Sustainable Tourism Planning Processes using Information Systems in Coastal Protected Areas: A Methodological Approach

Paúl Carrión-Mero[1], Lady Bravo-Montero[1,*], Ginger Diaz-Macias[1], María Valdiviezo-Cuzco[1], Numa Calle-Lituma[1] and Gricelda Herrera-Franco[2]

[1]*ESPOL Polytechnic University, ESPOL, Guayaquil, Ecuador*
[2]*Universidad Estatal Península de Santa Elena, Santa Elena, Ecuador*

Abstract

Biodiversity conservation is key to sustainable development in territories. Protected Areas (PAs) represent 17.6% of terrestrial and continental waters. In Ecuador, the Playas Villamil National Recreation Area (ANRPV, acronym in Spanish) is a system that preserves coastal ecosystems and ensures the sustainability of resources. However, this PA faces deficiencies in the operation of aquatic adventure tourism. The objective of this article is to propose a methodological guide for the operation of aquatic adventure tourism through a systematic process of design thinking and participatory tools to maximize logistical benefits in the area. The methodology includes: i) diagnosis of the situation of adventure tourism operations in the territory, such as interviews, surveys, Political-Economic-Social-Technological-Environmental-Legal (PESTEL) analysis, and Strengths-Weaknesses-Opportunities-Threats (SWOT) matrix, ii) strategic implementation of benchmarking, iii) proposal of a methodological guide validated by experts. This study revealed shortcomings in tourism operations, such as i) lack of technical support (57% of visitors surveyed require information on safety regulations), ii) absence of clear regulation, iii) erosion problems in the adjacent beach strip, and iv) deficiencies in administrative management. The methodological guide established in this study included a manual of functions and requirements of the ANRPV (e.g., certificate granted by the Ministry of the Environment). Guidelines were also established for aspects of the administrative management of tourism activities, emphasising continuous training and monitoring of activities, which are aligned with the Sustainable Development Goals (SDGs), with greater emphasis on SDG 8, SDG 12, and SDG 17. This study determined that the interaction of stakeholders (adventure operators, cantonal government officials, and the Protected Area) is crucial for the sustainable management of PAs.

Keywords

Governance, Preservation, Administration, Participatory approach, Ecotourism, sustainability

1. Introduction

Globalisation is a central issue for economic development and urban planning, impacting industries such as technology, manufacturing, energy, food, transportation, finance, and tourism [1]. Likewise, tourism has experienced rapid growth since the 20th century. In 2000, there were 678 million tourists worldwide, and by 2010, this number had increased by 42.12%. The United Nations World Tourism Organisation (UNWTO) estimated that by 2030, the number of tourists travelling around the world will exceed 1.8 billion [2]. On the other hand, the number of tourists concentrated in one area puts pressure on the site's tourist carrying capacity (TCC) [3]. TCC is the limit of tourist presence in an area that does not impede the daily activities of residents or prevent tourists from enjoying the destination, causing excessive tourism [4, 5].

ICAIW 2025: Workshops at the 8th International Conference on Applied Informatics 2025, October 8–11, 2025, Ben Guerir, Morocco
*Corresponding author.
pcarrion@espol.edu.ec (P. Carrión-Mero); lkbravo@espol.edu.ec (L. Bravo-Montero); gldiaz@espol.edu.ec (G. Diaz-Macias); macevald@espol.edu.ec (M. Valdiviezo-Cuzco); nscalle@espol.edu.ec (N. Calle-Lituma); grisherrera@upse.edu.ec (G. Herrera-Franco)
0000-0002-9747-7547 (P. Carrión-Mero); 0000-0003-4398-505X (L. Bravo-Montero); 0009-0001-2446-1640 (G. Diaz-Macias); 0009-0005-2483-8080 (M. Valdiviezo-Cuzco); 0000-0002-3882-1133 (N. Calle-Lituma); 0000-0001-9558-6099 (G. Herrera-Franco)

Alternative tourism emerged around 1980, prioritising natural environments. Later, in the 1990s, it became associated with the principles of sustainable tourism, which integrate economic, social, and environmental dimensions [6]. This concept encompasses various types of tourism, such as ecotourism and sports tourism. Ecotourism initially focused on nature, but its purpose has expanded to offer recreational experiences and education through observation and study of the natural and cultural values of the environment [7]. Sports tourism is characterised by travellers' motivation to engage in physical activity at their destination, whether to actively participate in a competitive event or recreational sports in a natural land or aquatic environment [8].

It is essential to preserve the natural environment and authentic cultures in tourist areas, promoting socioeconomic development under sustainability criteria [9]. Protected Areas (PAs) are recognised by international organisations such as the International Union for Conservation of Nature (IUCN) [10], through the World Commission on Protected Areas (WCPA) and the United Nations Educational, Scientific and Cultural Organization UNESCO [11]. These organisations play a key role in protecting natural and cultural heritage. In this evolving context, in 2024, the UNWTO changed its name to "UN Tourism" to promote social, economic, and environmental change. Since the early 1990s, this institution has worked in partnership with PAs to mitigate soil degradation, wildlife disturbance, and resource overuse [12]. According to the IUCN, PAs are geographically defined and managed areas, through legal or other effective means, for the conservation of biodiversity and cultural values [10]. However, these international guidelines require equitable governance, where the community and state actors work together with national governments [13].

Ecosystems conservation is crucial to the global economy, since a large part of the population, especially the most vulnerable, depends directly on natural resources and biodiversity [14]. International agreements of the IUCN, such as the World Commission on Protected Areas (WCPA), the Convention on Biological Diversity (CBD), and the Ramsar Convention on Wetlands, are significant for meeting the Sustainable Development Goals (SDGs) of the 2030 Agenda [15]. The IUCN collaborates with more than 14,000 scientists from 39 countries on five continents, including Asia, Europe, Oceania, Africa, and the Americas, generating scientific knowledge and viable policies to improve conservation efforts in Protected Areas [16]. In Europe, areas of importance for biodiversity and ecosystem services in the northern zone represent 78.21% and in the western region, 77.55% [17]. Latin America and the Caribbean are habitat to 50% of global biodiversity due to their wetlands and forests [18, 19]. The Engenho Pequeno Protected Area in the Atlantic Forest (Brazil) evidenced challenges by urban pressure (e.g. logging, livestock farming, and uncontrolled land use). Community participatory in workshops and critical education programs were performed to preserve soil resources [20]. In natural areas, adventure sports are managed by specialised operators under government regulation. Coastal destinations are the most attractive for water adventure sports, such as in Ancón (Peru), where surfing, sport fishing, swimming, and cultural visits are performed, promoting environmental sustainability through mountain hiking and canopy tours [21].

