Original Research Article

Analysis on distribution pattern and influencing factors of noctualis community of overwintering black-necked crane in Caohai, Guizhou Province

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Abstract: Caohai in Guizhou province is an important winter habitat for black-necked cranes. Based on the data of field observation in the last two years, the related distribution and factors of black-necked crane night habitat community in Caohai winter were found. The kernel density estimation method was used to explore the spatial distribution of nocturnal habitat of crane population. BIOENV analysis and typical correspondence analysis were also used to investigate the environmental impact of nocturnal habitat distribution. The night habitat of black-necked crane is mainly in two places south and west of the lake, and the single area group is more significant. The water depth and the distance from the settlement were the main reasons for the black-necked crane to choose its night habitat. Deep water provides a sense of security for the black-necked crane, while staying away from settlements avoids human disturbance. The results of this study can provide a reference for the protection and management of black-necked Hexiang group in Caohai Lake, Guizhou Province. The protection of the night habitat should closely consider the effective protection of the lake water area, water quality and aquatic living resources, as well as the environmental optimization around the settlement.

Keywords: Black-necked crane; Caohai wintering ground; Nocturnal distribution; Environmental impact factors; Ecological protection

1. Introduction

Guizhou Caohai, as one of the most complete and typical plateau wetland ecosystems in southwest China, is famous for its unique natural environment and rich biodiversity. In particular, as an important wintering ground for the eastern population of black-necked cranes, Caohai attracts a large number of black-necked cranes to roost every year, becoming the focus of ecologists and bird lovers at home and abroad. Relevant studies show that Caohai, Weining, Guizhou, has taken specific measures and achieved results in promoting the comprehensive management of ecological civilization, emphasizing the importance of Caohai wetland as a habitat for rare birds such as black-necked cranes. The paper pointed out that through the implementation of a series of ecological restoration and protection measures, the ecological environment of Caohai Wetland has been significantly improved, providing a better habitat environment for birds such as black-necked cranes [1-3]. In recent years, with the continuous advancement of ecological civilization construction and the enhancement of environmental protection awareness, Guizhou Caohai National Nature Reserve has achieved remarkable results in promoting the comprehensive management of ecological civilization, providing a safer and more suitable habitat for rare birds such as the black-necked crane. However, with the continuous expansion of human activities and the change of natural environment, the distribution pattern of black-necked cranes' winter night habitat community is also affected by many factors. Therefore, in-depth analysis of the distribution pattern and influencing factors of the

nocturnal community of the overwintering black-necked crane in Caohai, Guizhou, not only helps to reveal the ecological habits and adaptive mechanisms of the black-necked crane, but also provides scientific basis for the protection and management of the Caohai wetland ecosystem.

2. Overview of night habitat community of black-necked cranes in Caohai wintering ground

2.1. Importance of Caohai in Guizhou Province to black-necked crane over winter night habitat community

As one of the key wintering sites for black-necked cranes in China, Caohai, Guizhou, provides important support for nocturnal flocks of this species. Due to its unique mountain and cold ecology and diverse aquatic plants, Caohai has created an excellent living environment for the black-necked crane. The lake is wide, the water surface covers a suitable area, and the diversity of life is rich, which can not only feed the black-necked crane, but also give it safety protection. In winter, when the black-necked crane searches for a habitat, it will choose to rest on the surface of the water away from predators and human activity. The depth of Caohai Lake and the quiet fishing area fully meet the black-necked crane's need for night habitat. The ecological protection and environmental quality of Caohai are very important for the survival of black-necked cranes. The vast wetlands and abundance of aquatic plants around the lake provide the black-necked crane with a plentiful food source, including a variety of fish, insects and plant roots. These rich food resources help maintain the strength and health of the black-necked crane during the winter. The relatively little human activity around Caohai reduces human disturbance and predation pressure, helping the black-necked crane to get enough rest at night.

Caohai is not only an important wintering ground for black-necked cranes, but also one of the important areas for global migratory bird protection. The preservation of the ecological environment, especially Caohai, is not only chimed with the stability of the black-necked crane, but also closely related to the theme of the healthy and rapid development of the ecosystem. Maintaining the ecology of Caohai and expanding the sustainability of the black-necked crane habitat can challenge the stability of the black-necked crane population on a global scale, while advancing the pace of biodiversity conservation. Continuous monitoring of Caohai and active participation in the practice of scientific management will lay the foundation for ecological protection in the following ways, and provide academic experience and data basis.

