Liaohe National Park based on big data visualization Visitor Perception Study

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[Abstract]

National parks are one of the important types of protected area management systems established by IUCN and a management model for implementing effective conservation and sustainable use of natural and cultural heritage in countries around the world, and they assume important roles in conservation, scientific research, education, recreation and driving community development. In the context of big data, this study takes China's Liaohe National Park, a typical representative of global coastal wetlands, as a case study, and using Python technology to collect tourists' travelogues and reviews from major OTA websites in China as a source. The text spans from 2015 to 2022 and contains 2998 reviews with 166,588 words in total. The results show that wildlife resources, natural landscape, wetland ecology and the fishing and hunting culture of northern China are fully reflected in the perceptions of visitors to Liaohe National Park; visitors have strong positive feelings toward Liaohe National Park, but there is still much room for improvement in supporting services and facilities, public education and visitor experience and participation.

▶ Key words: Big data, Visualization, National Park, Visitor Perception, Tourist Review

[요 약]

국립공원은 세계 자연 보존 연맹(WWF)이 수립한 보호지역 관리 체계의 중요 유형 중 하나이며, 또한 자연 및 문화 유산의 효과적인 보호와 지속적인 이용을 실현하는 세계 각국의 관리 모델이다. 이러한 공원은 보호, 과학 연구, 교육, 레크리에이션 및 지역 개발을 비롯한 중요한 역할을 담당하다. 대용량 데이터의 배경 아래, 본 연구는 전 세계 연안 습지의 대표적인 대상인 중국 랴오하 국립공원을 사례 지역으로 삼아 파이썬 기술을 사용하여 중국의 주요 관광 OTA 사이트 중 하나인 망픈웨이(Mafengwo), 셰어이(Gonglve), 큐난우(Chujingyou), 메이툰(Meituan) 및 대중점평넷(Dianping)의 관광객 여행기와 댓글을 데이터 소스로 수집하였다. 텍스트 시간 범위는 2015년부터 2022년까지이며, 총 2,998개의 댓글과 166,588개의 단어를 포함하다. ROST 콘텐츠 마이닝 및 Gephi 소프트웨어를 사용하여 랴오하 국립공원 방문객의 만족도, 인지 과정, 공선 네트워크, 감정 성향 등을 시각적 분석하였다. 결과는 다음과 같다. 야생 동물 및 식물 자원, 강과 바다가 결합 된 자연 경관, 습지 생태는 랴오하 국립공원 방문객의 인식에서 충분히 반영되었다. 방문객은 랴오하 국립공원에 대해 강한 긍정적인 감정을 가지고 있지만, 시설 서비스, 대중교육, 방문객 참여 경험 등에서 여전히 개선할 여지가 있다.

▶ 주제어: Big data, 시각화, 국립공원, 관광객 예측, 관광객평론

I. Introduction

Since the establishment of the first national park in the world, Yellowstone National Park, in the United States on March 1, 1872, with the continuous progress of national park construction, a large number of tourists have come to know, visit, and experience the representative national parks. The demand for providing the public with rich experiential products will continue to expand. Under the premise of strict protection, the sustainable and non-consumptive use of national park resources to drive and radiate the development of surrounding communities, and to provide the public with natural education and recreational experience has become one of the key functions of national park construction.

The Liaohe National Park is a typical representative of global coastal wetlands, and its related research has received widespread attention from scholars, with a significant increase in the number of research achievements. The integration of ecological tourism development plays an important role in the study of Liaohe National Park, and scholars have explored issues such as wetland wildlife conservation and the revitalization and utilization of fishing and hunting culture. For example, Li Youzhi, Cui Lijuan and others have studied the species diversity and spatial distribution of wetlands in Liaohe National Park, while Chen Guanbin has conducted remote sensing assessments of the number of wild animal and plant populations in the park. Liu Jin has studied the environmental functions of Liaohe National Park, especially the peak and plateau of carbon and their mechanisms, while Sun He has planned and designed the ecological tourism strategy for Liaohe National Park. Li Na has studied the development strategy of cultural and historical tourism in Liaohe National Park. However, it is not difficult to find that existing achievements mostly discuss the development from the perspective of multidisciplinary integration, such as ecology,

