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## GEOTOURISM POTENTIAL AND CHALLENGES IN THE ARCHIPELAGO OF SAN ANDRÉS, PROVIDENCIA, AND SANTA CATALINA (COLOMBIA)

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## POTENCIAL GEOTURÍSTICO Y DESAFÍOS EN EL ARCHIPIÉLAGO DE SAN ANDRÉS, PROVIDENCIA Y SANTA CATALINA (COLOMBIA)

### Abstract

The Archipelago of San Andrés, Providencia, and Santa Catalina (Colombia) is a well-established tourist destination with numerous geosites that show a marvelous natural and cultural heritage of great importance and attractive for the development of geotourism. Although this region is visited mainly for its spectacular coastal landscape, until now, there was a lack of geological information and interpretation about those emblematic geosites. Therefore, it is very important to develop a geoconservation strategy by promoting sustainable geotourism through improving the knowledge of the geological elements of this region. The landscape value of this region must be globally recognized to improve and protect its heritage resources through geotourism and geoeducation with geoconservation purposes, so that it motivates an efficient management that describes guidelines that promote the development of an appropriate tourist infrastructure, centers of scientific and cultural interpretation, dissemination and educational materials, active exchange with geoparks, continuous improvement and participation of the local communities.

**Keywords:** coastal geomorphology, geodiversity, geotourism, geoeducation, Archipelago, local communities

### Resumen

El archipiélago de San Andrés, Providencia y Santa Catalina (Colombia) es un destino turístico consolidado con numerosos geositios que muestran un maravilloso

patrimonio natural y cultural de gran importancia y atractivo para el desarrollo del geoturismo. Si bien esta región es visitada principalmente por su espectacular paisaje costero, hasta ahora faltaba información e interpretación geológica sobre estos emblemáticos geosítios. Por lo tanto, es muy importante desarrollar una estrategia de geoconservación que promueva el geoturismo sostenible por medio de la mejora del conocimiento de los elementos geológicos de esta región. El valor paisajístico de esta región debe ser reconocido a nivel mundial para mejorar y proteger sus recursos patrimoniales por medio del geoturismo y la geoeducación con fines de geoconservación, de manera que se motive una gestión eficiente que describa lineamientos que promuevan el desarrollo de una adecuada infraestructura turística, centros de interpretación científica y cultural, materiales de difusión y educativos, intercambio activo con geoparques, mejora continua y participación de las comunidades locales.

**Palabras clave:** geomorfología costera, geodiversidad, geoturismo, geoeducación, archipiélago, comunidades locales

## 1. Introduction

Colombia is a country with extremely rich geodiversity, represented by mineral and energy resources, water reservoirs, mountain ranges, caves, fossil deposits, volcanoes, snow-capped mountains, hot springs and hundreds of rocks of different compositions, origins, and ages, which reveal important evidence of the geological history of our country. Colombia's geological heritage, consisting of a set of geodiversity elements of high-value, includes places of great scenic beauty as well as those of little visual or aesthetic interest, but of valuable scientific or didactic interest. Geoscientists have been discovering new geopatrimonial sites that enrich and diversify Colombia's geological heritage. However, at present, most of them are seriously threatened for not having adequate protection measures.

In this sense, the Colombian Geological Service, as the authority responsible for ensuring the protection of the Nation's geological heritage, is promoting actions aimed at the conservation and sustainable use of geological heritage, based on its research, conservation, use as a resource, dissemination, and enhancement. The Archipelago of San Andrés, Providencia, and Santa Catalina (ASAPSC) is situated in the Caribbean Sea about 750 km northwest of mainland Colombia (Figure 1), and it encompasses a total area of 57 km<sup>2</sup>, including the outer cays, reefs, atolls, and sand banks. San Andrés is the largest island in this archipelago, it has an area of 26 km<sup>2</sup>; Providencia (17 km<sup>2</sup>) and Santa Catalina (1 km<sup>2</sup>) islands are located 80 km to the northeast. Although the archipelago is geographically closer to Nicaragua (Central America) than to Colombia (South America), the ASAPSC has been part of the Republic of Colombia since 1822, and it is rich in geodiversity and biodiversity.

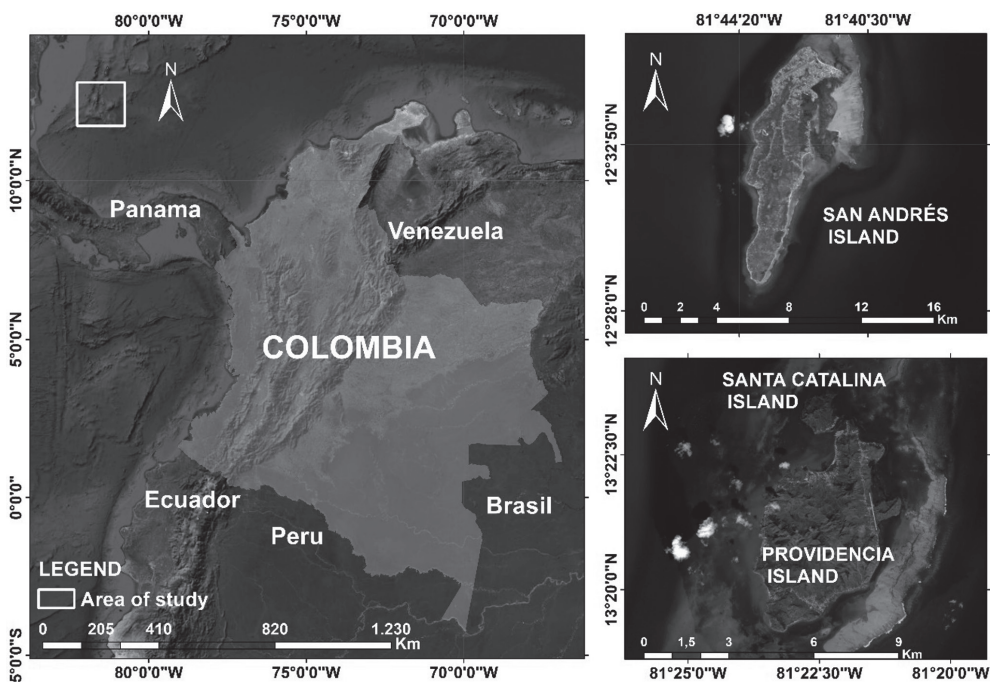
The ASAPSC is one of the most extensive reef systems in the Atlantic and it constitutes the largest extension of coral reefs in Colombia; in fact, the island platforms of seven of its ten true atolls extend over 2,188 km<sup>2</sup> (Díaz, 2000). Coastal erosion is the most important geomorphological process and it has largely participated in the creation of a very rich geological diversity, which produces cracks, caverns and necks in the lower part of the rocky escarpments that make up the margins of the islands, triggering phenomena (such

as rock falls or landslides) that put life at risk, and the homes of the inhabitants of the island, as well as its tourism and economy. Its marine and coastal ecosystems are home to its famous “sea of seven colors”. Regarding people, the native population, the “raizales”, has its own language: Creole. On the other hand, it is a coastal region, which promotes an interaction between man and the environment that is completely different from what takes place in other regions of the country. This rich and diverse natural and cultural heritage makes this area one of the best natural and cultural tourist destinations in Colombia for both Colombian and foreign people.

The worldwide concern for the conservation and valuation of the natural and cultural heritage has arisen because of understanding that a territory can have invaluable heritage wealth and, therefore, it must be preserved for future generations, which is essential for sustainable development.

Geoconservation is the identification, protection, and management of sites and landscapes that are not only important for their rocks, fossils, minerals, or other geological or geomorphological features of interest, but which also make a special contribution to our Earth heritage and which can illustrate the processes which formed the planet. (Geopark Management Toolkit, n.d., par. 13)

Figure 1. Left, geographical localization of the ASAPSC. Right, maps of the San Andrés, Providencia and Santa Catalina islands



Note. Own construction.

The main objectives of this paper are to emphasize the geotourism potential of the coastal region of the ASAPSC and to identify the most suitable geosites for geotourism development with geoconservation purposes, in order to capture the tourists' attention through the use of natural and cultural heritage elements as a novel strategy for socioeconomic development of the region.

## 2. Literature review

“The term geodiversity is a relatively recent concept, but one that is widely used and disseminated, with a marked tendency to consider it as a synonym of “geological diversity” (Ríos et al., 2020, p. 101) (e.g., Al-Zubaidi et al., 2014; Durán et al., 1998; González et al., 1997; Serrano-Cañadas & Ruiz-Flaño, 2007a, 2007b; Sharples, 1995). “Geodiversity is a vital concept for the efficient management of geological heritage (Gray, 2008), therefore it requires a very adequate definition” (Ríos-Reyes et al., 2021, p. 108). Geodiversity can be defined as the geological diversity of a region around elements such as geological structures (faults, folds, stratifications, foliations), minerals, rocks, fossils, or soils, as well as geomorphological features of relief and natural resources (Brilha et al., 2018; Gray, 2013; Gray et al., 2013; Koh et al., 2014; Kozłowski et al., 2004; Urquí-Carcavilla et al., 2007). Kozłowski et al. (2004) define geodiversity as “the natural variety on the surface of the earth, referring to geological and geomorphological aspects, soils and water resources, as important as other systems created as a result of endogenous and exogenous processes and human activity” (as cited in Giudice et al., 2021, p. 51288). “According to Urquí-Carcavilla et al. (2007), the existence of elements that constitute the geological heritage of a region contributes as a geosource to the social, economic, and cultural development of the society” (Ríos-Reyes et al., 2021, p. 108).

Geotourism is a relatively new form of tourism that is progressively making its way in Colombia.

The aesthetic and scenic significance of the elements that constitute the geological heritage of a region can turn them into attractive geosciences for the development of geotourism, development policies to eradicate poverty, promote sustainable growth, defend human rights and democracy, promote gender equality and overcome environmental and climate challenges, through which tourists can not only enjoy but also learn from the geological heritage and promote good practices for its geoconservation. (Dowling & Newsome 2010; Hose, 2011, as cited in Ríos-Reyes et al. 2021, p. 108)

Geotourism represents a part of tourist activity, whose main attraction is the geological heritage (Newsome & Dowling, 2010; Hose, 2011).

According to Turner (2006), this definition is based on the concept of geodiversity, being a novel form of tourism that has been growing on a large scale. According to Hose (2008), geotourism is defined as the provision of resources and interpretive services to promote the value and social benefit of places of geological and geomorphological interest and to ensure their conservation and use by tourists beyond appreciation esthetic. (Ríos-Reyes et al., 2021, p. 108).

In 2011:

At the International Geotourism Congress held at the Arouca Geopark (Portugal) under the auspice of UNESCO, discussions around Geotourism in Action were held; where the Arouca Declaration was consolidated, through which they sought to unite efforts to achieve the following definition of geotourism: a form of tourism based on the strengthening of the identity of a territory, considering its geology, landscape, environment, culture, aesthetic values, heritage and well-being of its inhabitants, under a sustainable concept, which contribute to the benefit of future generations (Arouca, 2011). However, numerous authors have approached this concept from different perspectives, providing different definitions (Urquí, López, and Valsero, 2007; Dowling & Newsome, 2010). Therefore, geotourism must address the social, cultural, environmental, patrimonial, and geological definition of a region, not only for the observation and appreciation of the elements that constitute it but also for the understanding of the processes that have acted in the evolution of the Earth (Arouca, 2011) in order to identify, protect and conserve its geosites (Hose, 2011). (Ríos-Reyes et al., 2021, p. 108).

Moreover:

Geotourism is focused on following several general principles that basically promote the custody of the region, the well-being of local communities, and the quality of the experience for tourists (Cariño, Murrieta, and Contreras 2012). Geotourism has become an important activity (Dowling and Newsome 2010; Torabi et al. 2017). Its main objectives include the geoscientific knowledge transfer, the sensitization in relation to geological heritage and its conservation needs, the preservation of the assets that constitute it, allowing its legacy to be transmitted to future generations, the promotion of its potential as a georesource for the enjoyment and learning of tourists, and the sustainable development of tourism (Urquí, López, and Valsero 2007; Ruban, 2015). According to Schaefer and Farias (2020), geotourism represents a niche tourism that seeks to rescue those destinations that are not traditional for future generations or that give a new aspect to conventional tourism through a novel alternative for the development of tourism. (Ríos-Reyes et al., 2021, p. 108)

According to Arouca Declaration on Geotourism (2011), it is necessary to integrate geodiversity-biodiversity and cultural elements to insert them in the tourist context. “In recent years, alternatives for the use of geological heritage and the preservation of geodiversity have been promoted, since geotourism linked to geodiversity has been activated throughout the world” (Koh et al., 2014, as cited in Ríos-Reyes et al., 2021, p. 108).

