



ASSESSMENT OF TOURISM ACTIVITIES AND ENVIRONMENTAL IMPACTS ON ECOSYSTEMS IN HA LONG BAY WORLD NATURAL HERITAGE SITE

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Abstract

Ha Long Bay, a UNESCO World Natural Heritage site, has become a globally renowned tourist destination, attracting millions of visitors annually. However, the rapid growth of tourism poses significant challenges to managing and preserving this heritage site. The study reveals that tourism activities have notable impacts on the ecosystem, with 32.5 % reporting minor effects on mangroves, 36.4 % on coral reefs, and 34.4 % on beach activities. Despite progress in waste management and biodiversity conservation, Ha Long Bay's ecosystem continues to face negative impacts from environmental pollution caused by boats, tourist waste, and pressures on endemic flora and fauna. The lack of sufficient financial resources, technological capabilities, and inadequate management measures have hindered effective conservation efforts. The research highlights the critical role of local communities and tourists in mitigating these negative impacts and emphasizes the need for increased investment, stringent management, and heightened awareness to ensure the sustainable protection of this natural heritage site.

Keywords: Ha Long Bay; Natural heritage; Tourism activities; Impact on ecosystem; SWOT model method.

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1. Introduction

In Vietnam, overexploitation and encroachment have significantly reduced natural ecosystems such as forests, coral reefs, and seagrass beds, leading to a decline in biodiversity and increasing environmental pollution, particularly in

coastal and marine areas. Ha Long Bay (Quang Ninh), a renowned natural heritage site, faces immense pressure from human activities including maritime transport, tourism, mining, and waste disposal. With unique ecosystems comprising caves, semi-enclosed water zones, and lagoons

nestled among islands, Ha Long Bay boasts exceptional biodiversity. However, its coral reefs, sensitive to water quality, are at high risk of degradation. In response, the Ha Long Bay Management Board has implemented various measures to conserve and restore ecosystems while safeguarding the sustainable value of this heritage site against the adverse impacts of exploitation and pollution.

Natural heritage is a typical relic, scenic spot created by nature and has special aesthetic value. This is an ecosystem with beautiful landscape, is home to a large number of species of organisms, brings many values, contributes to society, has outstanding global value in terms of science, conservation or aesthetics. Depending on their scientific or aesthetic significance, such sites can achieve international recognition as world natural heritage. Representing the nation's image on the global stage, these sites hold immense cultural, aesthetic, and economic value. Thus, conserving these treasures and protecting their environments is a collective responsibility. Vietnam's Environmental Protection Law 2020 emphasizes the duty of all citizens to safeguard natural heritage. Article 21, Clause 3, mandates that organizations, communities, households, and individuals must participate in protecting natural heritage, while also granting them benefits under the ecosystem service payment framework as stipulated by law. Article 138 elaborates on payments for natural ecosystem services, where users compensate providers for the value of services like forest environments, wetlands, marine

ecosystems, and geological formations for tourism, recreation, or aquaculture, as well as carbon storage for greenhouse gas mitigation. Organizations or individuals engaging in activities such as water surface exploitation, recreational services, or tourism must pay for ecosystem services to ensure the protection and sustainable development of these natural systems [1].

In addition, the Vietnamese government has introduced regulations to safeguard the environment in natural heritage sites. Article 21, Clause 7, of Decree 08/2022/ND-CP specifies measures for environmental protection within natural heritage areas: core zones are regulated as strictly protected zones, while buffer zones are managed as restricted-emission zones. Natural ecosystems must be prioritized for preservation and restoration, while polluted or degraded soil and water environments must be rehabilitated. Core values of biodiversity must remain intact, and ecosystem services should be developed sustainably. Geological, ecological, and biodiversity indicators must be surveyed, monitored, and reported regularly. In emergency cases of significant environmental threats, the Ministry of Natural Resources and Environment will recommend emergency measures to the Prime Minister, including limiting discharge volumes and specifying implementation zones and timeframes.

