

Research Article

Surrounding Environment and Civil Airport Fire Emergency Management Based on Big Data Simulation

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Received 21 May 2022; Revised 24 June 2022; Accepted 5 July 2022; Published 20 July 2022

Academic Editor: Shadi Aljawarneh

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The new generation of information and communication technologies represented by the Internet of Things, big data, and cloud computing are developing rapidly. Through continuous integration with other emerging technologies, the Internet of Things technology accelerates its penetration into the fields of smart medicine, new energy, and materials. In this article, we will explore the airport peripheral environment and civil airport fire emergency management. In airport emergency management, bird strike and fire management are the most frequent problems. Bird strikes most often occur in aircraft take-off, taxi, and landing areas. Therefore, the study of airport environmental characteristics is particularly important. In order to improve the emergency support capability of the civil airport fire department and the level of airport operation support, it is necessary to clarify the factors that affect the emergency support capability of the airport fire department. This article is based on the research of the airport surrounding environment of Big Data Internet of Things and applies it to the research of civil airport fire emergency management, which improves the emergency ability of airport firefighters.

1. Introduction

“Big data” has become a buzzword in today’s production and people’s lives. Everywhere, such as mobile communication, website access, microblog news, video uploading, product generation, and scientific experiments, social and commercial activities will continue to generate various types of data [1]. The research value of big data is huge, especially when big data is integrated into today’s Internet of Things, the integration of big data and the Internet of Things will surely elevate the intelligence of human society to a new level, and its development prospects are unlimited [2]. Nowadays, the Internet of Things is widely popularized, and the amount of big data has increased sharply. The integration of the Internet of Things and big data has become an inevitable trend in the development of various disciplines [3]. In this article, we will explore how big data affects the Internet of Things and how it integrates with daily production and life applications [4]. “Bird strike” is the abbreviation for safety accidents caused by planes colliding with birds during take-off, landing, or flight. It is also called “bird strike.”

Today, there are more than 10,000 bird strikes in the world every year, and the International Aviation Federation has upgraded bird strike disasters to category “A” aviation disasters. This article examines more than 30 existing flights in large civil airports [5]. First, it studies the environmental characteristics of the airport. The climate in the airport is suitable and the bird resources are relatively abundant [6]. Therefore, the bird community structure and environmental structure of the airport and its surrounding areas are studied. It is very necessary to conduct research. It is necessary to analyze the factors that may cause bird strikes in the airport and its nearby areas through the research results, find out corresponding preventive measures, and improve the flight safety factor of the airport [7]. According to the statistics of the International Civil Aviation Organization, the number of aircraft accidents during the take-off, taxiing, and landing phases accounted for more than 60% of the total number of aviation accidents [8]. In the above stages, the emergency response task of aircraft emergencies is mainly undertaken by the airport fire rescue department, and the emergency protection ability of airport firefighters is the key to ensuring

the smooth implementation of rescue activities [9, 10]. The results show that the most important impact on civil airport fire emergency management capabilities is the basic quality, followed by the professional quality, professional skills, and professional knowledge of firefighters. By attaching importance to these factors, our fire management capabilities will be improved [11, 12].

2. Materials and Methods

2.1. Overview of the Study Area. The research airport is 45 km away from the city. The traffic around the airport is developed. There is National Highway 2513 on the north side, connecting neighboring provinces and surrounding areas; on the east side, there is Provincial Highway 324, connecting the surrounding districts and cities; in front of the gate is 104 National Road, connecting the urban area and certain areas. As a large-scale civil airport, the airport is also the central airport of the economic zone. It can radiate air travel for the surrounding population of 100 km, including 20 prefecture-level cities, with a radiating population of 120 million. The research airport has an important influence on the economic development of the surrounding area. The airport covers an area of about 3800 mu, and it can transport up to 1 million passengers every year.