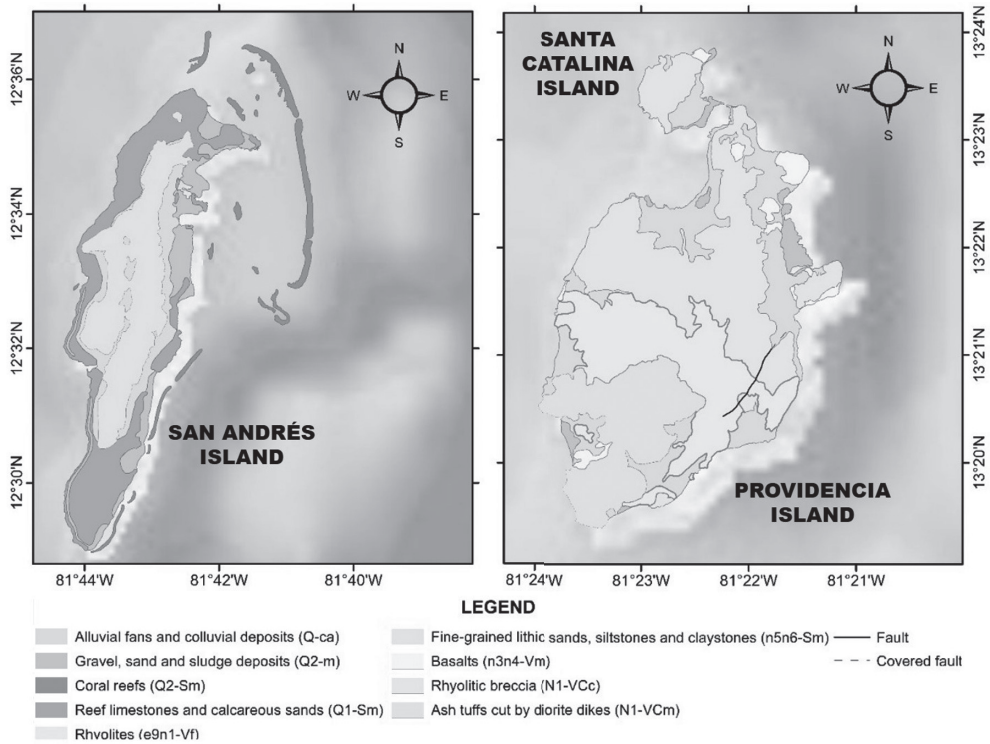
The importance of tourism has been increasing in the development of the Colombian economy, this has contributed to the generation of new sources of employment, the increase in the arrival of international tourists, strengthening of national destinations, greater air connectivity, support for projects friendly with the environment and the improvement of the hotel offer in the country. (Ríos-Reyes et al., 2021, p. 109)

## ***2.1 Geological background***

The ASAPSC constitutes one of the most outstanding physiographic features in the Caribbean Sea: it comprises nine volcanic islands (from south to north: Albuquerque, Este-Sureste,

San Andrés, Providencia, Roncador, Quitasueño, Serrana, Serranilla and Bajo Nuevo), and other submarine volcanic (ridges and seamounts), tectonic and sedimentary landforms (Idárraga-García et al., 2021). It has “a long geological history which is tightly linked to the formation of the Caribbean Sea to at least early Cenozoic times” (Geister & Díaz, 2007, p. 9), and it is made up of a set of oceanic islands, atolls and coral banks aligned in a NE direction and parallel to the Nicaraguan rise (Gamboa et al., 2012), which apparently originated from volcanoes arranged along tectonic fractures in the oceanic crust, oriented predominantly towards the NE and SW, and are limited to the north by the Pedro Fracture and to the south by the Hess Escarpment. It is mainly made up of volcanic rocks, some intercalations of reef limestones between volcanic series and marine deposits (Geister & Díaz, 2007). The current structure of the reef complexes is the result of the subsidence of the volcanic basements, which have been covered with carbonates of biogenic origin with the presence of corals, algae, and molluscs, among others, which occurred during the Neogene and the Quaternary (Díaz et al., 1996). A generalized geological map of the ASAPSC is presented in Figure 2.

Figure 2. Generalized geological map of the ASAPSC



Note. Own construction.

San Andrés Island is crossed from south to north by a small mountain range with coconut trees; it shows a flat topography and La Loma Hill as the highest point (85 masl) in the island. Its length from north to south is 13 km, while its width from east to west is 3 km.

“San Andrés’ soils indicate that their formation is due to the eruption of a volcano, which threw rocks older than the seafloor to the surface, creating the islands. Despite this, there is fertile soil, primarily red clay” (LAC Geo, 2020, par. 14). It is easy to find small sandy deposits on the island, especially in the neighborhood of La Loma Cove.

Aside from the main settlements, the island is almost entirely covered in grass, trees, and other vegetation, and sand along the coastline rather than rocks. The central area is marked by a chain of hills (Flowers, Orange, Shingle, and Lion’s Hill). In addition, a feature named Rock Point is located on the southeastern coast. Suky Bay lies in the central western part of the island near Cove Seaside. (LAC Geo (2020, par. 14-16)

The northern part of the island has a beach, however, the western part of the island has no beaches. The island has only small, ephemeral streams draining the land area, but it has not major rivers.

According to Vargas (2004), San Andrés Island is constituted by three geomorphological units: (1) reefs, beaches, and mangroves; (2) peripheral emerged reef platform; (3) hills and escarpments. The beaches represent a small sector of the island, are mainly to the north and east, and are characterized by having a coral and white color, with variable width and little inclination. The occurrence of reef edges is characteristic as either low cliffs or small escarpments, gently sloping platforms with jagged edges, rough surfaces, and karstic morphology. The mangroves provide a picturesque and gloomy landscape of swamps within which characteristic plant species stand out that emerge on areas of sand interspersed with peat and plant remains. The emerging reef platform area is characterized by developing a flat to gently sloping morphology with a very low relief, within which small undulations and cavities and residual hills formed by the oldest rocks (San Andrés Formation) stand out. The hilly area is oriented north and northeast in the central part of the island, highlighting geoforms such as escarpments with heights up to 30 m that border a large part of the western side of the range, plateaus, morphological depressions (El Cove) and denuded hills.

Providencia and Santa Catalina comprise three geomorphological units: one characterized by flat areas and gentle slopes (mainly beaches and mangroves), another of hills and edges with a moderate to high slope (Santa Catalina Island and cliffs), and a last one of areas of high slopes and steep cliffs observed in the central part of the island (The Peak). Additionally, along the coast there are isolated geoforms (keys or stacks such as Basalt Cay or Crab Cay) as erosive remnants.

Stratigraphically, San Andrés is constituted by sedimentary rocks of the San Andrés and San Luis formations of Middle to Upper Miocene and Pleistocene ages, respectively, and by Quaternary deposits (Bürgl, 1959). The San Andrés Formation consists of a sequence of fossiliferous sparitic microcrystalline limestones. The San Luis Formation is composed of biosparitic coralline limestones and coarse-grained to conglomeratic calcareous sandstones towards the top. Quaternary deposits include mainly clay residual soils; clay and peaty deposits with levels of calcareous sands and plant remains associated with mangroves; clay, peaty lake deposits and sandy limestone lenses, slopes (colluvium and debris); calcareous sand deposits and anthropogenic origin (sanitary and hydraulic landfills).

Providencia and Santa Catalina are mostly volcanic (Old Volcanic Series and Young Volcanic Series), with some intercalations of limestone and Quaternary marine deposits south of Providencia (Geister & Díaz, 2007). The Ancient Volcanic Series is composed of finely banded rhyolites of probably pre-Miocene or early Miocene age, forming a dome with an area of exposure that extends from east to west through the center of the island; ejection cones composed of rhyolitic breccias develop locally (Geister, 1986; Geister & Díaz, 2007). The Young Volcanic Series outcrops around the rhyolitic dome and is composed of lavas, pyroclastic and epiclastic material of mainly basaltic and dacitic composition of Middle Miocene, covered by pyroclastic deposits; locally, columnar and padded structures are observed (Geister & Díaz, 2007). The explosive volcanism of Providencia Island is recorded in pyroclastic deposits such as ash, breccias with clasts of all sizes, and tuffs that extend around the rhyolitic dome covering the other units (Geister & Díaz, 2007). On the other hand, the rhyolitic dome and younger deposits are cut by some mafic dykes with tendencies towards the NE and NW associated with extensional fracturing. The main lithological units of Santa Catalina Island comprise slag deposits that consist mainly of vesicular basalts (Geister & Díaz, 2007). Towards the south, there are intercalations of reefs and lagoon sediments from the Middle to Early Miocene with the presence of microfossils within the lava flows and pyroclastic material (Geister, 1986).

In Providencia and Santa Catalina there are Holocene terrestrial deposits restricted to beaches, swamps and sloping debris at the foot of the hills, most of these being of solely siliciclastic origin. Pleistocene deltaic deposits are visible around the coast at Kalaloo Point, emerging approximately one meter above sea level and associated with the maximum rise of this during the Sangamonian interglacial (Geister & Díaz, 2007).

The Island of San Andrés, due to its geographical position in the Caribbean region, is highly vulnerable to tropical storms and hurricanes; historical records report various disastrous hurricane events since the 1930s, and the most recent occurred in 2020 (hurricanes Eta and Iota) and 2022 (hurricane Julia). Another phenomenon that occurs frequently on the island is flooding, particularly in urban areas. According to Carvajal (2009), Providencia and Santa Catalina present different risks associated with geological processes, such as volcanism, earthquakes, tsunamis, and changes in sea level, but the main risk is linked to climatic processes, such as hurricanes.

The geomorphological processes derived from the dynamics and the environment in which these islands are framed affect them continuously and generate risks with great short-term incidence, which affect the population and infrastructure. The intense erosion and the advance of the cliffs due to the action of the waves cause destabilization of civil works, such as the road and some houses, such as those located in Rocky Point, La Florida and Lazy Hill, among others. The possibility of minor risks associated with falling blocks is generally the product of quarrying in an artisanal and informal way.

### 3. Methodology

Geotourism is an activity that has become popular in recent years as an innovative strategy for sustainable development. It primarily depends on geosites whose identification and subsequent assessment are important for the development of geotourism and protection of

geosites (Štrba, 2019). The comprehensive evaluation of geosites is a task that numerous authors (Ansori et al., 2022; Brilha, 2016; Fassoulas et al., 2012; Kubalíková & Kirchner, 2016; Tomić et al., 2020) have committed to in order to contribute to the management and protection of geosites and, therefore, the geological heritage of a specific region.

In this study, 39 geological sites of interest located in the ASAPSC were inventoried, characterized, assessed, and qualitatively evaluated. In order to identify the potential geosites of scientific, educational and touristic interest, the methodology of Brilha (2016) was adapted and modified, and sites with a score equal to or greater than 3.0 were selected as potential geosites. For the selection of the geological sites, criteria inspired by some researchers that show the importance for geological heritage were considered (Brocx & Semeniuk, 2007, 2011; Đurović & Đurović, 2010; Nazaruddin, 2020). The criteria focus on geological heritage, particularly of scientific, educational, recreational, cultural, economic, and functional interest (Gray, 2004, 2005; Nazaruddin, 2020). These criteria are:

- 1) Rare occurrence: Unique or unusual geological sites.
- 2) Representativeness of geological characteristics and processes.
- 3) Scientific value: Geological features that offer research and curiosities.
- 4) Educational value: Geological features that offer educational opportunities.
- 5) Aesthetic value: Geological features and landscapes of exceptional natural beauty.
- 6) Recreational value: Geological features with existing and potential recreational uses.
- 7) Cultural or historical values: Sites of cultural or historical importance.

