Environmental Values and Tourism Perceptions at New Local Geopark Caota Sand Dunes, Taoyuan, Taiwan

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Abstract. Caota Sand Dunes Geopark was established in June 2020 and conserves a landscape of coastal sand dunes at the Taoyuan coastline. This is the first geopark in Taiwan to promote the value of coastal dunes, recognizing their ecological value and their protection function in the face of climate change. This geopark has been actively promoted and attracts many visitors owing to its unique and photogenic landscape. In the initiation phase of a geopark it is significant to get feedback on the planning and services, to evaluate the existing management strategies for future development. Therefore, this study will assess tourist perceptions through visitor comments from Google reviews, to explore how well the core values of the geopark are represented in visitors’ experiences. A qualitative methodology based on review analysis has been used to find themes and patterns. Many reviews point out that washed-up waste is still a huge issue at the Caota dunes and mention that the Geopark development has not been completed. However, there is consensus on the fact that Caota Dunes is a very promising site, and with more planning underway it can become a successful geopark. Future management strategies should address the issues that are pointed out in the reviews for the sustainable development of this scenery post the Covid-19 Pandemic.

1. Introduction
Caota Sand Dunes Geopark has officially opened in June 2020. This Geopark conserves a landscape of coastal sand dunes, which can reach up to 20 m, and stretch for circa 8km along the Taoyuan coastline. The sand dunes take shape because of seasonal strong winds that spread and accumulate the sand in this region. This is the first geopark in Taiwan to promote the value of coastal dunes, recognizing their ecological value and their protection function in the face climate of change [1,2]. Since the geopark is opened, the area has been actively promoted to attract more visitors, and it is becoming a popular tourist destination owing to its unique and photogenic landscape. This distinct environment provides a good tool for environmental education, which is also one of the core values of the geopark and visitors are motivated to learn more about the environment [3]. For example, information signs are placed at the entrance, there is an exhibition about sand dunes at the visitor centre and to create interaction with visitors an interactive 3D VR-experience has been set-up.

In the initiation phase of a geopark it is significant to get feedback on the planning and services, to evaluate the existing management strategies for future development [4]. Therefore, this study will assess tourist perceptions for Caota sand dunes through visitor reviews. The geopark has a target point to enhance the environmental values of its visitors through environmental education and it is hoped that the connection with, knowledge about and appreciation for nature is strengthened and that people are motivated to actively contribute to conservation of nature. Environmental values are defined as pro-environmental behaviour and it can come forward in conservation of resources, concern for the natural
environment or ethical principles that are underlying factors in guiding individual to pro-environmental behaviour [5]. How well are these values represented in the review comments? And what other topics are frequently discussed by people that have visited the sand dunes? For this study 480 comments on Google Reviews are analysed, to explore how tourists perceive the area by observing main themes that are correlated to positive and negative responses. From this review analysis, suggestions are made to indicate where improvements are needed to create a better environment and increase the tourism satisfaction rate.

2. Study area

Caota dunes geopark has been open for just over a year at the time of writing, and it attracts more and more tourists to this region. Over thousands of years the dunes have covered this area, and currently it is the largest sand dune system in Taiwan. The rivers transported sediment from higher land to the coastal area, and typical grassy wetlands have formed behind the dunes, due to assembling water from rivers that are blocked by sand dunes [3][6]. These dunes are a unique ecosystem in Taiwan, containing specially adapted salt-tolerant and windproof plants. Dune environments have proven to be neglected ecosystems before [2], where many do not realize that dunes also have a unique story to tell, can be highly educative in terms of geology and ecology and have many supporting functions. The Caota dunes also have a high geological value, in terms of geoherdage there are many interesting features and the distinct environment provides a good education tool, and therefore could attract many visitors when properly constructed and managed as a geopark.

