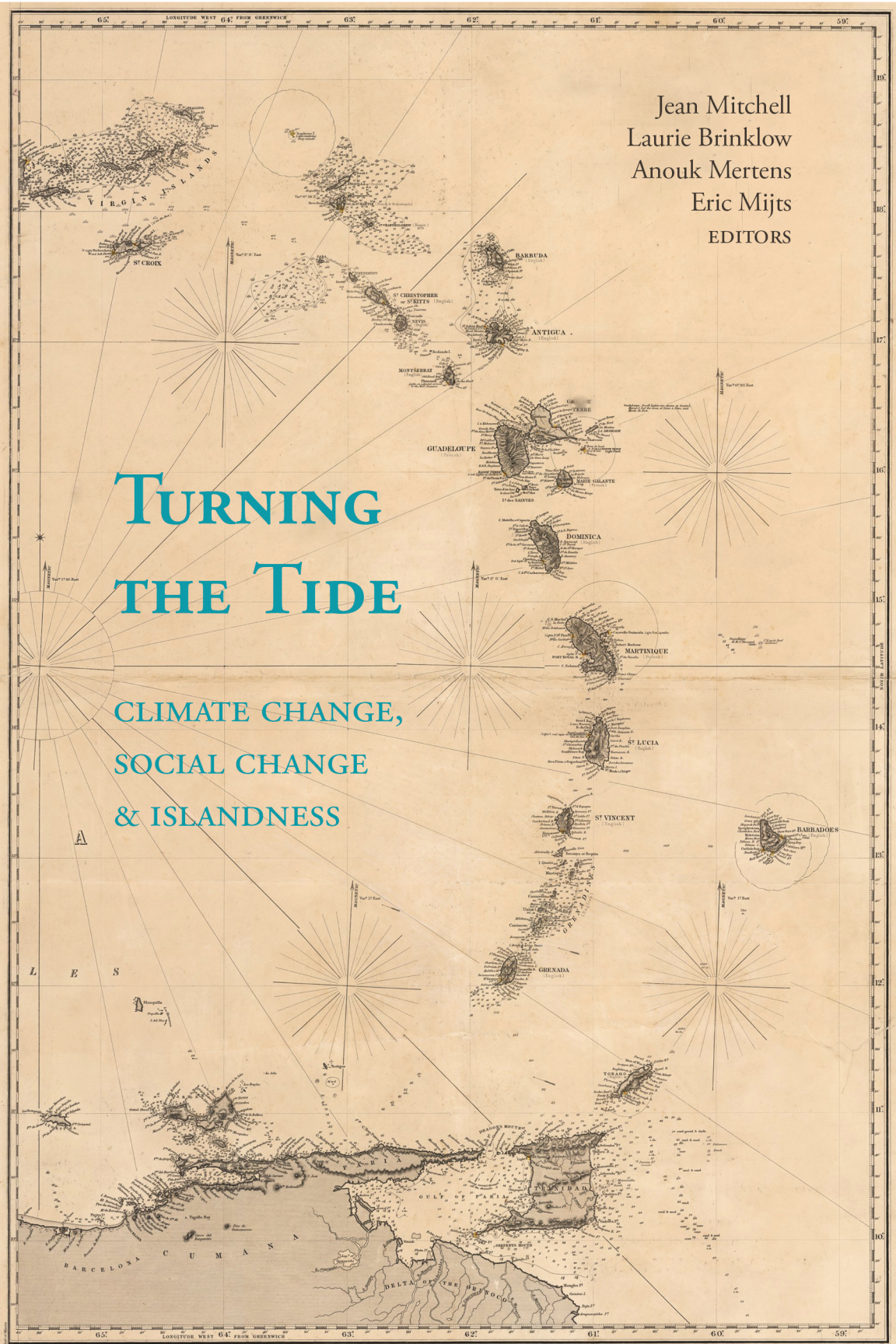
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CLIMATE CHANGE, SOCIAL CHANGE & ISLANDNESS

Mapping traditional and local knowledge to foster climate change adaptation: The case of cultural heritage in small islands

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INTRODUCTION

This chapter shares the research and methodologies of the *Heritage Ecologies* project, based at the Islands and Small States Institute (ISSI) of the University of Malta and funded by the European Commission under the Marie Sklodowska-Curie Action programme (grant agreement No. 101090288). Fully titled "Heritage Ecologies: Culture, resilience and development in island states," this project investigates how cultural heritages are impacted by climate change and the role played by heritage and local knowledge in promoting climate change adaptation and sustaining social and environmental resiliencies, focusing on insular geographies.