The case study for this research comprised the Playas Villamil National Recreation Area (ANRPV, an acronym in Spanish), Ecuador, that was declared a "National Recreation Area" in 2011 by the Ministry of the Environment [22]. This PA comprises subtidal ecosystems, sandy beaches, dunes, low shrub forest, coastal mangroves, nesting sites for sea turtles distributed across eight families, and a coastal lagoon [23]. It is one of the most visited beach resorts in the country due to its proximity to the leading source centre (Guayaquil city). However, there is inadequate management in the ANRPV by adventure tourism operators offering water sports, evasion and non-compliance with government requirements, and weak synergy between the leading actors. Furthermore, due to a lack of geomorphological knowledge of the area, there is no awareness of the erosion and pollution caused by the concentration of tourists [24]. Proper management of tourism in protected areas is essential in categorising the level of acceptability of tourist activities to conserve biodiversity and the landscape [25].

This study proposes guidelines for improving adventure tourism operations in the ANRPV, establishing the following research question: How can a methodological management proposal contribute in practice to tourism in coastal areas declared PAs? The objective of this study is establish a methodological guide for aquatic adventure tourism operations in the ANRPV, using information system principles

and participatory-systematic techniques for the sustainable management of natural resources that support decision-making. Surveys, interviews, and a comparative matrix for protected area management (benchmarking) are also developed. The Strengths-Weaknesses-Opportunities-Threats (SWOT) and Political-Economic-Social-Technological-Environmental-Legal (PESTEL) analyses allow for the identification of internal and external factors that affect the pillars of sustainability for the maximisation of logistical benefits in the water sports area, considering responsible practices with the ANRPV.

2. Materials and Methods

This study used a non-experimental semi-quantitative approach [26], considering tools that contribute to adventure operations within the ANRPV. The non-participatory direct observation technique was used for data collection, as this research focuses on a water sports adventure operator within the ANRPV. PESTEL analysis was also used from an external perspective, and the SWOT matrix was used to identify internal and external factors. Figure 1 summarizes the tools used in this study.

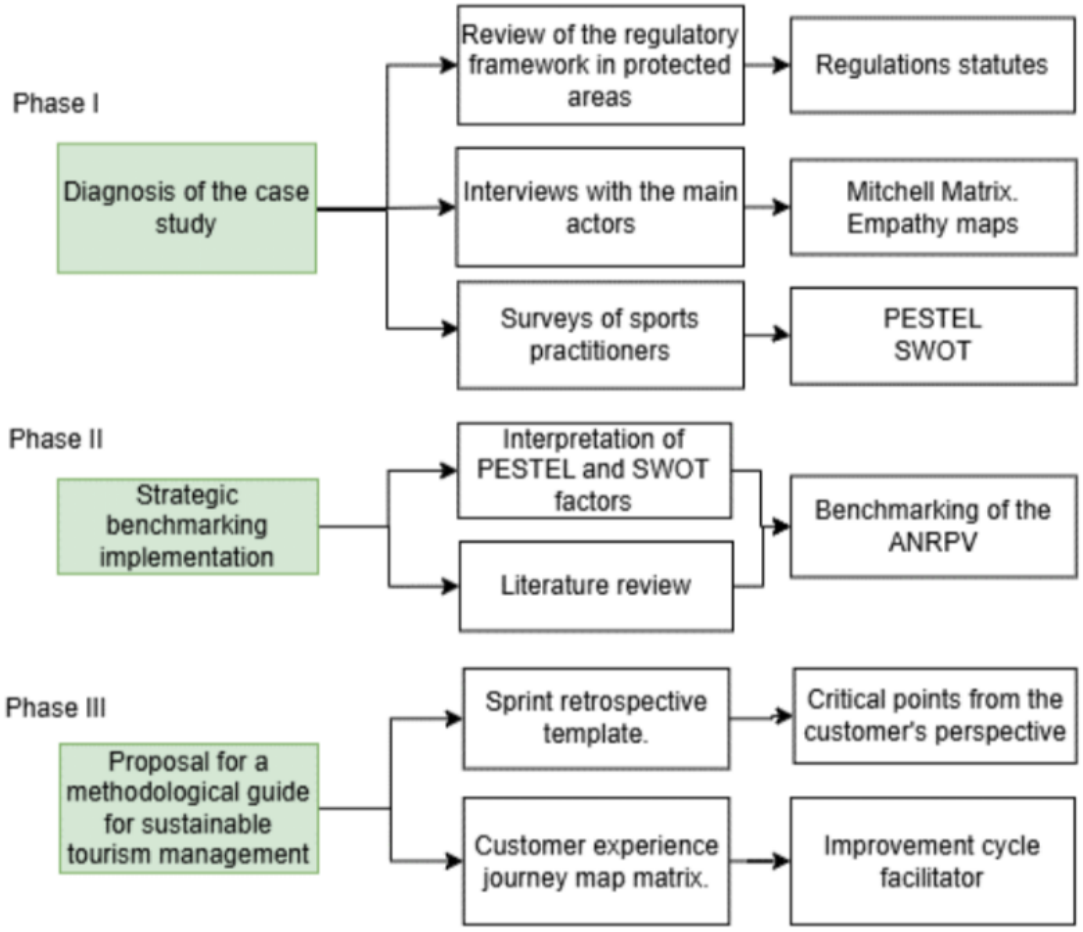

Figure 1: Methodological framework for the sustainability of the ANRPV AP.

2.1. Analysis of the geographical context of the ANRPV

The case study (ANRPV) is located in the canton of Playas, in the province of Guayas, Ecuador, bordered by two parishes, "General Villamil de Playas" and "Posorja of Guayaquil" (Figure 2b). The ANRPV covers an area of 2,478.12 hectares, with 14 km of beach, an average annual temperature of 24.8°C, and a dry, semi-arid, mega-thermal tropical climate [27]. According to the National Institute of Statistics and Census (INEC), the canton of Playas has a population of 58,768 inhabitants [28]. The main economic

activities are fishing, tourism, and agriculture. Most tourist services are located in the northern sector of the PA due to its extensive beachfront. The ANRPV registers service providers, tour operators, and street vendors to formalize permits and regulate the area [27]. According to the Ministry of Tourism, in 2018, the Playas canton recorded overnight stays by tourists from the main distribution centers that most visit the area: Guayas (33,671), Cuenca (93,568), and Quito (21,303) [22].