geography, and planning. There is still a lack of literature exploring the tourist experience of wetlands in Liaohe National Park from the perspective of the audience object. Therefore, this study aims to provide visitor experience data for the construction of tourist experience in Liaohe National Park by exploring the literature and measurement theory of experience perception and constructing a model of the interaction of experience perception elements for the tourist experience function in Liaohe National Park.

Monitoring online travel agency (OTA) customer reviews using Python technology allows for in-depth research on customer experience perceptions through natural language processing (NLP) and text analysis techniques, which offer several advantages. Firstly, Python has powerful data processing and text analysis libraries that can automatically handle large amounts of customer review data and extract and analyze valuable information. Secondly, using Python's NLP library for sentiment analysis can quickly understand customer perceptions of travel products and services, helping businesses and government departments better understand customer needs and improve service quality. Furthermore, using Python's text analysis techniques for topic analysis can identify keywords, themes, and topics in customer reviews, revealing customer preferences and needs for travel products and services, thereby enabling better formulation of tourism product and service strategies and enhancing market competitiveness. Additionally, by using Python's data visualization library, analysis results can be presented in graphical form to better communicate research findings. Finally, analyzing customer reviews on mainstream OTA platforms can provide valuable decision-making guidance and improvement directions for tourism businesses and government departments to timely adjust and improve tourism products and services, enhance customer satisfaction and loyalty, and ultimately increase competitiveness and image.

This study utilizes Python technology to monitor reviews of mainstream Online Travel Agencies (OTAs) and conducts in-depth exploration of network comments and public opinion data. By establishing a data evaluation model, the study aims to understand the needs and emotional changes of tourists in a more scientific and intelligent way. Through data visualization, the study investigates tourists' experiential perceptions and comprehends their satisfaction, spatial distribution, activity content, and emotional tendencies during the experience of wetland wildlife. On the premise of adhering to ecological protection strictly, this study provides scientific evidence for better tourist experience and ecological environment protection education in Liaoning River National Park, and serves as a reference for subsequent development and management decision-making of the national park.

II. Theoretical Research

1. National Park

The concept of the "National Park" was first originated in the United States. In 1832, the renowned American artist, George Catlin, embarked on a journey through the American West, where he became concerned about the potential impact of the Great American West development strategy on Indian civilization, wildlife, and wilderness [6]. To address these concerns, Catlin promoted the establishment of the world's first national park in the United States in 1872 - Yellowstone National Park. Since 1872, more than 200 countries and regions worldwide have been actively promoting the development of national parks, resulting in the establishment of numerous national parks. This development has led to the emergence of related concepts such as "National Forest Park," "National Geological Park," "National Wetland Park," "National Marine Park," "National Nature Reserve," and "World Natural Heritage."

2. Visitor Perception

Visitor perception is a study of the image of a tourist region from the perspective of the tourist, and it is mostly conceptualized by scholars in several countries at the level of psychological perception. Hunt, Crompton considers visitor perception as a perception, feeling, emotion and general impression formed by the individual tourist about the tourist place[10][11]. Huang Zhenfang believes that visitor perception is the sum of tourists' impressions based on their cognition and experience of the destination[12]. Cheng Jinlong believes that visitor perception is the overall, abstract and generalized cognition and evaluation of tourist places by tourists, which can reflect the overall product characteristics and comprehensive quality level of tourist places[13]. Gunn refers to the impressions formed before the tourist's field visit as primary perceptual images and those formed after the field visit as induced perceptual images, depending on the source of information[14]. Based on previous studies, Fakeve further generalized visitor perception into three levels: primary perception, induced perception, and composite perception[15]. Baloglu proposes that visitor perception consists of three dimensions: cognitive perception, emotional perception and overall perception[16]. This concept has been accepted by many scholars, and this paper also adopts this classification criterion to study visitor perception in Liaohe National Park.

