FEBRUARY 2025

Coastal Protected Areas Conservation Management Plan *2025 – 2029*

Aruba Conservation Foundation

Together for *Nature.*

Table of Contents

Foreword

The **Aruba Conservation Foundation (ACF)** is an independent, non-profit conservation management organization (CMO), mandated by the government of Aruba through a service level agreement (SLA) to manage the legally designated terrestrial and marine protected areas, associated ecosystems, biodiversity, and habitats. ACF works together with the public and private sectors and our diverse community of stakeholders, taking an integrated approach to delivery of our mandate of protecting, preserving, and restoring the island's natural heritage and broader goals of contributing to the sustainable development of Aruba.

ACF protects, preserves, and restores Aruba's valuable heritage, seen from an ecological, environmental, geological, cultural, archaeological, and historical perspective, with the ultimate aim to secure a measurable improvement in the overall biodiversity, health, and (climate) resilience of Aruba's terrestrial, coastal, and marine ecosystems.

As a custodian of the protected areas of Aruba and the biodiversity they harbor, ACF promotes sustainable practices that integrate environmental, social, cultural, and economic objectives, and that address long-term concerns in meaningful ways, to ensure that our natural resources remain relevant for present and future generations. Whenever and wherever necessary, ACF applies the Precautionary Principle (a principle of environmental law) as a strategy to cope with possible risks and potential harm to nature, where scientific understanding is yet incomplete - as is still largely the case for Aruba.

ACF operates within the national and international legal frameworks and environmental policies, and according to the principles of Biodiversity Conservation and Ecosystem-Based Management (EBM), applying best practices and the Conservation Standards (Theory of Change) to deliver high conservation performance and tangible results.

ACF's Multi Annual Corporate Strategy 2023 – 2032 (ACF MACS 2023 – 2032) articulates a clear ambition and direction for the organization in its transition from a traditional park management organization to a modern conservation management organization. Guiding the development of conservation management and action plans is ACF's Protected Areas Conservation Management Framework 2025 – 2034, which lays a strong foundation for stability and growth of biodiversity and ecosystem-based conservation, and ecological sustainability, within a broader context of the sustainable development goals (SDGs) and biodiversity conservation priorities for the protected areas, as indicated in the ACF MACS 2023 – 2032. As such, ACF has clustered the protected areas according to ecosystems, associated biodiversity and habitats, resulting in three Protected Areas Conservation Management Plans (PACMPs), each following a 5-year cycle as of 2025: a Terrestrial PACMP, a Coastal PACMP, and a Marine PACMP.

This document was developed through a process of field observations, literature research and extensive stakeholder engagement with key stakeholders, including nature experts and NGOs, authority representatives, tourism representatives, tour operators, government representatives, institutions and social NGOs.

As ACF applies adaptive management as a systematic approach to decision-making and planning in nature conservation, ACF emphasizes flexibility, learning, and continuous improvement. This involves monitoring the outcomes of conservation actions, assessing their effectiveness, and adjusting management strategies based on new information and changing circumstances. This entails that priorities and actions may be revised annually, also based on available resources.

Executive summary

Aruba's coastal ecosystems are vital to the island's biodiversity, cultural heritage, and economic resilience. The **ACF's Coastal Protected Areas Conservation Management Plan (PACMP) 2025–2029** provides a strategic framework to protect, restore, and sustainably manage these fragile environments in the face of increasing human pressures and climate change impacts. The plan aligns with national policies, such as Aruba's Spatial Development Plan (ROP) and Nature Conservation Ordinance, and global frameworks, including the Kunming-Montreal Global Biodiversity Framework and the UN Sustainable Development Goals (SDGs).

Strategic Objectives

The Coastal PACMP outlines key conservation objectives to address Aruba's most pressing coastal challenges:

- **Protect and Restore Coastal Habitats:** Enhance the resilience of mangroves, beaches, dunes, saliñas, and reef islands through habitat restoration, erosion control, and invasive species management.
- **Improve Coastal Water Management:** Restore hydrological systems, such as saliñas and mangroves, to support biodiversity, control flooding, and mitigate climate change impacts.
- **Promote Sustainable Coastal Development:** Integrate nature-based solutions, such as blue-green infrastructure and ecosystem-based adaptation, to balance urban expansion with environmental stewardship.
- **Strengthen Marine and Coastal Species Conservation:** Implement targeted conservation programs for key species, including nesting sea turtles, migratory and resident (sea)bird species, and critical marine life.
- **Reduce Pollution and Marine Debris:** Enhance waste management infrastructure and policies to prevent runoff pollution, plastic litter, and industrial discharges from threatening the coastal biodiversity and ecosystems.
- **Foster Community Engagement and Education:** Increase awareness and stewardship by engaging local communities, businesses, and stakeholders through outreach, capacity-building, and participatory management.
- **Enhance Governance and Partnerships:** Strengthen regulatory frameworks, improve enforcement, and foster collaborations with local, regional, and international stakeholders to drive evidence-based conservation efforts.

