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State of the Art of Geodiversity, Geoconservation, and Geotourism in Costa Rica

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Abstract: Over the last decades, Costa Rica became established as a world-leading ecotourism destination due to its environmental policies and environmental awareness. The country is located in a dynamic region where the combination of tectonics and volcanism, and tropical climate and vegetation have molded its landscapes. Our aim is to carry out a review of the geodiversity, geoconservation, and geotourism status in Costa Rica. We analyzed different geomorphic environments (volcanic, coastal, karstic, glacial, and fluvial), prospecting the importance of environmental policies and the Conservation Areas National System for the promotion of national geoheritage through geotourism. Our results are critical for the promotion of geosciences to the wider public throughout geotourism and conservation decision-makers. In dynamic, geomorphic, tropical, and developing countries with strong anthropic pressures over their geo- and biodiversity, geoheritage studies might be a priority for increasing their revenues through geotourism and reducing the pressure on their natural resources.

Keywords: geoheritage; geodiversity; geomorphosites; geotourism; geoconservation; environmental policies; Central America; Latin America; geoparks

1. Introduction

Geodiversity, geoheritage, geoconservation, and geotourism concepts are closely related. These research lines have increased significantly since the 1990s [1]. Geodiversity is the natural range (diversity) of geological (rocks, minerals, and fossils), geomorphological (landforms, landscapes, topography, and physical processes) and soil features, assemblages, systems, and processes [2]. Therefore, bedrock, landforms, and soils are evaluated by their uniqueness and representativeness. The concept of geodiversity is analogous to the biodiversity concept, but with a strong timescale contrast. Geodiversity, then, emphasizes the links between geosciences, wildlife, and people in one environment or system [3]. The importance of geodiversity escalates depending on the intensity of the relationships between the different Earth system processes and their interrelations [4–7].

Geoheritage studies around the world have demonstrated marked growth since the early 1990s [8]. Moreover, the International Union for the Conservation of Nature (IUCN) and United Nations Sustainable Development Goals identify geoheritage and geoconservation importance [9]. Geoheritage needs to be appreciated by the wider community through tourism. Geotourism is a form of tourism centered on some aspects of the Earth's geological and/or geomorphological heritage that can have beneficial or negative impacts on geoheritage [10]. The geoconservation community must work to ensure geoheritage conservation in protected areas gain more significance in local, national, and international agendas for nature, sustainable development, and human well-being [11].

Abundant quantitative and qualitative methods to inventory geodiversity and geoheritage have been proposed in the last two decades [12,13]. Due to its geographical nature and discipline novelty, geoheritage studies are more common in temperate than tropical regions [14]. In Latin America,

studies on geomorphosites have been increasing, however, in Central America and Costa Rica they are scarce and mostly focused in volcanic landscapes [15]. For example, Poás Volcano National Park geomorphosites were studied, the most visited volcano in Central America [16,17]. Moreover, a geomorphosites comparison was made of the volcanoes Poás in Costa Rica, Paricutin in Mexico, and Teide-Pico Viejo in the Canary Islands of Spain [18]. Recently, an integrated approach for the inventory and management of the geomorphological heritage of the Irazú Volcano National Park was presented [19]. Newly, the Miocene-Quaternary volcanic and paleoglacial geoheritage, and geotourism promotion of Chirripó National Park were studied [20].

Geotourism focuses on the geological and geomorphological features of the landscape. However, in recent years the focus has introduced the links between geodiversity, biodiversity, archaeological and cultural values, gastronomy, and/or architecture [21]. During the last decades, geotourism has increased worldwide as a useful tool for promoting natural and cultural heritage encouraging local and regional economic development [22,23]. Geotourism has a long tradition in countries like South Africa, New Zealand, and Australia [24–26]. Geoparks are a relatively new concept, today geotourism is also sponsored mainly within geoparks, but other regions also possess an important geotourism potential, therefore new assessments of the geotourism resources of a particular area are important for geotourism-development [27,28].

From the 1970s to the 2000s, Costa Rica became settled as one of the world's leading ecotourism destinations [29]. During the 1960s, the Costa Rica Government and private institutions started to systematically produce conservation strategies that encompassed the creation of several protected areas and natural resources protection measures. These environmental policies/laws, in addition to ecotourism, a sensitive environmental consciousness, and protecting secondary forests from conversion, transformed Costa Rica into a reforestation hotspot of the neotropics [30]. In addition, ecotourism has played a meaningful role in the country's low-income and rural communities [31]. According to the World Travel and Tourism Council [32], tourism represents 13.1% of the Gross Domestic Product (GDP) of Costa Rica. Furthermore, between 2016 and 2018, 64% of the international visitors mentioned having done some form of ecotourism activity during their stay in Costa Rica [33].

Despite UNESCO's efforts to develop geoparks, they have been principally limited to temperate regions [25,27,34]. Nevertheless, a previous study suggested that many national parks and non-protected areas in Costa Rica have the geophysical and cultural elements, as well as the infrastructure, to be declared as geoparks [35]. Hence, we hypothesize that by improving geodiversity and geoheritage studies in Costa Rica, geotourism can be promoted through geoconservation using the existing extended protected areas national system. Furthermore, the objective is to present a review of the geodiversity, geoconservation, and geotourism status of Costa Rica. Therefore, the different geomorphic environments of the country are presented to emphasize the importance of the national protected areas system and environmental policies to promote Costa Rican geoheritage through geotourism.