2.2. Common distribution pattern of black-necked crane over winter night habitat community

The black-necked crane, a rare and nearly extinct bird, has a very unique distribution of its night habitat community, and contains rich information on the choice of winter migration. Their choice of habitat is influenced by many factors, such as considering the threat level of natural enemies, which leads to the black-necked crane preferring to choose a hidden and safe environment as its habitat. In their winter habitat in Caohai, their nocturnal communities tend to be concentrated near water and in more sheltered areas. The winter night habitat communities of black-necked cranes are often distributed in wetland reserves, which not only have rich food resources and comfortable living environment, but also have high ecological diversity, providing a good environment for black-necked cranes to coexist with other species.

The black-necked crane roosts at night in places as far away from people's areas of activity as possible, so as not to be restricted by many environmental factors such as noise and light hazards. Black-necked cranes are scattered and roost independently at a certain distance from each other, which may be to dilute competition and

improve survival chances. This unique distribution characteristics and behavior pattern are the product of the black-necked crane's gradual adaptation in the long-term evolution process, and also the result of its selection of Caohai environmental conditions. The in-depth understanding and maintenance of such a critical area has far-reaching practical significance for the efficient management of the black-necked crane winter cluster.

2.3. Night habitat habits of black-necked cranes in Caohai overwintering ground

The black-necked crane has its unique dwelling habit in winter night. They often rest in the right depth of the lake, which seems to be a tailor-made safe haven for them. The depth of the lake provides a certain amount of concealment, but not too much obstruction to their movement, creating enough safety for the night. Black-necked cranes tend to live in groups, and tight groups effectively improve defense. When the sun goes down and the light shines on the lake, the black-necked cranes begin to gather. They snuggle together to ward off the dangers that may arise at night. At dawn, when the first rays of sunlight break the sky, they disperse again to begin the day's activities. During its night perch, the black-necked crane manages to stay alert. Alert, rest and alert, these three states are perfectly integrated in them. Their senses are acute, and any slight movement will attract their attention. It is worth noting that the black-necked crane is highly sensitive to human interference. Noise, lights and other distractions from human activity can make them uncomfortable. As a result, they tend to choose habitats away from the noise of humans in order to ensure the peace and security of the night. This persistent pursuit of a peaceful environment reflects their wisdom in surviving in nature and their high regard for their own safety. We should respect their habits and create an undisturbed living space for these beautiful creatures.

3. Study on the distribution pattern of nocturnal habitats of overwintering black-necked crane in Caohai

3.1. Data collection

Data collection is mainly carried out through systematic field observation and accurate measurement methods to ensure the accuracy and reliability of data. The main wintering habitat of black-necked cranes is Caohai, Guizhou Province. The annual observation cycle is mainly arranged in the winter overwintering time of the black-necked crane, that is, from November of each year to March of the following year, during which the complete overwintering period is covered. The observation activities, starting in the morning and continuing for at least 10 hours until night, are designed to completely record the roosting state of black-necked cranes at night. In the key area of Caohai, the team set up fixed observation stations and activity monitoring stations, while using high-end telescopes and professional cameras to facilitate bird observation. In order to accurately record the black-necked crane's night roosting location, global Positioning System (GPS) equipment is used to accurately mark the roosting location each night, and record the water depth, distance from the resident's address, and other environmental information. The black-necked crane pays special attention to monitoring in its nighttime habitat, recording its nighttime behavior dynamically through infrared cameras and night vision equipment, and recording the sound information of the surrounding environment with sound monitoring equipment. The collection of these data not only helps to confirm the accurate distribution of night habitats, but also provides real and detailed information for subsequent analysis.

In addition to observational data, the study also collected ecological and environmental data related to Caohai, including water quality detection data, aquatic plant coverage and fish resource distribution. These data are helpful to understand the ecological conditions of the nocturnal habitat, and compare with the observed data,

so as to reveal the influencing factors of the nocturnal habitat distribution. Through the in-depth analysis of these data, we can explore how environmental factors affect the distribution pattern of black-necked cranes in Caohai, and provide scientific basis for the formulation of conservation strategies.