The characterization was carried out through the characteristics supported by information from the literature, detailed field observation, the description of the sites, based on the parameters of other investigations (Brilha et al., 2018; Nazaruddin, 2017, 2020). The parameters considered to carry out the qualitative assessment of geosites include typological category, heritage category, heritage subcategory, value criteria, location, and main characteristics.

#### **4. Results and discussion**

The ASAPSC has a wealth of heritage made visible by its beauty and unequalled exotic rarity. Currently, it is one of the most desired and visited sites by tourists due to its natural and cultural heritage. In this article, the selection of potential geosites were based on the above-mentioned criteria and, of course, on their natural and cultural heritage contents (Tables 1-3).

These potential geosites reveal very interesting aspects on the regional evolutionary history of the ASAPSC, including several coastal erosion and sedimentation landforms, ecosystem diversity with a rich fauna and flora, and cultural traditions of the native Raizal people. In

addition, there are many other geosites that can be included in geotourism activities. However, priority should be given to the geosites further described below, because, in addition to their attractiveness and accessibility, already possess infrastructure necessary for the development of tourism. The proposed inventory of sites of geological interest includes 17 potential geosites located throughout this archipelago, which can be considered under a geoconservation perspective.

Geosites can be important at the international, national, regional or local level. Protected sites can be used to promote understanding of the history of planet Earth among the general public and for education and research. However, people are generally not aware of the risks to which they are exposed, they underestimate those they recognize and overestimate their ability to face them. Given the non-removable nature of geological elements, it is essential to have a regulatory framework for their conservation, since the abiotic world directly affects the balance of ecosystems, which inevitably conditions the existence of human beings.

Table 1. Proposal for a preliminary inventory of sites of geological interest in San Andrés Island

Code	Geo-site	Typology	Heritage category	Heritage subcategory	Value criteria	Elements	Location	Main Characteristics
GEO-1	Limestone mining open pit	Area	Natural	Geological	Scientific, Educational, Economic, Touristic	Mining, Sedimentology, Economic geology	San Andrés	In the Island of San Andrés, limestone represents the only mineral resource of importance, although due to the high content of impurities of detrital origin, it makes them unattractive for the cement industry, except for the coral-line limestone of the San Luis Formation and the microcrystalline limestone of the San Andrés Formation.
GEO-2	Big Pond Lagoon	Area	Natural	Biological	Ecological, Scientific, Educational, Economic, Touristic	Geomorphology, Biodiversity, Lagoon	San Andrés	The Big Pond Lagoon is a small body of semi-salty water located in the La Loma sector. It is not suitable for swimming, but ideal for adventure, romance and contact with nature. This natural spring with exotic landscapes is a refuge for birds, stiles, crabs, palms, mangoes and other fruit trees that surround it.
GEO-3	Mountain Range	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Biodiversity, Sedimentology	San Andrés	The Mountain Range of the San Andrés Island constitutes a hill range axis with a series of hills ranged in a line and connected by high ground.

<i>Code</i>	<i>Geo-site</i>	<i>Typology</i>	<i>Heritage category</i>	<i>Heritage subcategory</i>	<i>Value criteria</i>	<i>Elements</i>	<i>Location</i>	<i>Main Characteristics</i>
GEO-4	Morgan's Cave	Area	Natural	Geological	Scientific, Educational, Ecological, Landscape, Touristic	Geomorphology, Marine erosion, Karstification	San Andrés	Cavity formed in fossiliferous coralline limestones communicated through various galleries with the Caribbean Sea and is located to the east of the island. It has some stalactites and stalagmites and is surrounded by ferns and other shrubs, and is directly connected to the Caribbean Sea and with the passing of the time a limestone species has formed with the very curious appearance of the open jaws of a maritime creature worthy of observation by its continuous visitors, who at the same time have the opportunity to visit the coconut museum in Morgan's cave in San Andrés.
GEO-5	Coastal plains	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Biodiversity, Sedimentology	San Andrés	Coastal plains are deposition landforms of low relief adjacent to a shoreline, which can be truncated in some areas where the rocky littoral extends into the shoreline. They are associated with marine fluvial processes and can diminish significantly due to land use.
GEO-6	Spratt Bight Beach	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Biodiversity	San Andrés	A gentle place with numerous features of coastal deposition, erosion, and colorful waters. Spratt Bight Beach is the most recognized beach in San Andrés thanks to its excellent location and all the commerce and tourism that has been generated around it. With almost 500 meters of extension, it is an essential visit for all those who come to the island looking to enjoy the Caribbean atmosphere and the exquisite gastronomic offer, which makes this beach a very popular place for tourists.

Code	Geo-site	Typology	Heritage category	Heritage subcategory	Value criteria	Elements	Location	Main Characteristics
GEO-7	Johnny Cay	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Biodiversity	San Andrés	Small island where you can enjoy one of the best soft white sand beaches. In addition, calypso, reggae and soca, and also to savor a very fresh fried fish, with patacón and coconut rice, accompanied by rum cocktails, and other typical dishes of the region.
GEO-8	Santander Cay	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Biodiversity	San Andrés	Santander Cay is located to the east of the Island of San Andrés, very close to the capital city of the department, in the San Andrés Bay. The airport is very close to this place.
GEO-9	Old Point Mangroves National Park	Area	Natural	Biological	Ecological, Scientific, Educational, Economic, Touristic	Marine erosion and sedimentation, Biodiversity, CO <sub>2</sub> capture, Coastal risk mitigation	San Andrés	Old Point Mangrove National Park is the largest fringing mangrove system in the San Andrés Island. It has mangrove forest, seagrass meadows, macroalgae communities, tropical dry forest and brackish water lagoons and is a sanctuary of marine species of flora and fauna. It constitutes a coastal wetland, which is very important for erosion and flood control, as a barrier against hurricanes, for coastal protection and to improve water quality. A fundamental territory for the inhabitants of San Andrés, since the mangrove ecosystem is integrated into their cultural memory.
GEO-10	Rose Cay	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Biodiversity	San Andrés	Rose Cay (Aquarium de San Andrés Island) is one of the favorite destinations for tourists, where it is possible to observe and enjoy the biodiversity of marine species by snorkelling.
GEO-11	Haynes Cay	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Biodiversity	San Andrés	From Rose Cay, it is possible to walk between corals to Haynes Key, where there are palm trees, soft white sands, crystal clear waters and a beach kiosk with cool people from San Andrés Island, who

Code	Geo-site	Typology	Heritage category	Heritage subcategory	Value criteria	Elements	Location	Main Characteristics
								serve tourists and offer food, drinks, cocktails in a musical atmosphere full of reggae. Here, the activities will be developed exclusively during the day. On the other hand, it is important that you know that both the Natural Aquarium and Haynes Cay are on the boat ride to also reach Johnny Cay.
GEO-12	Cocoplum Bay Beach	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Biodiversity	San Andrés	A soft place with numerous features of coastal deposition, erosion, soft white sands and turquoise waters, known for its forests of huge coconut trees and typical food restaurants. This quiet place is conducive to bathing.
GEO-13	Rocky Cay	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Biodiversity	San Andrés	Rocky Cay is one of the most interesting places on the island of San Andrés. This is located in front of Cocoplum Beach, from where it is possible to get there on foot. This is a small cay with hardly any vegetation and very close to it is the ghost ship aground, which makes this a very famous place visited by tourists. When the tide rises, it is not possible to walk to Rocky Cay, as the manta rays arrive there.
GEO-14	San Luis Beach	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Biodiversity	San Andrés	A gentle place with numerous features of coastal deposition, erosion, soft white sands, and crystal clear waters.
GEO-15	Low hills	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Biodiversity	San Andrés	Low hills represent geographical accidents that refers to an eminence of the land that does not exceed 100 m in height. They occur near the San Luis Beach.

Code	Geo-site	Typology	Heritage category	Heritage subcategory	Value criteria	Elements	Location	Main Characteristics
GEO-16	The Blowing Hole	Point	Natural	Geological, Biological	Scientific, Educational, Touristic	Hidrogeology	San Andrés	It is located at the southern tip of the Island. It is a natural phenomenon produced by a series of underground tunnels that begin in the coral reefs and end in a single hole several meters from the water. When the tide rises and a wave manages to force its way into these tunnels, it blows compressed air through the hole.
GEO-17	Cat Bay Point	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Biodiversity	San Andrés	From this site, it is possible to travel north along a reef platform approximately 1.5 km long to El Cove Bay.
GEO-18	Coral reef platform	Area	Natural	Biological	Ecological, Scientific, Educational, Touristic	Biodiversity, Geomorphology, Marine erosion	San Andrés	The islands of the Archipelago of San Andrés, Providencia and Santa Catalina and their inhabitants depend on the coral reefs that surround them, since in addition to being their natural barrier against the forces of the sea, they constitute a refuge for fish when they are born and grow.
GEO-19	El Cove Bay	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Biodiversity	San Andrés	The Cove Bay stands out in San Andrés thanks to its deep blue waters perfect for diving and for being the favorite point for the disembarkation of the tourist cruises that arrive. This is the ideal place for those who want to experience diving, its deep and crystal clear waters, and exotic and colorful fishes and coral reefs.
GEO-20	Island House Museum	Point	Cultural	Tangible (immovable property)	Historical, Scientific, Educational, Touristic	Museography, Archeology	San Andrés	It presents the cultural and gastronomic wealth of the islanders.
GEO-21	Bautiste Church	Point	Cultural	Tangible (immovable property)	Religious, Architectural, Social collections	Cultural, Touristic	San Andrés	Erected at the highest point on the island, and with the capacity to seat 1,000 people, it has served many generations.

Note. Own construction.

The geoconservation of the geodiversity, biodiversity and cultural heritage of the ASAPSC establishes a link with the heritage values of the territory and constitutes a responsibility and obligation for public administrations and society in general, due to its intrinsic value and its possible uses in the future.

Table 2. Proposal for a preliminary inventory of sites of geological interest in Providencia Island

<i>Co-de</i>	<i>Geo-site</i>	<i>Typology</i>	<i>Heritage category</i>	<i>Heritage subcategory</i>	<i>Value criteria</i>	<i>Elements</i>	<i>Location</i>	<i>Main Characteristics</i>
GEO-22	Fresh Water Bay Beach	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Petrology, Biodiversity	Providencia	A soft place with numerous features of coastal deposition, erosion, soft white sands, and fresh, crystal clear waters. Finely banded rhyolites forming a volcanic dome, although their formation has not been determined with absolute dating methods. However, Geister & Díaz (2007) propose a pre-Miocene or early Miocene age for this rhyolitic dome.
GEO-23	South West Bay Beach	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Petrology, Biodiversity	Providencia	A soft place with numerous features of coastal deposition, erosion, soft white sands, and fresh, crystal clear waters. The explosive volcanism of Providencia Island is recorded in ash-like pyroclastic deposits (South West Bay Volcanic ashes).
GEO-24	Manzanillo Beach	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Biodiversity	Providencia	A soft place with numerous features of coastal deposition, erosion, soft white sands and crystal clear waters; on this beach you can enjoy live music over a bonfire, practice beach volleyball or simply sunbathe. Occurrence of reefs and lagoon sediments.
GEO-25	Iron Wood Hill	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Biodiversity	Providencia	Pyroclastic and epiclastic rocks deposited on land. Dry forest.

