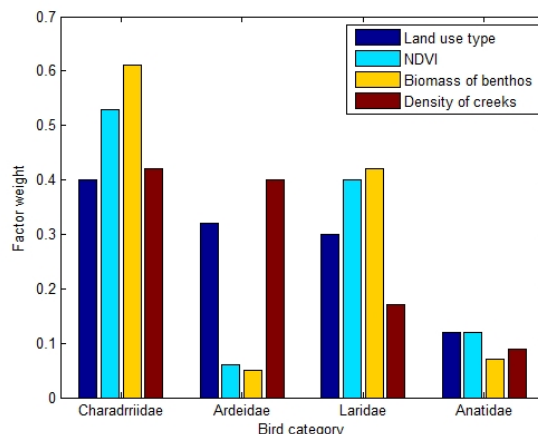


FIG. 2 THE FACTOR WEIGHT FOR BIRD HABITAT SUITABILITY ANALYSIS IN NATURE RESERVE

## Habitat evaluation process

### *Habitat analysis and evaluation extraction of polygonal geographic units*

Bird habitat suitability analysis and evaluation process is actually a geospatial superposition analysis operation, the commonly used method is to study the various factors within the region of the grid layer according to different weights for spatial stacking calculation. Factors affecting the distribution of birds, such as tidal flat terrain, vegetation type, tidal distribution and benthic organisms, have spatial and geographical characteristics. The influencing factors are digitized and rasterized under the same geographic coordinate system to obtain various influencing factors Raster layer, the raster layer consists of a standard rectangular or square grid cell, the grid cell row and column values represent the geographical location, the grid cell value represents the quantitative value of the impact factor. Through the habitat impact factor model, we can get the influence degree of each quantitative value of the influencing factors on the distribution of the birds' groups, and then calculate the weight of each grid unit according to the importance of the various influencing factors to the bird habitat Habitat suitability index or score.

According to the influencing factors of choice-weight-based spatial superposition operation of this conventional suitability index calculation and analysis process, the shortcomings of several points. First, the amount of computation is very large and flexible and convenient. Second, the region is divided into a standard shape such as a rectangle or a square, hexagonal analysis unit, which does not take into account the spatial distribution of regional ecological geography and other characteristics, analysis and evaluation unit does not have the ecological environment semantics. The establishment of this evaluation model is based on the terrain, vegetation and other ecological environment gradient change in the study area of a homogeneous polygon of the ecological evaluation of plaques, and then superimposed on the spatial analysis of the various indicators of the various effects factor quantization value, and finally according to the influence factor suitability mathematical evaluation model and the weight of each map of the suitability index calculation. What is characterized by the calculation unit is a polygonal pattern, the calculation process is calculated for the polygon attribute field value, the calculation is small and the speed is fast. After the quantization value of each influencing factor attribute in the homogeneous polygon ecological unit is established, each influencing factor is suitable for birds. The weight of the model is adjusted quickly and the weight is adjusted quickly and easily. The calculation and analysis unit takes full account of the ecological characteristics of the environment and has spatial ecological correlation. The analysis unit has clear ecological semantic features. The concrete implementation is based on the support of E-cognition, based on Landsat5TM Remote Sensing Image Map, November 26, 2005, bird protection zone boundary, elevation and water depth, and so on. Based on object-oriented Based on image hue, brightness, saturation, texture, size, elevation and spatial distribution as the main segmentation, the polygonal computer automatic segmentation segmentation of homogeneous ecological unit under medium scale and large compactness.

### ***Geographic spatial quantification of influencing factors and habitat suitability index calculation***

Bird habitat suitability analysis technology combines the mathematical model with remote sensing and GIS technology, and its habitat influence factor data spatial geography quantization is based on the object-oriented image segmentation technology to extract the homogeneous polygon ecological evaluation unit. The humanoid machine interprets the types of land types of each unit. The trench density is calculated by using the high-resolution aerial image to interpret the trench data and the polygon evaluation unit. The trench length and area in each evaluation unit are obtained, which is compared with the area of the evaluation polygon. For the calculation of vegetation components, due to the use of vegetation index (NDVI) to replace, each polygon evaluation unit by a number of remote sensing pixels, the polygon evaluation unit within the remote sensing pixels for vegetation index calculation and average to get the evaluation unit of the vegetation index. For the calculation of benthic biomass is the use of biomass distribution map and analysis unit for polygon geographic overlay operation.

Bird suitability reflects the comfort of birds living and breeding environments in wetlands. The influence of each factor on the distribution of birds is not isolated. They are different in different combinations, but they are mutually reinforcing and mutually reinforcing. In the calculation of suitability index of bird, the linear habitat suitability and influence factor combination function are used.