Most of the east side of the airport is a residential area. There are no farms in the village. The farmland is mainly planted with seasonal crops. There are several small forests scattered around the village. There is a lotus pond in the northeast corner with sufficient water resources and less vegetation. Close to the airport is the provincial highway and the abandoned Yellow River. The abandoned Yellow River is located in the east of the airport. The flow direction of the river section within the observation range is a U-shaped turning from northwest to southeast to southwest to northeast. The closest distance to the easternmost part of the airport is about 300 m, within the observation range. The widest part of the river is about 100 m. The riverbank is flat and the vegetation is lush, mainly cherry trees, willow trees, neem trees, and various weeds. There are no duck and goose farms in the observation area of the river.

Most of the airport fence is farmland and woods during the week, and most of the farmland is planted with seasonal crops. There is a forest close to the north and west of the airport fence, with an area of about 0.027 km², and the main tree species is poplar. There is a small river running north-south beside the forest, with a width of about 20 m. There is an airport drain in the middle of the north side of the fence. The sanitary conditions are poor and there is no cover. It is easy to breed mosquitoes and attract birds to forage. There is a nursery near the middle on the north side of the fence, which is roughly east-west and covers an area of about 0.253 km². The nursery mainly contains many kinds and numbers of plants, which provides a place for birds to forage and hide. There is a vegetable greenhouse on the east side of the nursery, which is enclosed. To the east of the north side of the fence is an orchard, covering an area of about 0.027 km². It is mainly planted with pear trees. Due to manual management, there are fewer weeds in the orchard.

The expansion and construction in the southeast and southwest affected bird activities and brought some impact to the investigation.

The airport consists of a passenger waiting hall, an internal flight area, and an office area. The concrete pavement in the flight area of the airport has runways, taxiways, connection roads, patrol roads, etc., and the rest are lawns. The flight area is east-west, with a total length of 3600 m, and the light belts on the east and west sides are local dominant grass species. The flight area is dominated by lawns. The lawn vegetation composition is basically the local dominant grass species. Two rows of east-west bird blocking nets are arranged on the north side of the lawn near the fence. The bird blocking nets are parallel to the fence and perpendicular to the ground. The bird blocking nets are 3000 m in length, the height is 5 m, and the mesh size is 40 cm². The grass species in the lawn are mainly local dominant grass species with many species, and more insects in summer. The grass height in the lawn is basically kept below 20 cm, and the airport regularly organizes the spraying of pesticides on the lawn, including pesticides and herbicides. There are exposed drainage ditches near the fence in the north of the lawn, and the internal drainage ditches are all dark water ditches, which facilitate the drainage of the accumulated water in the flight area to the airport, and are covered by a linear drainage cover. The office area in the airport has a large green area and rich vegetation.

2.2. Research Methods. The Internet of Things is known as the third wave of development in the global information industry after computers and the Internet [13]. The International Telecommunication Union formally expounded the concept of the Internet of Things in its report. Any object in the Internet of Things exchanges information and communication anytime and anywhere to truly create a network of precise positioning, precise identification, and intelligent monitoring and management [14, 15].

The development of the Internet of Things is based on the expansion and extension of the Internet, and the ultimate development goal is comprehensive perception, reliable transmission, and intelligent processing [16]. Among them, the network layer is the link of information exchange between the perception layer and the application layer. Through the processing and exchange of sensor information, the application layer provides powerful resource support for the processing of different enterprises and truly realizes the intelligence and informatization of different industries. From July 2019 to June 2020, the transect method was used to collect statistics on birds and environmental changes in different seasons within an average of 5 km around Guanyin airport and its surrounding areas. The survey frequency was twice a month. The observed environmental factors include seasonal environmental factors, such as the types and growth status of crops in farmland, the area occupied, the vegetation composition, and change patterns of grassland and woodland; there are also factors that do not change with the seasons, such as rivers, ponds, and residential areas. Environmental factors are mainly measured and recorded, combined with interview methods.