This area has wide beaches, beautiful scenery, and a wide range of hotels and restaurants stretching from the breakwater to the area known as the oyster fair [29]. It encompasses 29 species of flora, including mangroves (17 of them are native seven are introduced, and the five left are mangroves). Mangroves can retain nutrients, but it also accumulates heavy metals from sediments due to shrimp farms located on the site [30]. The ANRPV has 259 species of fauna (36% are fish, 27% are macroinvertebrates and birds, and 9% are mammals and reptiles) [23]. The recreation area, which provides for zones for educational, tourist, research, recreational, and nature contact activities (Figure 2c). The sustainable use zone includes human settlements, infrastructure, and services for visitors. Finally, the protection and recovery zones conserve ecosystems and habitats that are under threat, seeking the partial or total recovery of the ecosystems.

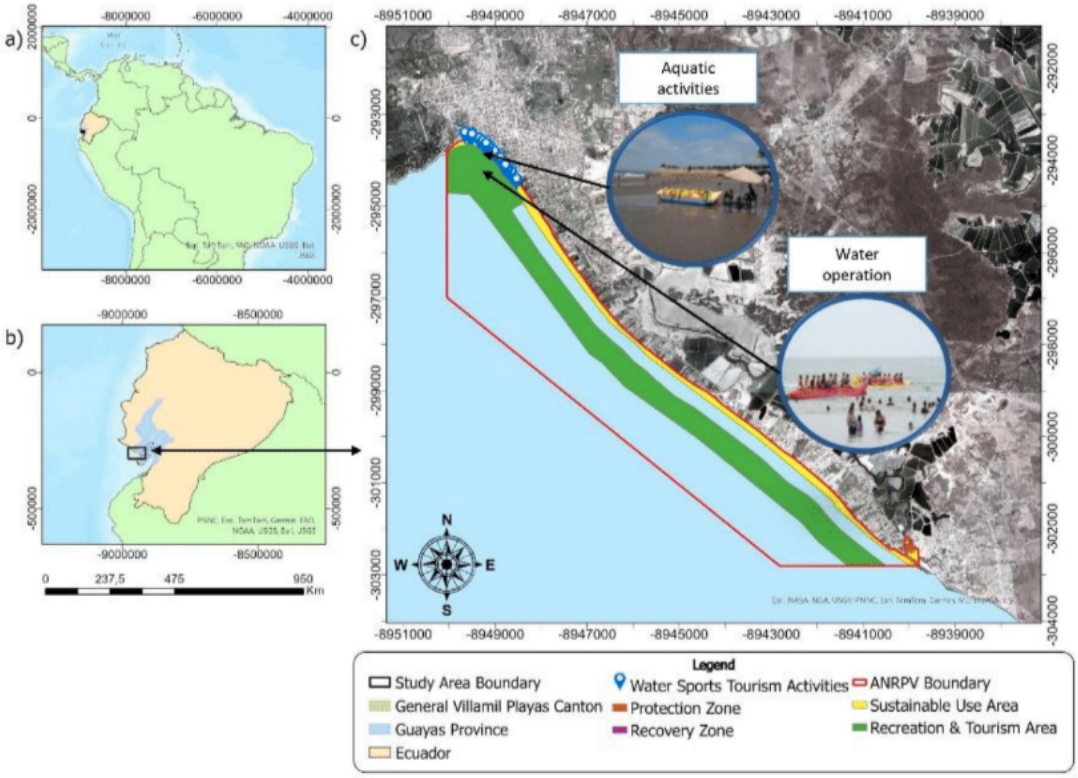

Figure 2: Location of the ANRPV. a) Representation on a scale of South America; b) Context in Ecuador; c) Case study.

2.2. Diagnosis of the case study

2.2.1. Review of regulations

In this phase, a review was conducted of national regulations governing the ANRPV and adventure tourism operations within the PA [31, 32, 33]. Legal frameworks are essential as they increase the conservation benefits of the territory and involve private operators in the provision of tourist services in the PA [34]. Regulations directly related to the ANRPV and adventure tourism operations were analyzed, including: the General Regulations for Tourist Activities, the Regulations for Adventure Tourism Operations, and the ANRPV Management Plan-2021 [27].

2.2.2. Methodologies for identifying stackeholder

Mitchel's matrix was used to identify key actors as the most involved or definitive stakeholders, characterized by three attributes: power, legitimacy, and urgency [35]. This analysis allows us to understand the influence that actors have on the PA, considering three criteria for selecting actors: i) power (authority, resources and attractiveness, budget, technology, value chain, intellect, and recognition), ii) legitimacy (levels of desirability for the territory and society), and iii) urgency (temporal sensitivity and criticality). These criteria were assigned values between 0 and 3 (0: does not possess, undesirable, or not critical, and 3: maximum, highly desirable, and highly crucial). Key actors were selected based on the following criteria: i) tourism sector leaders, ii) experts in environmental regulation, iii) residents of areas surrounding the ANRPV, and iv) actors related to adventure tourism.

This phase also included the development of the empathy map (EM), which allows us to observe the customer's needs and perceptions to produce innovative ideas [36, 37]. The EM consists of six areas: (a) Thinking and Feeling—what goes on in the user's mind; (b) Seeing—what the user sees in their environment; (c) Hearing—how the environment influences the user; (d) Saying and Doing—what the user says and how they behave in public; (e) Pain—the frustrations, difficulties, and risks that the user experiences; and (f) Gain—what the user needs.

2.2.3. Surveys of sports practitioners

Surveys were conducted among visitors who participate in water sports. As the exact number of people who participate in this activity is unknown, a reference value of approximately 6,240 people who visit the Playas Villamil resort during the low season in June and July 2021 was used [29]. A target population (N) of 1,000 people who participate in this sport during the low season, taking weekends into account, was considered. The representative sample (n) was calculated using the sampling equation in Eq. 1 for a finite population [38]. The following static parameters were considered: $p = q = 0.5$, confidence level of 80% ($z = 1.28$ and $\in = 0.0691$). The representative sample of (n) was 54, which represents the number of athletes surveyed.

$$n = \frac{(2^2 \cdot p \cdot q \cdot N)}{\epsilon^2(n-1) + Z^2 \cdot p \cdot q} \tag{1}$$

Where p: probability of success, q: probability of failure, z: confidence level $\in$: sampling error.

2.2.4. Internal and external factors PETEL-SWOT

A SWOT-TOWS analysis was developed that integrates both internal and external factors, identifying the strengths, weaknesses, opportunities, and threats of the related area [39]. Considering the data from the interviews and surveys, each factor was weighted with values between 0 (very low relationship) and 7 (very high relationship). From 1 to 3 (if the answer is "No") and from 4 to 7 (if the answer is "Yes"). Finally, strategies were identified based on: strengths and opportunities (SO) located in the success zone, weaknesses and opportunities (WO) being the illusion zone, strengths and threats (ST) being the attrition zone, and weaknesses and threats (WT) being the vulnerable zone.