Key Conservation Actions and Targets

The Coastal PACMP sets ambitious yet achievable conservation targets, including:

- **Restoration of 50% of degraded coastal habitats**, such as mangroves, beaches, and dunes, through ecological restoration and sustainable management practices.
- **Establishment of ecological corridors** to enhance connectivity between critical habitats and promote species movement.
- **Reduction of pollution by 30%** through improved wastewater management and community-based clean-up initiatives.
- **Protection and management of 100% of Aruba's nesting sites** for sea turtles and migratory (sea) birds.
- **Development and implementation of sustainable tourism guidelines** to minimize environmental impacts and promote eco-tourism opportunities.
- **Implementation of a robust Monitoring and Evaluation (M&E) framework**, utilizing tools such as GIS mapping, biodiversity surveys, and stakeholder feedback to track progress and adapt management strategies.

Threats and Challenges
Aruba's coastal ecosystems face multiple, interconnected threats that require urgent attention:

- **Climate Change Impacts:** Rising sea levels, coastal erosion, and extreme weather events threaten the structural integrity of key habitats.
- **Urbanization and Coastal Development:** Encroachment on sensitive coastal zones leads to habitat fragmentation, pollution, and disturbance of wildlife.
- **Invasive Species:** Non-native flora and fauna outcompete native species, altering ecosystem dynamics and reducing biodiversity.
- **Unregulated Tourism and Recreation:** Increasing visitor pressure on fragile coastal environments can lead to habitat degradation and loss of biodiversity.
- **Insufficient Resources and Enforcement:** Limited capacity and funding pose significant challenges to effective conservation management and regulatory compliance.

Conclusion
The **Coastal Protected Areas Conservation Management Plan 2025–2029** provides a comprehensive roadmap to protect and sustainably manage the island's invaluable coastal ecosystems. Through strategic conservation actions, stakeholder collaboration, and adaptive management, this plan aims to ensure the long-term resilience of Aruba's coastal heritage. By implementing the CCMP, Aruba reaffirms its commitment to safeguarding its unique biodiversity and securing a sustainable future for generations to come.

Acknowledgements

This Coastal Conservation Management Plan 2025- 2029 was developed by Natural Dialogue, Fleming Ecology and the Aruba Conservation Foundation, through stakeholder consultation sessions, and funded by the Dutch Caribbean Nature Alliance (DCNA).

This Plan has been approved by the Minister of Nature and the Department of Nature and Environment and is published through the official government channel *Landscourant* and on the website of the Aruba Conservation Foundation.