By adopting the term "ecologies," we aim to highlight the relational aspects connecting cultural heritage, in its multiple expressions and materialities, environmental histories, and sustainable futures. Curiously, the concept of heritage ecologies is equally used, although with a different focus, in the title of the book edited by Bangstad and Pétursdóttir. Here the authors use the concept to express "an ecological understanding of heritage" and it involves "human and other-than-human actors" (Bangstad & Þóra Pétursdóttir, 2021). For our research, the interconnections, and interdependence, between culture and environment are central.

Another central approach of this project is the focus on two distinct and different cultural areas, the Mediterranean, with a focus on the Maltese archipelago, and the Southwestern Indian Ocean, specifically looking at the archipelagos of Comoros, Mauritius and Seychelles, and the islands of Mayotte and Reunion.

While climate change impacts cultural and natural contexts, heritage management and traditional cultures can provide solutions through established

cultural systems, integrating ecological preservation and socio-economic development. Departing from the results of a systematic literature review on climate change and cultural heritages in insular contexts and contributing to the larger field of the intersections of climate and heritage (Fatorić et al., 2017; Maldonado-Erazo et al., 2021; Orr et al., 2021), we investigate the integration of heritage and local knowledge within UNESCO-managed sites, national heritage elements and examples of ongoing heritagization processes, while addressing changing livelihoods and socio-economic and environmental vulnerabilities. Relevant for insular contexts experiencing the impacts of environmental and climate disruptions, the integration of cultural values in climate change impact mapping and policy decisions may increase participatory methodologies and enable differentiated approaches that sustain localized resilience and adaptation programs.

SMALL ISLANDS, CLIMATE CHANGE AND CULTURAL HERITAGE

Global discussions regarding climate change brought islands to the forefront. Small islands are, in fact, suffering the most severe impacts of climate change (Moncada et al., 2021).

Being extremely vulnerable to climate change due to their small territory and particular exposure to sea-level rise, small islands and archipelagos became crucial case studies in a global scenario (Pugh & Chandler, 2021). While climate change impacts cultural and natural contexts, heritage management and Indigenous cultures may provide solutions through traditionally established cultural systems that integrate ecological preservation and social development. One of the most pressing fields of research is rising sea levels and how cultural traditions can integrate systems of response to it (Rudiak-Gould, 2013).

The growing field of research focusing on islands, archipelagos, and small states (Baldacchino, 2018) has brought new conceptual frameworks such as "islandness" (Gupta, 2010), "littoral" (M. Pearson, 1985), "archipelago" or "aquapelago" (Baldacchino, 2012; Hau'ofa, 1994) that enables us to focus our attention on the particularities of seeing the ocean and its lands as a method to open interdisciplinary pathways.

Regarding climate change and its impacts, the field of Island Studies has brought to the forefront islands' fragilities, oceanic ecological disturbances

and disappearing island nations (Formosa et al., 2017). Interdisciplinary approaches have been fertile in pushing diverse and interconnected ways of studying insular territories (Baldacchino, 2008) through interdisciplinary methodologies and regarding geographies in relation: between islands, archipelagos, atolls, coastal regions and mainlands (Roorda, 2020). Equally, in heritage studies, small islands and states have been studied in their specific vulnerabilities and challenges (Briguglio et al., 2010) and in the relevant field of the interdependence between heritage, Indigenous knowledges and ecological contexts (Brabec & Chilton, 2015).

In all the chosen sites, maritime circulations produced multiple local knowledges related to the ocean and weather patterns that should be incorporated in research on oceanic futures and the Anthropocene (Keller, 2019), as well as on the dialectics between conservation and development (Baldacchino & Niles, 2011a). Institutions such as UNESCO recognize the role of culture in the sustainable development of SIDS while the relations among heritage (UNESCO, 2011), development and social capital has been the topic of research (Wiktor-Mach, 2019), fundamental for this proposal. The United Kingdom Commission of UNESCO has been at the forefront of this work, with the initiative "Heritage and our Sustainable Future" (UNESCO, n.d.-a), researching biocultural heritage, climate change, and sustainable development. In the case of the islands investigated here, we assist a growing inclusion in UNESCO lists of natural and cultural heritages, translating regional biodiversity and cultural histories. While Mayotte Island does not currently have any UNESCO label, there are efforts to use heritagization as a source of economic development and tourism, following the examples of Mauritius and Seychelles (Khan & Amelie, 2015).

Assuming, as mentioned above, relational dynamics between cultural heritage, environment, and sustainability, this research project was theoretically and methodologically built as a network of diverse heritage elements and territories.