![Figure 1. The boundaries and different areas of the Geopark.](image)

Although the Caota sand dune area is one of the few remaining natural barriers in Taiwan, it is threatened by human interventions due to increasing land demand and industrialization. Over time the dunes are used as waste depot, landfills have been created in the older dune rows and parts of the dunes have been converted to fishing ponds and industrial sites [6]. To stabilize the dunes and accumulate more sand, bamboo sand fences have been placed on top of the dunes to retain sand, but they are not well maintained. The new geopark will protect the dunes from further development and the area is divided into three sections (Figure 1); the core section, with the most complete sand dune ecology, will be accessible only
for research and environmental education (by application) to preserve the dunes and nature, while the general section will be opened for public and be accessible for recreation purposes. The third section is a rehabilitation area, not open to the public and currently the location of multiple landfills, where nature can be restored [1]. Along the beach, much waste is found along the shoreline. Due to strong currents around Taiwan, waste is transported from surrounding countries by the ocean to the Taiwanese coasts, but also recreational waste and waste from the nearby landfills end up at the shoreline [7]. There are regular clean up events in the area by NGO’s and volunteers, but the amount of waste that is assembling along the shoreline is too much to get under control.

Restrictions to control the pandemic have decreased outdoor activities in the spring and summer of 2021 in Taiwan, and the geopark has had fewer visitors than initially anticipated. Post Covid-19 Pandemic tourism development is often a top priority at coastal sites; when the Covid-19 restrictions will be eased, many areas would want to attract tourists again for further economic development, while nature conservation that thrived under worldwide lockdowns, might come in second [8]. This new geopark might be a good practice for both economic benefits and ecosystem benefits, since it plans to educate tourists about the natural environment and nature conservation and tourism management can be developed in a sustainable way. This study can be beneficial for sustainable development of the geopark and provide ideas for future management strategies based on tourism perceptions, while also promoting environmental education.

Figure 2. a) The wind turbines are constructed on top of the dynamic sand dunes. b) washed up waste is visible everywhere at the beach. c) the bamboo sand fences are not maintained and wear down, leaving traces of bamboo throughout the landscape.

3. Methods

To assess the tourist perceptions of visitors at Caota Sand Dunes, data from Google Maps Reviews were examined. This is a large online open database that collects ratings and reviews. Visitors can rate and/or comment on their experience after visiting the geopark; the lowest rating is 1 star and the highest (most satisfactory) rating is 5 stars. Currently the average rating is 4.1 out of 5 stars, based on 1,576 reviews at 8 August 2021. The Park officially opened in June 2020 and the reviews containing comments were collected for one year from 8th August 2020 - August 8th 2021. Ratings without comment were omitted and the comments have been processed anonymously. After exclusion (based on available comments and dates) 480 comments were selected for further analysis. The comments have been processed anonymously and demographic data are not presented. The comments reflect views and thoughts of tourists that visited the geopark. The textual reviews from the databases are extracted and combined in Excel and the data are analysed using NVivo 12, using the Reflexive Thematic Analysis approach for qualitative data analysis by coding the texts in NVivo 12 to indicate themes and patterns [9]. Each comment was coded, and in these coding labels environmental values were indicated. The label ‘recommendations’ brings forward different (environmental) concerns from visitors, and will be discussed separately. After this
qualitative data analysis, a frequency count has been done on these themes and the average satisfaction rate of the reviewers is determined.

4. Results
The Caota Sand Dunes geopark highly values the ecological function of the dunes and strives to engage the public and educate people about the dune landscape. From the reviews it is evident that many visitors appreciate the peacefulness and remoteness of this landscape, and they are surprised that Taoyuan has such a unique attraction. A total of 12 recurring themes related to visitor’s perceptions has been identified during the review analysis (see Figure 3). The site seems particularly popular during sunset, but people warn of hard winds, especially during the winter monsoon. Unfortunately, washed-up waste is still a huge issue at the Caota dunes, which is pointed out in many reviews. Various visitors also show their environmental concerns related to the waste and ask everyone to help clean up and don’t leave any waste. Besides the waste problem, it is mentioned that the scenery is disturbed by the bamboo fences on the dunes; it is said that they destroy the natural beauty of the dunes or the degraded fences make it difficult to walk because of all the debris. Over the last year there were not that many tourists due to Covid-19 restrictions, this also comes forward in reviews indicating that there were only few tourists. Most people seem to visit for a short time, typically during sunset, to take pictures and enjoy the view. Some comments mention leisure activities like sandboarding, or that it is a good place for children playing in the sand. Visitors also mention that they are attracted to this site through pictures of other people on social media, like Facebook or Instagram. Taking good pictures is highly valued by visitors, as lots of comments give tips on how, when and where to take the best pictures. Moreover, the promotion of the geopark as “the Sahara Desert of Taiwan” seems to be successful, as many people enthusiastically reconfirm this in their comments and compare the bare sand dunes to desert landscapes. Table 1 displays more detailed information on the content of the comments for each theme.