<i>Co-de</i>	<i>Geo-site</i>	<i>Typo-logy</i>	<i>Heritage category</i>	<i>Heritage subcategory</i>	<i>Value criteria</i>	<i>Elements</i>	<i>Loca-tion</i>	<i>Main Characteristics</i>
GEO-26	Three Brothers Cays	Area	Natural	Geologi-cal, Bio-logical	Scientific, Educa-tional, Land-scape, Touristic	Geomor-phology, Marine erosion and sedimentation, Biodi-versity	Providencia	Three Brothers Cay represents a small bird sanctuary, which is part of the McBeam Man-grove Swamp National Park. It is a protected breeding ground for the birds and going there is not really allowed (restrcited kayaking and snorkeling).
GEO-27	McBeam Mangrove Swamp National Park	Area	Natural	Biological	Ecologi-cal, Scien-tific, Edu-cational, Economic, Touristic	Marine erosion and sedimen-tation, Biodiver-sity, CO <sub>2</sub> capture, Coastal risk mitiga-tion	Providencia	It includes the McBeam La-goön, and the Three Brothers and Cangrejo cays, presenting a unique beauty due to its envi-ronmental richness highlighted by mangroves, reefs and cays. Here stands out the barrier reef that protects the coasts, which is the second largest in the Ca-ribbean. This great coral reef, with its varied formations, to-gether with the reef lagoon that forms in front of the McBeam mangrove, give the sea a spec-tacular range of colors that go from deep blue to a translucent aquamarine green (“Sea of the Seven Colors”).
GEO-28	Maracaibo Bay	Area	Natural	Geologi-cal, Bio-logical	Scientific, Educa-tional, Land-scape, Touristic	Geomor-phology, Marine erosion and sedimentation, Biodi-versity	Providencia	Maracaibo Bay not only offers an incredible panoramic view, and also serves as a natural platform to get to know one of the most spectacular places in the Caribbean, we speak of course of the McBeam Man-grove Swamp National Park.
GEO-29	Crab Cay	Area	Natural	Geologi-cal, Bio-logical	Scientific, Educa-tional, Land-scape, Touristic	Geomor-phology, Marine erosion and sedimentation, Biodi-versity	Providencia	Crab Cay is volcanic in origin and stands out like the last bit of resistance against the coastal erosion. Here, the sea is shallower and brighter, provid-ing a beautiful turquoise color. There is a little trail to the top of the Crab Cay, a marvelous site to take photos. Kayaking and snorkeling.

Code	Geo-site	Typology	Heritage category	Heritage subcategory	Value criteria	Elements	Location	Main Characteristics
GEO-30	Garret Bay	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Biodiversity	Providencia	Predominant cover: Grasslands, dense bushes and coconut crops. Predominant uses: Dense shrubs.
GEO-31	The Peak	View Point	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Petrology	Providencia	Finely banded rhyolites outcrop here and constitutes a volcanic dome, although their formation has not been determined with absolute dating methods. However, Geister & Díaz (2007) propose a pre-Miocene or early Miocene age for this rhyolitic dome. It is the highest point on the island, with 320 meters above sea level. The view is spectacular as is the path that you climb, full of streams and natural springs.

Note. Own construction.

Table 3. Proposal for a preliminary inventory of sites of geological interest in Santa Catalina Island

Code	Geo-site	Typology	Heritage category	Heritage subcategory	Value criteria	Elements	Location	Main Characteristics
GEO-32	Morgan's Head	Point	Natural	Geological, Biological	Cultural, Historical, Scientific, Educational, Touristic	Geomorphology, Marine erosion, Biodiversity	Santa Catalina	It is a rock sculpted naturally by erosive agents in the shape of a human profile.
GEO-33	Mona Bay	Area	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion and sedimentation, Biodiversity	Santa Catalina	Mona Bay is connected to Cabeza de Morgan and to a path that communicates with Fort Warwick. Mona Beach, known only by its name, is located within Mona Bay and the beach that is farthest from the Lovers' Bridge and requires a 30-minute walk to get there. Therefore, due to the fact that it is a somewhat remote beach, it has the advantage of being less popular with tourists. This is one of the best places

Co-de	Geo-site	Typo-logy	Heritage category	Heritage subcategory	Value criteria	Elements	Loca-tion	Main Characteristics
								to watch people snorkeling. In Santa Catalina we find quiet and little visited beaches like this one, where we find local fishermen. To the south of the island there are restaurants that offer fresh fish and seafood, located in a town with Caribbean-style wooden houses.
GEO-34	Fort Warwick	Point	Cultural	Tangible (Movable property)	Historical, Touristic	Geomorphology, Biodiversity, Cannon	Santa Catalina	Fort Warwick is a historic place where the settlers put up a military defense of the island with canyons because the strategy was to shoot enemies from long-range boats. There, they ended the attempts of Spanish, French and Dutch pirates to seize a strategic place for naval transit along the continental coast.
GEO-35	Ecological footpath	Section	Cultural	Tangible (Immovable property)	Touristic, Architectural, Sports and Recreational, Educational, Monitoring, Sensitive	Geomorphology, Biodiversity, Environmental	Santa Catalina	Ecological footpath through which it is possible to go hiking for those who want to enjoy nature and observe the fascinating fauna and flora, which is part of the guidebook for tourists and travelers. This boardwalk was built with figures of seahorses and colored crabs. Through this it is possible to access a little-visited tourist destination, which offers diving, non-motorized water sports, snorkeling, ecological walks through natural trails, horseback riding and return to the island by bicycle or by boat, among others.
GEO-36	Mangrove Swamp	Area	Natural	Geological, Biological	Ecological, Scientific, Educational, Economic, Touristic	Marine erosion and sedimentation, Biodiversity, CO <sub>2</sub> capture, Coastal risk mitigation	Santa Catalina	The mangrove swamp of the Santa Catalina represents a fascinating ecosystem, which is much more than what people usually think. It constitutes a coastal forest composed by mangrove trees, which are a group of non-related trees and shrubs that growth and reproduce in soils with high salinity and low oxygen. However, it has been affected by marine litter due to poor waste management practices and its abundance is increased by natural

Code	Geosite	Typology	Heritage category	Heritage subcategory	Value criteria	Elements	Location	Main Characteristics
								catastrophes occurrence that affects coastal settlements, as occurred in November-2020, when two hurricanes destroyed homes and deposited litters in mangroves, in the Colombian Caribbean (Garcés-Ordóñez et al., 2021).
GEO-37	Lovers' Bridge	Section	Cultural	Tangible (Immovable property)	Cultural, Touristic, Sports and Recreational, Sensitive	Geomorphology, Biodiversity, Natural, Cultural and Environment	Santa Catalina	The Lovers' Bridge that joins the islands of Providencia and Santa Catalina, is unique not only for its incredible coloring. This picturesque floating bridge helps the 200 inhabitants of the island of Santa Catalina to cross the sea to get to the city center, the school, and the hospital. Small wooden benches decorated with figures of crabs and lanterns that are lit in the evening run along the entire length of the bridge. However, many people have other reasons for crossing it: the beach, delicious seafood and island architecture.
GEO-38	Old Cannon	View Point	Cultural	Tangible (Movable property)	Historical, Touristic	Geomorphology, Biodiversity, Cannon	Santa Catalina	Old Cannon represents a historical place of Santa Catalina Island. Such cannon date back to the days of piracy on the island. In the past, Providencia was a pirate haven and much treasure remains undiscovered, buried on the island. It's said that type of cannons were deployed by the infamous pirate Henry Morgan to keep the Spanish at bay (and away from his treasure which he hid all over the islands).
GEO-39	Bucanera Point	View Point	Natural	Geological, Biological	Scientific, Educational, Landscape, Touristic	Geomorphology, Marine erosion, Biodiversity	Santa Catalina	Bucanera point forms part of a headland, which constitutes a landform of coastal erosion. The headland itself is made up of Early Miocene basaltic and andesitic lava flows, but Bunta Bucanera is characterized by the presence of Holocene muddy coastal deposits and mangrove swamps (Posada et al., 2011).

Note. Own construction.

Globally, disasters are becoming more complex and are constantly growing because of they are related to social and historical structures and global dynamics that reveal historically constructed risks and socio-environmental inequities. Therefore, it is essential that local communities have the capacity to manage their territory, knowing their history, being aware of the existing risks and taking measures to reduce them. That is why it is necessary to integrate risk management into the development model of the ASAPSC, and thus move towards sustainable development. This is something that has been evidenced by the natural disasters that have been affecting this island territory. Therefore, a fundamental strategy is the geoconservation of coral reefs and mangroves, since these are a protective barrier for the ASAPSC capable of dissipating wave energy by more than 95%, generating a stronger and less eroded beach system and providing food security to the islanders.

#### **4.1 Geodiversity**

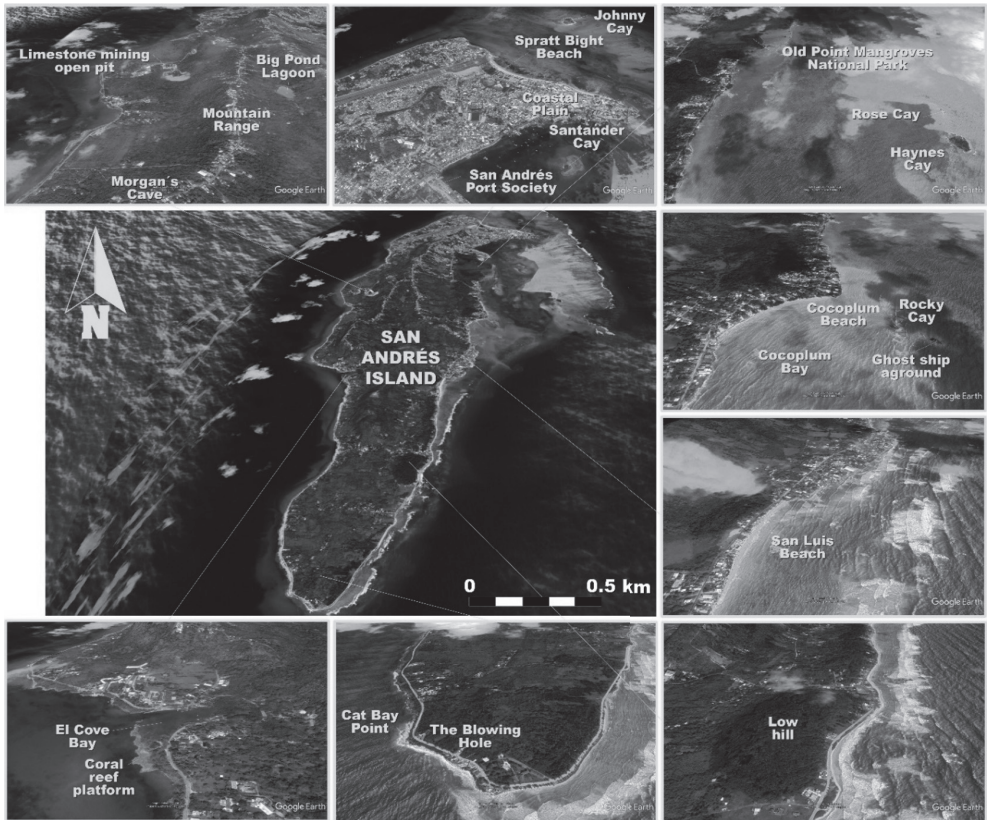
The proposed geosites have an added value thanks to their landscape, to their scientific, aesthetic, historical, cultural and academic attraction, uniqueness and beauty. These features can be used as geotourism resources, which are illustrated through photographs in a didactic and explanatory way, revealing the most important geological agents that have acted in the modeling of the current landscape (Figures 3-6).

San Andrés Island (Figure 3) has an excellent diversity of geomorphology, geology, and landscape. It presents a coastal morphology with beaches (Spratt Bight, the Mansion, Rocky Cay, Sound Bay, Decameron San Luis, Tom Hooker, and Elsy Bar) (Figure 4), coastal edge, cliffs, storm deposits, mangroves, anthropic fillings, reef platform peripheral emerged, hills in the central part of the island and associated quaternary deposits. Its shape is elongated in a NS direction, with a length of 12.5 km and a maximum width of 3 km. In the central part, there are a series of hills with maximum elevations of 86 meters above sea level. The areas adjacent to the coastline are generally flat, with elevations no greater than five meters (INGEOMINAS, 1996).

The reef complex that surrounds the island is arranged in NE direction; it has an approximate length of 18 km and a maximum width of 10 km, with a total area of 97.5 km<sup>2</sup> (Díaz, 2000). Stratigraphically, the island is made up of Neogene calcareous rocks and Quaternary deposits of different compositions. Neogene rocks are defined by two formations that contrast lithologically and morphologically: the San Andrés Formation, from the Miocene, and the San Luis Formation, from the Pliocene. Quaternary deposits are represented by artificial fill materials, sanitary and hydraulic landfills, deposits of lake origin, associated with mangrove forests and slopes and deposits of winds, beaches and storms (CORALINA-INVEMAR, 2012).