3. Network text analysis

Network text analysis is one of the effective means of mining Internet information materials through big data technology, and refers to the process of using text to extract useful patterns or relationships and extract meaningful information or values from them for analysis. Network text analysis can be a scientific research method that filters and extracts meaningful information from text data through keyword analysis, and uses this information to analyze group opinion, evaluation or social phenomena and trends, and then make

predictions[17].

In terms of analyzing tourist perceptions, there are several methods, including questionnaire surveys, scales, interviews, and online text analysis. However, questionnaire surveys and scales have high requirements for questionnaire design, and the range of people covered by the questionnaire is not broad enough, leading to bias in the results. Structured and semi-structured questionnaires, as well as researchers themselves, can induce and interfere with tourists when filling out questionnaires. Furthermore, the perception obtained from questionnaires is passive, while interviews can obtain tourists' spontaneous and authentic perceptions. However, interviews are more costly and have a narrow scope of investigation. Online text analysis has become a popular method of analyzing tourist perceptions due to its scientific and operability advantages[18].

III. Study Area and Research Methodology

1. Study Area Overview

The Liaohe River is one of the seven major rivers in China, with a total length of 1,345 kilometers and a basin area of 219,000 square kilometers. The Liaohe River is a source of water for living and agriculture for more than 15 million people in Liaoning Province, China. The Liaohe River basin accounts for 15.55% of the population and 13.39% of the land area of Liaoning Province, and has very important ecological, environmental, economic and social significance[19]. Liaohe National Park was developed by the Liaoning Provincial Government of China on the basis of the Liaohe Estuary National Nature Reserve established in 1988(Fig.1), it has 249,600 hectares of wetlands spread over its territory, rich in resources and diverse in type. The park is home to 477 species of wildlife, these include 24 species of national Class I protected animals, such as Grus japonensis, Larus

saundersi and Phoca largha Pallas, and 54 species of national Class II protected animals, such as Cygnus cygnus and Grus grus[20].
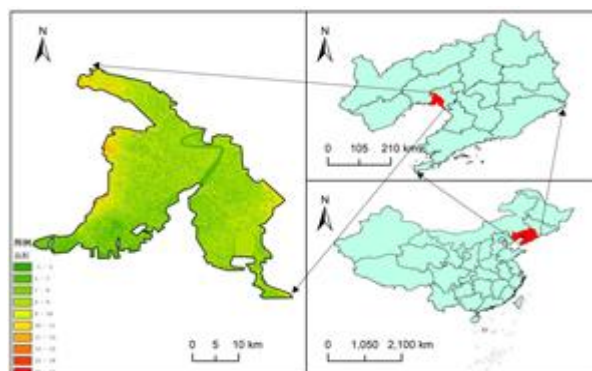
Fig. 1. Map of the study area.

Liaohe National Park is on the East Asia-West Pacific migration route of the nine major bird migration routes in the world[21]. It is an important stopover and destination for migratory birds from East Asia to Western Australia, with over one million waterfowl stopping or breeding there each year. It is the breeding site of the largest population of Larus saundersi in the world; an important resting place for the north-south migration of Grus japonensis, the southernmost limit for natural breeding and the northernmost limit for wintering; and an important whelping site for Phoca largha Pallas[22]. Liaohe National Park is a typical representative of global coastal wetlands. Inclusion in the UNESCO List of Wetlands of International Importance in 2004.In 2005, it was named as one of the "Six Most Beautiful Swampy Wetlands in China" by China National Geographic magazine. In 2013, it was awarded as one of the "Top Ten Charming Wetlands in China" by China Central Television. Inclusion in the second group of "International Wetland Cities" by the Secretariat of the Convention on Wetlands in 2022[23].