Table 1

| Themes                          | Frequency |
|---------------------------------|-----------|
| Beautiful, Special              | 250       |
| Sunset                          | 200       |
| Wind                            | 150       |
| Parkign and navigation issues   | 100       |
| Planning                        | 75        |
| Pollution                       | 50        |
| Wind Turbines                   | 30        |
| Desert                          | 20        |
| Disappointing                    | 15        |
| Educational                     | 10        |
| Hot                             | 5         |
| Bamboo fence                    | 2         |

![Figure 3](https://example.com/figure3.png)

**Figure 3.** Frequency of the most mentioned themes
Table 1. Detailed description of each theme

| Theme               | Description and association in comments                                                                                                                                                                                                 |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bamboo fence        | Most comments about the bamboo fence have negative associations with the fences, people mention:<br>● It is dangerous, you easily can hurt yourself at the sharp edges<br>● They make it difficult to reach the beach<br>● The fences are landscape pollution, disturbing the natural attractiveness |
| Beautiful, special  | The reviews are very positive on the sand dune landscape, and often in combination with sunset it is indicated as an attractive and unique landscape;<br>● Beautiful, special, good, nice or related expressions are used to describe the landscape |
| Desert              | The dune landscape is often compared to a desert landscape, which is a characteristic that people highly value.<br>● Descriptions like ‘another world’, or ‘it feels like I’m in another country’, highlight the uniqueness and positive association with the desert landscape<br>● Also, in the promotion of the geopark it is named the ‘Sahara Desert of Taiwan’ and visitors have picked up on that, as it is regularly mentioned in the comments. |
| Disappointing        | When describing feelings of disappointment after a visit to the geopark, following reasons were mentioned in the comments:<br>● Dunes are too hard to climb, especially when there is a strong wind<br>● Not as spectacular as expected<br>● Too messy/polluted |
| Educational         | Educational sections in the comments are often correlated to the formation of the dune landscape and descriptions of the landscape;<br>● People cited facts they read on the information signs, about the protection function of the dunes, dune formation or coastal ecology.<br>● Some visitors mention that unfortunately there are few signs that can educate the people on sightseeing groups<br>● The strong northeast monsoon is often mentioned related to dune formation |
| Hot                 | Comments labelled ‘hot’ refer to hot sand or hot weather.<br>● Visitors point out that in summer during noon it can be very hot, if the sun is strong<br>● Some comments recommend others to bring slippers or closed shoes, to protect your feet from hot sand |
| Parking and navigation issues | Parking and navigation issues also include issues on finding the right entrance and finding parking spots;<br>● Navigation to the place seems difficult for some people, because Google maps sends them to the wrong site, for example people end up at the landfill site<br>● Moreover, there often seems to be misunderstanding where to park the car, as many people park along the road because they cannot find the parking lot<br>● People often miss the road to the entrance because they assume it is a restricted area<br>● Few people positively commented on parking, mentioning there is a decent parking lot, while other say there is not enough parking space<br>● Comments recommend to put more signs, |
| Planning            | Under the theme ‘planning’, remarks are made about the development of the geopark, and it is indicated the area is not fully planned yet. Things that often come forward are: |
The lack of public restrooms or other facilities, like local vendors, it is mentioned that more of these facilities are needed if it wants to develop into a tourist area.