This allows us to establish dialogues between two different cultural and geographic regions and analyse diverse political existences. While Malta is a Small Island State (SIS), Comoros and Seychelles are considered Small Island Developing States (SIDS). The islands of Reunion and Mayotte are Sub-National Island Jurisdictions (SNIJs), being French Overseas Departments.

As we will see, these distinct political entities, particularly in the Indian Ocean region, translate into historical processes that are still very much part of the contemporary realities of these islands and archipelagos.

NAVIGATING CLIMATE CHANGE AND CULTURAL HERITAGE IN INSULAR TERRITORIES

At the beginning of this project, a systematic literature review was carried out, to understand the body of work regarding three main questions: how climate change is affecting heritage in insular geographies; how cultural heritage has been integrated into initiatives coping with the effects of climate change; and the role of community participation, and, thus, traditional and local knowledge, in actions for resilience and sustainability in insular contexts. The first conclusion was an expected one, that despite small islands being at the forefront of the impacts of climate change their contexts are still understudied regarding climate change, particularly against the background of the intersections between climate change and cultural heritage.

The analysed literature covers diverse important dimensions which we organized into six broad categories: Climate Justice and Human Rights, Governance and Participation, Traditional and Local Knowledge, Cultural and Ecosystem Services, Heritage Systems and Landscapes, and Long-term Sustainability and Resilience. These themes intersect with each other in several ways, highlighting the need to understand the impacts of climate change on legal and human rights (Giacomini, 2022; Wewerinke-Singh & Hamman, 2020), and local and Indigenous culture and knowledge with profound attachments to territories (Gharbaoui & Blocher, 2018; McNamara & Westoby, 2016; J. Pearson et al., 2021; Thornton & Pillay, 2022). These themes also cut across aspects of governance (Farran, 2020; Perdikaris & Boger, 2022; Walter & Hamilton, 2014) and different kinds of heritage, particularly landscapes and cultural ecosystem services (Islam et al., 2022; McNamara et al., 2021; Smart et al., 2021). The long-established separation between culture and nature has been under scrutiny (Dürr & Pascht, 2017), turning cultural heritage into a central field of exploration.

Our literature review revealed important gaps to address. One is the almost complete absence of African islands from the literature on cultural heritage and climate change, despite the Atlantic and Indian Ocean African archipelagos experiencing harmful impacts by climate change and presenting important vernacular cultures. These are practices, beliefs and cultural expressions that are localized and in profound connection with the natural environment, which is understood as having cultural meanings. Our research aims to address this gap, presenting case studies that contrast with the

more present Caribbean and Pacific Ocean contexts in the literature.

There is a need to recognize community participation and its direct connection with local ecological knowledge systems and Indigenous culture alongside scientific knowledge in climate change actions. The case studies presented in the last section of this chapter show initiatives that, one way or the other, follow this direction, where local communities' engagement and familiarity with the environment prove to be beneficial in both cultural and environmental protection and in raising awareness for the need to adapt to the impacts of climate change. The need to consider long historical processes foregrounds local cultures as crucial to understanding how societies have adapted to changes over long periods and how, in conjunction with scientific studies, they can find answers on how to face unknown circumstances at a pace that does not allow a gradual adaptation.

This aspect calls our attention to the existence of vast repositories of knowledge and cultural relations with the environment that are outside the strict scope of listed heritage elements. The need to understand knowledge and cultural contexts as systems is fundamental, allowing encompassing approaches that acknowledge the intimacy of livelihoods with the surrounding landscapes and natural resources.

THE INSULAR TERRITORIES

Before analysing three case studies that present different modes of integrating cultural heritage in climate change action and environmental conservation, we will briefly explore the three locations this chapter addresses: Reunion Island, Mayotte and Comoros. Although not including here the archipelagos of Malta, Seychelles and Mauritius, the analysis of all heritage elements included in this project was made in a relational and comparative mode, allowing a comprehensive perspective and mutual learning regarding positive methodologies and practices.

All these insular territories present important cultural contexts and are experiencing the effects of climate change that aggravate the existing anthropogenic pressures on the environment and vernacular heritages.

La Réunion is a French Overseas Department since 1946, after being a French colony for almost three centuries. Being known by Arab sailors as *Dina Morghabine*, it was inhabited in the 17th century and called Bourbon Island.

The orography of the island is marked by high volcanic peaks and cirques, with an active volcano on the southeast of the island (the *Piton de la Fournaise*) and coastal slopes. Three main cirques, Mafate, Cilaos, and Salazie, constitute the mountainous heart of the island, with deep valleys progressing into fertile plains towards the ocean. The Western and southwestern coast present narrow coral lagoons. Volcanic cirques are the natural amphitheatres with an accentuated height and verticality, remains of the old volcano's craters, while the remparts are steep rock walls. These features are prominent in volcanic islands.