2. Data Collection

In this study, we used Python to collect the review information of tourists after their visit, and the review information was used as a data sample. The

selected target websites are the top five Online Travel Agency (OTA) websites in China: 'Mafengwo.com', 'Qunar.com', 'Ctrip.com', 'LY.com', and 'Dianping.com'. The time span is from October 2015 to December 2022,enter the keyword "Liaohe National Park" and save the text of the online review in an excel file. In order to ensure the relevance and validity of the text, the comment data needs to be cleaned and noise reduced after all the comment information is obtained. For example, eliminate pictures and comments that are not related to the destination, eliminate advertising comments and duplicate comments, fix typos, etc. After screening and sorting, the sample size of this study was 2998 entries with a total word count of 166,588.Compared with traditional methods such as questionnaire surveys, using Python for data collection has the advantages of large sample size, rich content and fast acquisition[24]. As a result, the text content is time-sensitive and more authentic.

3. Analysis Method

After data collection with Python, ROST Content Mining was used to extract high-frequency words from web texts. Through the classification and ranking of high-frequency words, the satisfaction, spatial distribution, landscape perception, services and facilities, and emotional tendency of tourists in the tourism experience activities of Liaohe National Park were analyzed. At the same time, the keyword co-occurrence matrix from the previous step is input into Gephi, and the visualization and analysis function of Gephi is used to generate a visualized "tag cloud map" of tourism experience in Liaohe National Park. Exploring the semantic structure and correlation between key high-frequency feature words, forming a semantic network map of tourists' travel experience in Liaohe National Park. The sentiment analysis module in ROST Content Mining was used to analyze the satisfaction and emotional states of the public experience.

IV. Analysis results

1. Word frequency analysis

High-frequency words were proposed using ROST Content Mining. The high-frequency words reflect the tourists' awareness of each element in the tourist image of Liaohe National Park. In general, the lexical nature of high-frequency words is dominated by nouns, adjectives, verbs and adverbs. Nouns mainly refer to the scenery, geographical information, names of plants and animals, cuisine, transportation and accommodation of Liaohe National Park; adjectives are the subjective evaluations of tourists on the cuisine, natural environment atmosphere and historical and cultural atmosphere, attractions and objective conditions of Liaohe National Park, and tourists' own overall touring process in Liaohe National Park; verbs show the thoughts, behaviors and perceptions of tourists during the touring process.

In order to express the real perceptual image of visitors to Liaohe National Park more visually, a word cloud map was created by visualization function software(Fig.2). The size of the font in the graph corresponds to the frequency of its occurrence. "beach," "scenic," "scenery," "nice," "very" are the top five high-frequency words. Among them, "beach" is mostly the main word in the comments and appears most frequently, indicating that wetlands are the core attraction in the visitor experience.

Fig. 2. High-frequency word cloud of the Liaohe National Park

2. Satisfaction Analysis

From the experienced perceptions, it can be seen that in terms of satisfaction with the experience, Visitors describe the experience of Liaohe National Park as "pretty good", "very", "worthwhile", "convenient", "good", "special" and "beautiful". Among them, "pretty good" ranked first among the adjectives, indicating that visitors' perception of Liaohe National Park is more prominent. "Convenient" is the second most frequent adjective, which indicates that transportation accessibility is an important factor influencing visitors to participate in the theme experience of Liaohe National Park. Spatially visitors will choose the area closer to them to participate in the experience. Due to some uncontrollable reasons, such as the weather and renovation of the park, some visitors were not able to get the desired experience as planned, so there was a little disappointment, expressed in words such as "regret" and "average", indicating that there are still many problems in terms of services and facilities. During the experience process, the perception of the national park as a nature education and ecological experience is relatively low, and only "conservation" and "education" appear in the high-frequency vocabulary, indicating that in the current public experience process, the facilities and contents are relatively single; Terms such as "interactive" and "lively", which reflect a strong sense of public participation, appear less frequently, indicating that the main tourist perception method of visitors is mainly mass tourism.