2. Materials and Methods

2.1. Geographical Setting of Costa Rica

The Cocos-Caribbean plates subduction margin, the Panama microplate, and the Cocos volcanic range subduction favor Costa Rican tectonic activity [36]. This dynamic has formed three morphotectonic units: forearc, volcanic front, and backarc, which controlled the lithological distribution in the country (Figure 1) [37]. The fore arc extends along the Pacific coast with an abrupt topography of the Cretaceous-Quaternary age [38]. The volcanic front includes the Guanacaste, Tilarán, Aguacate, Central, and Talamanca ranges composed mainly of volcanic and sedimentary rocks of Paleogene-Quaternary age [39]. The backarc extends from the Caribbean plains of the Tortuguero lowlands in north-eastern Costa Rica to the rugged emergent morphology of the Southern Caribbean [40]. The climate and precipitation patterns are influenced by the latitudinal migration of the Intertropical Convergence Zone, ENSO, northeast trade winds, cold fronts, and tropical cyclones [41]. The interaction of trade winds and

topography produces Pacific and Caribbean differentiated climates. The Pacific side presents a bimodal rainfall distribution, while it is difficult to define a dry season for the Caribbean side (Figure 2) [42].

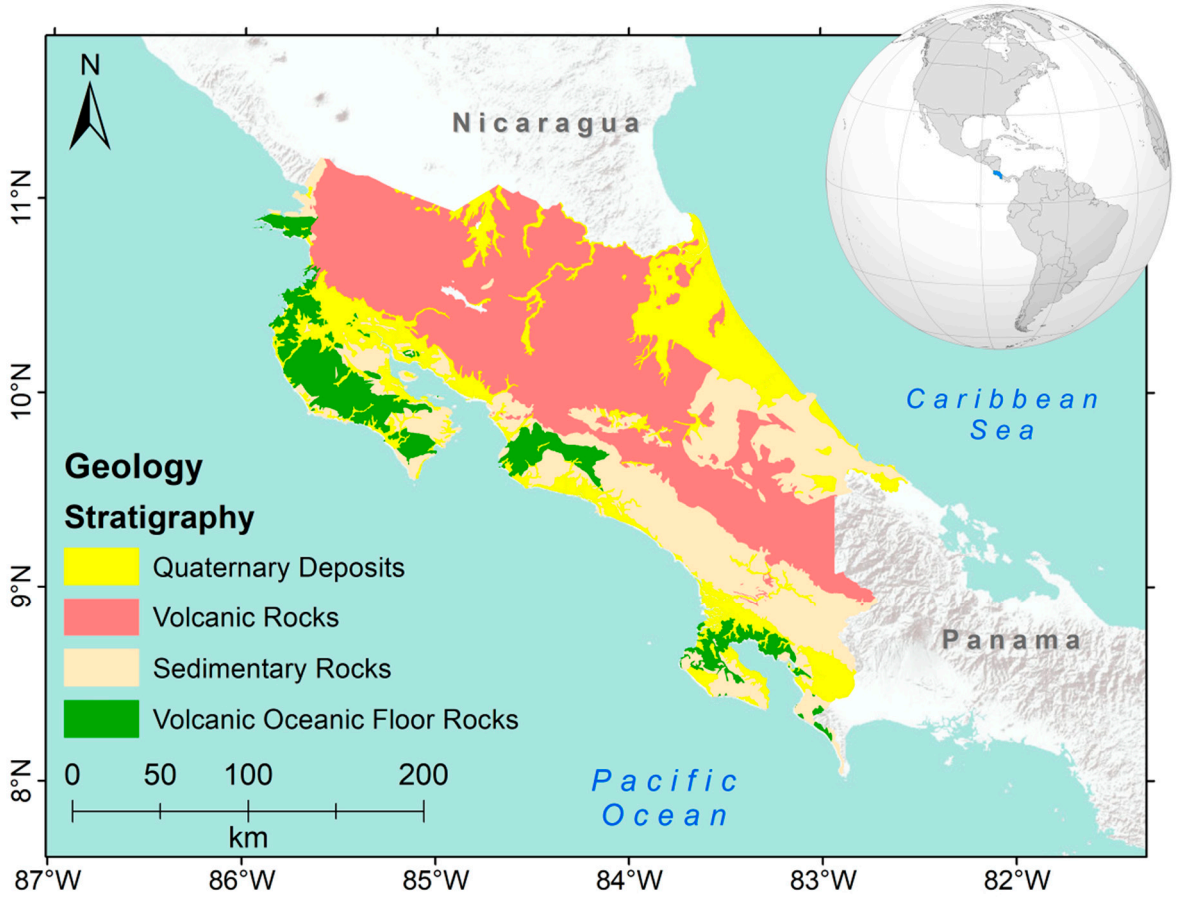

Figure 1. Location and principal rock and sediment types in Costa Rica, based on [38].

The high number of endemic species, levels of forest composition and configuration, and a varied biodiversity position Costa Rica as a megadiverse country. The country holds approximately 6% of the worldwide biodiversity, consisting of mountain cloud forests, evergreen moist forests, seasonal forests, dry forests, paramos, coastal, and wetlands ecosystems [43]. Deforestation and landscape fragmentation dominated from the 1950s until the mid-1980s. Afterward, a series of environmental policies reversed deforestation together with the rise of ecotourism and the development of more sustainable agricultural production alternatives reaching a forest cover of 51% of the country [44]. In 2018, the population in Costa Rica reached five million inhabitants and, during the last three decades, its population shifted from a marked rurality to a clear urban trend reaching 75% of the population in 2011. Currently, the Greater Metropolitan Area accounts for 65% of the population (approximately three million inhabitants) of Costa Rica, occupying 14% of its surface [45].