Coastal Areas Conservation Management Plan 2025-2029

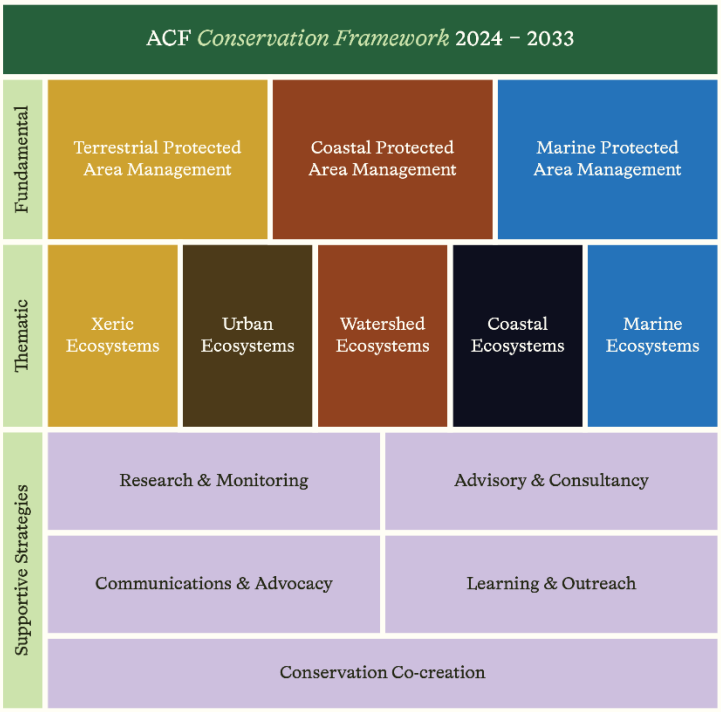
1. Introduction

1.1 Context

Conserving coastal areas presents a unique set of challenges for Aruba, not only due to their unique and dynamic nature and the variety of ecosystems they encompass, but also due to the high anthropogenic activity in Aruba's coastal areas. The coastal area is a high activity area with a diverse of socio-economic pressure impacting nature. The primary challenges for coastal conservation in Aruba include habitat loss and degradation, pollution, tourism and recreation, erosion and sedimentation, climate change. ACF will apply Integrated Coastal Zone Management (ICZM) - a comprehensive approach to managing coastal areas in a sustainable way. It aims to balance environmental, socio-economic, and cultural objectives to ensure the long-term health and productivity of coastal zones, and recognizes the interconnectedness of land and sea, involving the coordination of various stakeholders and sectors to reduce the impact on Aruba's coastal areas.

The Coastal PACMP 2025–2029 builds upon the principles and objectives of the ACF Protected Areas Conservation Management Framework 2025–2034, focusing specifically on safeguarding Aruba's coastal ecosystems and biodiversity. It outlines a holistic and inclusive strategy to achieve ecologically sustainable, socially relevant, and economically viable conservation outcomes. This plan emphasizes collaboration at all levels—local, regional, and international—while fostering greater appreciation and support for the intrinsic and functional value of Aruba's coastal ecosystems. Central to this approach is ACF's "Cycle of Business," which integrates biodiversity conservation, the enhancement of ecosystem services, and the development of sustainable nature-based experiences that reinforce commitment to nature conservation.

Aligned with ACF's Multi-Annual Corporate Strategy (MACS) 2023–2032 and the government's National Biodiversity Strategy & Action Plan (NBSAP 2024-2030), this plan adopts evidence-based, adaptive management principles to improve protected area management and develop ecosystem-based approaches for Aruba's coastal environments. The plan identifies two key focus areas: Fundamental Conservation, addressing ACF's core responsibilities in managing protected coastal areas and their ecosystems, and Thematic Conservation, which targets specific species, habitats, and island-wide research opportunities. The strategy also incorporates critical elements from the Conservation Framework, such as promoting inclusive conservation practices, adopting innovative technologies, and advocating for a shift toward an eco-centric worldview where the "Rights of Nature" serve as a guiding principle.



Effective landscape-scale management of coastal ecosystems, including their protected areas and the natural infrastructure that supports them, is essential to achieve conservation goals and ensure the sustainability of these vital areas. ACF's top priority is therefore to develop, according to modern standards and best practices, a Conservation Management Plan for the coastal protected areas, their ecosystems and associated biodiversity.

Figure 1: ACF Conservation Framework 2024-2033

1.2 Vision

This vision has been derived through stakeholder engagement sessions. It incorporates the ACF perspective as defined in the Multi Annual Corporate Strategy 2023 – 2032 (ACF MACS 2023 – 2032), and ACF's Protected Areas Conservation Management Framework for 2025 – 2034. It is the agreed, stakeholder-generated output from workshops on both the coastal and terrestrial environments; it can therefore be applied generically to these ecosystems:

By 2050 Aruba builds an inclusive society that respects and protects (at least 30%) of our natural environment, stimulating (resilient) nature to grow and thrive in all its beauty and diversity with the active involvement of our local community. We aim for a future where all our choices and the efforts Aruban residents, government and guests [humans on the island] help our unique landscapes and wildlife to flourish, ensuring a rich healthy environment for future generations.

[By 2050 Aruba leads the Caribbean/world/island world in conserving nature.]