The PESTEL approach was applied to assess external factors, considering expert criteria [40], by the following criteria: i) at least one national expert in environmental regulations; ii) an expert in adventure tourism in coastal areas; and iii) academic training (third level or higher). The experts assigned an impact level weight, ranging from 1 (0% impact level) to 5 (100% impact level). Each factor is related to the characteristics of PESTEL (Table 1), with ratings ranging from 1 (very low impact level) to 5 (very high impact level). A weighted distribution was assigned among the PESTEL categories to assign relative importance [41]. The average local weighting was determined using Eq. 2 and the global weighting using Eq. 3.

$$Average\ Local\ Weight = x = \frac{\sum_{k=0}^{n}(local\ weight)}{n} \tag{2}$$

$$Global\ Weight = Category\ Weight \cdot local\ weight \tag{3}$$

Table 1
External factors of PESTEL.

Category	Factors	Description
Political	P1: Change of name of the Ministry of the Environment	The change in the name of the MAE allows the AP direct access to the Undersecretary of Heritage and speeds up procedures, requirements, and needs.
	P2: The new mayor's office	The new ANRPV mayor's office raises many concerns and expectations for the new administration.
Economic	E1: The VAT increase	Price increases by service providers due to the VAT increase from 12% to 15%.
	E2: Payment facility implemented by the SRI	The SRI in 2024 allows service providers to easily pay their tax obligations.
Social	S1: The religious festival of Saint Peter for fishermen	From June 28 to 29 each year, the canton celebrates the religious festival of San Pedro for fishermen.
	S2: Insecurity in the Canton	The presence of criminal gangs affects businesses in the tourism sector.
Technological	T1: The use of drones for mapping work	The use of drones has had a significant impact on tourism, allowing for the recording of breathtaking panoramic views of natural landscapes.
	T2: Cameras suitable for monitoring	Monitoring of surface and subtidal waters using cameras suitable for El Niño and La Niña currents.
Legal	L1: Law on strengthening tourism activities	Law to strengthen tourism activities passed in 2024, whereby community-based tourism will receive financial assistance for projects of this type.
	L2: Ministerial Agreement for Sustainability	Ministerial agreement for the economic agenda with economic and social action that will lead Ecuador to achieve the goal of net zero carbon emissions by 2050.
Enviromental	E1: Legal actions that disturb protected areas	The MAE takes legal action against private companies that hold public music events in protected areas such as beaches where turtles nest.
	E2: Ecological transition	The MAE announces an ecological transition plan that avoids the carrying capacity of natural ecosystems

Note: Ecuadorian Ministry of the Environment (MAE, Spanish acronym); Internal Revenue Service (SRI, Spanish acronym); Value Added Tax (VAT).

2.3. Strategic benchmarking proposal

This phase describes benchmarking analysis, which consists of identifying and implementing methods that have produced positive results in other projects and it is used in companies, hospitals, and government agencies to improve the quality of their processes and results [41]. The adventure tourism operation in coastal protected areas of different countries was analysed to compare participatory strategies, the relationship with adventure tourism operators and tourists, technologies and tools, education and awareness programs, and finally, the results and impacts. These criteria were rated from 1 to 5, with 5 being the best practice and 1 being the worst practice.

2.4. Proposal for a methodological guide validated by experts

An initial prototype of the methodological guide for adventure tourism operations was designed based on strategic diagnostic tools and analysis of the Protected Area regarding the adventure operator. It included: key tourism concepts, requirements for an adventure operator, elements of a business plan, zoning, operations plan, contingency plan, among others. The proposal was progressively validated through interviews with experts, going through phases such as low, medium, and high-resolution prototypes. Validation tools such as Customer Experience Journey Map and Retrospective Print Template were used for continuous feedback to adjust the methodological guide to the actual conditions of the study área [42, 43].

3. Results

3.1. Diagnosis of the case study in relation to the adventure operation

3.1.1. Review of the ANRPV regulatory framework

The adventure operator complies with Article 9 of the RENTAP regarding permits for tourist activities within the PA, but does not comply with the safety regulations of Article 7 of the ROTA detailed in the Table 2. The regulations are necessarily focused on biodiversity conservation, visitor safety, and the economy.

Table 2
Fundamental regulations for the management of adventure activities.

Normatives	Details	Source
Constitution of the Republic of Ecuador	Articles 405, 406, and 407: The objective of the National System of Protected Areas (SNAP, acronym in Spanish) is the conservation of biodiversity and ecological functions.	[33]
Adventure Tourism Operating Regulations (ROTA acronym in Spanish)	Art. 7. The operator must display the Tourism Registry and the Single Annual Operating License. It must also comply with the safety standards established for adventure activities, the contingency plan, and the maintenance plan	[31]
ANRPV Management Plan	Chapter 7 establishes the protection zones and permitted activities.	[27]
Special Regulations for Tourism in Protected Natural Areas (RETANP acronym in Spanish)	Art. 9: The National Environmental Authority grants environmental permits to carry out tourist activities within Natural Heritage Areas.	[44]
Regulations to the Organic Code of the Environment (CODA acronym in Spanish)	Articles 142 and 143: Establish that SNAP protected areas are divided into management zones such as: protection, recovery, public and tourist use, sustainable use, and marine-coastal community management.	[32]

3.1.2. Interviews with stakeholders

The ANRPV director was identified as a key stakeholder, with a value of 3.91, influencing the development of sustainable and responsible tourism operations at the site. At the same time, the case study operator and the GAD of Playas Villamil, with values of 2.28 and 2.54, play a dominant role with legitimate authority and high influence on decision-making in sustainable operations and regulatory actions (Table 3).

The EM identified what is needed for adventure operations. The director of the ANRPV shows that the adventure operator does not comply with regulations and requires professionalization (Figure 3). This affects water activities due to unknown sustainable guidelines, informing the guide for adventure operators.

Table 3
Mitchell¨s Matrix for the ANRPV analysis.

Selected stakeholders (SS)	Degree of power (A)		Degree of Legitimacy (B)		Degree of urgency (C)		Total
	TV	NV	TV	NV	TV	NV	
SS1: Director of the ANRPV	16	1.43	6	1.28	6	1.88	3.91
SS 2: Adventure operator	14	1.43	6	1.28	4	1.25	2.28
SS 3: GAD director	15	1.53	5	1.06	5	1.56	2.54
SS 4: person who participates in water sports	10	1.02	5	0.85	5	1.25	1.09
SS 5: Visitor (tourist)	8	0.82	4	0.85	2	0.63	0.43
SS 6: Private sector	5	0.51	4	0.85	2	0.63	0.27
SS 7: Person from the receiving community	8	0.82	5	1.06	2	0.63	0.54
SS 8: Service provider from other industries	8	0.82	4	0.85	3	0.94	0.65
SS 9: Adventure operator from other cantons	5	0.51	3	0.64	2	0.63	0.20
SS 10: Local fishermen	9	0.92	6	1.28	2	0.63	0.73

Note: TV: Total Value; NV: Normalised Value; Total was calculated by the product among A, B and C variables.