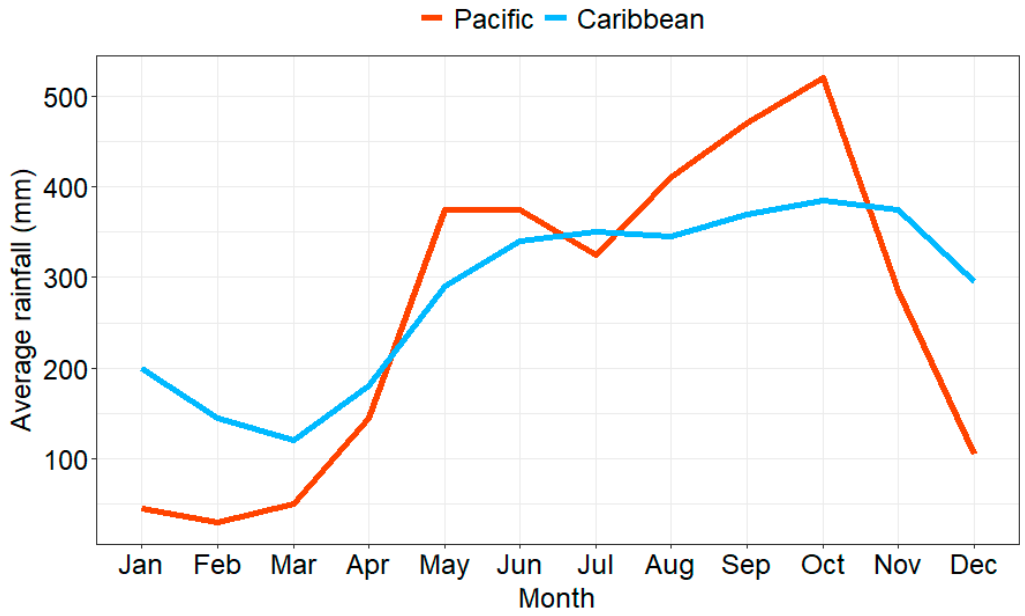

Figure 2. Costa Rican Pacific and Caribbean basins rainfall trends [46].

2.2. *Geodiversity and Geotourism in Costa Rica*

Costa Rica is one of the best ecotourism destinations in the world with a sustained growth in international arrivals, revenues, and protected areas visitation during the last decades (Figure 3) [47]. These protected areas are managed by SINAC (Conservation Areas National System). The top activities realized for international tourists are mainly seaside tourism, ecotourism, and adventure tourism [33,48]. Interestingly, ecotourism is related to specific geomorphic environments that comprise the surface processes and landforms of Costa Rica. We gather previous works to map and depict the main geomorphic environments and relate its geodiversity with the most visited national parks and geomorphosites of the country.

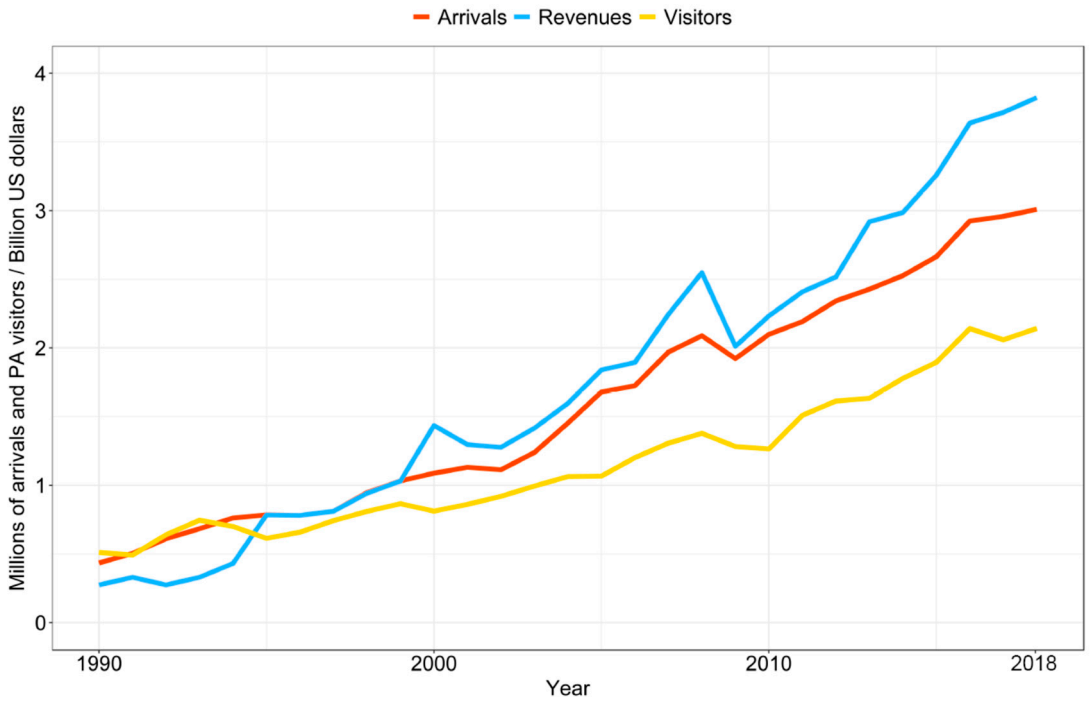

Figure 3. Millions of international arrivals and protected areas, and billions of US dollars revenue from tourism in Costa Rica between 1990 and 2018 [33].

Due to its tropical nature, fluvial environments dominate the country's landforms with several water basins, lakes, and wetlands [49]. Another important geomorphic environment in Costa Rica is its volcanic landscapes [39]. Otherwise, Costa Rica presents Caribbean and Pacific coasts, and their plethora of landforms [40,50]. There are two smaller in extension but very interesting geomorphic environments that have also been described in detail. The first is the karst environments [51,52], and the second is the glacial landscape limited to the Talamanca Range [53,54].

The geomorphic environments map of Costa Rica showing its geodiversity was developed in two phases. First, we considered existing geological and geomorphological maps [38,48], particularly geomorphic genesis studies, and a 10-m Digital Elevation Model (DEM). Second, we produced the cartography within a Geographic Information System (ArcGIS 10.3) as a medium-scale geomorphological map [55]. We grouped each geomorphic environment according to its genesis (volcanic, fluvial, coastal, karstic, and glacial). Each geomorphic environment is explained geographically and dynamically. These results are put in the context of the protected areas that could enhance the understanding of geodiversity and promote geotourism in Costa Rica.