- Lack of information provision; people recommend to increase the accessibility to the geopark area and provide more parking space.
- Some comments recommend to install a faucet so that people can rinse off the sand after their visit.
- Visitors are positive about the constructed trail from the parking lot to the dunes.

### Pollution
- Pollution and washed-up waste are mentioned in numerous reviews.
  - Many people are concerned about the waste problem, and recommend that all people should take out their own waste.
  - Some say it spoiled their visit, while other are not too much bothered by the amount of waste.
  - Also, the smell of nearby industries and landfills is mentioned.

### Sunset
- Most tourists that left comments, visited during the sunset period.
  - They advise other people to do the same, because the light is better for photographs and it’s not too hot and

### Wind
- The wind in this geopark is much stronger during the winter monsoon and visitors have both positive and negative associations with the strong wind.
  - There are many comments about wind and sand blown in the face and eyes.
  - People recommend to check the weather before visiting and don’t come if it is too windy, or wear goggles when visiting during heavy wind.
  - The strong wind is also impressive and attracts people.

### Wind Turbines
- The wind turbines on top of the sand dunes are a distinctive sight and are mentioned in the reviews.
  - The wind turbines are seen as part of the landscape, many people like it or are impressed by their magnitude.
  - Few comments mention they disturb the natural landscape.

Several recommendations presented advice or needs for a better waste management and clean environment. Comments such as “I also hope that tourists can take away their own rubbish by themselves”, “I hope that the scenery will not be destroyed by too many human factors” or “The beautiful scenery must be matched with complete supporting measures” indicate concerns and hopes visitors have for the future of this geopark.

Figure 4a is a record of the number of visitor reviews per month from August 2020 - July 2021, which might give a rough estimate about when most tourists visit the area. Even though this year might not be very representative due to Covid19 measures (Taiwan has not been in lock-down, but there have been restrictions in access to outdoor areas in spring and summer 2021), the visit comments are very low in the winter months (December - February). Figure 4b displays the visitor satisfaction rate, showing that most visitors rated very positively.
5. Discussion

Main target points of the Caota sand dunes geopark are, amongst others, education and conservation. The city government of Taoyuan plans to promote the area for coastal tourism and also plans to train local coastal eco-narrators, provide tourists with guided commentary services and educate visitors about the concept of protecting coastal ecosystems and important ecosystem functions [10]. To support education, currently some signs are constructed in the geopark with information about the dune environment and flora and fauna, and there is a visitor centre with an exhibition hall, with more information on sand dune geology, marine ecological conservation and environmental education. However, in none of the review comments this visitor centre or guided services are mentioned, and many people seem to have problems finding parking spots or navigating to the park entrance. Improvements are needed in visitor guidance to the geopark, and the environmental education could be promoted more through clear signposts, guidance towards the visitor centre and by hosting educational activities such as workshops, to attract and increase the environmental understanding of visitors [11]. Visitors are positive about the designated path from the parking lot towards the dune area, but they mention it is hard or dangerous to walk up the dunes (due to the steepness of the dunes or the sharp bamboo fences). It can be considered to start removing bamboo sand fences in the more crowded areas, as tourists point out the fences are dangerous and pollute the landscape [12]. Moreover, the bamboo fences retain garbage that is blown up by the wind, or even worsen the problem by tearing up pieces of plastic that are caught by the structures. Studies have demonstrated that if dunes are more dynamic and less regulated by human actions, they can build up stronger and create a more natural landscape [13,14]. Moreover, to protect the vulnerable dune environment, designated paths to the beach or along the dunes can be considered to guide tourists through the geopark.

There are many comments about the strong wind, especially during the winter monsoon. People mention that it is annoying to visit when the wind is strong, because they get sand in their clothes and eyes, and the windblown sand hurts their face. To motivate tourists to visit throughout the year, visitor guidelines with tips about clothing or protective structures for strong winds can be helpful. But at the same time tourism should be managed carefully in these sensitive environments, the construction of new objects or pathways should take into account the flora, fauna and natural dune dynamics.