In fact, there have been a number of studies on the impact of tourism activities on the environmental landscape. The study by Tran Thi Huong and colleagues assessed the impact of tourism activities on the natural and social environment in Ban Lac, Chieng Chau commune, Mai

Chau district, Hoa Binh province. The main research method is to survey and investigate along the route to determine the causes of impacts on the natural and social environment, combined with analysis of water quality and environmental components and calculation of solid waste and wastewater from tourism activities to assess the pressure of tourism on the environment of the area. The research results show that the amount of waste generated from tourism activities is 1,302 kg/day, accounting for 40.77 % of the total amount of solid waste in the whole area. The amount of wastewater from tourism is 10,055.75 m³/year. The source of the waste affects the surface water quality of the area. In addition, local culture is disrupted and conflicts arise in sharing benefits within the community. To reduce negative impacts and move towards sustainable ecotourism development, local authorities need to apply long-term solutions such as: Environmental planning; Raising awareness for people and tourists; Support activities from stakeholders are needed. This study has provided important information for the management and development of sustainable ecotourism in Ban Lac, while emphasizing the need for cooperation and coordination from stakeholders to ensure the protection of the environment and local society [3].

The study of author Truong Sy Vinh (2019) has shown that the increase in tourism activities here has caused many problems for the ecological environment. The results show that, on normal days, the environmental carrying capacity of Cuc Phuong National park mostly does not exceed the carrying capacity, even

at a very slight level. However, on peak days or holidays, the number of visitors exceeds the carrying capacity of the ecosystem, causing problems with clean water supply and transportation systems. Based on these results, the study proposes a number of solutions such as limiting the number of visitors during peak seasons, organizing reasonable tour programs, upgrading infrastructure and equipment for tourism. These measures aim to protect the ecological environment and ensure sustainable development of tourism in Cuc Phuong National park [4].

Thus, our state has issued regulations on environmental protection for natural heritage and has also conducted studies on the impact of tourism activities on the environmental landscape. However, sub-regulations and practical guidelines for assessing the environmental impacts of tourism on natural heritage remain underdeveloped, lacking a robust scientific and practical foundation for effective implementation. Furthermore, quantifying these impacts is challenging due to the non-market characteristics of tourism activities. To address these issues, it is imperative to develop accessible, scientifically robust tools to enhance the management of tourism in natural heritage areas, thereby improving local economic and social development outcomes.

This article presents research findings on the current state of tourism and its management within Ha Long Bay, a UNESCO World Natural Heritage site. It also evaluates the extent to which tourism activities impact the ecosystem of this natural heritage area, as managed by the Ha Long Bay Management Board.

2. Methodology

2.1. Secondary data collection method

This study selectively inherits and utilizes secondary data from previously published research, reports, and official documents related to the study area, including:

- Natural and socio-economic conditions of Ha Long.
- Reports on tourism activities in natural heritage areas.
- Reports on the current state of natural heritage management.
- Biodiversity reports of natural heritage areas.
- Information from existing legal documents on waste management in Ha Long Bay.
- Data from scientific studies on the collection, classification, and disposal of hazardous and recyclable waste in Vietnam and globally.

Information from programs on waste sorting at the source, is obtained through newspapers, television, and the internet.

2.2. Field surveys combined with sociological investigation

Field surveys and investigations are conducted across multiple routes. Planned surveys took place in May and June of 2024, along six tourist routes currently operational within Ha Long Bay's World Natural Heritage area:

- Route 1: Tourist port - Van Canh park area
- Route 2: Tourist port - Cave park area

- Route 3: Tourist port - Marine culture park area

- Route 4: Tourist port - Marine entertainment center area

- Route 5: Cruise tourism exploration route

- Route 6: Coastal port areas: Tuan Chau, Vinashin, SunGroup

The sociological investigation method requires high levels of enthusiasm and rigor from researchers to accurately achieve the study's objectives. This involves verifying the accuracy of collected data, filling gaps in information, and supplementing existing materials. To gather specific and reliable data, survey subjects are selected based on local social conditions. Before conducting interviews, the study surveyed Ha Long's demographics, including age, gender, household size, occupation, education level, and income. This method is crucial for the study as it enables direct interviews with tourists visiting the heritage site, tourism managers, and service providers. These interactions help identify the impacts of tourism activities on Ha Long Bay's ecosystem, the responsibilities of stakeholders, and their willingness to contribute financially to ecosystem conservation.

- The sample size for the survey, when the total population is unknown, is calculated using Yamane's formula (1967) [5]:

$$n = Z^2 \frac{p x (1 - p)}{e^2}$$

in which:

- n: The required sample size to be determined.