Being a volcanic island with a tropical climate and significant climatic and environmental amplitude, the island presents a remarkable diversity of landscapes and ecosystems.

Europeans first settled in the coastal regions, under a slave plantation society, while the almost inaccessible hinterland was the territory of maroon communities (enslaved persons escaping the coastal plantations) until the turn of the 19th century. After the abolition of slavery in 1848, Asian (mostly Chinese and Indian) contract workers and free migrants (craftsmen and traders) settled on the island.

Culturally, Reunion is a Creole society, and the island's population, thus, has East African, Comorian, Malagasy, Indian, Chinese and European heritage. Despite this, the official language is French, with the Reunionese Creole being widely spoken and recognized as a regional language in 2014, being taught and learned in schools and the university.

Reunion presents two UNESCO World Heritage elements, the *Piton, cirques and remparts of Reunion Island*, the heart of the local National Park, inscribed as UNESCO Natural Heritage in 2010, and the *Maloya*, a musical and dance performance originating from the slavery times, inscribed as UNESCO Intangible Heritage in 2009. Besides these two elements, there are several other cultural and natural heritages inventoried. The island is also known for its vanilla plantations, considered also a local cultural heritage.

Mayotte, also known as *Maore* in the local Shimaore language, is a French Overseas Department since 2011. In 1841, the Malagasy sultan Andriantsoli, ruling over Mayotte, sold the islands to France, who in 1886 established protectorates in the whole archipelago of the Comoros. In 1974 a referendum was held to decide the independence of the Comoros, and the majority of the voters in Mayotte opted to remain a French territory. After diplomatic disagreements, France called for a second referendum in Mayotte in 1976, with

more than 99 percent of votes in favour of remaining in France. In the same year, a resolution by the United Nations declares the sovereignty of Comoros over Mayotte, a decision that France never accepted. Until today, this is a delicate dispute, with serious consequences for both Mayotte and the Comoros. The major islands are *Grande Terre* (*Maore*), where the capital Mamoudzou is located, and the *Petite Terre* (*Pamanzi*), where the colonial administration was settled. Besides French, two more languages are spoken, the *Shimaore*, a Bantu language related to Swahili (as the languages spoken in Comoros) and the *Kibushi*, related to Malagasy, denoting the cultural heritages of the population.

Both islands are surrounded by several islets, protected by a remarkably extensive coral lagoon. The territory is geographically and culturally part of the Comorian archipelago. The archipelago has a volcanic origin, with Mayotte island presenting several mountains, such as the renowned *Mont Choungi*, and Pamanzi presenting the volcanic lake *Dziani*, filling an old crater. Both islands have extensive coastal mangrove areas, with numerous small bays and coastal valleys. The cultivation of the *Ylang Ylang* flower is one of the remarkable aspects of the territory, being a significant tourist attraction and having a significant economic value.

Despite not having any heritage element listed in UNESCO, Mayotte has intangible heritages included in the French national inventory (as of March 2025): the musical performances such as the *Mawlida Shenge*, a social and spiritual practice of a Sufi tradition, the *Mbiwi*, a musical and dance performance made exclusively by women, and the *Debaa*, a musical tradition with Sufi roots, performed also by women. Not listed in the national inventory but socially relevant is the *Shigoma*, another musical and dance performance. Intangible heritages include knowledge and practices that are maintained for their relevance and build senses of belonging to places and cultural contexts.

In addition, the Marine Parc (*Parc Naturel Marin*) was created in 2010 after two years of discussions with the local population. It covers the whole lagoon and the Exclusive Economic Zone of the department.

The **Union of the Comoros** is an archipelago with three main islands on the northern border of the Mozambique Channel. It gained its independence from France in 1975 and besides French, the official languages are the *shiKomori*, a Bantu language related to Swahili, with dialects in each of the islands (Walker, 2009, p. 11), and Arabic.

The archipelago has long been a bridge between the Eastern African coast

and Madagascar, inhabited at least since the 4th century (Walker, 2009, p. 10), Islamicized around the 10th century, with diverse sultanates on every island. The union is composed of three administrative regions, the islands of *Anjouan* (*Ndzuani*), *Moheli* (*Mwali*) and *Grande Comore* (*Ngazidja*), the largest island and where the union capital, Moroni, is located.

The three islands are of volcanic origin. The south of *Ngazidja* island is marked by the Karthala volcano and the three islands present coastal mangroves and coral lagoons, and tropical and subtropical forests on the hills. Vanilla and *Ylang-Ylang* are cultivated and have important cultural relevance, as well as clove, which is left to dry on the village streets and infuse the space with its characteristic scent.