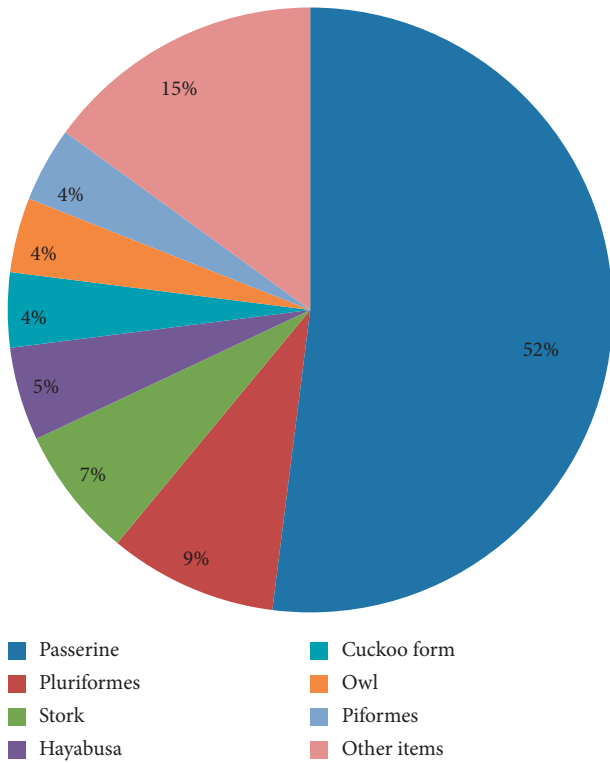


FIGURE 1: The species of birds in each order at the airport and surrounding areas.

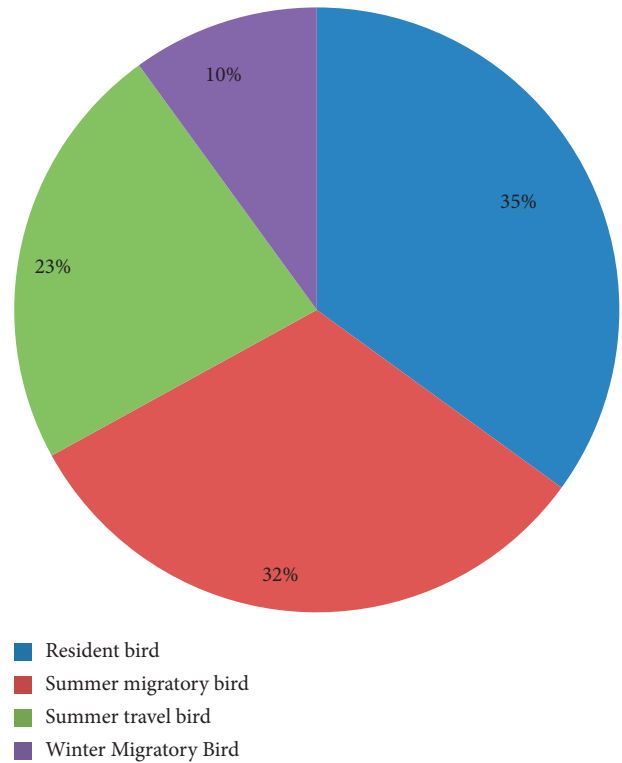


FIGURE 2: Airport and surrounding bird residence types.

3. Results

A total of 75 species of birds in 14 orders, 35 families, and 14 orders were found in the first anniversary of the airport from July 2019 to June 2020. There are 39 species in 19 families of Passeriformes, 52% of the total number of species, ranking first in the number of species; 3 families and 7 species of Platymoides, accounting for about 9.33% of the total number of species, ranking second in number of species; Gruciformes: there are 5 species in 1 family, and the number of species accounts for about 6.67% of the total, ranking third; the number of species of the remaining 11 orders is less than 5 species. See Figure 1 for the ratio of the number of different mesh types.