### ***Evaluation of bird's habitat suitability***

The island is divided into the appropriate polygon habitat evaluation unit, and the suitability of each evaluation unit is calculated according to the suitability analysis model and the habitat geospatial quantification value. The high value of the analysis unit corresponds to the good living environment of the birds, and the low value corresponds to the habitat suitability of the birds. (100~75), good adaptability (75~50), suitability (50~25), and the suitability of the bird habitat is the best Poor (25~0) 4 grades. With the support of GIS, the results of the suitability analysis of the four main bird groups are obtained. The distribution of the suitability grade units in the protected area was calculated, and the distribution area of the suitability grade of the four bird groups was obtained.

### **Statistical analysis of the results**

The results show that the geographical distribution of habitat suitability of the four bird groups is very different. From the geographical distribution point of view, the light beach area, to the light beach area adjacent, the sea tidal zone is a better adaptability of the east beach area, interspecific distribution area of the east beach water birds suitability is not high. The vegetation area adjacent to the dam boundary of the reserve is high density, the vegetation index is high, but the habitat suitability of the birds is generally the same, and the deep water area in the outer sea area of the reserve is generally poor in bird habitat. From the area statistical calculation, the suitable habitat area of the periods in the nature reserve is 6561hm<sup>2</sup>, accounting for 27% of the total area of the protected area. The suitable habitat area of the heron is 9187hm<sup>2</sup>, the total area of the protected area accounts for 30% of the total area of the protected area. The suitable habitat area of the wild duck is 6623 hm<sup>2</sup>, accounting for 28% of the total area of the protected area. The average proportion of the four bird populations is about 40%. Bird national nature reserve has a total planned area of 24155hm<sup>2</sup>, of which the core area is 16592hm<sup>2</sup>, and the core area accounts for about 69% of the total area of the protected area. From the area ratio, the proportion of the area of the other species is much lower than that of the core area, and the ratio of the area of the other species is much lower than that of the core area. In terms of the proportion of the average suitable habitat area, the proportion of the geographical space area suitable for the four bird populations in the protected area is low, so it is necessary to combine the remote sensing and GIS technology, according to the bird suitability analysis method and process as well as expert experience, the assessment of the suitability of birds in the protected areas and the surrounding areas, and provide the basis for the adjustment of the functional zoning of the protected areas.

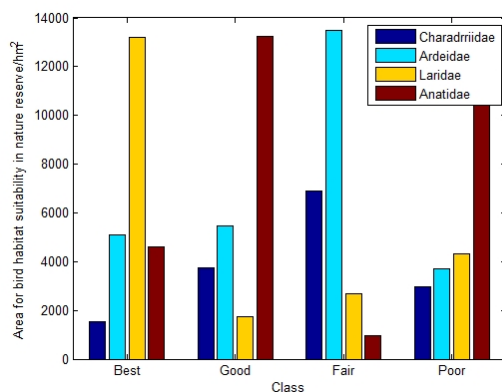


FIG. 3 THE AREA FOR BIRD HABITAT SUITABILITY IN NATURE RESERVE

The application method, process and result analysis of the research on the habitat suitability of birds by remote sensing and GIS technology show that the remote sensing data are timely, objective, integrated and more in the estuarine area where the ecological environment is rapidly changing. Source and multi-resolution, and the evaluation of bird habitat suitability can be carried out quickly, objectively, accurately and easily with the support of GIS technology. The result can provide the scientific basis for the protection and management of bird division in protected area.

## Conclusion

In the analysis of habitat suitability of birds, the object-oriented image segmentation method combines the remote sensing grid and the vector habitat geography data. The extracted polygon evaluation unit has habitat ecological homogeneity and spatial semantic features, and its suitability analysis. The results have spatial ecological significance. In the process of constructing the habitat suitability analysis model, the influence factors of remote sensing derived data are introduced into the rich and expanding natural and natural influencing factors, which makes the application scope and degree of remote sensing in the evaluation of habitat suitability of species habitat.

In the analysis of bird suitability, this study mainly focused on natural habitat analysis, habitat impact factor, habitat evaluation unit and suitability calculation, and the evaluation model was mainly based on linear mathematical model. The survival environment of birds is closely related to the geospatial. In the future, the spatial evaluation model of bird habitat suitability will be established based on the object-oriented method on the basis of polygon evaluation unit.

The analysis of the suitability of migratory habitats shows that the geographical space in the protected area is not very large, and natural factors such as erosion and human factors such as embankment will survive the birds. The environment has a great impact, it is necessary to strengthen the upper reaches of the Yangtze River to reduce the impact of the east bank erosion and sedimentation analysis of the study and control human activities range and intensity.

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