In terms of listed heritage, the country includes the Mwali Biosphere, integrated into the UNESCO Man and Biosphere Programme, and several natural parks, such as the *Khartala (Ngazidja)*, *Mont Nrtingui* and *Shisiwani* (*Anjouan*), and *Mitsamiouli-Nroude* and *Coelacanthe* (*Grande Comore*), this last one celebrating the rare coelacanth, which has the Comoros as one of its very few habitats.

Natural and cultural landscapes of the archipelago were included in four UNESCO World Heritage tentative lists in 2007: the Marine Ecosystems of the Archipelago, Land Ecosystems and Cultural Landscapes of the Archipelago of Comoros, Cultural Landscapes of the Parfum Plantations of the "Moon Islands" and the Historical Sultanates of Comoros, which file was very recently submitted to UNESCO, in March 2025.

The Comorian islands are equally rich in intangible cultural elements and traditional knowledge related to the environment (forestry, fishing, and agricultural activities).

HERITAGE ECOLOGIES

At the beginning of this text, we explained that adopting the term "heritage ecologies" reflects relational aspects connecting cultural heritage and environmental worlds. The intimacies between culture and environment are central to this research, as is the integration of heritage and local knowledge. In the territories studied for this project, we focus on three examples that highlight these connections in different ways.

In all the territories included in this research, local knowledge and traditional

modes of relating to the landscape are recognized in diverse ways—from a community-level identification with the heritage elements to the officialization of cultural belongings and values by their management entities. This represents the concept of intangible heritage itself: a continuation of knowledge and practices that can build a sense of identity, of belonging to places and cultural contexts. Often intangible heritages perform as anchors in contexts of rapid change and disappearance of the vernacular.

In the case of the natural heritage sites observed, interesting relations are established between the protected ecosystems, their natural features and their cultural importance for the local populations. The natural heritages here analysed offer interesting insights into the inclusion of traditional and local knowledge in the management of the listed sites, the promotion of their inherent cultural values and their importance in facing climate change impacts: the *Parc Naturel Marin* of Mayotte, the *Mwali Biosphere Reserve* in Comoros, and the *Parc National de La Réunion*.

Each site's management highlights the ecosystem's cultural relevance as part of the listing justification. These sites are living landscapes, incorporating inhabited places and traditional fishing or agricultural activities.

Table 1. Simplified information for each of the three case studies.

	Creation	UNESCO inscription	Main values
Mwali Biosphere Reserve	2001	2020	Rich land and marine biodiversity, marine turtle nesting place of world relevance, cultural heritages. Covers the island, islets and the marine territory
Pitons, cirques and remparts of Reunion Island	2007	2010	Volcanic landscapes with diverse ecosystems, cultural heritages and historical relevance. Covers 40 percent of the island.
Marine Park of Mayotte	2010		An extensive coral lagoon, extraordinary biodiversity and cultural heritages associated with the sea. Covers 69.000 km2, corresponding to 100 percent of Mayotte's marine territory.

The **Mwali Biosphere Reserve** is unique among these examples because it includes the Mwali island, its islets and its marine area (UNESCO, n.d.-b). The reserve is justified by the natural and cultural values that translate modes of living with an environment that spreads across the ocean and land. Besides the marine rich biodiversity, with the world's leading nesting sites for green turtles, humpback whale breeding sites, and a refuge for dugongs, the island's watersheds equally present important endemic species, such as the world's largest bat or significant populations of lemurs. Since the island is mostly uninhabited, large areas of dry and humid forests are well preserved.

The human presence is felt predominantly on the coast, and the population maintains vernacular modes of living, based on fishing, livestock, and agriculture. These are recognized as important to face not only impacts of the climate change but also the consequences of human activity as deforestation for agricultural fields or the growth of the construction industry and sand extraction.

The villages of Nioumachoi, on the south, and of Itsamia, on the east, are famous for their cultural relations with the environment. The headquarters of the park is located in Nioumachoi, which became the departing point for visitors wishing to visit the land and marine ecosystems, while Itsamia is renowned for the impressive number of turtles laying eggs in its beaches all

Figure 1. Southern coast of the island of Mwali, with the forest, coral reefs and the coastal islets. Photo by Pedro Pombo, 2024.

year round and became the symbolic village in Comoros for the preservation of the *Nyamba* (green turtle in shiKomorian) and *Male Nyamba* (hawksbill turtle in shiKomorian) (IOSEA Marine Turtle Site Network, n.d.).