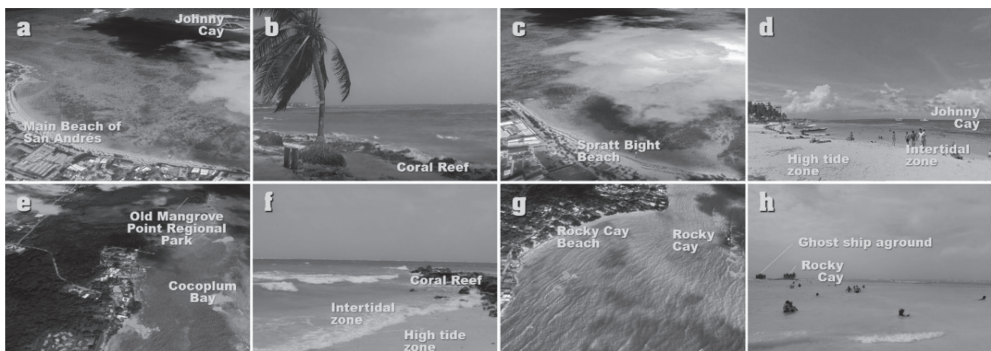
In Providencia and Santa Catalina stand out three sectors of beaches: Southwest, Freshwater, and Manzanillo. In addition, they are part of an extinct andesitic volcano, whose axis crosses the interior of the two islands. The extruded materials are dense and vesicular lavas, agglomerates, tuffs, and occasionally thin calcareous banks (Hubach, 1956; CORALINA-INVEMAR, 2012). Figures 5-6 illustrate several aspects on the Coastal geomorphological and lithological features of Providencia and Santa Catalina islands (Colombia).

Figure 3. Coastal landforms in San Andrés Island (Colombia)



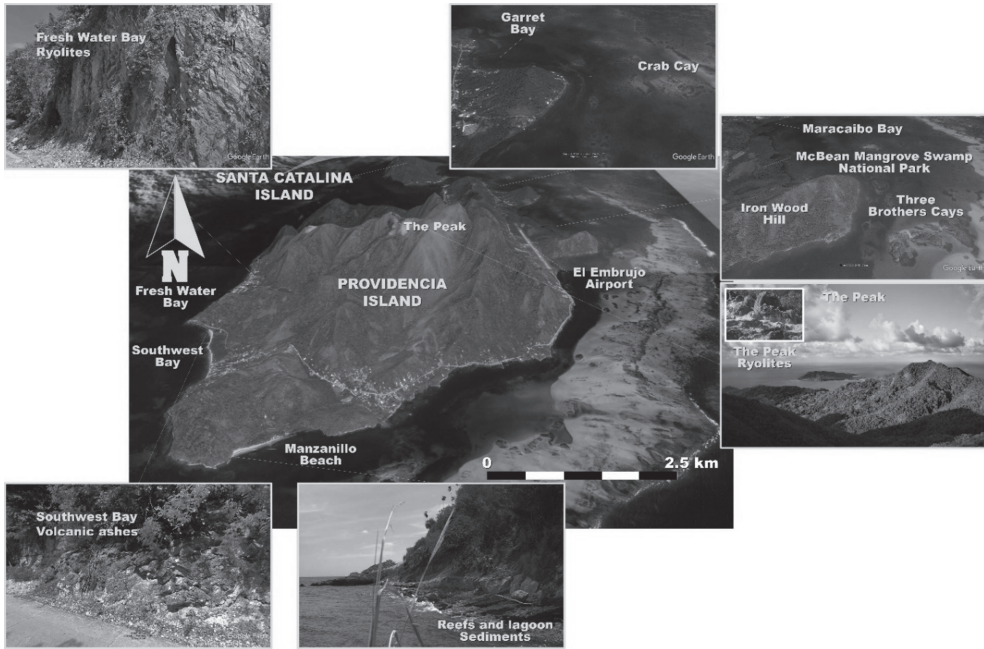
Note. Adapted and modified by authors from Google Earth (<http://earth.google.com>).

Figure 4. Main features of ASAPSC beaches



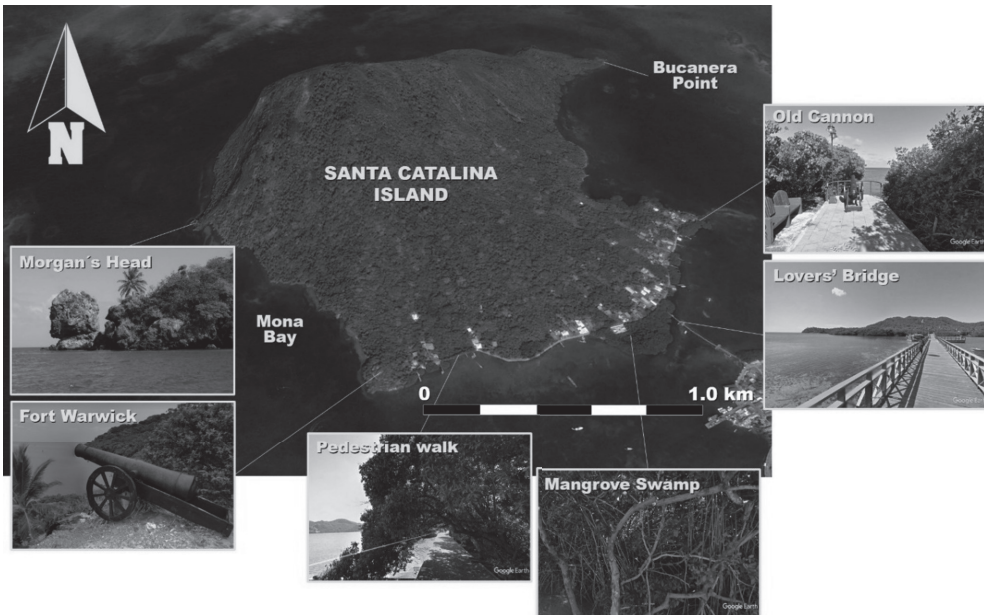
Note. Adapted and modified by authors from Google Earth (<http://earth.google.com>).

Figure 5. Coastal geomorphological and lithological features of Providencia Island (Colombia)



Note. Adapted and modified by authors from Google Earth (<http://earth.google.com>).

Figure 6. Coastal geomorphological and lithological features of Santa Catalina Island (Colombia)



Note. Adapted and modified by authors from Google Earth (<http://earth.google.com>).

## 4.2 Biodiversity

Colombia is a privileged country with coasts and islands in the Pacific Ocean and the Caribbean Sea. The territorial region of Colombia in the Caribbean Sea extends for 532.162 km<sup>2</sup> (Posada et al., 2009), of which the Seaflower Biosphere Reserve has an area of approximately 180.000 km<sup>2</sup> (CORALINA & INVEMAR, 2012), approximately 34% of the territory, and although it seems little, in this area there are more than 77% of the total extension of the coral areas of Colombia (INVEMAR, 2009, p. 59); therefore, it is evident that the coral areas of the ASAPSC are the most extensive, complex and developed areas of the country. Coral reefs constitute 78% of the total area of the country with a great variety of associated fauna and flora, which matches the beauty and harmony of the coral areas of the western Pacific. Coral reefs correspond to the second reef system in the Western Hemisphere with five large atolls, two barrier reefs, lagoon patches and fringe reefs and other coral formations with more than 85 species of coral and 100 species of sponges (CORALINA-INVEMAR, 2012).

The ASAPSC has the six environmentally strategic tropical marine ecosystems of Colombia: coral reefs, sea grasses, mangroves, rocky coastlines, beaches, and soft bottoms. It is characterized by exuberant vegetation of the arboreal and shrub type of transitional forest between dry and humid up to 20 m high, with few epiphytes and a scarce herbaceous and shrub layer (Figures 7a and 7b). The vegetation contributes to the stabilization of the soil, since it retains sand and mitigates erosion by the action of the wind. This region has four landscape units: sandy coastline (sandy beaches), rocky coastline (outcrops of coral rocks), mangrove swamp and transition zone between mangrove and terrestrial vegetation (zone associated with mangrove). In total, these units have an approximate extension of 40,000 linear meters (CORALINA-INVEMAR, 2012).

The coastline is one of the most important habitats on the Island of San Andrés, both for its beaches—a vital resource for tourism—and for the biodiversity it shelters, highlighting: birds, fish, mollusks, reefs, reptiles, among others, for different terrestrial organisms, for turtle nesting and as a resting place for migratory and resident birds. The rocky shoreline is distributed along the western side of the island and in sections of the eastern side between the South End, Rocky Cay, and the North End. The predominant species of flora are *Melanthera aspera*, *Tecoma stans* (Figure 7c), *Cordia sebestena*, *Conocarpus erectus*, *Zoysia matrella*, *Sesuvium portulacastrum* (Figure 7d), *Ipomoea pescaprae* and *Lippia nodiflora*, *Coccoloba uvifera*, *Hymenocallina caribaea* and *Morinda royoc* (CORALINA-INVEMAR, 2012). There are species that are not associated with a specific geomorphological unit but appear along the coastline and have characteristics that allow them to survive in the three geomorphological units.

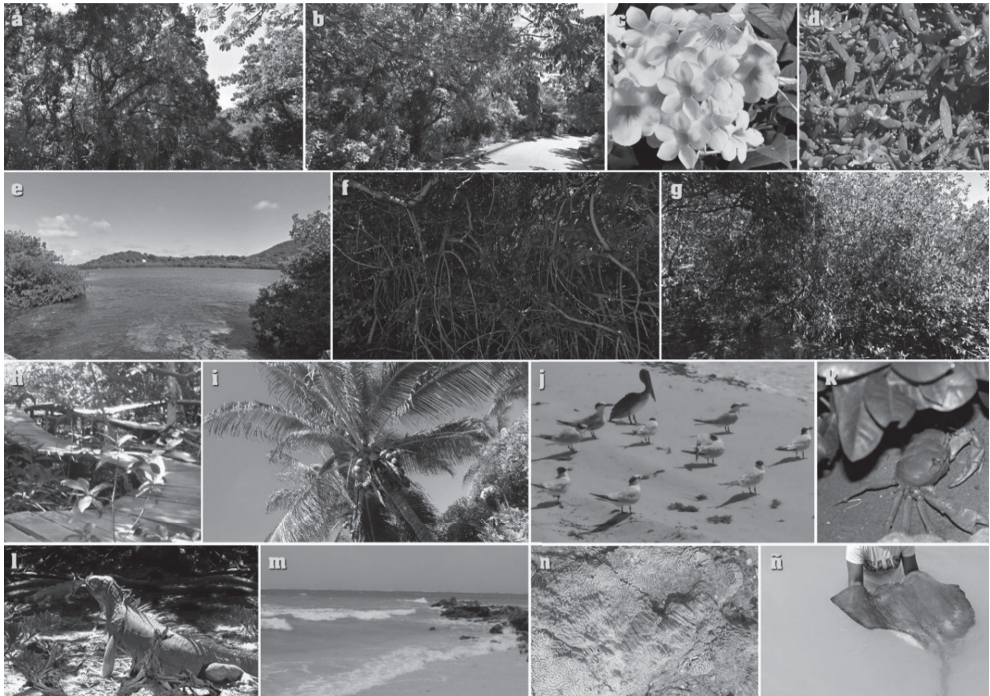
San Andrés Island has rich floral diversity in its vast mangrove swamps, the largest mangrove forest on the island being the Old Mangrove Point Regional Park. There are several mangrove forests (Figures 7e, 7g and 7h), rich with many species of flora and fauna revitalizing the ecosystem. There are also coconut palm trees (Figure 7i), breadfruit trees, tall growth of local trees, green and lush pastoral and farmlands. The vegetation of the littoral edge of Providencia and Santa Catalina has seven strata: arboreal, sub-arboreal, shrub, climbing, herbaceous, epiphytes and crasicale, predominantly the arboreal stratum

followed by the shrub stratum, the epiphytes, being the form of life with the least representation (CORALINA-INVEMAR, 2012). The cliffs vegetation is the unit that represents 50% of the coastal edge of Providencia. In the sandy beach landscape unit of the islands, the dominant species by cover include *Leucaena leucocephala* (Wild tamarind), *Hibiscus tiliaceus* (Majagua), *Coccoloba uvifera* (sea grape), *Lantana involuta* (Wild sage), *Blutaparon vermiculare* (Beach carpet), *Acacia collinsii* (Cock spur), *Eugenia acapulcensis* (Berrys) (CORALINA-INVEMAR, 2012).