3.2. Application of spatial distribution kernel density estimation method for black-necked crane night habitat points

The kernel density estimation method plays a key role in the study of the spatial distribution of noctiloci of black-necked cranes. Kernel density estimation (KDE) is a non-parametric statistical method used to analyze and visualize the spatial distribution characteristics of point model data. In this study, KDE was used to analyze the detailed spatial distribution of night habitat of black-necked cranes during the overwintering period in Caohai, Guizhou. The data were collected from two years of field observations, including the nocturnal roosting sites and locations of black-necked cranes in Caohai. In order to obtain the spatial density distribution of these points, Caohai was divided into a certain grid, and the spatial positions of each night dwelling point were recorded as discrete data points. KDE calculates for each grid point the contribution value of all the observation points around it to reflect the density change in different regions in a smooth curve. The Gaussian kernel function is used as the weight function to ensure the balance between the accuracy and smoothness of the result by selecting appropriate bandwidth parameters [4]. The results showed that the night habitat of Caohai black-necked crane was closely related to the lake. These places not only have suitable environmental characteristics, but also fully meet the safety and food needs of black-necked cranes.

The application of kernel density estimation method can quantify the spatial distribution characteristics of the night habitat of black-necked cranes, which not only reveals the main distribution area, but also provides scientific basis for subsequent conservation measures and management strategies. Through this method, we can better understand the role of environmental factors in the habitat selection of black-necked cranes, and guide relevant departments in the formulation of environmental management and conservation strategies.

3.3. Gathering rules and distribution characteristics of noctual-dwelling communities of black-necked cranes

The nocturnal community of black-necked crane showed significant gathering regularity and distribution characteristics over winter in Caohai. Through the kernel density estimation method, it can be clearly found that the night habitat is mainly concentrated in the area near the lake. They show a highly concentrated distribution pattern here, as if it were a unique “hot spot” in the land. Nocturnal communities are usually densely distributed, forming a relatively stable nocturnal community structure. It is like a small family that is closely connected, depending on each other and taking care of each other. This distribution pattern is closely related to water depth and human disturbance. Water depth plays an important role in this, and deep water areas provide a natural sense of security for the black-necked crane. The deep water acts as a barrier, allowing them to relax without worrying about potential threats from the outside world. At the same time, staying away from residential areas to reduce human disturbance is also a crucial factor. The noise, lights, and possible disturbances from human activities can make the black-necked crane uneasy and wary. As a result, they choose to avoid settlements and seek out areas that are relatively quiet and undisturbed by humans.

This distribution pattern fully demonstrates the wisdom and strategy of the black-necked crane in the process of adapting to the environment. They cleverly take advantage of natural conditions and avoid adverse factors to

ensure safety and comfort during night roosting. For us humans, understanding these rules and characteristics can better develop protective measures and create a more ideal wintering environment for black-necked cranes.

4. Analyze the influencing factors of nocturnal habitat distribution and propose protection strategies

4.1. Analysis and application of BIOENV

BIOENV analysis and canonical correspondence analysis (CCA) have been widely used to analyze the distribution pattern and influencing factors of noctualhabitat communities of overwintering black-necked cranes in Caohai. BIOENV analysis is a statistical method used to investigate the relationship between environmental variables and species distribution. Through this method, field observations are matched and correlated with multiple environmental variables to identify the environmental factors that best explain the distribution of species communities. In the study, BIOENV analysis screened out key environmental factors that may affect the nocturnal habitat distribution of black-necked cranes, including water depth, distance from the nearest settlement, and water quality. Canonical correspondence analysis (CCA) is a multivariate statistical method for dealing with complex relationships in ecological data. Through CCA, multiple environmental variables and species distribution data can be incorporated into the model to reveal the comprehensive impact of environmental gradient on nocturnal habitat distribution [5]. Using this analysis method, the explanatory power of environmental factors to nocturnal habitat behavior of black-necked cranes can be obtained, and which factors are the key variables driving the nocturnal habitat distribution pattern can be further clarified. By applying CCA, the water depth and human disturbance (distance from the settlement) were identified as the main factors affecting the selection of night habitat for black-necked cranes.

Through the BIOENV analysis, it was found that water depth was significantly positively correlated with the choice of night habitat, because deeper water could provide good shelter for black-necked cranes and reduce the impact of predators and other external threats. Typical correspondence analysis reveals that black-necked cranes tend to choose night habitats far from residential areas, indicating that human disturbance significantly affects their habitat selection [6]. For example, noise and light pollution at night can interfere with the rest and feeding of black-necked cranes, so they prefer to choose habitats far away from settlements. Through BIOENV analysis and typical correspondence analysis, it can be concluded that water depth and human disturbance are the main factors determining the night habitat selection of black-necked cranes, and these findings provide scientific basis for formulating effective conservation strategies.