The *Organization pour le Développement Socio-Economique d'Itsamia* (ADSEI) was created in 1991. They built the *Maison Tortue* (House of the Turtle) as a resource centre for the local population and visitors and to promote the conservation of turtles. In the last decades turtle meat consumption decreased significantly and today it is illegal to kill, sell, or buy meat and eggs. The local population's efforts in respecting turtle nests and preserving sustainable fishing techniques have had impressive results. An annual celebration of the Sea Turtle Day is now held, which promotes awareness activities with the local schools.

In Nioumachoi, as in Itsamia, traditional knowledge dialogues with the park management and scientific studies on how to preserve the environment while improving the fish stocks, has generated economic benefits from nature-based tourism and helped in efforts to adapt to the impacts of climate change. In both villages, nature-based tourism has slowly grown over the years, and locals are employed as guides and boat captains, generating economic benefits that partially help the population face the noticeable economic hardship.

Longer periods of dry weather and coastal erosion are the most significant effects of climate change. Both park officers and the local population mention that patches of forests have been seasonally drier than before. On the coast, the movement of sand is simultaneously causing extreme erosion of beaches, particularly those around Nioumachoi, and causing the death of mangroves where sand is deposited. These impacts are worsened by the ongoing illegal sand extraction and deforestation of agricultural plots.

Efforts have been made by the village inhabitants and the park administration to create a barrier with tree poles, acting as a soft wall, preventing the sea from entering the village, since the recent fall of an old and historic wall that defended the old settlement. Importantly, this intervention was chosen with a clear knowledge that hard walls accentuate erosion patterns, showing how traditional knowledge of sea behaviour and natural sand movements mesh with scientific studies of the changes observed to sustain community-led initiatives.

The reserve administration has a co-management approach and works closely with local community structures to make decisions and implement

initiatives, watch and protect the land and marine areas, and develop educational projects with local schools and activities such as mangrove plantation, observing the fishing stocks, and protecting turtle nests.

One of the benefits of co-management is that the population acts as a guardian of the territory, developing a sense of belonging and pride and being a crucial barrier to stopping poaching. It also provides a permanent observation of changes in the ecosystem, from shifting sands and beach erosion to changes in fish stocks or patterns in terrestrial fauna and flora. One important aspect is that integrating vernacular knowledge and sensibilities with scientific studies contributes to a better (possible) adaptation to changes that were not accounted for because they were not observable in the past or happened over much longer periods and without the urgency that is felt today.

The **National Park of Reunion**'s area listed by UNESCO as *Pitons, cirques et remparts de l'île de La Réunion* (The Pitons, cirques and remparts of Reunion Island) coincides with the so-called "heart" of the park: the volcanic peaks, walls and cirques that constitute the central landscape of the island (UNESCO, n.d.-c). It covers 42 percent of the island, and despite covering an area that is mainly uninhabited, it includes several villages and small towns in its area. Besides this "heart," the national park is surrounded by so-called "adhesion" areas, inhabited and cultivated valleys and slopes at mid-altitude between the highlands and the coast. These areas are not considered part of the national park but where the populations and administrative bodies are invited to promote sustainable activities.

Here it matters to highlight the recognition by the park management of the cultural heritages in its landscapes and the adhesion areas: agricultural traditions, knowledge of the fauna and flora, cultural and religious significance of particular places, and creole architectures representative of inhabiting islets in the volcanic cirques that have been until recently (and in some cases still are) very remote and difficult to access. The charter of the park defines its protection and valorization objectives. Centring the management on the human presence and the natural and cultural heritages, it aims at conserving the territory by establishing a balance between protection and development and a sustainable exploration of the natural resources.

The park adopts, in its management directives and promotion, a label that is part of the French national parks: *Esprit parc national* (Spirit of the National Park). This label aims to promote local products, value the local know-how, and respect the cultural heritages associated with the landscape

Figure 2. The Piton Anchaing, in the Salazie cirque, Reunion. This peak is named after a Malagasy marron king. Photograph by Pedro Pombo, 2024.

of the parks that promote sustainable development. In the case of Reunion, this label recognizes local actors that develop economic activities— agriculture and agroforestry or sustainable tourism practices—as well as the creole architecture of the villages in the volcanic circuses. This shows how the preservation of the natural ecosystems is assumed as the enjoyment of its ecology and cultural values that were born over time. For this, the administration of the park includes a service that promotes the label of *Esprit parc national* and is in close contact with local actors, individuals, and associations, that with this seal not only contribute to the preservation of the park but gain visibility for their activities. The locals and visitors can buy products from vanilla pods to honey to jams that are locally sourced and sustainably produced, keeping alive local techniques and knowledge.