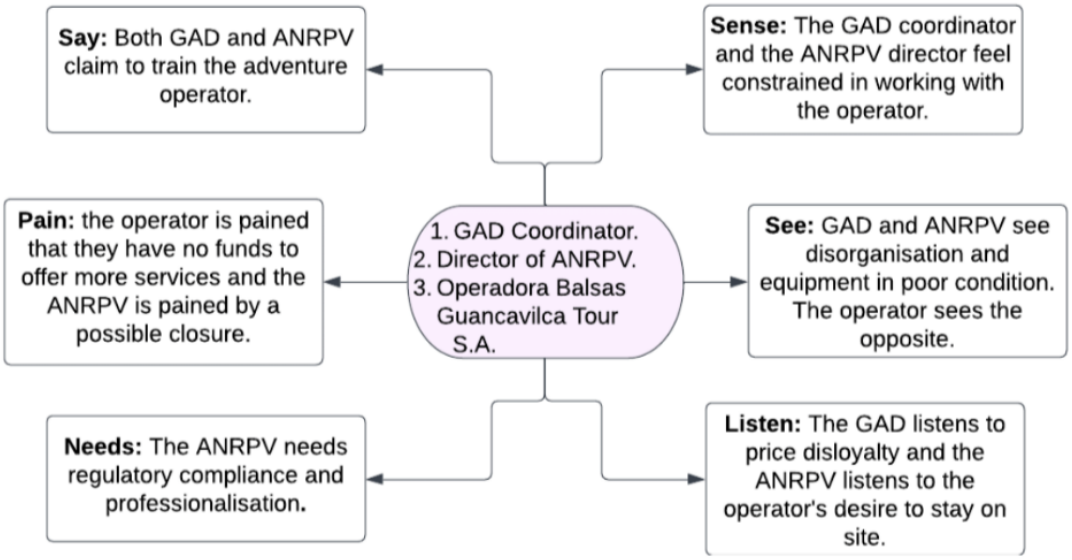

Figure 3: Statements identified by interviewed actors.

3.1.3. Surveys of water sports participants

The surveys were conducted among 54 water sports enthusiasts at Playas Villamil, Ecuador, during the low season in June 2024 on weekends. There is an apparent lack of information provided to sports enthusiasts about safety regulations before engaging in the activity, as 57% requested such information. In addition, 19% were interested in knowing the sea and wind conditions. In terms of best practices, 48% suggested implementing badges to identify operators in the area. 63% considered that there is no excess of operators, although some acknowledged that perception changes depending on the season.

3.1.4. PESTEL analysis

Most experts indicate that one of the factors that most impacts the AP area is insecurity in the canton due to antisocial elements, with an overall weight of 0.7. Access to the heritage secretariat through the name change of the MAE also accelerates PA procedures and needs, and the ease of tax payment for service providers in the area has a significant impact. Finally, considering technologies such as drones and monitoring of subtidal and surface waters are among the factors with a 40% impact on the ANRPV area (Table 4).

Table 4
Representative PESTEL analysis.

Category	Factors	%	Category Weight	Local Weight*	Global Weight
Political	P1: Change of name of the Ministry of the Environment	80	0.4	0.6	0.24
	P2: The new mayor's office	40	0.2	0.6	0.12
Economic	E1: The VAT increase	60	0.3	0.7	0.21
	E2: Payment facility implemented by the SRI	80	0.4	0.7	0.28
Social	S1: The religious festival of Saint Peter for fishermen	80	0.4	0.7	0.28
	S2: Insecurity in the Canton	100	1	0.7	0.7
Technological	T1: The use of drones for mapping work	60	0.3	0.3	0.09
	T2: Cameras suitable for monitoring	60	0.3	0.3	0.09
Legal	L1: Law on strengthening tourism activities	60	0.3	0.25	0.075
	L2: Ministerial Agreement for Sustainability	40	0.2	0.25	0.05
Enviroment	E1: Legal actions that disturb protected areas	60	0.3	0.35	0.105
	E2: Ecological transition	80	0.4	0.35	0.14

3.1.5. SWOT matrix in the ANRPV context

This analysis highlighted the main internal and external factors of the ANRPV about adventure tourism involving water sports, showing that the ANRPV's statutes and management plan provide good support and are accessible to any individual seeking information about the PA.

The ST and SO cross-analysis yielded the highest scores for the focus on defensive and offensive strategies in the area, as shown in Table 5 and Table 6. These data relate to the need for visitor safety not only for water activities but also in the ANRPV, with the implementation of risk signage on the beach and the presence of lifeguards. By understanding the ANRPV management plan, the permitted recreational spaces can be used to promote sustainable events at the site.

3.2. Strategic benchmarking proposal

Of the five Protected Areas, "Great Barrier Reef Marine Park-Australia" received the highest score in three criteria: best participation strategy, which stood out for its polycentric governance; best technologies and tools, due to automatic detection with AI/YOLO; and monitoring with MMP to verify water quality and check coral conditions [45]. It achieved the highest scores in guide training, participatory monitoring, and adventure and tourism operations (Shark Bay, Australia) (Figure 4).

3.3. Proposal for a methodological guide validated by experts

The Methodological Guide for Adventure Tourism Operations in the ANRPV was validated at three prototype levels (low, medium, and high resolution) (Table 7). The Retrospective Sprint and Customer Experience Journey Map tools were used to identify the main criteria where feedback or validation from experts was needed. For the first low-resolution prototype, feedback was received on the adventure activities that can be carried out in the ANRPV in line with adventure regulations, to include them in the methodological guide [46]. The medium-resolution prototype required the attachment of the primary permit for adventure operations within a Protected Area, together with the risk forms that must be known.

Table 5
SWOT analysis of external and internal factors of the ANRPV related to adventure tourism.