1.3 Objectives

These strategic and operational objectives are designed to create a robust framework for managing Aruba's key coastal ecosystems, ensuring both their ecological integrity and their contribution to local and global biodiversity conservation efforts. They address the complex challenges facing the land-based environments, ensuring a focused and coordinated approach. They are based on the thematic conservation priorities set out in the ACF's Protected Areas Conservation Framework 2025-2034, including the strategies and actions necessary to conserve

and manage the cluster of protected areas and ecosystems effectively[1], and the priorities identified in the stakeholder engagement process which were:

1. Beaches and Barancas
2. Salinas
3. Mangroves
4. Reef Islands
5. Dunes

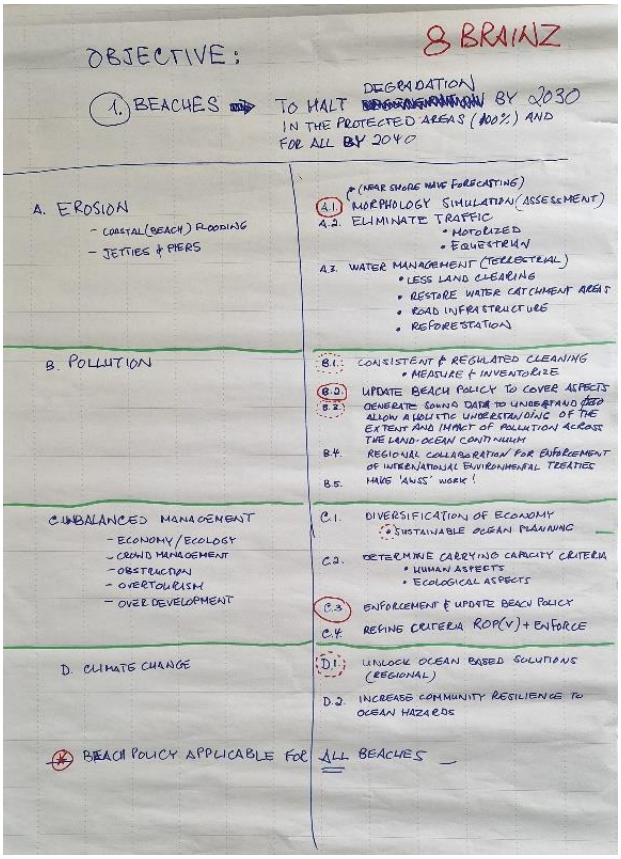


Figure 2: Flipchart paper from the workshop exercise to generate objectives, issues and, from those, key actions; in this case for beaches.

1.4 Strategic Objectives:

1. *Enhance Habitat Resilience*: Protect and restore coastal habitats, including mangroves, dunes, saliñas, and reef islands, to ensure their long-term ecological integrity and ability to adapt to climate change impacts.

2. *Safeguard Biodiversity*: Conserve key species, including endemic and migratory wildlife, by maintaining and enhancing critical habitats and reducing anthropogenic pressures.

3. *Promote Sustainable Tourism*: Develop and enforce sustainable tourism practices that minimize environmental impacts while supporting eco-tourism and local livelihoods.

4. *Mitigate Pollution*: Implement measures to reduce pollution from urban, industrial, and recreational sources, ensuring healthier ecosystems and water quality.

5. *Foster Community Stewardship*: Engage local communities through education, participation, and co-management initiatives to promote long-term conservation efforts.

[1] For example: borders and zoning; rules and regulations; managing pressures and threats mitigation; nature protection and enforcement; natural resource management; climate change adaptation; sustainable visitor recreation management, etc.

6. *Strengthen Climate Adaptation*: Integrate climate resilience into all conservation efforts to mitigate the impacts of sea-level rise, storm surges, and changing weather patterns.

7. *Enhance Governance*: Strengthen legal frameworks, regulations, and enforcement mechanisms to protect coastal ecosystems from unsustainable development and exploitation.

1.5 Operational Objectives:

1. *Habitat Restoration*: Rehabilitate 60% of degraded coastal habitats through native vegetation replanting, erosion control, and hydrological restoration within five years.

2. *Species Monitoring and Protection*: Establish monitoring programs for key species such as sea turtles, terns, and endemic reptiles, and enforce no-disturbance zones during critical life stages.

3. *Pollution Reduction*: Achieve a 30% reduction in pollutants entering coastal ecosystems by upgrading infrastructure, enhancing waste management systems, and enforcing industrial discharge regulations.

4. *Tourism Compliance*: Ensure 80% adherence to sustainable tourism guidelines by developing visitor management plans and eco-tourism certifications.

5. *Community Engagement*: Involve 75% of local communities in conservation programs through education campaigns, citizen science projects, and volunteer opportunities.