The inclusion of these activities and the adhesion areas in the park management also addresses diverse consequences from anthropogenic interference, such as invading exotic plants that have important connections with cultural heritage and traditional ways of life sedimented over time. One paradigmatic example is the cultivation of chouchou. Introduced in the 19th century, it is one of the gastronomic symbols of the island. The leaves and fruits are widely used in gastronomy and the dried stalks trussed for straw hats. It is also an invasive plant in the national park, and so the management of its presence includes the sensitization and participation of the local populations. Dialogues

such as this one are important since there is the need to recognize the economic and cultural values of the cultivation of this plant while also realizing that its uncontrolled growth is damaging the environment. The annual chouchou festival in the town of Salazie, in one of the three cirques, includes many producers recognized by the *Esprit du parc national* label.

Invasive species and the knowledge of endemic flora is also particularly important after wildfires. One impact of climate change is a higher propensity of wildfires, with longer and drier dry seasons (besides the permanent activity of the *Piton de la Fournaise* volcano), and in different years significant wildfires, some of them burning primary forests, have ravaged several areas of the island. Ninety percent of these fires are related to human activity. While the park has permanent campaigns aimed at visitors, the accessibility of the classified landscapes is a permanent concern. The recovery of the landscape is done with special attention to invasive species whose growth is stimulated by the fires, and the local knowledge about the landscape and scientific studies of endemic and invasive plants is fundamental for the regeneration of the natural heritage.

Another important dimension of how cultural and natural heritages are deeply connected is the recognition of the historical and cultural importance of the toponymic of the heart of the park and the creole architecture of the small urban centres in the cirques. Many of the peaks are named after maroon kings and communities (often with Malagasy-origin denominations) and this important heritage, with which a significant part of the Creole population identifies, imprints meaningful cartographies upon the natural landscape, where symbol and natural features embody a past that is memorialized. The Creole aesthetics of many houses in the Salazie and Cilaos cirques are a testimony of the occupation of the highlands during the second half of the 19th century and are integrated into the cultural values of the park, with local tourism companies providing guided tours integrating architecture, landscape, and traditional products. One important aspect of this is also the highlighting of the so-called *jardins creoles* (creole gardens), house gardens that traditionally included medicinal, edible, and decorative plants and fruits, and are part of the cultural life of the island. The knowledge of the plants that these gardens embody is equally connected with the locally known as *tizaniers*, persons who know medicinal plants and how to prepare infusions (*tizanes*). Creole gardens are also an important part of the Seychellois cultural heritage (Penda Choppy & Vel, 2021).

The integration of cultural and natural values translates the social history of the territory and enables local populations to sustain vernacular means of production and living, honour symbolic places inside the park, and maintain local knowledge of the fauna and flora.

The **Parc Naturel Marin de Mayotte** (Marine Park of Mayotte) management structure and areas of research include the local traditions and cultures associated with the lagoon. The objectives of the management plan are to define a balance between the development of human activities and the protection of the natural and cultural heritages (Marine Natural Park, n.d.).

The marine cultural heritage is one of the areas of intervention of the park, which has been promoting the study and inclusion of traditional techniques and knowledge in actions of conservation and coping with the effects of climate change. Driest seasons and drier landscapes (with severe water shortages in 2023 and 2024), associated with deforestation have significantly increased runaway sediments into the lagoon, affecting the quality of the coastal water and the health of the coral reefs. Simultaneously, mangroves are affected by sea level rise, pollution, agriculture and rapid urbanization, and their decline severely affects the coastal ecosystems and the ability to face extreme tropical weather events.

The island presents several issues related to climate change including soil and coastal erosion, mangrove degradation, bleaching of double coral barriers, higher-magnitude cyclones, and increased air temperatures (Mori et al., 2024, p. 3). In December 2024, the intense cyclone Chido hit, leaving Mayotte devastated and highlighting the need to have infrastructures that are cyclone-proof. In recent years (with special incidences in 2023 and 2024), there have been long periods of water shortages, leading to occasional episodes of cholera and other waterborne diseases.

Despite local ecological knowledge in Mayotte being an understudied field, there are diverse dimensions in the park administration that directly deal with cultural aspects. The local pirogue has one floater and is called *laka* in Shimaori. Pirogue is a traditional type of canoe dugout boat made from a large log, existing across the globe with regional variations. Usually with one or two side floaters, lateral extensions with a floating piece of wood that offering stability. Laka are still widely used in Mayotte, often propelled by motor instead of the traditional sails. Today, fewer persons have the knowledge to build them, and slowly the transmission of this art is being lost. It is

Figure 3. The lagoon on the northern area of Mayotte. Photograph by Pedro Pombo, 2024.

a cultural symbol and indispensable to the life of fishing communities living on the shore. Since 2014, the park has organized an annual festival to honour the pirogue, the *Laka Festival* renting embarkations to the local fishing communities and establishing a race around the islet of M'Buini.