- Z: The Z-score value from the Z-distribution table is based on the selected confidence level. Commonly, a 95 % confidence level is used, corresponding to $Z=1.96$.

- p: The estimated proportion of success for the sample size n . According to Yamane's formula, $p=0.5$ is chosen to maximize $p(1-p)$, ensuring the most conservative estimate for sample size determination.

- e: The allowable margin of error. Typical values for e include ± 0.01 (1 %), ± 0.05 (5 %), and ± 0.1 (10 %), with ± 0.05 being the most widely used.

Using the sociological investigation method, two survey forms were developed:

- One targeted at tourists.
- One targeted at accommodation providers.

These surveys aim to assess the willingness to pay for an ecosystem conservation fund in Ha Long Bay. The total number of samples calculated by the formula is approximately 200 votes.

Survey structure:

- Section 1: Information on tourism activities within Ha Long Bay World Natural Heritage site.

- Section 2: Evaluation of the ecological impacts of tourism activities on the World Natural Heritage site.

2.3. SWOT model method

Using SWOT analysis, the study evaluates the current state of tourism, highlighting strengths, weaknesses, opportunities, and challenges in managing Ha Long Bay as a World Natural Heritage site.

Based on statistical results and interview results, through the SWOT tool (S - Strengths, W - Weaknesses, O - Opportunities, T - Challenges) analyze the strengths and weaknesses of biodiversity and ecosystem values, and tourism activities at the world natural heritage site of Ha Long Bay; analyze opportunities and challenges for biodiversity conservation, resource exploitation and environmental protection associated with ecotourism at the world natural heritage site of Ha Long Bay.

3. Research results

3.1. Evaluation of tourism activities and management at Ha Long Bay World Natural Heritage site

3.1.1. Strengths in tourism management

According to interviews with the Ha Long Bay Management Board, the tourism industry in Ha Long Bay demonstrated a remarkable recovery post-COVID-19, attracting 7.13 million visitors and generating revenue of 14.491 trillion VND in 2022. By early 2024, the bay welcomed over 610,000 tourists, including 529,000 international visitors, reinforcing its global appeal. The management board has implemented stringent environmental protection measures, such as waste control and regular water quality monitoring, contributing to preserving the bay's natural environment. Furthermore, new tourism products like ecotourism, MICE tourism, and cultural and sports events have been introduced to enhance service quality and evenly distribute tourist traffic.

In addition, policies have been reviewed and adjusted to address practical management needs. Natural landscapes, geological formations, and ecosystems are well-preserved, with community outreach and education yielding positive results. Water quality is monitored periodically, waste sources are controlled effectively, and international cooperation has been strengthened. Revenue from entrance fees has increased annually, providing essential resources for management and conservation efforts. Tourism development activities are aligned with the principles of heritage conservation, ensuring safety and enriching the visitor experience.

3.1.2. Weaknesses in tourism management

Despite positive growth, the rapid expansion of tourism presents significant challenges. Overcrowding, pollution from tourist boats, and socio-economic pressures are critical issues. Waste disposal, wastewater management, and ecosystem conservation require ongoing efforts from authorities and tourism businesses. Service quality remains uneven, with significant disparities between different tourism routes. While Routes 1 and 2 attract the largest number of visitors, other routes remain underutilized. Additionally, infrastructure requires upgrading to meet growing demands; for example, out of 505 tourist boats, 13 are still under repair, and other facilities need improvement.

Although measures like limiting the number of tourist boats and designating restricted areas have been implemented, enforcement and monitoring remain

insufficient. This is compounded by a lack of coordination among agencies and inconsistent application of regulations. Limited resources in terms of personnel, finances, and technology hinder effective oversight, leading to non-compliance and negative environmental impacts. Addressing these issues requires enhanced inter-agency collaboration, adequate resource allocation, and greater community awareness of environmental protection and sustainable tourism practices.

3.1.3. Opportunities in tourism management

The Ha Long Bay Management Board has outlined plans for synchronized management mechanisms, including regulations on tourist boat operations, quality improvement plans, and guidelines for managing service activities like kayaking and rowboats. Since 2016, the number of operational boats has been reduced from 533 to 505, with a focus on improving quality and efficiency. Wooden boats have been replaced with steel-hulled or equivalent materials to ensure safety and meet tourism demands.