6. *Invasive Species Control*: Eradicate invasive species from 70% of affected coastal ecosystems and reintroduce native species to restore ecological balance.

7. *Climate Resilience*: Implement adaptive measures in 70% of coastal ecosystems, including the restoration of natural buffers such as mangroves and coral reefs.

8. *Policy and Enforcement*: Establish clear legal protections and enforce regulations for 100% of critical coastal ecosystems within five years.

2. Coastal Ecosystems: biodiversity value, pressures, threats, conservation actions and targets

Aruba, the smallest and westernmost of the Dutch Leeward Islands, lies within the Aruba-La Blanquilla chain along the Venezuelan continental border. Unlike Bonaire and Curaçao, Aruba rests on the Venezuelan continental shelf, shaping its distinct geology and ecosystems (Van den Oever, 2000). The island's flat terrain is punctuated by Mount Jamanota, its highest point at 189 meters. The geological foundation of Aruba consists of folded metamorphic and igneous rocks from the Cretaceous period, overlaid in places by limestone deposits from the Eocene, Neogene, and Quaternary periods. These formations define the island's unique landscapes and contribute to its biodiversity. The Aruba Lava Formation (ALF) in the central and northeastern regions, a tonalite/batholith complex, and limestone deposits collectively support Aruba's xerophytic vegetation and provide critical habitats for Coastal species.

Aruba's coastal zone represents the area of transition between the marine and terrestrial, and is the most dynamic of the ecosystem groups. This dynamism is, in part, the result of the ecological processes that affect coastal ecosystems, but it is also subject to range of heavy human pressures. Collectively, these include high winds and storms, tourism pressure, general and point source pollution, erosion, and the various impacts of climate change.

The northern, windward coast is characterised by constant wind, salt spray, and the sea which always carries a heavy swell and delivers breaking waves whose impact has played a crucial role in shaping the coastal geomorphology; including important features such as the bocas, beaches, sandbars, saliña Druif, mobile dune systems, caves, barancas and rock pools. The leeward coast is fringed by a series of reef islands, which are located in their marine ecosystem but here are considered within the coastal; the beaches, and the mangroves, all of which provide the preferred space for international tourism and related coastal development and recreation. There are also a number of saliñas along the coastline whose varied ecologies support important and specialised habitats and species.

Fortunately, many of the most fragile sites lie within the boundaries of protected areas. However, these designations bring challenges in terms of integrating a range of potentially conflicting land use objectives. Furthermore, recent research has significantly advanced understanding and management of these ecosystems. Mücher et al. (2024) analysed historical land cover changes since 1900, providing a comprehensive view of land use trends and their implications, complimented by De Freitas et al (2023) who published a landscape ecological vegetation map of Aruba. Henkens et al. (2024) conducted a baseline study highlighting pressures and threats to coastal wetlands from terrestrial water management practices and the text for saliñas below draws heavily on this work. Verweij et al. (2024) explored sustainable scenarios for balancing human and ecological needs. Together, these studies offer critical perspectives for addressing the complexities of land use and conservation in Aruba. In addition, Spaans Lagoen (Protected Area and Ramsar Site) is subject to the implementation of the stakeholder derived management plan (Jones-Walters, 2017) via the Turning the Tides project (Nature Today, 2024); and the Western Wetlands (Ramsar Site) management plan is currently being written.

2.1 Saliñas

The saliñas of Aruba are crucial wetlands that play a key role in the island's hydrology, biodiversity, and ecosystem services. Historically, they have supported seasonal fluctuations in water levels and salinity, fostering dynamic plant and animal communities adapted to these demanding conditions. Natural saliñas, such as those at Malmok and Cerca, exemplify this seasonal variability, with their saline waters hosting species like the seagrass *Ruppia maritima*, amphidromous fish such as the Lyre Goby (*Evorthodus lyricus*) and Fat Sleeper (*Dormitator maculatus*), Mountain Mullet (*Agonostomus monticola*), and the range-restricted Molly (*Poecilia vandepolli*), as well as crustaceans including fiddler and land crabs, freshwater shrimp and brine shrimp. These habitats are vital for resident and migratory birds, reptiles, and mammals, including the endemic Aruba cat-eyed snake (*Leptodeira bakeri*) and native bat species.