2.3. Environmental Policies and Geoheritage in Costa Rica

For more than six decades Costa Rica has made strong efforts to protect its natural environment from public and private sector initiatives [43]. Both, government and non-governmental organizations began to steadily established conservation strategies that comprised the creation of a robust national conservation areas system and natural resources protection measures through environmental policy and laws. In addition to ecotourism, the country has a sensitive environmental consciousness and protecting secondary forests from the high ongoing deforestation rates along the tropics [56]. Therefore, an extensive bibliographic review was carried out on Costa Rican environmental legislation in its first steps, as well as on the international agreements, in which the country has participated [57–60]. This methodological step gives a historical reconstruction of environment conservation that has been carried out in the country [61,62], where emphasis was placed on how these regulations have allowed for the conservation of the geoheritage in Costa Rica [63–68]. In parallel, we identify the worldwide and Latin American efforts of geoheritage assessments on protected areas [69–71].

3. Results

3.1. Geomorphic Environments and Geodiversity of Costa Rica

The main geomorphic environments in Costa Rica are fluvial, coastal, and volcanic, but glacial and karstic landscapes also make up the geodiversity of the country (Figure 4). The country is transversally divided into two basins, Pacific and Caribbean, which are drawn due to the topographic barrier imposed by a continuous chain of ranges that cross with an NW-SE orientation. This same condition controls the amount of rainfall on each basin. In general, Caribbean means are up to 3000 mm while Pacific means are between 1500 and 3000 mm annually.

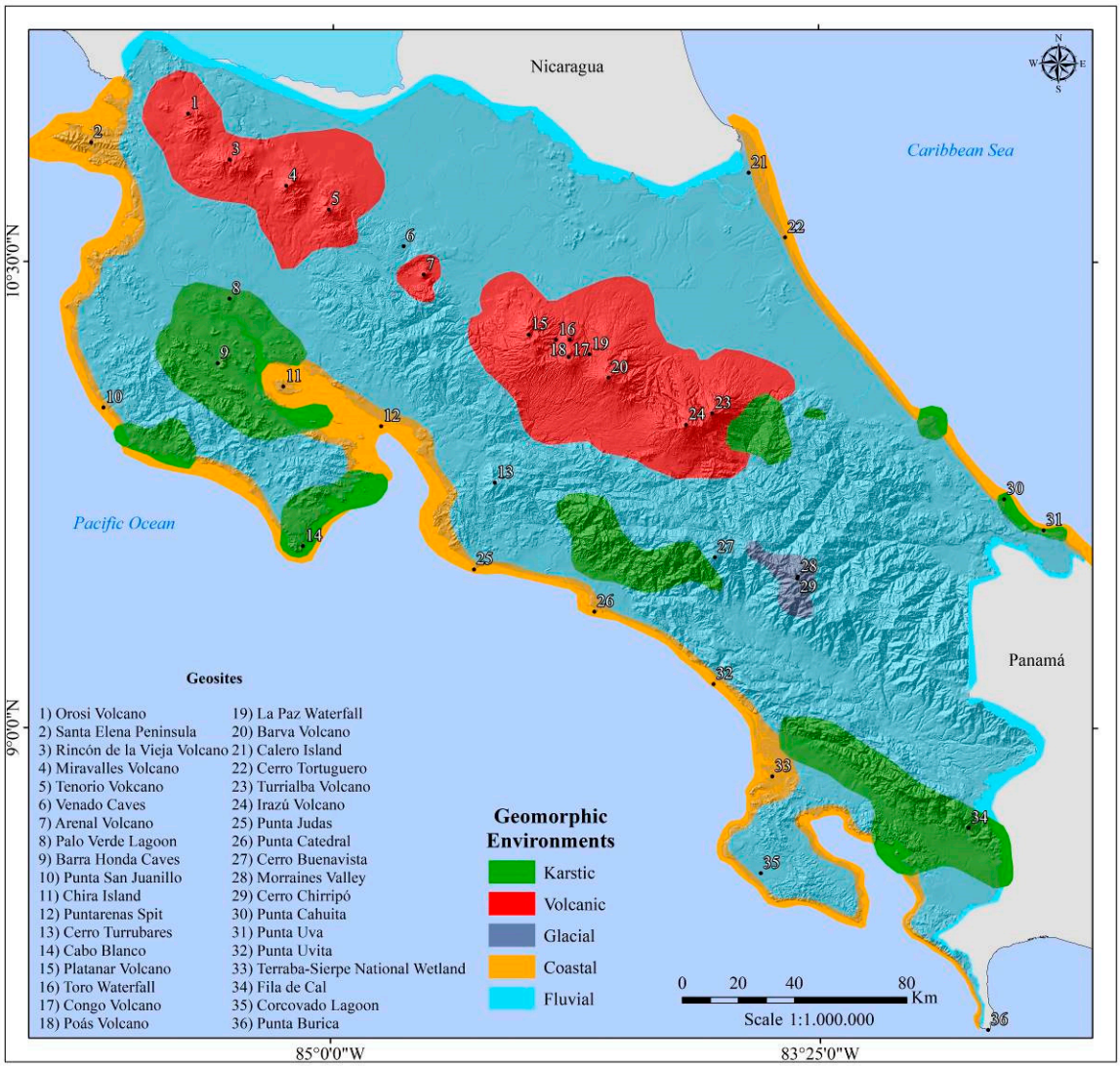

Figure 4. Geomorphic environments of Costa Rica.