Strengths	Weaknesses
S1: E- Large territory enabling coastal ecosystem conservation.	W1: S-Lack of lifeguard towers in the ANRPV
S2: EC-Recreation area, tourist residence, commercial, service, and urban facilities.	W2: E-Insufficient signage in the area.
S3: L-AP management plan to regulate and control the area.	W3: P-The location of the fishermen is very close to the area for tourist activities.
S4: P-The AP has the support of government entities such as the GAD, the naval checkpoint, the Ministry of Tourism (Mintur), the Secretariat of Resources, Ecu-911, and CODA.	W4: L-Lack of a contingency plan for water activities.
S5: S-It has nearby sites for exploring mangroves, mountains, and trails.	W5: E-Lower income during low seasons for service providers.
Opportunities	**Threats**
O1: T- Access to drones for AP monitoring via the Civil Aviation Directorate.	T1: S-Insecurity in the Playas Villamil canton due to antisocial behavior.
O2: P2 Direct access to the Undersecretary of Heritage to speed up processes following the name change of the Ministry of the Environment.	T2: EC-Price inflation due to the increase in VAT from 12% to 15%.
O3: L-Law to strengthen tourism activities, promoting competitiveness and promotion.	T3: E-Risks in water activities due to the presence of microplastics.
O4: EC- Arrival of numerous tourists from Guayaquil, Cuenca and Quito.	T4: E-Erosion in the area where water activities take place.
O5: S- The San Pedro de los Pescadores festival strengthens local intangible heritage.	T5: T-Lack of submarine monitoring cameras for the area to capture currents such as climatic phenomena (El Niño and La Niña).

Table 6
SWOT analysis of external and internal factors of the ANRPV related to adventure tourism.

	Total	Zones	Strategies
SO	133	Success	Offensive strategies: promote ANRPV rules, use permitted areas, and protect vulnerable zones.
WO	127	hope	Adaptive strategies: stakeholder roundtables to diversify tourism in permitted areas of the ANRPV.
ST	134	attrition	Defensive strategies: risk signage and drone/camera monitoring for species conservation.
WT	120	Vulnerable	Survival strategies: ensure visitor safety and propose contingency plans for adventure operations.

Table 7
Validation of the Methodological Guide.

Criteria evaluated	Resolution	Details
On-site activities	Low	Identify and diversify possible activities.
Guide design	Low	Correct the color palette and place the ANRPV logo.
Regulations	Medium	Review security rules, user registration, and operator permits.
Feasibility	High	Meets PA requirements and is feasible.
Technical value	High	Based on relevant data for adventure operations.

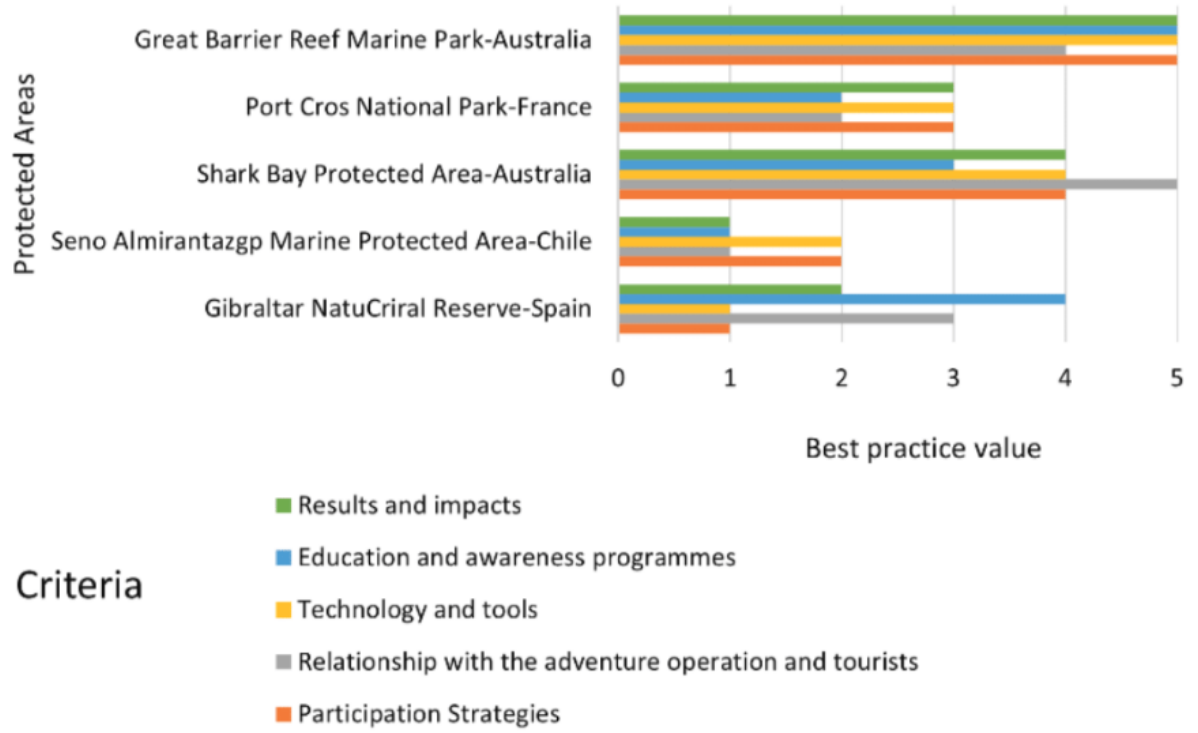

Figure 4: Benchmarking of five worldwide Protected Areas.

4. Discussion

The review of regulations revealed the existence of a regulatory framework for adventure tourism in PA. However, compliance is limited in practice due to non-compliance with adventure tourism operations and a lack of efficient intergovernmental interaction. Similar studies show that the problem is not the absence of laws but the challenge of making them work [34]. According to Miao, a comprehensive law should be proposed that includes regulations for all types of protected areas and incorporates concepts of adaptive participatory management, participatory governance, and impact assessment [47]. Each director of protected areas must be familiar with the context of service providers to communicate the regulations effectively. In the case study of the ANRPV, interviews revealed that the members of the operator Balsas Guancavilca Tour S.A. are mostly older adults, which makes it difficult for them to adapt to new regulations and technologies.

The Mitchell matrix revealed that the ANRPV, the cantonal GAD, and the local operator have dominant roles in decision-making, but do not work in coordination, as the assessment of good governance in Australia mentions the importance of stakeholder participation [48]. The EMs made it possible to identify that the needs of the leading actors are mainly related to the lack of technical support, since they do not work as an operator but as an association, regulatory gaps, and conflicts of interest, which coincides with Leung's findings on the challenges of collaborative management in coastal protected areas [49].

Surveys of water sports enthusiasts showed that 57% require guidance on safety rules, which indicates a lack of knowledge about safety procedures for visitors before and during water activities. There is an inherent risk of drowning when participating in water activities, and drowning accounts for 7% of the global burden of injury-related deaths [50]. For this reason, the methodological guide highlights the importance of life jackets in good condition. Likewise, it emphasises the importance of an instructional talk before the activity, a first aid kit that the guide must carry, a disclaimer, and a user matrix for athletes. Research such as that conducted by Palacios highlights that the lack of induction protocols and signage in coastal destinations can increase risks and decrease the perception of quality of the

destination [21].