The airport is located in the southeastern part of the North China Plain. The number of resident birds is the largest, with 26 species, accounting for about 35% of the total; summer migratory birds are second, with 24 species, accounting for 32% of the total; and the third, 17 species of migratory birds, accounting for about 23% of the total; winter migratory birds are the least, 8 species, accounting for about 10% of the total. Resident birds and summer migratory birds are an important part of the birds around Guanyin Airport. Breeding birds accounted for 67% of the total number of species, and nonbreeding birds accounted for 33% of the total number of species (see Figure 2).

The types and proportions of 75 species of birds around the airport are shown in Figure 3.

According to the relative importance value, there are 11 species of most important birds, accounting for 15% of the

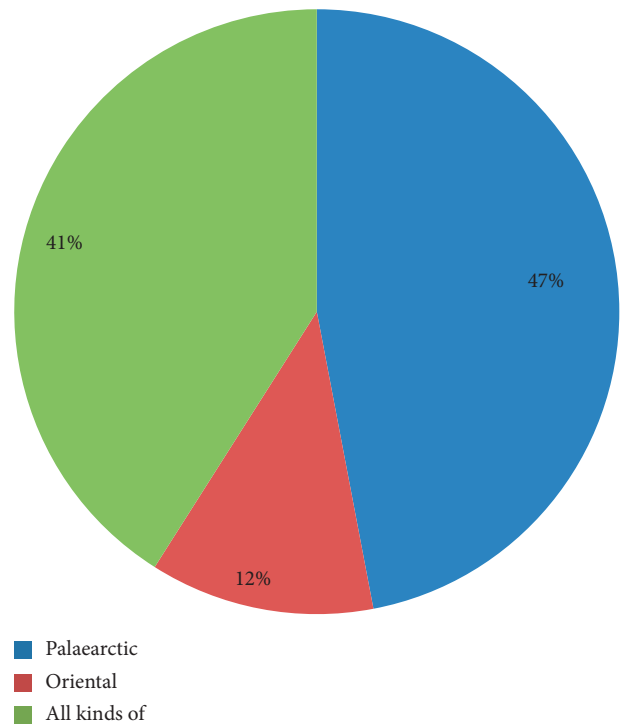


FIGURE 3: The airport and surrounding bird fauna map.

total number of species; 10 species of important birds, accounting for 13% of the total number of species; 22 species of less important birds, accounting for the 29% of the total number of species; 32 species of least important birds,

accounting for 43% of the total number of species. The details are shown in Figure 4:

Calculating the comprehensive risk of bird strikes for the birds in the airport fence shows that there are as many as 6 species of birds with $R > 0.7$. In this survey of the airport and its surrounding areas, a total of 75 species of birds were recorded. Through calculations, the relevant indices of bird community structure in each season were calculated and analyzed. See Table 1 for details.

The diversity index of the bird community in spring and autumn is high, the homogeneity index is high, and the degree of dominance is low. The community structure in spring and autumn is relatively stable, and the individual distribution among species is relatively even. Because it is an airport, the status of dominant species cannot be determined. The scale of bird migration in this area is not large, and the impact on the local bird community structure is small. Comparing spring and autumn, the community diversity index in spring was higher than that in autumn, and the community structure in spring was more stable than that in autumn. It is speculated that part of the reason is that there are more migratory birds in autumn than in spring. According to statistics, 8 species of migratory birds can be observed in spring, accounting for 2.5% of the total in spring. There are 14 species of migratory birds observed in autumn, accounting for 3.6% of autumn. The number of migratory birds observed in spring is lower than that in autumn. Among migratory birds, this is consistent with the observed results. In summer and winter, the diversity index is low, the homogeneity index is low, and the dominance index is high, indicating that the social structure is relatively unstable in summer and winter, and the dominant species are obvious. If we compare the diversity index of summer and winter communities, we can see that the diversity index in winter is higher than that in summer, and the community structure in winter is more stable than in summer; in winter, the number of species and birds decreases, and the distribution of individuals among different species is more even.

In the seven habitats divided by the airport, the diversity index is arranged from largest to smallest: nursery, water area, farmland, woodland, grassland, breeding area, and residential area. See Table 2 for the relevant indices of the community structure of each habitat.