3. Cognitive Analysis

3.1 Landscape Cognitive

From the vocabulary of landscape cognitive impressions of visitors to Liaohe National Park, it is clear that visitors come to Liaohe National Park with the theme of experiencing wetland ecology. The main attraction comes from the red beaches full of Suaedavheteroptera Kitag, and the overall environment of the experience area is good and rich in all kinds of resources. Visitors' current experiences are still mainly sightseeing tours, and there are fewer educational, recreational, and community involvement functions based on national parks. Although sensory words such as "nature", "ecology" and "green" appear in the vocabulary, they are less frequent, and it can be concluded that nature education and ecological experience in Liaohe National Park are less frequent in the corresponding visitor experience.

3.2 Service and Facility Cognitive

In the vocabulary statistics of services and facilities perceived by visitors to Liaohe National Park, transportation ranks first with modern transportation such as sightseeing cars and electric cars, followed by walking; it shows that people are still concerned about the convenience of transportation and travel when they participate in the experience. The frequency of words related to environmental interpretation such as "guide", "tour guide" and "science museum" is relatively low, which indicates that there are few services and facilities for visitors' experience in Liaohe National Park, and the public has a shallow perception of environmental interpretation, science explanation and nature education activities in the process of experience.

4. Common Line Network Analysis

The word frequency analysis only reflects the basic situation of visitors' perceptions in Liaohe National Park, but it is more important to identify the inner connection between high-frequency words and the structural relationship between perceptual dimensions. Based on the common line relationship between high-frequency words, this study further draws the semantic network map of visitor perception in Liaohe National Park using Gephi, and at the same time uses a modular algorithm to cluster and analyze the semantic relationship between high-frequency words, and finally identifies the core modules of visitor
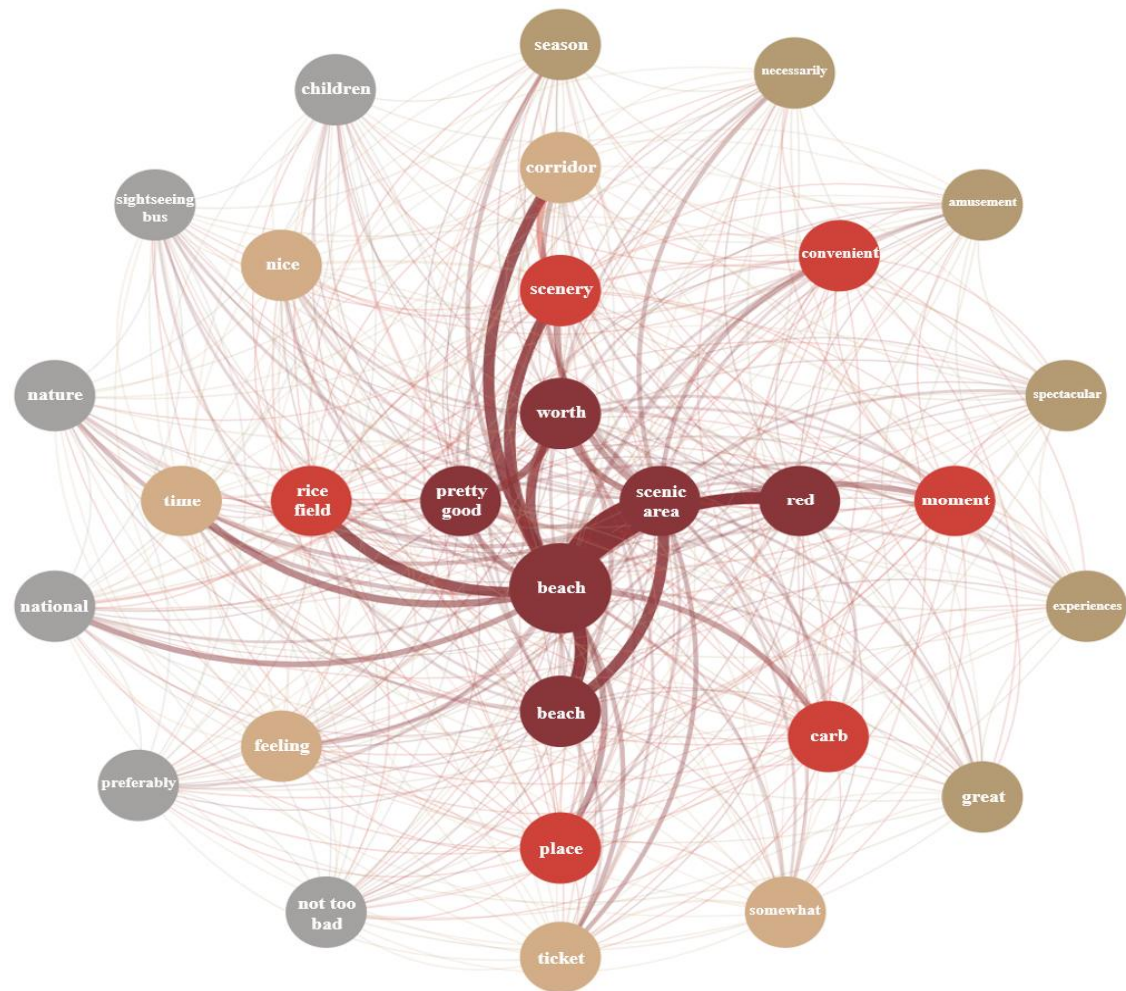
Fig. 3. Liaohe National Park Visitor Review Glossary Common Line Network Map