The PESTEL analysis identified high-impact factors such as insecurity, with an overall weighting of 0.7/1. This affects visitors' perception of the destination, limits tourism operations, discourages private investment, and hinders the continued presence of technical staff in the field. This phenomenon is not unique to Ecuador: In Costa Rica, the government has promoted community surveillance and environmental education programs to reduce ecological crimes and improve coexistence between visitors and residents in areas such as Corcovado [51]. These experiences demonstrate that, in the face of external threats such as insecurity, the most effective solutions combine government presence, local participation, and technology. In the case of the ANRPV, proactive governance is essential to consolidating a sustainable and safe tourism model.

The SWOT analysis showed that ANRPV to be in a zone of erosion, highlighting the need for defensive strategies against threats such as the implementation of risk signage, surveillance control to monitor species and vulnerable areas of erosion where there is a greater presence of visitors to counteract negative impacts [52]. Similarly, Rezazadet in the Bashgol Protected Area (Iran) formulated strategies focused on improving monitoring of the area, collaboration with local communities, and the development of low-impact tourism activities [53].

The comparative analysis with international APs showed that the best levels of community participation, technology, and guide training, as in the case of the Great Barrier Reef, achieve more effective management. These data validate the application of good practices adapted to the local context, as proposed by Marciniak [41]. In contrast, other research questions the direct transferability of foreign models without considering specific sociocultural aspects. The methodology implemented in this study is aligned with innovation approaches such as design thinking, which highlight the importance of direct feedback and progressive learning [42, 43]. Internationally, experiences such as the "Methodological Guide for Local Tourism Development (Peru)" with a participatory and strategic approach [54].

5. Conclusions

This study proposed a methodological guide for the operation of adventure tourism involving water activities in the ANRPV, developed as a practical tool to optimize management in coastal areas declared PA. Its application is geared toward advising and decision-making in tourism operations, strengthening coordination among stakeholders, and improving operational procedures. In this way, it contributes directly to environmental conservation and to improving service quality. The integration of the tools such as Mitchell matrix, empathy maps, PESTEL, SWOT, surveys, and interviews allowed as to structure the proposal of a methodological guide considering: i) continuous training, ii) standardised safety protocols, iii) optimised administrative management, and iv) use of technology for conservation.

International benchmarking identified practices such as polycentric governance and automated monitoring, which were incorporated and adapted to the local context. The situational diagnosis of the ANRPV that covers a landscaping interest that includes wide beaches and ecosystems of high ecological value, revealed deficiencies in tourism operations such as administrative disorganization, poor communication and non-compliance with safety regulations. The interviews and Mitchell's matrix identified the director of the ANRPV as the definitive actor with a normalized value of 3.91, followed by the adventure operator with 2.28 and the GAD of Playas with 2.54, showing the need for effective coordination. The empathy map revealed technical shortcomings derived from the high average age of the operator's members, limiting the adoption of new practices.

Surveys of water sports enthusiasts indicate that 57% require prior information on safety regulations, 48% demand identification badges for operators, and 19% request information on sea and wind conditions before the activity. The PESTEL analysis determined that insecurity is the most critical external factor, with an overall weight of 0.7. At the same time, the cross-SWOT positioned the ANRPV in a zone of attrition ($ST = 134$ points), requiring visible signage, monitoring with drones and underwater cameras, as well as contingency plans.

Validated at three levels of resolution, the methodological guide proved to be viable, applicable, and

adaptable, serving as a basis for future adventure operators in the ANRPV. Its flexible and participatory content makes it replicable in other coastal protected areas with similar socio-environmental and regulatory realities, contributing not only to improving visitor service and safety, but also to the active conservation of ecosystems and the strengthening of sustainable tourism development. For future research, complementary tourism zoning methodologies should be addressed to identify areas suitable for recreation, promoting modalities such as ecotourism, scientific tourism, and community tourism.

Acknowledgment

The authors are grateful for the support by the research project titled “Registration of sities of geogical interest in Ecuador for sustainable development strategies”, code CIPAT-004-2024.

Declaration on Generative AI

The authors have not employed any Generative AI tools.

References

[1] L. Dwyer, Globalization of tourism: Drivers and outcomes, Tourism Recreation Research 40 (2015) 326–339.
[2] ONU, 1.800 millones de turistas para el 2030: ¿desastre u oportunidad?, 2025.
[3] G. Marcel, National parks in europe, Studia Universitatis" Vasile Goldis" Arad. Seria Stiintele Vietii (Life Sciences Series) 23 (2013) 91.
[4] M. JAYA-MONTALVO, J. BRIONES-BITAR, L. SOTO-NAVARRETE, R. ESPINEL, P. CARRIÓN-MERO, Tourism carrying capacity of geosites on santa cruz island, galapagos, for its sustainability, WIT Transactions on Ecology and the Environment 263 (2024) 127–138.
[5] P. Carrion-Mero, L. Soto-Navarrete, B. Apolo-Masache, J. Mata-Perello, G. Herrera-Franco, J. Briones-Bitar, Environmental assessment and tourism carrying capacity in geosites of the ruta del oro geopark project, Geoheritage 17 (2025) 1–22.
[6] L. Christou, Is it possible to combine mass tourism with alternative forms of tourism: The case of spain, greece, slovenia and croatia, Journal of Business Administration Online 11 (2012) 1–8.
[7] G. Tapia, Turismo sostenible. introduccion y marco financiero, Revista de investigacion en modelos financieros 1 (2014).
[8] M. Latiesa, J. L. Paniza, Turistas deportivos. una perspectiva de analisis, Revista internacional de sociología 64 (2006) 133–149.
[9] A. Dłużewska, Z. Podgórski, A. Giampiccoli, Ecosystem services versus wellbeing-implications for sustainable tourism: the host perspective., 2022.
[10] K. MacKinnon, R. Smith, N. Dudley, P. Figgis, M. Hockings, K. Keenleyside, D. Laffoley, H. Locke, T. Sandwith, S. Woodley, et al., Strengthening the global system of protected areas post-2020, 2020.
[11] I. Bokova, Las zonas protegidas son esenciales para salvaguardar el medio ambiente mundial, 2025.
[12] UNWTO, Ecoturismo y áreas protegidas - onu turismo, 2025.
[13] N. Ash, G. Aguilar, Protected planet report 2024 executive summary executive summary, 2024.
[14] OECD, Biodiversity, natural capital and the economy, 2021.
[15] OECD, Naturaleza 2030: una naturaleza, un futuro: un programa para la unión 2021-2024, 2021.
[16] R. Mubarak, B. Oberle, Uicn 2022, 2022.
[17] e. a. Howland, Protected planet report 2024, 2022.
[18] J. H. Maldonado, R. d. P. Moreno-Sánchez, Servicios ecosistémicos y biodiversidad en américa latina y el caribe, 2023.
[19] M. Leon, G. Cornejo, M. Calderón, E. González-Carrión, H. Florez, Effect of deforestation on climate change: A co-integration and causality approach with time series, Sustainability 14 (2022) 1–14. doi:10.3390/su141811303.