![Figure SEQ Figure\* ARABIC 4. a) visitor comments per month 2020-2021. b) Ratings of visitors (1 star: displeased, 5 stars: content).](image-url)
5.1 Coastal waste management
Pollution in the dunes is a topic which recurs in numerous reviews; people point out that they are sad and upset by the amount of waste at the beach, the landfills and industrial pollution. Although the beach litter is confronting for many visitors, it also helps raise public awareness of beach pollution and visitors also often remark that everyone should help keep the environment clean and call out to other visitors to take their own waste, or help out during clean-up actions. The concerns about the waste management point out that visitors already have high environmental values. Nevertheless, it often has a negative impact on their visit and more attention needs to be drawn to the management of waste in the sand dunes. Taiwan already has many concerned citizens who voluntarily join clean-up actions or NGO’s that host events to raise awareness about environmental pollution, but the geopark can add to this by directing their environmental education on ways to control and prevent beach litter. This can be done through information provision and by motivating visitors, local communities and governments to help keep the dune environment clean. To better regulate the waste issues, clean-up actions could be funded and organized more frequently. As part of the geopark management, regular clean ups can be planned, or visitors can be actively involved in waste management. For example, small incentives can be given to those who bring back waste after their visit to the dunes; the visitor centre can hand out waste bags and for each filled bag visitors get a gift or discount on other tourist attractions. Community involvement is an increasingly important part of dune management around the world and also one of the core points of this geopark. Together with public participation, communities can help maintain the environment and help reduce marine and beach waste.

Another strategy seen in tourism areas to reduce waste or create awareness about environmental pollution in coastal areas, is for example the construction of art works from beach trash. These artworks can be exhibited at the visitor centre or at certain points in the park. Workshops and guided tours hosted by local community members, park managers or artists could also actively involve visitors in waste collection and creation of their own artworks. Nonetheless, to reduce waste also land-based waste policies need to be addressed; by strengthening regulations around plastic packaging, promoting reduce, reuse and recycle campaigns and banning plastic bags and (wish)balloons, the amount of beach waste can already be drastically reduced. This is seen in a study at the North Sea shores in Europe; due to tightened legislation in various countries, which have banned free plastic bags and the release of balloons, less single-use plastic has been found in the last ten years at the shores of the North Sea [15].

5.2 Further research
This explorative study can be used as guidance for future research, to further identify themes and issues at Caota Sand Dunes Geopark. Other research at this site can collect information on the sources and types of the beach litter, to see what are the best strategies and policies to reduce waste in this area. To get more detailed information on visitor perceptions, questionnaires with targeted questions can provide more insight on tourist behaviour and visions for the future of the geopark, or determine underlying factors for certain perceptions. Moreover, when the geopark will be further developed and attract more visitors, it is significant to measure the impact of tourism on the vulnerable dune landscape. All these studies will provide new information for possible management strategies and it is significant to include as many stakeholders as possible when developing new strategies.

6. Conclusion
From the review comments it is evident that the Geopark development has not been completed yet; comments point out that there is a lack of facilities, the visitors suggest better signage to find the entrance and many people think the current parking space is too small. Environmental education is rarely mentioned in the reviews, and information provision and modes of environmental education therefore could be improved in the future geopark management, as it is one of the core values. Nevertheless, it
seems that the reviewers in general have a high environmental awareness, as they express their concerns about the waste issues and give suggestions on how everyone should help keep the environment clean. Generally, the visits to the geopark were rated high, which means tourists are satisfied with their visit and there is consensus that Caota Dunes is a beautiful landscape and a very promising site. With more planning underway it can become a very successful geopark and future management strategies should address the issues that are pointed out in the reviews. Geoparks can be important tools for awareness building and education of locals and tourists on the importance of preserving the sand dunes and for the post-Covid19 tourism development this geopark and its imperatives for environmental education can focus on the sustainable development of this scenery, reduce the amount of waste and increase environmental awareness.

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