To optimize visitor distribution, Quang Ninh province has introduced new routes and attractions. Three premium cruise routes have been piloted, enhancing connectivity and reducing visitor congestion in core heritage areas. Scientific studies since 2017 have highlighted the unique values of Ha Long Bay, providing effective management and conservation solutions.

Furthermore, initiatives such as relocating fishing village residents to

onshore housing since 2014 and banning fishing in strictly protected zones since 2018 have supported biodiversity preservation. Promotional activities have diversified through social media and international media partnerships. Tour guides, boat staff, and multimedia tools such as signage, CDs, and videos are leveraged to inform tourists and raise community awareness about ecosystem conservation.

3.1.4. Challenges in tourism management

Interviews with the Ha Long Bay Management Board reveal ongoing challenges that must be addressed to ensure sustainable ecosystem conservation. Climate change poses significant threats, including rising sea levels and altered habitats for various species. Effective preventive and adaptive measures are essential to address these challenges.

Tourism management and monitoring require strict and continuous enforcement to ensure all activities comply with environmental regulations. This necessitates close cooperation among local authorities, tourism businesses, and local communities. Additionally, enhanced research and impact assessments of human activities are crucial for developing effective conservation strategies. These studies provide insights into the effects of tourism and climate change on ecosystems, enabling the proposal of appropriate measures to protect and sustain the natural heritage of Ha Long Bay.

3.2. Assessment of the impacts of tourism activities on ecosystems in the Ha Long Bay World Natural Heritage site

3.2.1. Survey results from tourists

Ha Long Bay attracts a large number of tourists every year, including both domestic and international visitors. The frequency of tourists visiting this world natural heritage site varies from first-time to second-time visitors. This reflects the desire of visitors to explore and experience new things in the bay. First-time visitors to Ha Long Bay are often attracted by the magnificent natural landscape and cultural values, while those who return for the second time want to enjoy more of the interesting experiences they have had. Most tourists stay in the Ha Long Bay World Heritage site for 2 to 3 days (accounting for 51.6 % and 20.8 % of the total survey). This shows that tourists often choose a sufficient amount of time to explore and enjoy the experiences in Ha Long Bay, from sightseeing, cultural experiences to participating in entertainment and relaxation activities.

The average cost of a trip to Ha Long Bay usually ranges from 500,000 VND to 3,800,000 VND, depending on the length of stay, food costs and type of accommodation chosen by visitors. Ha Long Bay stands out with its natural beauty and diverse caves, attracting a large number of visitors. Therefore, the number of tourists to Ha Long Bay is always high and tourism activities are constantly developing. However, along with the

growth of sea tourism, Ha Long Bay is also facing many negative environmental problems, affecting the natural landscape and ecosystem here.

** Assessment of current status of domestic solid waste*

Table 1 provides detailed information on the types of solid waste commonly found in Ha Long Bay and the percentage of impact of each type. Accordingly, plastic bottles account for the highest proportion at 17.6 %, followed by tissue paper and cans at 16.7 % and 16.6 %, respectively. These are common types of waste and have a great impact on the marine environment. Plastic bags, at 11.5 %, and cigarette butts, at 11.1 %, are also significant sources of pollution, negatively affecting the marine ecosystem. Food waste and disposable plastic waste account for 8.5 % and 9.5 %, respectively, indicating the need to control and manage waste from tourism and daily activities. Styrofoam waste, at 8.2 %, and other household solid waste, although only at 0.3 %, also contribute to the total amount of waste and need to be effectively treated. Analysis of Table 1 clearly shows that plastic bottles, tissues and cans are the types of solid waste that have the greatest impact on the environment of Ha Long Bay. This raises an urgent need to reduce the use of plastic products and increase recycling measures. Waste such as plastic bags, cigarette butts, leftover food and single-use plastic waste also need to be strictly managed to minimize negative impacts on the ecosystem.

Table 1. Percentage of solid waste from tourists common in Ha Long Bay

Solid waste	Percentage of impact (%)
Plastic bags	11.5
Plastic bottles	17.6
Cans	16.6
Tissues	16.7
Cigarette butts	11.1
Food waste	8.5
Disposable plastic wast	9.5
Styrofoam wast	8.2
Other household solid wast	0.3

** Impact of tourism activities on coral reef ecosystems*

Coral reefs in Ha Long Bay are an important part of the marine ecosystem, however, they are facing some serious problems:

- *Devastation due to tourism activities:* Many coral areas are destroyed by unsustainable tourism activities, such as kayaking, illegal diving, or destructive fishing methods.