One of the most colorful and striking groups on the coast of the ASAPSC are birds, their presence in this area is due, among other things, to the fact that in the habitats that make up the coastal zone, in addition to being the first feeding and resting areas for migratory species after long journeys, they provide foraging and reproduction areas for resident species. Given its geographic location in the Western Caribbean, it constitutes an important passage site for a considerable proportion of migratory bird species during their movements from North America to South America and vice versa. However, the birds in Figure 7j are a pelican and several terns, which are local, not migratory. In fact, there are more than 100 migratory species recorded on the islands (Hilty & Brown, 1986; McNish, 2003). According to the Humboldt Institute and Bird Life International, the high diversity of birds led to the inclusion of the ASAPSC, which forms part of the Seaflower Biosphere Reserve, and represent an IBA (Important Bird Area) (Moreno et al., 2003; Romero, 2005). Several subspecies of birds are endemic, these include Green-breasted mango (*Anthracothorax prevostii hendersoni*), Black-whiskered vireo (*Vireo aléliqueus subsp. Canescens*), Tropical mockingbird (*Mimus gilvus subsp. Magnirostris*), Yellow warbler (Golden) (*Setophaga petechia flavida*), Bananaquit (*Coereba flaveola oblita*), and Black-faced grassquit (*Tiaris bicolor grandior*).

Among the aqua faunal species found here are oysters and crabs. The Blue land crab (*Cardisoma guanhumi*) (Figure 7k) has been the main semi-terrestrial animal used in the island's diet, culture, and tradition for generations. It is present on San Andrés, Providencia, and Santa Catalina, but its distribution throughout the islands is not uniform. The number of crabs in the forest is much higher (up to 15 times) than in cultivated areas. The coral species (Figure 7l) found in the island's shores are staghorn coral (*Acropora cervicornis*), Elkhorn coral (*Acropora palmata*), pillar coral, brain coral (Figure 7m), encrusting gorgonian or encrusting polyps (*Erythropodium caribaeorum*), star coral (*Astreopora sp.*), soft corals (*Alcyonacea sp.*), finger coral (*Porites porites*) and sea pens (cnidarians). The only wild mammal that has been recorded from San Andrés is the Jamaican fruit bat (*Artibeus jamaicensis*). In the ASAPSC, the iguana (Figure 7n) is one of the most representative fauna icons, however, it is under strict protection, given the hunting of its species, that is consumed in dishes derived from the typical island gastronomy. Given the above, the "Johnny Cay Regional Park" was created, where these reptiles are raised and protected, in addition to being the main attraction for residents and tourists who visit the key. Through resolution 622 of August 23, 2018, Coralina adopted environmental protection measures for manta rays (Figure 7ñ) associated with "tourist activities that involve baiting, feeding and/or direct contact with them" and others are issued provisions.

Figure 7. Biodiversity of the ASAPSC

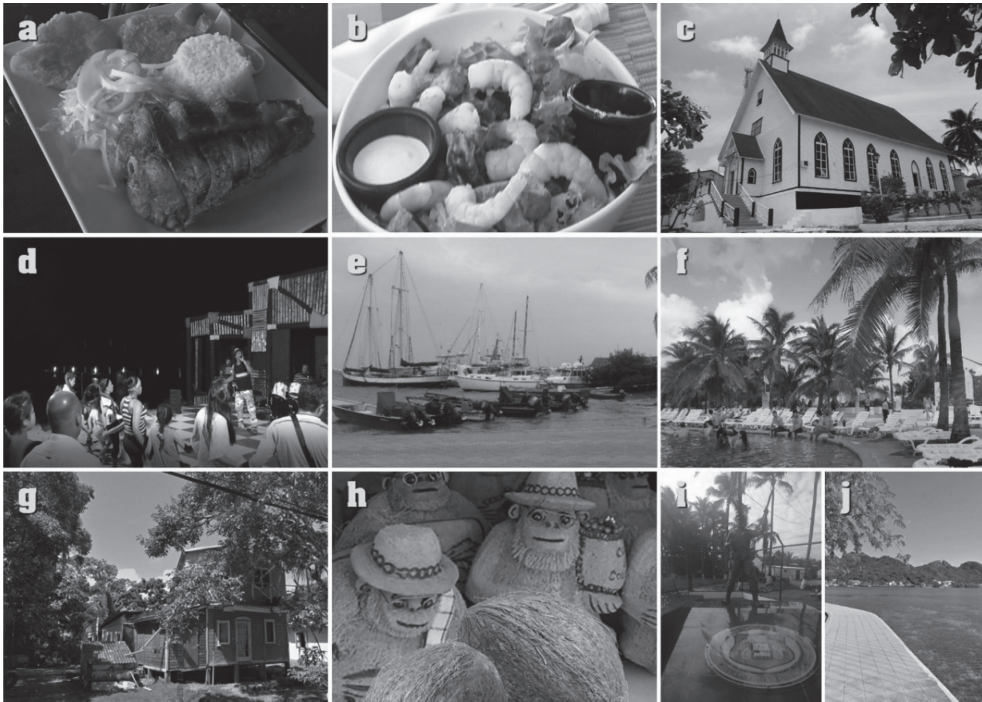


*Note.* Own photographs.

### ***4.3 Cultural heritage***

The ASAPSC is an unmissable place for lovers of culture (Figure 8), with several various musical, linguistic, historical, and architectural attractions. Among the elements that are part of tangible cultural heritage, the following stand out: churches and temples religious, which represent the foundations of the idiosyncrasy and spirituality of the Raizal in which oral ancestral ties and the transfer of customs are ensured, education and literacy; the island house; public buildings of historical value, such as María Inmaculada School or the Sunrise Park administration building; musical instruments; literature; plastic arts; archeological artifacts. The insularity is given by the fact that in the ASAPSC, there is a closed Raizal society, which reinforces the feeling of isolation of the rest of the world. These characteristics have allowed them to be preserved cultural elements that would probably have disappeared in another geography and have created a close relationship between the habitants and their environment.

Figure 8. Cultural features of the ASAPSC



*Note.* (a)-(b) Gastronomic offers. (c) Baptist church. (d) Caribbean music shows. (e) Leisure port. (f) Hotel offers. (g) Typical architecture of the island made of wooden buildings. (h) Handicrafts. (i) Historical monuments. (j) Trails for ecological walks.  
Source: Authors.

The natural and cultural potential geosites with high use values (ordered by quantitative assessment) reveal very interesting aspects on the regional evolutionary history of the ASAPSC, including several coastal erosion and sedimentation landforms, biodiversity, and cultural legacy (Table 4). The inventory and quantitative assessment of the most valuable occurrences of the natural and cultural heritage are very important in any geoconservation strategy and in the establishment of priorities in site management. The inventory of sites of geological interest includes the identification of potential geosites, the qualitative assessment, the characterization and selection, whereas the quantification refers to numerical assessment and descriptive analysis of results.

Table 4. Quantitative evaluation of geosites on the ASAPSC

Code	Geosite	Associated publications	Scientific value	Didactic teaching	Ecological	Cultural	Historical	Aesthetic for tourism	Landscaping	Rarity	State of conservation	Vulnerability	Accessibility	Visibility	Qualitative valuation
GEO-1	Limestone mining open pit	3,0	5,0	5,0	1,0	1,0	1,0	3,0	1,0	5,0	5,0	1,0	5,0	5,0	41,0
GEO-2	Big Pond Lagoon	3,0	4,5	4,5	5,0	1,0	1,0	5,0	4,0	5,0	5,0	5,0	4,5	4,5	52,0
GEO-3	Mountain Range	3,0	3,5	3,0	4,5	1,0	1,0	3,5	4,5	3,0	4,0	3,0	3,5	4,0	41,5
GEO-4	Morgan's Cave	4,0	5,0	5,0	5,0	3,5	5,0	5,0	3,0	5,0	4,0	5,0	4,5	4,0	58,0
GEO-5	Coastal plains	3,0	4,0	4,0	4,0	2,0	1,0	3,5	4,5	3,0	4,0	3,0	5,0	5,0	46,0
GEO-6	Spratt Bright Beach	4,0	4,5	4,5	5,0	2,0	1,5	5,0	5,0	3,5	4,0	5,0	5,0	5,0	54,0
GEO-7	Johnny Cay	5,0	5,0	5,0	5,0	3,5	2,5	5,0	5,0	3,5	4,0	5,0	4,0	4,5	57,0
GEO-8	Santander Cay	3,5	4,5	4,5	5,0	3,5	2,5	5,0	5,0	3,5	4,0	5,0	4,0	4,5	54,5
GEO-9	Old Point Mangroves National Park	5,0	5,0	5,0	5,0	1,0	1,0	5,0	5,0	5,0	4,5	5,0	5,0	5,0	56,5
GEO-10	Rose Cay	3,5	3,5	3,5	5,0	3,5	2,5	5,0	5,0	3,5	4,0	5,0	4,0	4,5	52,5
GEO-10	Haynes Cay	4,5	4,5	4,5	5,0	3,5	2,5	5,0	5,0	3,5	4,0	5,0	4,0	4,5	55,5
GEO-12	Cocoplum Bay Beach	3,0	5,0	5,0	5,0	2,0	1,5	5,0	5,0	3,5	4,0	4,5	5,0	5,0	53,5
GEO-13	Rocky Cay	5,0	5,0	5,0	5,0	3,5	3,5	5,0	5,0	3,5	4,0	5,0	4,0	4,5	58,0

Code	Geosite	Associated publications	Scientific value	Didactic for teaching	Ecological	Cultural	Historical	Aesthetic for tourism	Landscaping	Rarity	State of conservation	Vulnerability	Accessibility	Visibility	Qualitative valuation
GEO-14	San Luis Beach	3,5	4,5	4,5	5,0	2,0	1,5	5,0	5,0	3,5	4,0	4,5	5,0	5,0	44,0
GEO-15	Low hills	1,0	2,5	2,5	4,0	1,0	1,0	2,5	3,5	3,0	4,0	3,0	4,5	4,0	36,5
GEO-16	The Blowing Hole	4,0	3,5	3,5	4,0	3,0	1,0	5,0	4,5	5,0	5,0	5,0	5,0	3,5	48,5
GEO-17	Cat Bay Point	3,0	4,5	4,5	5,0	1,0	1,0	4,5	5,0	3,5	3,5	4,0	5,0	5,0	49,5
GEO-18	Coral reef platform	5,0	5,0	5,0	5,0	1,0	1,0	5,0	5,0	2,0	4,0	5,0	5,0	5,0	53,0
GEO-19	El Cove Bay	4,5	4,5	4,5	5,0	2,0	1,0	5,0	5,0	3,5	4,5	5,0	5,0	5,0	54,5
GEO-20	Island House Museum	4,5	5,0	5,0	2,0	5,0	4,0	4,0	1,0	3,5	4,5	3,5	5,0	5,0	40,5
GEO-21	Bautiste Church	4,5	5,0	5,0	2,0	5,0	4,0	4,0	1,0	3,0	4,5	3,5	5,0	5,0	48,0
GEO-22	Fresh Water Bay Beach	4,0	4,5	4,5	4,5	1,0	1,5	4,5	5,0	3,5	4,0	4,5	5,0	5,0	51,5
GEO-23	South West Bay Beach	3,5	4,5	4,5	5,0	1,0	1,5	4,5	5,0	3,5	4,0	4,0	5,0	5,0	51,0
GEO-24	Manzanillo Beach	2,5	4,5	4,5	5,0	2,0	1,5	4,5	4,5	3,5	3,5	4,0	5,0	5,0	50,0
GEO-25	Iron Wood Hill	2,5	4,5	4,5	4,5	1,0	1,0	4,5	4,5	3,0	4,0	4,0	3,0	4,5	45,5
GEO-26	Three Brothers Cays	4,0	5,0	5,0	5,0	3,5	2,5	5,0	5,0	3,5	4,0	5,0	4,0	4,5	56,0

Code	Geosite	Associated publications	Scientific value	Didactic for teaching	Ecological	Cultural	Historical	Aesthetic for tourism	Landscaping	Rarity	State of conservation	Vulnerability	Accessibility	Visibility	Qualitative valuation
GEO-27	McBeam Mangrove Swamp National Park	5,0	5,0	5,0	5,0	1,0	1,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	57,0
GEO-28	Maracaibo Bay	3,0	3,0	3,0	4,5	1,0	1,0	3,5	4,0	3,0	4,0	4,5	5,0	5,0	44,0
GEO-29	Crab Cay	4,0	4,5	4,5	5,0	3,5	2,5	5,0	5,0	3,5	4,0	4,0	4,5	4,5	55,0
GEO-30	Garret Bay	4,0	4,0	4,0	4,5	1,0	1,0	4,0	4,5	3,5	4,0	4,5	4,5	5,0	48,5
GEO-31	The Peak	4,5	4,0	4,0	4,0	1,0	1,0	5,0	5,0	3,0	4,0	5,0	5,0	5,0	50,5
GEO-32	Morgan's Head	4,0	4,5	4,5	4,5	3,0	3,0	5,0	5,0	5,0	4,5	4,5	2,0	4,0	53,5
GEO-33	Mona Bay	3,5	4,0	3,5	5,0	1,0	1,0	5,0	5,0	3,5	4,5	4,5	2,0	4,0	46,5
GEO-34	Fort Warwick	3,0	3,5	3,0	3,5	2,0	5,0	4,0	4,5	4,0	4,0	4,5	5,0	5,0	51,0
GEO-35	Ecological footpath	3,5	4,0	4,0	3,5	4,0	2,0	5,0	5,0	3,5	4,5	5,0	5,0	5,0	54,0
GEO-36	Mangrove Swamp	3,5	4,5	4,5	5,0	1,0	1,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	54,5
GEO-37	Lovers' Bridge	3,5	2,5	2,5	3,5	3,0	2,0	5,0	5,0	3,5	4,0	5,0	5,0	5,0	49,5
GEO-38	Old Cannon	2,5	3,5	3,0	3,5	2,0	4,5	3,5	4,5	4,0	4,0	4,5	5,0	5,0	49,5
GEO-39	Bucanera Point	3,0	5,0	5,0	5,0	1,0	1,0	5,0	5,0	3,5	4,0	4,0	2,5	3,5	47,5

Note. Own construction.