The nursery structure is more complex, including trees and low shrubs. Most birds build nests on trees. Trees provide a habitat for birds, low shrubs provide a shelter for birds, and there are also seed-bearing weeds, which provide a food source for birds. The main plants in the nursery are ginkgo, eucommia, rose, cocklebur, bermudagrass, *Imperata cylindrica*, and other vines. In addition, there is sufficient water in the nursery to provide a water source for the survival of birds. The structural levels of this area are relatively rich, and the vegetation at different heights meets the habitat and survival requirements of different birds. Therefore, the nursery habitat is the most stable habitat type among the 7 habitats in Guanyin Airport and its surrounding areas.

The dominant species of birds in each plot are shown in Table 3.

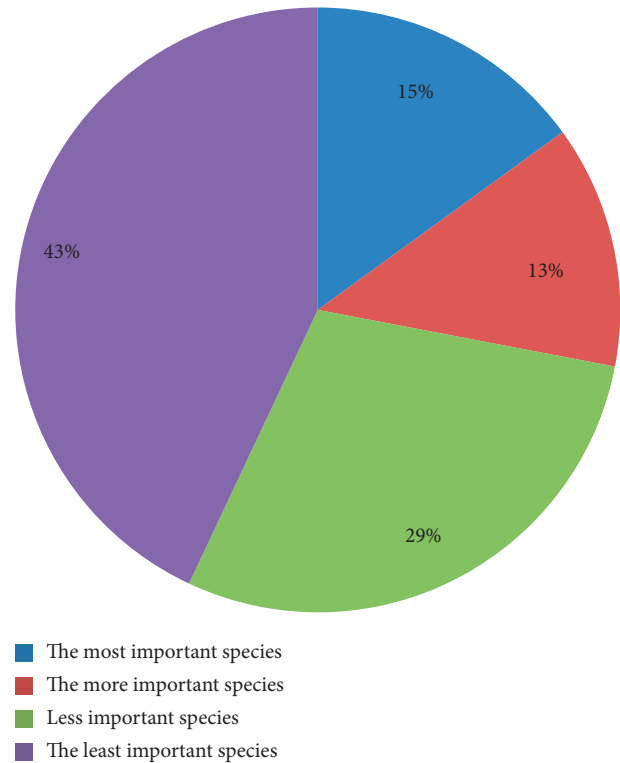


FIGURE 4: The relative importance of the airport and surrounding birds.

The composition of birds in different areas has a certain similarity. Among them, the similarity coefficient of plot 1 and plot 4 is the highest, and there are 34 common species; the similarity coefficient of plot 1 and plot 5 is the lowest, with 19 common species, as shown in Table 4.

Airport birds have different daily activity rhythms in different seasons, as shown in Figure 5.

There are significant differences in the daily activity frequency of birds in summer, as shown in Figure 6.

4. Discussion

4.1. Analysis of Influencing Factors of Civil Airport Fire Emergency. According to the basic rules of the airport fire department, the competency requirements of some airport firefighters were analyzed in detail. In the case of emergency aircraft rescue, firefighters must not only extinguish the affected aircraft but also provide basic medical assistance to the wounded, and use the knowledge of the fire brigade's emergency response capabilities in other areas. The multiple interactions between the commander and the airport firefighter finally determine the main factors that affect the firefighter's airport emergency response capability.

In recent years, the incidence and losses of fires in China have been increasing year by year, and the problem of a small number of firefighters and insufficient firefighters skills in China has gradually emerged. Overall, there is still a big gap between the number of firefighters in China and industrialized countries. Due to the lack of active firefighters, it is very necessary to organize full-time firefighters in areas far

TABLE 1: Bird community structure in different seasons in and around the airport.