- *Water pollution:* Improperly treated waste discharge from residential areas and tourist facilities, along with increased pollutants from tourism activities, have reduced water quality, causing damage to coral reefs.

- *Climate change:* Warming seawater and ocean acidification are major threats to coral reefs. These changes make corals susceptible to bleaching and death, seriously affecting marine biodiversity.

The degree to which tourism activities affect coral reef ecosystems in the Ha Long Bay World Natural Heritage Site is presented in Table 2.

The survey results from Table 2 indicate that 36.4 % of tourists believe

tourism activities in Ha Long Bay have little to no significant impact on coral reef ecosystems. This reflects the effectiveness of environmental protection measures and monitoring efforts implemented by the Ha Long Bay Management Board. The 24/7 monitoring system and strict environmental regulations have successfully mitigated many negative impacts of tourism. Additionally, tourist awareness of environmental protection has improved, supported by informational signs and announcements placed at key stops throughout the bay, fostering a greater appreciation for the natural beauty of coral reefs.

Table 2. Impact of tourism activities on coral reef ecosystems in Ha Long Bay World Natural Heritage site

Impact level	Percentage (%)
No impact	13.2
Minimal impact	23.2
Minor impact	36.4
Moderate impact	19.2
Significant impact	8.0

However, 8.0 % of respondents expressed concerns about significant negative impacts on coral reefs, highlighting potential risks associated with littering, uncontrolled tourism activities, and non-compliance with environmental regulations. While most impacts are perceived to be mild or moderate, continued efforts and strengthened environmental protection measures are crucial to minimize any negative effects, ensuring the preservation and sustainability of Ha Long Bay's unique ecosystems.

** Impact levels of tourism activities on mangrove ecosystems*

Mangrove forests are a very important ecosystem for the environment, playing a role in protecting the coast, creating habitats for many animals and helping to regulate the climate. However, mangrove forests in Ha Long Bay are currently facing a number of problems:

- *Area reduction:* Land exploitation for tourism development, infrastructure projects and climate change have reduced the area of mangrove forests.
- *Environmental pollution:* Waste from residential areas and tourist areas near mangrove areas also contributes to the decline in the quality of the living environment of the mangrove ecosystem.

The degree to which tourism activities affect mangrove ecosystems in Ha Long Bay World Natural Heritage site is illustrated in Table 3.

Table 3. Impact levels of tourism activities on mangrove ecosystems in Ha Long Bay World Natural Heritage site

Impact level	Percentage (%)
No impact	12.7
Minimal impact	21.3
Minor impact	32.5
Moderate impact	26.5
Significant impact	7.0

The research results indicate that 34.0 % of surveyed tourists believe tourism activities have little to no significant impact on mangrove ecosystems. Specifically, 12.7 % reported no impact, while 21.3 % believed the impact was minimal. This suggests that the environmental protection and monitoring measures implemented by the Ha Long Bay Management Board have

been effective to a certain extent. Strict environmental regulations, combined with a 24/7 monitoring system, have significantly reduced the negative effects of tourism activities. A notable proportion of respondents, 32.5 %, considered the impact of tourism to be minor, indicating that while tourist presence and activities exist, their impact on mangrove ecosystems remains manageable. This can be attributed to increased environmental awareness among tourists and effective coordination from the management board in maintaining and safeguarding the ecosystems.

However, some respondents pointed out that tourism does have certain adverse effects on mangroves. This highlights the need for the management board to further enhance protective measures, strengthen

monitoring efforts, and raise awareness among both tourists and residents about the importance of environmental preservation. From this analysis, it is clear that while most surveyed tourists perceive the impacts of tourism on mangrove ecosystems as mild or moderate, there is still a need for continued environmental protection efforts. To ensure sustainable development and the best possible preservation of this valuable ecosystem, ongoing initiatives to protect the environment must remain a priority.

3.2.2. Impact levels of different tourism activities on ecosystems in Ha Long Bay World Natural Heritage site

The levels of impact of tourism activities on ecosystems in Ha Long Bay World Natural Heritage site are illustrated in Figure 1.