Thirty-nine (39) sites of geological interest were identified, described, and valued, which, according to the adapted and modified methodology of Brilha (2016), present a scientific, educational, and tourist value of 36.5 to 58.0. Of this inventory of sites of geological interest, twenty-three (23) have potential as geosites because they have a score equal to or greater than 50.0. Morgan’s Cave (GEO-4) and Rocky Cay (GEO-13) represent the most important geosites according to the score obtained (58.0), followed by Johnny Cay (GEO-7) and McBeam Mangrove Swamp National Park (GEO-27) with 57.0; Old Point Mangroves National Park (GEO-9) with 56.5; Three Brothers Cays (GEO-26) with 56.0; Haynes Cay (GEO-11) with 55.5; Crab Cay (GEO-29) with 55.0; Santander Cay (GEO-8), El Cove Bay (GEO-19) and Mangrove Swamp (GEO-36), with 54.5; Spratt Bight Beach (GEO-6) and Ecological footpath (GEO-35) with 54.4; Cocoplum Bay Beach (GEO-12) and Morgan’s Head (GEO-32) with 53.5; Coral reef platform (GEO-18) with 53.0; Rose Cay (GEO-10) with 52.5; Big Pond Lagoon (GEO-2) with 52.0; Fresh Water Bay Beach (GEO-22) with 51.5; South West Bay Beach (GEO-23) and Fort Warwick (GEO-34), with 51.0; The Peak (GEO-31) with 50.5; Manzanillo Beach (GEO-24) with 50.0. From the educational and tourist point of view, these geosites reflect the need to carry out the installation of signage and interpretive panels aimed at a general public, which facilitate not only the development of geo-educational activities but also the identification and understanding of the geological elements and processes present there. It is equally important to note that the absence of infrastructure and facilities to provide security and a better experience to the public is mainly observed.

The intangible cultural heritage of the ASAPSC refers to the ancestral practices, expressions, knowledge, or techniques transmitted by the Raizal people from generation to generation, finding in the coexistence with the sea their reason for being. These valuable elements (religion, language, literature, music, gastronomy, or identity) contribute to cultural diversity, creativity and social well-being, territorial management, the creation of territorial identity, and the generation of economic income, although many of these elements are at serious risk of disappearance. Through many generations, the Raizal people have transmitted cultural practices in harmony with the preservation of species and with the protection of this natural environment.

Table 5. Intangible heritage on the ASAPSC

<i>Type of activity</i>	<i>Heritage category</i>	<i>Heritage subcategory</i>	<i>Value criteria</i>	<i>Elements</i>	<i>Location</i>	<i>Main Characteristics</i>
Patron saint festivities of San Andrés	Cultural	Intangible	Religious, Social, Touristic	Cultural and Touristic	San Andrés	Celebration of the patron saint festivities with stops and indigenous cultural presentations.
Caribbean Evenings Party	Cultural	Intangible	Social, Artistic, Touristic	Folk, Dance, Native instruments, Music, Gastronomy	San Andrés	Folkloric demonstrations, typical dances, demonstration of native instruments and presentation of musical groups, gastronomy.
Replica Flower Party	Cultural	Intangible	Cultural, Social, Economic, Touristic	Parade	San Andrés	Jolgorios whose main expression is the silletero parade.

<i>Type of activity</i>	<i>Heritage category</i>	<i>Heritage subcategory</i>	<i>Value criteria</i>	<i>Elements</i>	<i>Location</i>	<i>Main Characteristics</i>
Bill & Mary Calypso Festival	Cultural	Intangible	Artistic, Touristic	Folk, Native instruments, Music	San Andrés	Festival that allows us to promote island talent of all ages, in addition to providing a space for new talent to find opportunities that contribute to caring for our cultural traditions.
Sea Week	Cultural	Intangible	Artistic, Touristic	Art, Music	San Andrés	The Sea Week is organized by the National Navy with the support of local businesses. The city is adorned in multiple ways, stores are decorated with marine motifs and retreats are offered by the National Navy band and some shows of various kinds that accompany the celebration.
International Theater Festival of Ethnic Roots	Cultural	Intangible	Artistic, Touristic	Scenic art, Music	San Andrés	The International Theater Festival of Ethnic Roots is a meeting of the protagonists of the scenic art, where its landscapes and public spaces are the perfect setting to offer five days dedicated to the theater, the laughter that is in the puppets, the magic of the works in the open air and the close proximity of the theater.
International Triathlon Festival	Cultural	Intangible	Sports and recreation, Touristic	Sports	San Andrés	The paradisiacal island of San Andrés becomes the venue for one of the most demanding and competitive sporting events in the country that combines swimming, cycling and athletics.
National holidays August 7	Cultural	Intangible	Cultural, Social, Touristic	Parade	San Andrés	National parade, with cultural presentations from the island.
Race Day	Cultural	Intangible	Cultural, Social, Touristic	Parade	San Andrés	National parade, with cultural presentations from the island.
Afro-Colombianity and African Heritage Day Festival	Cultural	Intangible	Cultural, Social, Touristic	Folk, Art, Music, Gastronomy	San Andrés	During this festival it is remembered that more than a celebration, it is a commemorative event in which the abolition of slavery in Colombia is remembered, the contributions that this ethnic group made to the community

Type of activity	Heritage category	Heritage subcategory	Value criteria	Elements	Location	Main Characteristics
						revolution and the liberating cause, their sporting achievements, political, artistic and their fight for preservation.
Green Moon Festival	Cultural	Intangible	Educational, Linguistic, Artistic, Religious, Sports and Recreational, Touristic	Art, Cine, Music, Sports, Gastronomy	San Andrés	The Green Moon Festival is celebrated annually on the Island of San Andrés to manifest the way of being typical of the anglophone “Creole” people of the Caribbean and brings together the artistic, gastronomic, intellectual, religious, sports, cinematographic and, in particular, musical expressions of the islanders.
Regional Meeting of Choirs	Cultural	Intangible	Religious, Artistic, Touristic	Music	San Andrés	The Regional Meeting of Choirs brings together choral groups from the different churches of San Andrés, Providencia and Santa Catalina in order to seek to remain as a driving force for the preservation, strengthening and dissemination instrument of the Raizal culture.
Seaflower Film Festival	Cultural	Intangible	Artistic, Touristic	Talks, Film and documentary screenings, Workshops	San Andrés	In San Andrés, talks, film and documentary screenings, and workshops on the environment are held, with the objective of strengthening the cultural values of the archipelago, in contrast to its natural wealth.

Note. Own construction.

Gastronomy is one of the distinctive features and occupies a privileged place in the cultural structure. It is rich in seafood (fish, crabs, snails, among others) and other components of Raizal culture, but *rundown* is distinguished as a typical dish. Raizal people are the native population from San Andrés, Providencia, and Santa Catalina, they are product of the miscegenation between indigenous, Spanish, French, English, Dutch, and Africans people, prioritizing the British culture, since it was the one that most strongly colonized the islands from the Caribbean. Its Afro-Anglo-Antillean cultural roots are manifested in a strong cultural identity that differs from the rest of the Colombian population and the Raizal language is one of the Caribbean dialects of English, which have many Africanisms. In addition, the archipelago was visited by slaves and pirates, who used these islands as a refuge, lair, and storage of all the stolen wealth. Morgan’s Cave is one of the most outstanding attractions from San Andrés, since it contains the most striking character of the seas, “Henry Morgan”, whose legends and stories are the favorite by natives and tourists.

A Carib Indian aboriginal population never settled on the islands, but San Andrés and Providencia were visited now and then by Miskito Indians from the Central American coast, who came to catch fish and turtles. The islands were “discovered” early in the 16th century by Spanish sailors. The first settlers on the islands at the beginning of the 17th century were Dutch smugglers and English Puritans. The islands changed hands between English and Spanish rulers from 1641 to 1822, with occasional conquests by pirates from Jamaica and Haiti. (Parsons 1956, 1964, as cited in Geister & Díaz, 2007, p. 8)

Even though San Andrés Island has experienced an economic boom since 1953, when it was declared a free port by the government of General Rojas Pinilla, it has a shortage of water, inadequate waste management, excess population, high levels of poverty, erosion of most of its beaches, overexploitation of fishing and environmental problems; in addition to this, thousands of tourists visit the ASAPSC annually, however, the overwhelming pace of unsustainable tourism has been devouring this territory. Undoubtedly, the economy of the population is sustained by tourism and depends to a great extent on it, although ecological damage over a long time has contributed to the constant deterioration of San Andrés Island. In 2000, it was declared Biosphere Reserve by UNESCO, named “Seaflower Biosphere Reserve”, which not only includes the islands, but also about 10% of the Caribbean Sea, amounting to a vast marine area of 300000 km<sup>2</sup> in order to ensure the preservation and conservation of this ecosystem, which is rich in biodiversity (Howard, 2006). Unfortunately, the surroundings of San Andrés Island and the pier have become a graveyard of forgotten rusty boats, among which two colossal ships stand out to the detriment of the landscape that the beautiful sea of seven colors offers us. Over exploitation of fishing has caused some species, such as the shovel snail—which has been part of the island’s gastronomy—to be on the way to extinction. A large part of the population lacks a water supply, mainly extracted from aquifers, due to the lack of rivers and natural sources.

The ASAPSC represents a territory whose literary tradition, although limited, is significant, highlighting different stories, poems, autobiographies, or novels by various writers that present a historical radiography of the culture of these Caribbean islands. Its literature reflects the political and social makeup in the shadow of different empires and rulers, but they are especially a window on the way in which the cultural identity of the islanders was created due to the historical events that took place in their territory. On the other hand, the regional identity is perceived as a product of numerous nationalities that have contributed to shaping who they are today. The original is African, although these roots are not the only ones that distinguish the inhabitants of this region, because it is precisely because of their cultural, linguistic, and racial wealth that they are in a special category on the Colombian ethnographic map. The inhabitants of the ASAPSC are an amalgamation of all the cultures that once populated the islands, and in the stories we can see how the current San Andrés was arrived at.

Another very important aspect in the molding of the island identity refers to religion, since the Baptist church was inserted in the ASAPSC, which was left by the English-speaking settlers, although with the arrival of the Spanish and the establishment of the Colombian Government, the presence of the State was manifested mainly through institutions such as the ecclesiastical. A narrative is an account of relevant events and experiences over time. Typically, the unique pattern of a narrative reflects the meaning attributed by the

narrator and sheds light on the motivations and behaviors (Woodside & Megehee, 2010). However, the island narrative has ultimately contributed to preserving, rescuing, and promoting their ancestral values, adopting the term “Raizal” to differentiate themselves from Afro-descendants and to recognize themselves as natives of a unique place in all aspects. In this way, they have survived the social, economic, and cultural changes of the Caribbean islands. Today, Raizal people struggle to maintain a culture as intact as possible; to speak Creole language; to practice their religion; to listen, dance, and create their music; for their authenticity as islander people. The multiple relationships that have emerged between the islanders and the natural environment, that characterize the ASAPSC, have been significantly shaped and informed by different narratives (Table 6).