Season	Diversity index	Evenness index	Dominance index	Average density (only/ha)
Spring	2.3594	0.6952	0.1384	1.2624
Summer	2.1352	0.3544	0.1646	3.1586
Autumn	2.3351	0.9575	0.1573	3.1358
Winter	2.4853	0.6843	0.1694	1.2568

TABLE 2: Bird community structure in different habitats at the airport and surrounding areas.

Habitat type	Diversity index	Evenness index	Dominance index
Nursery	2.6957	0.6584	0.1598
Farmland	2.3648	0.9755	0.1574
Grassland	1.9546	0.6824	0.6553
Woodland	1.3955	0.4687	0.2494
Breeding area	1.6844	0.4983	0.3614
Waters	2.1976	0.4586	0.1558
Residential area	1.5863	0.2392	0.3466

TABLE 3: The distribution of birds.

Plot	Number of species/species	Density/(only/hm ²)	Activity frequency (%)	Diversity index	Uniformity index	Advantage types
Plot 1	16.42 ± 1.45a	37.46 ± 10.45b	2.02 ± 0.34ab	1.33 ± 0.74b	0.14 ± 0.36b	Sparrow, goldfinch
Plot 2	9.51 ± 0.35b	9.35 ± 3.47b	1.12 ± 0.41ab	1.76 ± 0.36b	0.99 ± 0.05a	House swallow, sparrow, skylark, goldfinch, and magpie
Plot 3	9.64 ± 0.46b	7.95 ± 2.46b	0.42 ± 0.78ab	1.37 ± 0.18b	0.34 ± 0.06ac	House swallows, sparrows, bald crows, skylarks, and magpies
Plot 4	16.43 ± 1.35a	19.53 ± 3.45b	2.61 ± 0.47a	1.45 ± 0.26b	0.35 ± 0.45bc	House swallow, sparrow, and gray magpie
Plot 5	7.94 ± 0.17b	8.34 ± 1.54b	0.63 ± 0.07b	1.27 ± 0.17b	0.58 ± 0.64a	Sparrow, skylark, goldfinch, house swallow, and magpie
Plot 6	14.02 ± 1.65a	77.48 ± 11.58a	1.63 ± 0.23a	1.85 ± 0.07a	0.68 ± 0.01a	Sparrows, gray magpies, magpies, bead-necked turtledoves, goldfinches, and house swallows

TABLE 4: Similarity of bird spatial composition.

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
Plot 1	—	0.652	0.644	0.796	0.578	0.794
Plot 2	22	—	0.734	0.675	0.764	0.646
Plot 3	28	22	—	0.657	0.684	0.643
Plot 4	37	22	25	—	0.622	0.752
Plot 5	19	17	18	19	—	0.651
Plot 6	33	20	23	29	18	—

away from many professional companies and the Chinese fire department, especially in key locations such as airports. Full-time firefighters not only have the opportunity to extinguish the first fire of the unit, but can also provide super-regional support and excellent protection for fire rescue. The same full-time firefighter also has many shortcomings, such as the vitality and combat effectiveness of the team is severely limited, unable to meet the requirements of large-scale fire rescue.

With the continuous development of China's economy and the issuance of national policies, China's trade exchanges with other countries have become more and more frequent. Civil aviation has also developed rapidly due to its large transportation volume and fast transportation speed. The importance of the fire brigade, which is an important part of the airport's safe operation, has gradually become prominent, and it has received more and more attention from the Civil Aviation Administration, airlines, and

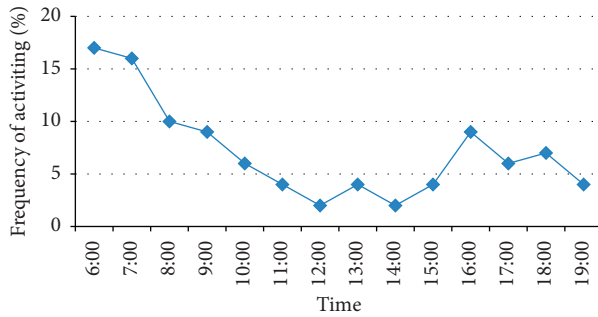


FIGURE 5: The daily activity rhythm of birds in spring.