Costa Rica is composed of active Quaternary volcanism in Guanacaste, Central volcanic ranges, and the Arenal tectono-volcanic complex. Otherwise, the Talamanca Range with Miocene-Quaternary volcanism preserves some volcanic forms heavily eroded by fluvial and glacial dynamics from the Last Glacial Maximum. There are other non-active volcanic ranges such as Tilarán and Aguacate. In the active volcanic range, several volcanoes have an active dynamism such as Rincón de la Vieja, Arenal, Poás, Irazú, and Turrialba (Figure 5). There are other massifs without historic activity but have retained most of their original morphologies despite the high erosion and weathering rates. Several volcanic landforms and landscapes are covered by dense forest and the influence of strong external agents' processes such as erosion and weathering, losing their original morphologies. Some magnificent structures sometimes hidden in the forests are waterfalls, which are common in lava flows fronts or faults showing their volcanic, tectonic, and fluvial interaction. Costa Rica presents many examples in both basins at the footslope of the volcanic ranges. Along the fluvial and volcanic mountain landscapes, high erosion, and weathering rates (triggered mainly by rainfall and seismicity) lead to common mass movement activity where landslides, rockfalls, debris flows, and even lahars are susceptible to occur. Mass wasting processes model the landscape dynamic as a sediment input in the fluvial system, but also affect anthropic activities.

Figure 5. (**a**). Volcanic landforms: Poás volcano National Park; (**b**). Irazú National Park; (**c**). Arenal National Park (photo courtesy of Leonel León); (**d**). Braulio Carrillo National Park and Barva volcano (photo courtesy of Leonel León).

The Northern Caribbean region is mainly Quaternary deposits from the erosion of the Guanacaste and Central volcanic ranges forming first, abrupt changes by knickpoints draw up with impressive waterfalls, the formation of wide and eroded alluvial fans that lead to extensive alluvial plains, river-estuarine channels in Tortuguero and Barra del Colorado, coastal lagoons, coastal bars, dynamic long beaches, and islands. Otherwise, the Southern Caribbean regions contiguity to Talamanca Range foothills form a narrow coastline transition where hills, coral reefs, islands, beaches, and carbonate platforms dominate the coastline (Figure 6). On the other hand, the Pacific basin is intricated due to its lithological diversity and rapid base-level change from active and relict volcanic ranges (i.e., Guanacaste, Central, and Talamanca) and Fila Brunqueña (a steep-fronted, sedimentary linear mountain range that runs subparallel to the Southern Pacific coastline). This condition favors the formation of massive alluvial fans leading to the dynamic valleys or tectonic depressions (e.g., General Valley, Central Volcanic Depression, and Turrialba), as well as several levels of alluvial terraces leading to the alluvial plains (i.e., Tempisque, Tárcoles, Parrita, and Térraba) with their meanders until reaching the coast. Pacific coastal landforms are more diverse than the Caribbean coastline, comprising gulfs, bays, coves, sea stacks, arches, tombolos, beaches, and deltas covered by mangrove and dozens of islands (Figure 7).

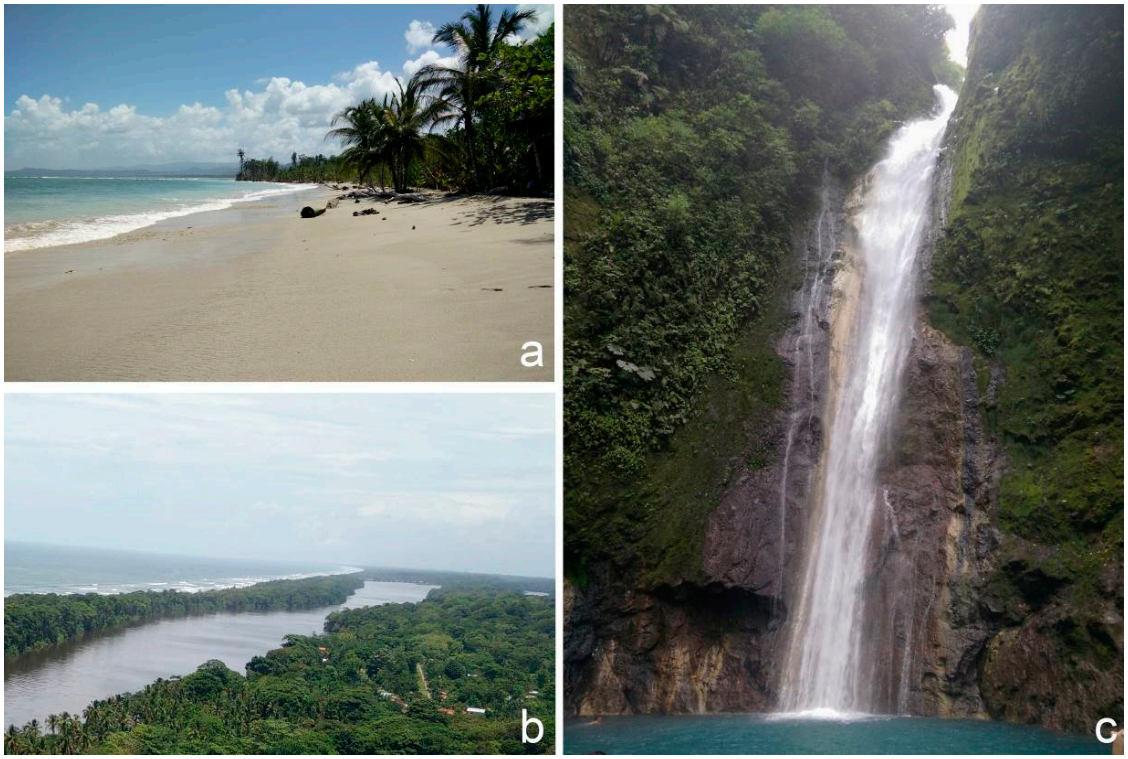

Figure 6. Caribbean basin fluvial and coastal landforms: (**a**). Beach at Cahuita National Park; (**b**). Coastal bar and lagoon at Tortuguero National Park; (**c**). Waterfall at the base of Poás Volcano near to Bajos del Toro.

Figure 7. Pacific basin fluvial and coastal landforms: (**a**). Punta Catedral, tómbolo at Manuel Antonio National Park (courtesy of Mario Murillo); (**b**). Punta Uvita at Marino Ballena National Park (photo courtesy of Leonel León); (**c**). Delta at Térraba-Sierpe National Wetland (photo courtesy of Néstor Veas); (**d**). Cabuyal beach, Liberia.