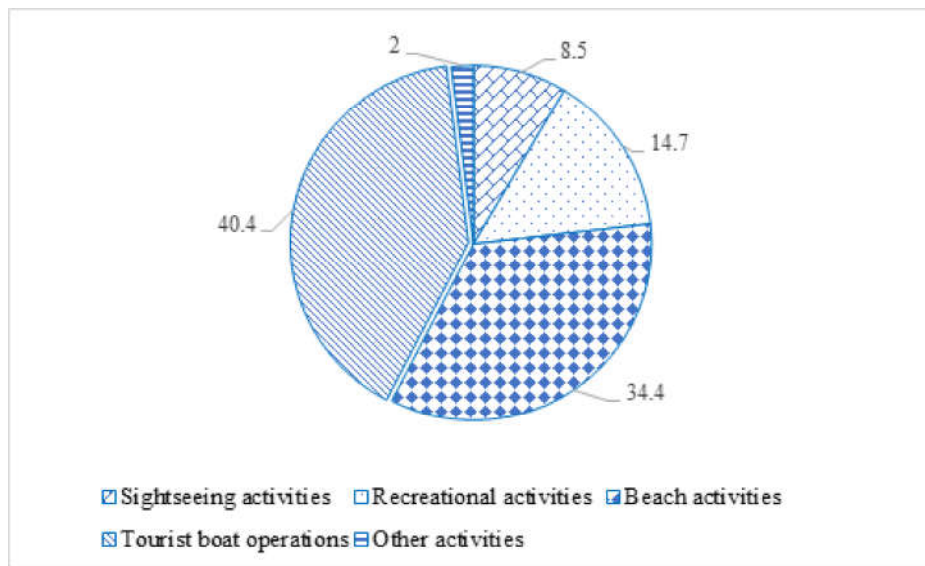


Figure 1: Impact levels of tourism activities on ecosystems in Ha Long Bay World Natural Heritage site

Figure 1 highlights that the operation of tourist boats is the most significant factor affecting Ha Long Bay's ecosystems, accounting for 40.4 %. Continuous boat activities contribute to noise pollution

and degrade water quality, particularly impacting marine species sensitive to environmental changes. Beach activities follow at 34.4 %, reflecting the popularity of renowned beaches like Bai Chay

and Minh Chau. While these activities provide substantial economic benefits, the increasing number of visitors and the use of personal care products contribute to a large amount of plastic waste and other pollutants, necessitating strict environmental management measures to ensure sustainability. Recreational activities, including adventure sports and cultural events, make up 14.7 % of the impact. These activities diversify tourism experiences and promote local economic growth but consume significant resources, generate waste, and pose risks to the habitats of local flora and fauna. Sightseeing activities, which account for 8.5 %, mainly focus on exploring the natural beauty of the bay and have a lower environmental impact. However, they still carry risks of soil erosion and damage to sensitive ecosystems. Additional activities like fishing and diving also have negative impacts, particularly when overexploitation or non-compliance with conservation regulations occurs.

Overall, tourism activities in Ha Long Bay are closely tied to the marine environment, offering both opportunities and challenges for its ecosystems. To achieve sustainable development, stringent management measures must be implemented, alongside the promotion of ecotourism and community awareness campaigns to emphasize the importance of protecting the natural values of this heritage site.

4. Conclusion

Ha Long Bay is celebrated for its pristine environment and stunning natural landscapes, underpinned by diverse and

rich ecosystems, especially its well-preserved forests with minimal human impact. These attributes make it a prime destination for tourists seeking recreation and relaxation. However, research reveals that uncontrolled tourism activities, including boat pollution, visitor waste, and pressure on endemic flora and fauna, have negatively impacted the bay's ecosystems. Key ecosystems like mangroves and coral reefs are affected, with 32.5 % and 36.4 % of surveyed participants respectively rating their impact levels as low. Beach activities, contributing 34.4 % of the impact, also place considerable strain on these ecosystems.

Despite efforts in biodiversity conservation and waste management, current measures remain insufficient to prevent environmental degradation. Raising awareness and fostering responsibility among stakeholders is vital for protecting Ha Long Bay. While many tourists and locals recognize the importance of environmental protection, some still lack full awareness of their roles in preserving the bay. A shortage of information about tourism's ecological impacts further complicates conservation efforts. Innovative educational programs and communication strategies are crucial to improving community awareness, driving behavioral changes, and ensuring the sustainable development and long-term protection of this World Natural Heritage site.

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