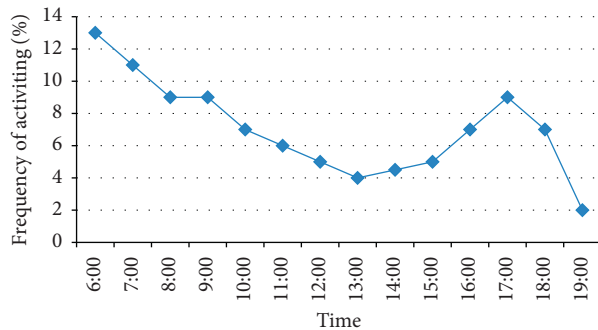


FIGURE 6: Daily activity rhythm of birds in summer.

airports. Therefore, the ability of airport firefighters is also a great challenge, and how to improve the emergency support ability of airport firefighters is also the focus of all aspects.

4.2. Fire Emergency Management Strategy for Civil Airports.

The improper allocation of emergency resources in small and medium airports is not caused by unilateral dereliction of duty by the airport management department. This includes improper government regulations and improper airport resettlement. Therefore, to solve the problem of insufficient allocation of emergency resources in small and medium airports, the joint efforts of civil aviation management departments, local governments, and airports are still required.

Regulations and standards must conform to China's national conditions. If the highest-level aircraft at the airport has less than 700 take-offs and landings in the busiest three months, the fire and emergency protection level of the highest-level aircraft can be reduced by up to one level. No matter how big the airport is, whether it is crowded or not, aviation accidents will happen, but the possibility of occurrence is very small or unlikely; aircraft accidents happen on the same type of aircraft, regardless of the size of the airport, whether it is congested or not, in terms of emergency response time and handling methods no difference. Therefore, it is not appropriate to use airport congestion as compensation for fire safety and emergency rescue protection levels but to consider the response time and protection capabilities of airport fire protection and emergency rescue services as compensation.

Utilize the resources of the airport premises. For small and medium airports in operation, it is recommended to sign an airport rescue contract or local emergency rescue plan, and clarify the responsibilities and obligations of local government agencies, companies, and unit camps in accordance with relevant regulations. Utilize emergency resources from ministries, enterprises, and local government camps to reduce or exempt emergency resource allocation that can be provided by local government agreements and emergency rescue plans, reduce insufficient small-scale resource allocation, reduce resource allocation pressure, avoid resource duplication, and eliminate energy waste. Improve the airport rescue system. The airport undertakes the main task of emergency rescue, improves the emergency rescue plan, clarifies the responsibilities and obligations of all parties, and actively allocates emergency resources to various local government agencies, enterprises, and institutions. In terms of emergency resource allocation, emergency training and education, local government departments, and enterprise troops should provide maximum support to comprehensively improve the comprehensive emergency rescue level of airport rescue personnel and minimize property losses.

5. Conclusion

The current era is an information era, and big data is the key word of this era. Through the integration of big data and the Internet of Things, human society has reached an unprecedented level of intelligence, which has brought unprecedented convenience to people's production and lives. At the same time, it briefly introduces the integration, management, and technical framework in data processing. China is rich in bird resources and poses a great threat to flight safety. With the emphasis on the ecological environment in recent years, we must pay attention to the impact on the ecological environment while carrying out bird strikes. How to balance bird strike prevention and protection of the ecological environment has become an important difficulty. After sorting out the data from the airport, this paper uses various analysis methods to effectively analyze the community structure in each season and habitat. China has not yet established target standards for the training and skill assessment of airport firefighters, and cannot effectively control some aircraft emergencies in a timely and effective manner. Therefore, analyzing the factors that affect the emergency response capability of the airport fire brigade and determining the degree of influence of each factor is of great significance for improving the airport's operational security level.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This paper was supported by the General Program of Civil Aviation Flight University of China (Grant no. J2019-029).

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