During the Last Glacial Maximum, along the highest mountains of Costa Rica over 3000 m, periglacial and glacial processes molded the mountains of the Talamanca Range leaving clearer relicts of erosional glacial landforms, such as volcanic slopes modified by glacial and periglacial action, glacial cirques, arêtes, riegels, roches moutonnées, as well as depositional landforms such as lateral moraines, till deposits, and glacial lakes (Figure 8; upper panel). Despite their relict condition, at present they are covered by páramo vegetation, which comprises of several endemic fauna and flora species. Otherwise, karst landforms are located along Fila Brunqueña, Gulf of Nicoya, and some parts of Nicoya beaches in the Pacific where mogotes, caverns, and sinkholes are the representative landforms. On the Caribbean side, karst landscapes are present in San Carlos, Turrialba, and the Southern Caribbean coastline where carbonate platforms, islands, and caves dominate this geomorphic environment (Figure 8; lower panel).

Figure 8. Glacial and karstic landforms: volcanic slopes modeled by glacial action and glacial lakes at Chirripó National Park (upper panel), and uplifted coral reef carbonate platforms in Uvita island, Limón (lower panel).

3.2. Geoheritage and Environmental Policies in Costa Rica

The creation of Yellowstone National Park in 1872 inspired the creation of other protected areas to care for endangered species or to preserve the scenic beauty of the country [57,58,62]. By 1940, Costa Rica had participated in the Washington Convention for the protection of flora, fauna, and scenic beauties of the countries of America, being the first time that the concept of a protected area was used in the country (Figure 9). This convention was approved by the Legislative Assembly of Costa Rica in 1966 through Law N°3763 [59,63]. At this time, the concept of geoheritage was not known but the laws took into consideration the scenic beauties, apart from the flora and fauna, to create a protected area. The central axis was directed to the biotic elements, but transversally the geoheritage was also

protected. After Costa Rica participated in the Washington Convention, some protected areas began to be created following the model used for the creation of Yellowstone National Park [62].

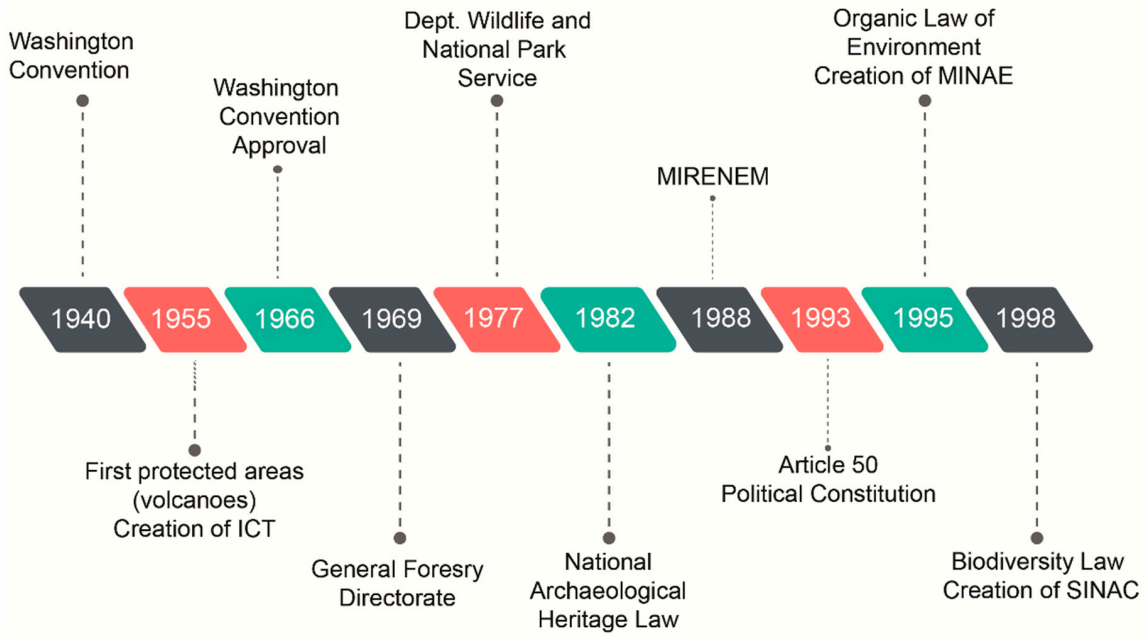

Figure 9. Brief summary of environmental policies that favored geoheritage in Costa Rica.

The first protected areas in Costa Rica were created in 1955 when the Law of the Costa Rican Tourism Board (ICT) was approved [60,61]. Article 6 of this law stipulated that each volcano in the country would become a national park taking, as reference, the area from the center of the crater of each volcano with a radio of 2 km around it [62]. Here, the interest in creating protected areas in order to have an economic income from tourism was evident. Yet, no element of the local flora or fauna is taken into consideration when deciding on the creation of national parks, but it was proposed based on an element of Costa Rica geoheritage such as the crater of the volcanoes. However, this article was repealed by the 1969 Forestry Law, because in its article 35C it established a definition of National Park and mentioned that the administration of national parks in Costa Rica was under the management of the National Park Service, an entity that did not exist at the time [68]. The definition of a National Park, mentioned in 1969 Forestry Law, indicates that among the elements to be protected within this management category are all geomorphological sites and habitats of special scientific or recreational interest, or that have a natural landscape of great scenic beauty [63,66]. In other words, at that time in Costa Rica, geoheritage was preserved exclusively under the figure of a national park.