4.2. Discussion on the main factors affecting the selection of night habitat for black-necked cranes

In the discussion of the main factors affecting the selection of night habitat of black-necked cranes, water depth and human disturbance are particularly important. Deep water provides a sense of security, which not only reduces the risk of predators, but also provides a stable habitat for the black-necked crane [7]. The increase in water depth has a direct effect on the defensive adaptability of the black-necked crane, which also explains the concentration of its night habitat near lakes. Human disturbance mainly refers to the influence of human activities and residential areas on the night habitat selection of black-necked cranes. When nocturnal habitats are close to settlements, black-necked cranes are susceptible to noise, light, and human activity, which increases their alertness and stress levels, causing them to avoid these areas. Field observation data show that black-necked cranes prefer areas far from settlements as night habitats, which significantly reduces the impact of stressors

and ensures their safety and health during winter. Based on the above analysis, the water depth and human disturbance are the important factors affecting the selection of night habitat for black-necked cranes, and have core effects on their night habitat behavior from two different perspectives: ecological environment and human activities, which provides a scientific basis for the formulation of night habitat conservation strategies for black-necked cranes.

4.3. Conservation strategies and lake management recommendations based on the study results

When protecting the night habitat of the black-necked crane, priority should be given to maintaining the water depth of the lake and controlling human disturbance. It is of great significance to increase the depth of Caohai waters and maintain a certain water depth change. Suitable and varied water depths not only provide black-necked cranes with space to escape potential threats, but also allow them to move more freely in the water. The increase in water depth is like building a natural castle for black-necked cranes, giving them a higher sense of security, so that they can rest and reproduce. At the same time, it is important to establish ecological buffer zones near settlements. By setting clear signs and regulations, limiting the scope and time of human activities, reducing noise interference and other measures, we can effectively reduce the negative impact of human factors on the habitat environment of black-necked cranes [8]. Let human activities and the living space of the black-necked crane maintain an appropriate distance, do not interfere with each other, and coexist harmoniously.

In addition, strengthening the protection of water quality and aquatic living resources can not be ignored. High quality water quality is the basis of reproduction of aquatic organisms, and rich aquatic biological resources are important food sources for black-necked cranes. We should pay close attention to the change of water quality, strictly control the discharge of pollutants, and avoid water pollution[9]. At the same time, active measures are taken to protect and restore aquatic vegetation to provide a good habitat and breeding site for aquatic organisms. Maintaining a stable food supply is essential for the survival of black-necked cranes during their overwintering. When they don't have to worry about finding food, they can devote themselves to roosting and breeding. This is not only conducive to the stability and growth of black-necked crane population, but also helps to maintain the balance and stability of the entire ecosystem[10]. Only if we pay attention to and effectively do a good job in the protection of water quality and aquatic living resources, can we create better wintering conditions for the black-necked crane, so that these beautiful creatures can reproduce freely in nature.

5. Closing remarks

Through the in-depth study on the distribution pattern and influencing factors of black-necked crane nocturnal habitat community during the overwintering period in Caohai, Guizhou, some practical results were obtained. The night habitats of black-necked cranes were densely distributed near the lake, and were remarkably clustered in a single township group. The main factors influencing the choice of night habitat include water depth and distance from the nearest settlement, where deep water can provide a sufficient sense of security for the black-necked crane, while distance from human settlements can help the black-necked crane avoid human disturbance. This study provides a valuable reference for the protection of black-necked crane population in Tengchong Lake and the management of lake use. The research results emphasize that the protection of the night habitat of black-necked cranes should take into account the effective protection of lake water area, water quality and aquatic living resources, as well as the optimization of the surrounding environment. However, the geographical coverage of this study is still limited, and the influencing factors may be different for the night

habitat of black-necked cranes with different geographical environments, and further research is needed. This study provides a valuable basis for the protection and management of the black-necked crane's night habitat, and subsequent studies can be further deepened on this basis, and similar studies are needed in more extensive areas to ensure the formation of a scientific and comprehensive protection strategy for the black-necked crane's night habitat throughout the country. In addition, more factors related to human activities, such as the specific type and intensity of human activities, are also worth considering in future studies.

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