perception in Liaohe National Park(Fig.3).The greater the density of lines, the higher the frequency of common lines. It is obvious from the figure that the semantic network diagram is centered on "beach" "red" and "rice field" "crab" "scenery" and "pretty good" are the most frequent occurrences.

In general, Liaohe National Park, as a typical representative of coastal wetlands in northern China, is popular among visitors for its wildlife resources, such as Grus japonensis, Larus saundersi, Suaeda heteroptera Kitag, etc. The value of its most original and complete core is recognized and acknowledged by visitors. The double checkerboard pattern of "red beach" and "Asia's largest reed field" also leaves a deep impression on visitors, especially Panjin rice, River crab and other

special foods, ecological agricultural products. The unique local humanistic value of its fishing and hunting culture in northern China has not been highlighted, and visitors pay little attention to it.

5. Emotional tendency analysis

Emotional tendency analysis is mainly used to discern the emotional tendency of public review texts by the positive and negative emotions conveyed in them. Tourism emotion is the visitor's intuitive response to the destination tourism experience and has a significant impact on visitor loyalty and satisfaction. The emotional change of tourists' experience of destination image is a dynamic process. A good destination image satisfies visitors' unique experiences of the destination and generates positive, positive emotions, which in turn

leads to repeated tourist behavior. On the other hand, negative visitor experiences, generate negative emotions, which in turn reduce visitor loyalty and satisfaction with the destination.

The segmentation statistics of positive, neutral, and negative emotions using the Affective Tendency Analysis tool under ROST Content Mining showed that visitors currently have much more positive than negative attitudes toward the Liaohe National Park experience. Visitors are satisfied with the experience and have high expectations for the Liaohe National Park experience. The number of online comments with positive emotions accounted for 69.25%, while the number of comments with neutral and negative emotions accounted for 12.95% and 17.8%, respectively. The analysis of visitors' positive and negative emotions is more helpful to reveal the strengths and weaknesses of Liaohe National Park. The number of comments with positive emotions is 3.89 times higher than the number of comments with negative emotions, which fully indicates that visitors have a better image perception of Liaohe National Park. It is worth emphasizing that among the online comments with positive sentiment, the number of highly positive sentiments is low, accounting for 23.61%, which indicates that Liaohe National Park has left a deep and good impression on visitors to be strengthened. It should be noted that the number of online reviews collected in this study is relatively sufficient, which to a certain extent reflects the greater awareness and influence of Liaohe National Park, but there is still potential and space for further improvement of the visitor experience of Liaohe National Park.