Since there was no entity in charge of managing each protected area of Costa Rica at the time, many more were created, such as National Monuments in Cahuita (1970) and Guayabo (1973); the National Parks in Poás Volcano and Santa Rosa in 1971, Manuel Antonio in 1972, Rincón de la Vieja in 1973, Chirripó, Corcovado and Tortuguero in 1975. The creation of these monuments and national parks protect the biodiversity of each of these, as well as the geoheritage inside them [61,62]. This period was tumultuous because many protected areas were created and the agricultural frontier in Costa Rica allowed land with forest aptitude to be gradually deforested, putting geoheritage at risk by not being in a management category that would give it the corresponding protection as valuable as the biodiversity itself. In addition, it was during these years that the Costa Rican government created institutions whose purpose was the conservation of the environment, such as the General Forestry Directorate (1969), the Department of Wildlife and the National Park Service created in 1977, entities that were responsible for administering the Forest Reserves and Protected Zones, Wildlife Refuges and National Parks, respectively [66,68].

The National Park Service was created in 1977 by Law N°6084 with the objective of managing each national park for the conservation of heritage (and geoheritage) in Costa Rica, as well as studying other landforms to identify which had unique characteristics for establishing new national parks [63,65]. In addition, this law definitely marks the protection of the geoheritage within the national parks by establishing that is it prohibited to collect natural materials such as minerals, rocks, fossils, and any other element of the geoheritage of each national park. The period from 1974 to 1982 was when the largest number of protected areas were created in Costa Rica. During this time, forest conservation efforts became important. More legislation was needed to protect biotic resources, but geoheritage did not have any specific legislation for its protection, as was the case in other Latin American countries. In Costa Rica, biodiversity was given priority, while geodiversity was protected as a secondary element below biodiversity. It was considered as part of the natural wealth but not as the main element of conservation [58,60,61].

During the 1980s, the Ministry of Energy and Mines was created, changing its name in 1982 to Ministry of Industries, Energy, and Mines and in 1988 turned into the Ministry of Natural Resources, Energy, and Mines (MIRENEM). Although efforts were made to protect the natural resources of Costa Rica, there was still no legal component to allow for the protection of environments. Therefore, in 1993, through Law N°7412, a reform was made to article 50 of the Political Constitution of Costa Rica, establishing that "every person has the right to a healthy and ecologically balanced environment". With this modification to the Political Constitution, the space was opened up for the formulation of new environmental legislation in Costa Rica. Therefore, in 1995 when the Organic Law of the Environment N°7554 was created (Figure 9), being the base of the environmental policies in Costa Rica, forming the Ministry of Environment and Energy (MINAE) [63,68]. In terms of geoheritage, this law defined the management categories of the protected areas. It also created the Natural Monument, the only category created exclusively for the conservation of the geoheritage in Costa Rica. The law defines the Natural Monument as "areas that contain one or more natural elements of national importance. They will consist of natural places or objects that due to their unique of exceptional character, their scenic beauty, or their scientific value are resolved to be incorporated into a protection regime". In this way, it is guaranteed that geoheritage in Costa Rica can be protected.

Another important event for the geoheritage of Costa Rica happened with the approval of the Biodiversity Law N°7788 in 1998 [67,68]. Conservation Areas National System (SINAC) was created by this law, which has under its jurisdiction all the protected areas of the country by unifying several departments under one institution for example the General Forestry Directorate, the Department of Wildlife, and the National Park Service (Figure 9). The only exception where SINAC does not have jurisdiction is with the Natural Monuments because the Organic Law of the Environment dictates that their administration corresponds to the municipalities. Nevertheless, all of the geoheritage within the other protected areas is administrated by SINAC [68]. The existence of SINAC guarantees that there will be an entity that in addition to protecting biodiversity will also protect the geodiversity in Costa Rica. So, it is responsible for protecting the scenic beauty, and historical and archaeological richness that serves to generate economic benefits in the country through tourism. In addition, the Biodiversity Law declared all wetlands as protected areas dedicated to the conservation and protection of biodiversity, soils, and water resources with their only use being for research and recreation [63]. This protects the geoheritage linked to the wetlands in their entire altitudinal and types across the country.

At international and regional levels, the country has adopted several policies such as the Central American agreement for the protection of the environment in 1989, Ramsar Convention on Wetlands in 1991, Convention of Biological Diversity in 1992, Mesoamerican Biological Corridor in 1997, Central American policy for the Conservation and Rational Use of Wetlands in 2002, and Marine Corridor of the Eastern Tropical Pacific in 2004. By 1998, all wetlands were protected areas and most Ramsar sites have management plans. Moreover, the National Strategy for Wetlands in 1993, the National Wetland Program in 1999, and the National Policy for Wetlands in 2001 were implemented [56].

On the other hand, in other countries, the landforms and landscapes of the territories were studied and analyzed with a view to their protection and use as a tourist attraction, which today is called geomorphosite, defined as any landform of the Earth surface that has added values to the population related to the cultural heritage of a territory [69]. This concept has gone through a series of transformations at an academic level, beginning in early 1990 until 2001 when the concept of a geomorphosite began to be used as an object of study. While in other parts of the world geomorphosites were proposed as objects of study for the protection of geoheritage, in Costa Rica they would have gone ahead by establishing the Natural Monuments for the protection of local geoheritage, being equivalent to the geomorphosite in terms of its definition, but the Costa Rican concept has a legal connotation that gives it validity. However, only in recent years, some geoheritage studies emerged [18–20].

A geomorphosite as part of a country's geoheritage has strong cultural origins. So, if there are cultural manifestations of interest they should be considered as part of geoheritage. In this case, Costa Rica through the National Archaeological Heritage Law N°6703 of 1982 guarantees that protection should be given to those sites of cultural interest for the history of the country [64]. In this context, a geomorphosite is the basic unit of geoheritage and must have cultural relevance in the added values given by the population. Therefore, in Costa Rica, there is the Natural Monument that by the country's legal definition resembles a geomorphosite as a conservation measure. In addition, everything related to scenic beauty, unusual relief, and scientific interest is protected in different laws within one of the management categories established in the Political Constitution [67,68]. This shows that in Costa Rica there has been an evolution in legal regulations for the protection of natural resources, giving priority to biodiversity, but geodiversity has likewise benefited from these same laws. Therefore, it is evident that Costa Rica has focused on the development of environmental policies that protect the national geoheritage.