Table 6. Conservation narratives and their characteristics in the ASAPSC

<i>Conservation narratives</i>	<i>Narrative characteristics</i>
Raizal narrative	Ancestral indigenous people of the Archipelago of San Andrés, Providencia and Santa Catalina, with its own language, culture, history, ancestors, and marine territories. The Raizal people is the ethnic group that is made up of the descendants of the Amerindians, Africans and Europeans who populated the Archipelago to build a society with its own language and culture. Its diversity is recognized and protected by the State and constitutes a wealth of the Nation. A set of manifestations, practices and expressions, such as Baptist religion, Creole language and oral tradition, that ratify a communion between nature, the sea and the Raizal culture that gave rise to the marine culture, which must preserve, promote and transmit. The Special Safeguarding Plan of Cultural practices, and ancestral knowledge of Raizal people with the sea is the result of a process, which brought together the efforts, enthusiasm and commitment from public and private sector institutions but above all, from members of the Raizal community of the Archipelago of San Andrés, Providencia and Santa Catalina. It seeks to offer as a legacy to present and future generations, strategies and tools for the consolidation of the cultural identity of the Raizal people in general, but particularly the roots of their marine territory; that territory that, as many scholars affirmed during the field work, constitutes the very essence of the Raizal, its umbilical cord, its prolongation in space and time.
Nature narrative	The Archipelago of San Andrés, Providencia and Santa Catalina is a natural wonder in which numerous species of coral inhabit that give rise to the range of blue, turquoise and green of the sea that surrounds its coastals line. It was declared in the year 2000 World Reserve of the Biosphere “Seaflower” by UNESCO, which includes the islands and their distant keys. It covers approximately 10% of the Caribbean sea, with three main islands, surrounded by coastal mangroves swamps and highly intact and productive associated coral reef ecosystems. The following criteria were taken into account by UNESCO to grant this recognition: high biodiversity, possibilities for testing and demonstrating sustainable development with the active participation of people, sufficient importance for conservation and administrative capacity to implement the zoning and management plan.
Destruction narrative	Unfortunately, this region of the Caribbean Sea has been affected by a progressive and dramatic substantial loss of biodiversity as a consequence of and the destruction of its habitats, the increase in human settlements and the associated coastal development, pollution, overexploitation of resources, the introduction of exotic species and climate change, etc.
Resource gestion narrative	The integral administration of resources for human development that the vision of the Biosphere Reserve supposes is conceived as a social and inclusive process in which the management of environmental authorities and government authorities are articulated, a situation that does not always occur.

<i>Conservation narratives</i>	<i>Narrative characteristics</i>
Conservation narrative	Different actions at the local level that involve public or private and community actors have been focused on the protection of species such as the Black Crab, which is of great relevance for the Raizal culture, because it is part of the local gastronomic heritage, desired by the islanders and tourists who visit the archipelago, for the local economy since it represents an important source of income for the raizales families, for the environment since it contributes in the cycle of nutrients, fertility and the health of the soils, for the culture since it is a native species and natural heritage of the islands, its capture, processing and preparation, belong to the ancestral traditional knowledge. The conservation strategy of the San Andrés, Providencia and Santa Catalina Archipelago can be based on the development of school projects and values in environmental education aimed at children and adolescents, which promotes a future generation of conscious people who contribute to the conservation of the natural resources and the improvement of the quality of life.

*Note.* Own construction.

#### **4.4 Geotourism assets and opportunities**

From a general perspective of tourism development, the ASAPSC has a diverse mix of natural and cultural assets. Geotourism specifically focuses on geology and landscape. This region has natural assets that provide a range of ecosystem services to the region and form the backbone of the drive for nature tourism. Some of these assets are geotourism resources, sufficient in diversity and geographic distribution in the region to sustain their development; however, it is important that government entities in the region consider starting to capitalize on the full potential and the opportunities of these assets. The annual arrival of tourists to this region, whose number has reached one and a half million visitors, currently has the environmental authorities of the Coralina Corporation concerned about the negative impact it could cause on the local ecosystem. Therefore, it is important to consider the carrying capacity, which is an indicator that has been implemented to establish how many people can live in the island territory, to prevent the deterioration of natural resources from continuing to accelerate due to their over-exploitation. In this way, it is necessary to immediately implement a sustainable tourism program in order to contribute to the management of the ASAPSC as a tourist destination. Geotourism in this archipelago—which can take advantage of its natural and cultural heritage—is an alternative for sustainability and for generating social, economic, and environmental impacts, meeting the needs of visitors, industry, environment, and host communities.

There are different tourist attractions in the ASAPSC: Morgan's Head, a rock slope in the western part of Santa Catalina Island; Old Providence National Natural Park, Cangrejo Cay, The Peak and Manzanillo Bay in Providencia Island.

North End is known locally as the center of the San Andrés Island, which concentrates the hotel zone, commercial, banking and government; Islander House Museum, created by the natives in order to acquaint visitors with the culture and customs of the inhabitants; La Loma, a town inhabited almost entirely by natives of the island and one of the best places to appreciate the traditional island architecture; Santander Cay, located opposite the pier and close to the coast of the San Andrés Bay, and whose name comes from the English

settlers that cultivated cotton and coconut; The Cliff (Peñon), limestone formation surrounding the airport, which is a rocky cliff about 30 m high above the airport; Cocoplum Bay, a beach located in the village of San Luis, right in front of the Rocky Cay, because of its shallow depth, with its white sand and blue green sea, is a favorite spot for tourists; La Piscinita, a natural formation that built the sea in the coral rock that surrounds the island; Rocky Cay Beach, on the north side of the San Andrés Island. (Best Beach for Rest, n.d.)

The ASAPSC is surrounded on its northwest side by a small coral reef and several keys that are home to varied fauna and flora, which are visited by many tourists every year. It is said that the small key in San Andrés Bay is the most visited place in this archipelago. Johnny Cay is a small coral islet that is located 1.5 km to the north of San Andrés Town. It is a scenic place with white-sand beaches surrounded by coconut plantations. The sea here is not suitable for swimming as the current of flow could be risky. A natural park was also created here in 2001. Haynes Cay is the place where cruise ships dock. There are a number of large coral farms here, with variety of species. The place is also popular for water sports activities like snorkeling and diving. Diving here with a mask and sandals (protection against sea urchins) colorful fish species can be seen. The Aquarium Cay is off to the east coast of San Andrés, adjoins the Haynes Cay. It is a popular center for snorkeling since the sea here has shallow and calm waters. However, the departmental administration has restricted the realization of tours to reach the ship stranded in Rocky Cay, because it represents a danger to the integrity of tourists and residents due to the advanced deterioration in which it is found.

San Andrés Island has wonderful and surprising landscapes, the declaration as a Biosphere Reserve by UNESCO and the national fervor revived in Colombian people due to the intense dispute with Nicaragua; all this make this region have valuable potential for the development of geotourism activities. The relevant scientific, educational, and aesthetic values of the natural and cultural heritage convert this region into a very important resource for outdoor tourism, sports, and health attractions (Figure 9). In addition to these activities, the ecotourism—such as hikes and birdwatching—will support other outdoor activities. However, it is necessary to understand the natural and cultural heritage of this region through geoeducation programs.

Geoeeducation, which has attracted the attention of scientists and educators (Lewis & Hampton, 2015), plays an important role in integrating local communities to improve their quality of life, providing social equity. In order to improve the outreach of heritage resources and the tourist experience through the understanding of geosites, it would be very useful to implement interpretative panels and georoutes to guide visitors through the natural and cultural heritage of the ASAPSC, improving its outreach information and upgrading the tourist infrastructure, trying to draw the attention of tourists who come to this region for several reasons. A better understanding of the heritage resources of the ASAPSC and their field of action contributes to the sensitization on geoconservation. Therefore, geoeeducation contributes to the conservation of this region of the Colombian Caribbean Sea and represents the most effective way to guarantee the contribution to the preservation of the environment in the long term, providing a combination of understanding, attitudes, and skills.

Figure 9. Geotourism attractions in the ASAPSC. (a) Ecological walks. (b) Horseback riding. (c) Cycling. (d)-(g) Water sports. (h) Blower hole. (i) Old boat stuck. (j)-(l) Pirate Morgan's cave



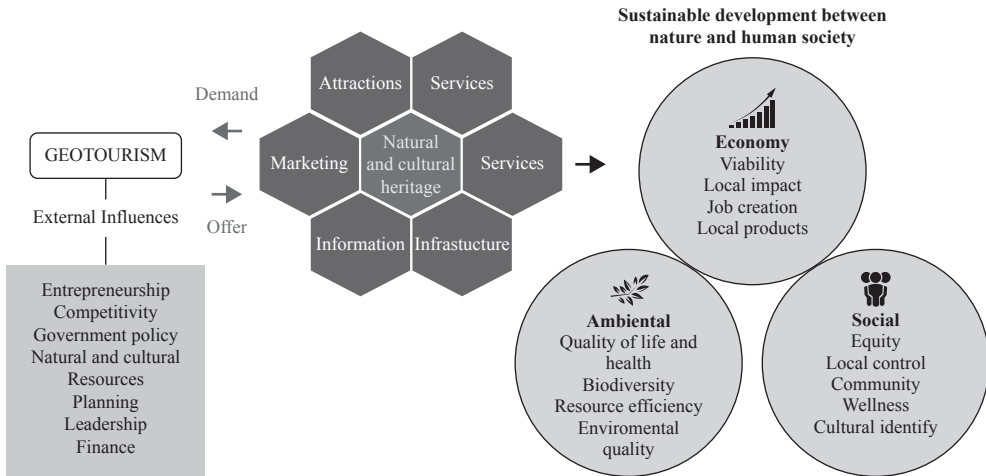
*Note.* Own photographs.

In the present article, we agree with Wakil et al. (2021), about how the resilience of local communities should be promoted in conjunction with the supply and demand of tourism. Figure 10 illustrates the geotourism operating system based on supply and demand, in which the interrelation between attractions, marketing, information, infrastructure, facilities and services is essential.

However, geotourism development is strongly influenced by several external factors (Gunn & Var, 2002). Sustainable development between nature and humans will guarantee viable economic activities in the long-term, maintain essential ecological processes and respect the socio-cultural authenticity of local communities. From the social, environmental, and economic perspective, it is important to highlight that the heritage resources of the ASAPSC play a vital role and could provide strong support for the development of geotourism and

geoeducation activities for geoconservation purposes of this territory and its patrimonial attributes.

Figure 10. Functional geotourism system



Note. Figure adapted and modified from Gunn & Var (2002).

## 5. Conclusions

This research seeks to show and promote the importance of preserving the natural and cultural heritage of the ASAPSC, allowing to identify geosites with high potential for tourist attraction, due to their scientific, academic, landscape, educational, religious, economic, gastronomic, social, cultural, artistic, historical, and aesthetic value for the geotourism development. We consider that this region can explicitly promote geotourism as a component of the tourism products available in the region. There is no doubt that it has the patrimonial resources and potential to support a coordinated, well-defined, and integrated promotion of geotourism. Geotourism is a nascent term in Colombia, which favors the strengthening of the territorial identity, and which can also be used as a strategy for its protection and development thanks to its social, environmental, cultural, historical, scientific, gastronomic, academic, aesthetic, economic, religious and sporting interest. These activities contribute to various factors at the national and international level, highlighting job creation, increase in arrival of tourists, trade, development of socio-economic activities, academic and cultural exchange. One of the best ways to raise awareness in local communities of the ASAPSC about the value of the natural and cultural heritage is through geoeducation, which can also contribute to its protection, conservation, and preservation. Therefore, it is important to establish strategic agreements with local communities, companies, public and private institutions, organizations, etc., with the aim of creating sustainable and sustainable plans focused on the conservation and preservation of the use and management of their heritage.

## 6. Acknowledgements

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