V. Conclusions and Limitations

In this paper, we collected web text data of visitors to Liaohe National Park, a typical representative of global coastal wetlands, and analyzed the tourism perceptions of visitors to Liaohe National Park in the hierarchical order of "cognition, emotion and whole" based on web text analysis and python data visualization. Based on the web text analysis method and python data visualization, we analyzed the tourism perceptions of visitors to the Liaohe National Park according to the hierarchy of "cognition, emotion and whole". The data comes from four of the most representative OTA websites in China, and has strong persuasive power due to the comprehensive perceptual content and balanced geographical distribution involved in the data visualization. The visual analysis led us to the following conclusions:

(1) Satisfaction level. Tourists are generally satisfied with the experience activities of wetland tourism theme in Liaohe National Park, and the experience quality is high. The tour is mainly in the form of sightseeing, and most tourists do not participate and enjoy the relevant functions that reflect nature education and ecological experience. Liaohe National Park lacks corresponding supporting facilities, but visitors have a high expectation of experiencing this theme and enjoying the wetland ecosystem resources more.

(2) Cognitive process aspects. The landscape perception of tourists, coastal wetlands as the theme of the experience is mainly based on mass tourism and educational tourism activities, visiting the landscape set up is also some wetland wildlife as the theme of the visit to the park. Some tourists will participate in study tours to the nature reserves in Liaohe National Park, and their activities are still superficial tourism. This is still far from what we expect, such as nature education, ecological experience, leisure and recreation, based on conservation first, quality, level and meaningful ecotourism experience activities in Liaohe National Park. Regarding the services and facilities perceived by visitors, the high-frequency vocabulary of the park's services and facilities is basically limited to "transportation", "convenience" and "park environment" but the environmental interpretation system, environmental interpreters,

and environmental interpretation signs that should support the national park are basically not mentioned. Visitors are still satisfied with the service requirements and related supporting facilities. The area with coastal wetland as the theme of experience activities has more or less built some science popularization and education bases, but it is far from satisfying the public experience function of Liaohe National Park and cannot fully provide the public with ecological experience services of nature education and other content.

(3) Effectiveness evaluation—emotional tendency. As a typical representative of global coastal wetlands, Liaohe National Park is attractive to tourists. From the results of the study, tourists have a positive and optimistic attitude towards wetland tourism-themed experiences, with a high degree of expectation and enjoyment. It is forward-looking to carry out activities of the nature of national park visitor experience with the theme of wetland tourism in Liaohe National Park, as long as the design of space setting, service and facility configuration, landscape and content is improved to improve the satisfaction of visitors and provide a special program of Liaohe National Park for the construction of ecological civilization.

This study is a useful attempt and exploration to enrich the connotation of public experience and theoretical innovation in Liaohe National Park, but there are still some limitations. First, in terms of data samples, the data collected from five Chinese OTA websites needs to be further expanded, and it is difficult to determine the representativeness of the samples due to the protection of tourists' private information, and therefore it is impossible to determine tourists' satisfaction from a scientific perspective. Secondly, the article still needs to deepen the dimension and depth of the theory of tourism image perception combined with online text data for measurement, especially in the study of tourists' emotional image, which can only be described from this dimension of positive, neutral

and negative. In future research, algorithms with better performance should be developed to describe visitors' emotions in more dimensions.

With the rapid development of big data technology, the field of tourism market and consumer behavior research is expected to integrate more deeply with artificial intelligence technology and become a new hot spot for future research.

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