4. Discussion

We presented a twofold output that shows why geoheritage can be promoted through geotourism in Costa Rica. First, we presented the geographical setting that led to the geodiversity of the country. Second, we showed how Costa Rican environmental policies coupled with a strong green consciousness could develop an extensive national protected areas system that can be the base to promote their geoheritage through geoconservation and geotourism.

Although there are laws and policies in favor of geoheritage and studies of geomorphosites have begun in the country, there are still some gaps that need to be filled. Natural Monuments exist as a national conservation category, but no one has proposed to implement it as law, and there are many interesting landforms outside management categories that could be the first Natural Monuments in the country [70–72]. The next step to be taken in Costa Rica in terms of geoheritage conservation is to elaborate a geopark proposal [9,73]. The protected areas system in Costa Rica is consolidated, so a good geopark proposal would enforce the legal framework of the country. A recent study developed a proposal in which national parks have the potential to be a geopark, and studies are already underway to make Chirripó National Park a geopark [35,73]. With this background it is possible to think about proposing more geoparks in the country because the landforms, the policies and the will to protect and promote the geoheritage exist. Costa Rica committed to implementing the Earth Charter, stating in one of its principles that important places of cultural and spiritual significance should be protected and restored [74]. Moreover, within the structure of SINAC there are functions such as managing, promoting, facilitating, and participating in the development of sustainable tourism in protected wild areas based on responsible practices of administration, planning, and its management. These functions are the basis to establish geoparks, since the existence of these national park's infrastructure facilitates accessibility and management. It would be necessary to make a study of each national park to understand in more detail its particularities.

The most visited national parks during recent years have been mainly volcanic or coastal protected areas with interesting geomorphic sites such as Poás, Irazú, and Arenal volcanoes or Manuel

Antonio, Marino Ballena, and Cahuita. Certainly, geomorphology as the base of regional geoheritage assessments [75], is a reliable foundation to understand the surface processes dynamics and therefore the genesis, morphology, evolution, and age of the geodiversity of a region or a country. For example, a study explained how the 1990s environmental policies favored the mangrove forests recovery in Térraba-Sierpe National Wetland, the biggest mangrove and delta of the country, and a region of high touristic visitation [76]. Summing the total visitation of national parks, coastal protected areas have more visitors every year than mountain and volcanic parks together due to an intense promotion of beach and sun tourism in prior decades. The explosion of ecotourism, as well as wellness and adventure tourism, have favored the affluence of millions of visitors to Costa Rican coasts. In addition, the country's great geodiversity and the easy-to-access facilities make these regions very attractive in terms of potential geoheritage studies in close collaboration with local governments when they do not belong to the national conservation areas system.

Volcanic and mountainous regions have huge geoheritage potential. Apart from the most visited volcanoes in the country (Poás and Irazú), there are other massifs with very interesting landforms and landscapes to be evaluated and appreciated such as Barva [77], Arenal, Tenorio, and Rincón de la Vieja [78]. Other frequently visited regions of Costa Rica such as Monteverde and their cloud forests are settled over huge debris avalanche deposits of the past, but this particular aspect is not evaluated [79]. Recent studies have given more imprints of the glacial dynamics during the Last Glacial Maximum of the highest summits of Costa Rica [80], especially in Chirripó National Park where hundreds of wetlands perform a critical hydrological and ecological function [81]. We can indicate that karst regions in Costa Rica are understudied and perhaps need more touristic promotion that can be reached with the adventure tourism rising. Conformingly, more geoheritage studies can be done, more information can be used to promote their conservation and appreciation through geotourism. Moreover, to foster the geo-interpretation, it is necessary to build more informative signs in the national parks and geomorphosites to promote the geodiversity. In addition, national rangers, environmental public employees, and touristic guides might understand and explain the geodiversity of the country in order to transfer this knowledge to different stakeholders. It is also important to make comparative studies with other successful previous experiences worldwide to apply or adapt some of their tools and methods in Costa Rica [25–27].

Potential geoheritage required studies, as well as public/private institutions' decisions or implementations in Costa Rica to enhance geotourism and geoconservation, might take into consideration the UNESCO guidelines to establish geoparks. A close collaboration between SINAC (Conservation Areas National System), ICT (Costa Rican Tourism Board), as well as universities and researchers who develop these studies must be developed towards a unified effort and better geotourism promotion. National geoheritage reviews are necessary to illustrate the potential regions to evaluate geodiversity and assess their geoheritage. Examples of these studies have been done in Spain, France, Mauritius, Chile, and Ecuador [82–86]. At the moment, enhancing geoheritage studies in tropical regions is a priority for developing countries to increase their revenues through geotourism and to leave their natural resources untouched. Due to the specific geomorphological conditions of low latitudes with intense precipitation and weathering rates, and strong anthropic pressures over their geo- and biodiversity, it is important to define tropical geoheritage and promote its study.

5. Conclusions

Costa Rica is known worldwide for its environmental policies that have emerged in the last 30 years, carrying out actions that helped establish several protected areas and positioned the country as a top ecotourism destination globally. A dynamic combination of tectonics and volcanism coupled with a tropical climate and vegetation have molded a geodiverse country, which comprises volcanic, fluvial, coastal, karstic, and glacial geomorphic environments. Our environmental policy review coupled with the national conservation areas system as a platform for geoconservation showed the high potential that Costa Rica has for the promotion of geoheritage by means of geotourism. In recent decades, Costa Rica

has accumulated the environmental maturity to ensure and indirectly protect its geoheritage for the enjoyment of future generations. Certainly, these outputs are critical for the promotion of geosciences to a broader audience through geotourism and conservation decision-makers. Increasing awareness in all relevant international institutions, as well as growing national implementations through the integration of local and regional stakeholders, are key to improving geoheritage and geoconservation for the following decades throughout the tropics.

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