[20] J. de Marins Costa, L. A. Swatuk, A. Ferreira Lopes, Identifying stakeholders and discussing a strategy for the participatory management of a protected area: the case of engenho pequeno, in rio de janeiro state, brazil, Environment, Development and Sustainability 24 (2022) 13260–13281.
[21] M. A. Ruiz Palacios, C. Pereira Texeira de Oliveira, J. Serrano González, S. Saénz Flores, Analysis of tourist systems predictive models applied to growing sun and beach tourist destination, Sustainability 13 (2021) 785.
[22] R. Prado, Plan maestro de turismo sostenible del cantón playas. obtenido de plan maestro de turismo sostenible del cantón playas, 2021.
[23] G. Mosquera, Plan de manejo de la playa de mar y franja adyacente de general villamil playas anrpv, 2021.
[24] F. A. Benavides Urrunaga, M. B. Córdova Córdova, et al., Estudio del proceso erosivo en la Playa Humboldt, Cantón General Villamil Playas, y Desarrollo de soluciones conceptuales para su mitigación,(periodo 2006-2023), Ph.D. thesis, ESPOL. FIMCM: Ingeniero Oceanográfico, 2024.
[25] B. Jaković, D. Tubić, R. Bakan, Adventure tourism position in tourism of protected areas: The state and interest of researchers in croatia, Interdisciplinary Management Research XVI (IMR 2020): Book of Proceedings (2020) 1091–1109.
[26] F. O. Zavaleta Chavez Arroyo, A. J. Sánchez Pantaleón, Y. P. Navarro-Mendoza, R. M. Esparza-Huamanchumo, Community tourism conditions and sustainable management of a community tourism association: The case of cruz pata, peru, Sustainability 15 (2023) 4401.
[27] G. Reck, A. Coloma, L. Zurita, C. Allan, Plan de manejo anr playas villamil. am. maae. 2021.009, 2021.
[28] INEC2025, Resultados censo poblacional 2022, 2021.
[29] El Comercio, General villamil, una de las playas más visitadas del guayas, 2021.
[30] MAATE, En el cantón playas suman esfuerzos para la protección del manglar, 2025.
[31] MINTUR, Reglamento de operacion-turistica de aventura 2020, 2020.
[32] CODA, Reglamento al código orgánico del ambiente. obtenido de reglamento al codigo organico del ambiente, 2019.
[33] Asamblea Nacional del Ecuador, Constitución de la república del ecuador, 2008.
[34] H. Bhammar, W. Li, C. M. M. Molina, V. Hickey, J. Pendry, U. Narain, Framework for sustainable recovery of tourism in protected areas, Sustainability 13 (2021) 2798.
[35] R. K. Mitchell, B. R. Agle, D. J. Wood, Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts, Academy of management review 22 (1997) 853–886.
[36] B. Ferreira, W. Silva, E. Oliveira, T. Conte, Designing personas with empathy map., 2015.
[37] E. Bittner, O. Shoury, Designing automated facilitation for design thinking: A chatbot for supporting teams in the empathy map method, 2019.
[38] G. Zurita, Probabilidad y estadística fundamentos y aplicaciones, Ediciones del Instituto de Ciencias Matemáticas ESPOL, Guayaquil-Ecuador (2010).
[39] H. Ponce, La matriz foda: una alternativa para realizar diagnósticos y determinar estrategias de intervención en las organizaciones productivas y sociales, Contribuciones a la Economía 16 (2006) 26–36.
[40] J. Laitinen, T. S. Katko, J. J. Hukka, P. Juuti, R. Juuti, Governance and practices for achieving sustainable and resilient urban water services, Water 14 (2022) 2009.
[41] R. Marciniak, El «benchmarking» como herramienta de mejora de la calidad de la educación universitaria virtual. ejemplo de una experiencia polaca, Educar 53 (2017) 171–207.
[42] A. Richardson, Using customer journey maps to improve customer experience, 2010.
[43] L. Albauy, ¿qué es una retrospectiva de sprint? - una guía y plantilla, 2025.
[44] RETANP, Reglamento especial de turismo en areas naturales protegidas, 2015.
[45] M. Gonzalez-Rivero, O. Beijbom, A. Rodriguez-Ramirez, D. E. Bryant, A. Ganase, Y. Gonzalez-Marrero, A. Herrera-Reveles, E. V. Kennedy, C. J. Kim, S. Lopez-Marcano, et al., Monitoring of coral reefs using artificial intelligence: A feasible and cost-effective approach, Remote Sensing 12 (2020) 489.

[46] G. L. Diaz Macias, M. C. Valdiviezo Cuzco, et al., Diseño de una guía metodológica para la operación de actividades de turismo de aventura acuáticas en la zona de playa del área nacional de recreación playas villamil, ESPOL. FCSH (2024).
[47] M. He, A. Cliquet, Challenges for protected areas management in china, Sustainability 12 (2020) 5879.
[48] B. P. Shields, S. A. Moore, P. F. Eagles, Indicators for assessing good governance of protected areas: insights from park managers in western australia, Parks 22 (2016) 37–50.
[49] Y.-F. Leung, A. Spenceley, G. Hvenegaard, R. Buckley, C. Groves, Tourism and visitor management in protected areas: Guidelines for sustainability, volume 27, IuCN Gland, Switzerland, 2018.
[50] A. E. Peden, D. Demant, M. S. Hagger, K. Hamilton, Personal, social, and environmental factors associated with lifejacket wear in adults and children: A systematic literature review, PLoS One 13 (2018) e0196421.
[51] Global, Corcovado, costa rica—informe del primer trimestre de 2025, 2025.
[52] F. Morante-Carballo, B. Apolo-Masache, F. Taranto-Moreira, B. Merchán-Sanmartín, L. Soto-Navarrete, G. Herrera-Franco, P. Carrión-Mero, Geo-environmental assessment of tourist development and its impact on sustainability, Heritage 6 (2023) 2863–2885.
[53] S. Rezazadeh, A. Jahani, M. Makhdoum, H. G. Meigooni, et al., Evaluation of the strategic factors of the management of protected areas using swot analysis—case study: Bashgol protected area-qazvin province, Open Journal of Ecology 7 (2017) 55.
[54] P. Pizarro, Guía metodológica para elaborar plan de desarrollo turístico, 2014.