Another cultural heritage associated with the sea is the significant *msindzano*, a paste applied by women on their faces which is widely used in the whole Comorian archipelago. The paste is obtained by rubbing sandalwood on a piece of coral. Since 1980, the capture of coral has been considered illegal, but it is still practised through this tradition. Since 2016 the park has engaged in the production of a ceramic base that can substitute the traditional coral one. Despite being an ongoing project, without clear results, it is an interesting case of the importance of establishing dialogues between traditional practices and contemporary concerns over biodiversity conservation. Mayotte has seen its population grow rapidly and steadily in the last few decades, raising the important question of how to adapt vernacular techniques and ways of living that have been sustainable for long periods to changing contexts that demand a rethinking of the use of natural resources.

CONCLUSION

The case studies presented show that the integration of local knowledge and modes of living with the management of natural and cultural sites is not only possible and desirable, but also effective in climate resilience and adaptation measures. In different modes, these examples show how governmental and institutional management of sites that focus on the preservation and conservation of the environment *also* consider their cultural significance and the human activities that exist inside protected areas. The vernacular cultures that this human presence embodies, which for the cases of Mayotte and Comoros are much older than a European colonial presence, constitute not only a testimony of the past but, most importantly, are essential elements that can guide approaches to sustainable futures and adaptation to the impacts of climate change. The separation between natural and cultural heritages becomes nuanced in the three cases through attention to the values and meanings the environment has for the local communities, and the conservation of natural sites needs to include its sustainable use. Our research suggests crucial questions: how to learn from the past and how to include this knowledge in the contemporary contexts facing anthropogenic pressure and climate change.

In all the examples, initiatives that involve the community at large and students reinforce a sense of belonging and pride in the heritage celebrated. If these initiatives are well explored, besides celebrating the past and the vernacular, they can provide important reflections on transforming and adapting what is known to new conditions. The examples from Mayotte, where the pirogue is celebrated as heritage despite the traditional boat-making art disappearing with the use of modern materials as fibreglass, and the experiments with substituting coral for ceramic while maintaining cultural habits, tell us that traditions and vernacular knowledge can adapt to novel situations and provide communication between established senses of belonging and contemporary changing scenarios.

In Mwali, on the other hand, decision-making processes that include representatives of the local communities and social and religious structures have been fundamental for the social and economic gains emerging from the preservation of the natural ecosystems. Local Park rangers patrol the protected sites of the island, school projects enhance the transmission of environmental knowledge and cultural attachments to the landscape, and the slow but steady growth of eco-tourism provides economic benefits for the villagers. In both

cases, marine conservation initiatives also mean a sustainable increase in fish and mollusc stocks and mangrove restoration actions sensitize the populations to new threats posed by climate change.

In a different context, the label *Esprit du parc National* provided by the Reunion Island National Park promotes sustainable agricultural and silvicultural practices, creates an economic value to local products, and recognizes senses of cultural identity by integrating them into the experience of visiting and living in the park.

In these three examples, culture and nature are inseparable, and the relationship between the administrative dimension of heritage management and the daily lives of the local communities is mediated by the inclusion of cultural meanings and vernacular modes of living.

This points to the relevance of collaborative decision-making processes, in which Mwali Biosphere is an example to follow. Heritage management is not always consensual, and that state and international institutions often have aims that collide with populations' expectations. In all these cases, but particularly in Mwali and Mayotte, economic insecurity and lack of prospects affects local residents, and often ideas of development and use of natural resources may seem to go against ideas of environmental preservation, as in many parts of the world (Walter & Hamilton, 2014). But when contexts of poverty and anthropogenic pressure on the environment are exacerbated by the impacts of climate change, it is more important than ever, and a matter of justice, to acknowledge the central role that Indigenous and local ecological knowledge and vernacular cultures have in equating futures between conservation and development (Baldacchino & Niles, 2011b).

One such example is to acknowledge the need to establish stronger dialogues between scientific and Indigenous cultural knowledge (Chanza et al., 2022), which must establish cultural and linguistic translations. Local languages and worldviews need to be considered by administrative and research bodies, as it has been analysed for the context of Mayotte (Banos et al., 2022; Mori et al., 2024).

Only with collective governance and fair recognition of the extraordinary cultural diversity of the world can a future be imagined, in the face of climate change and its unpredictable consequences.

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