However, many of the saliñas have been significantly altered by human activities. Bubali, Palm Beach, and Druif have experienced decades of effluent discharge from the Bubali wastewater treatment plant, which has struggled with capacity issues (Directie Natuur en Milieu, 2022). This has led to year-round freshwater conditions and high nutrient loads, particularly at Bubali. These altered conditions have fostered dense growth of *Typha dominguensis* and invasive species such as Water Hyacinth (*Eichhornia crassipes*), while supporting invasive fauna like Nile Tilapia (*Oreochromis mossambicus*) and Red-eared Slider turtles (*Trachemys scripta*). Despite these

changes (and partly due to), these saliñas remain essential habitats for migratory and breeding birds, with Bubali alone hosting over 200 bird species.

The saliñas group in the stakeholder workshop (see Appendix 1), also made reference to Spaans Lagoen, Rooi Lamoenchi, and Santo Largo. Spaans Lagoen is covered within the section on Mangroves as this is its dominant habitat. Rooi Lamoenchi, which is covered in the terrestrial management plan, has been widened at its seaward mouth and is also occasionally inundated with saline water. Aerial photographs of Santo Largo show that in 1957 the salina was filling with water and the three salt pans at the Northern end that were constructed for the commercial production of salt were apparently still in use (Jones-Walters, 2017). By 1987, 30 years later, red mangrove (*Rhizophora mangle*) had established within the area and by 1990 inlet-outlet pipes had been installed at the north-east end of the site and just to the west of the bridge across the pipelines that run to the south of the road. However, in 2017 the pipes were crushed during work by DOW resulting in raised salt concentration (due to evaporation of the sea water) that killed off the mangrove. These issues still need to be resolved.

The differences between natural and altered saliñas underscore their ecological complexity. While natural saliñas exhibit seasonal salinity cycles and support specialized communities, effluent-fed wetlands have become freshwater-dominated systems, hosting flora and fauna foreign to Aruba's ecosystems. Yet, both types are vital, offering resources for various species and contributing to Aruba's natural and cultural heritage. Notably, Bubaliplas and Saliña Druif are designated Key Biodiversity Areas (KBAs) and Important Bird and Biodiversity Areas (IBAs), with the five sites comprising the Western Wetlands being recognized as a Ramsar site in 2023. Restoration projects under the Western Wetlands initiative aim to reconnect saliñas to their natural hydrology and improve ecological health through adaptive management and community involvement (Henkens et al., 2024).

Table 1: Key Pressures, Threats, and Drivers for the Saliñas.

Threat	Pressure	Driver
Nutrient Overloading	Wastewater discharge from Bubali treatment plant leading to altered ecosystem dynamics	Capacity issues at wastewater treatment facilities
Habitat Fragmentation	Urban development and infrastructure expansion disrupting natural hydrology	Economic reliance on tourism and insufficient land-use planning
Invasive Species	Proliferation of species such as Nile Tilapia (*Oreochromis mossambicus*) and Water Hyacinth (*Eichhornia crassipes*)	Altered ecosystem conditions due to nutrient enrichment and lack of invasive species management
Water Movement Disruption	Poorly planned road and urban infrastructure altering water flow between saliñas and the sea	Lack of integrated hydrological management
Climate Change	Rising temperatures, altered precipitation patterns, and intensifying droughts affecting hydrology	Global greenhouse gas emissions and inadequate local climate adaptation strategies
Vegetation Loss	Habitat alteration and destruction due to human activities causing changes in ecological conditions	Inadequate protection of critical wetland vegetation and restoration delays
Erosion	Soil and habitat degradation from runoff and the widening of roois	Poor erosion control measures and absence of natural filtration systems
Biodiversity Decline	Reduced habitat quality for species such as terns, amphibious fish, and native crustaceans	Habitat disruption from nutrient overloading, invasive species, and habitat fragmentation
Hydrological Disruption	Reduced water retention and filtration capacity	Invasive vegetation and unregulated water management
Unregulated Development	Construction projects affecting saliñas such as Malmok, Cerca, and Spaans Lagoen	Lack of enforcement of environmental regulations

Aruba's saliñas face numerous interconnected pressures that jeopardize their ecological integrity. Nutrient overloading from wastewater discharge remains a persistent issue, especially at Bubali and Druif, where nutrient-rich effluent has fundamentally altered ecosystem dynamics. Invasive species, such as the Nile Tilapia and Water Hyacinth, threaten native biodiversity, while urban development and infrastructure expansion fragment habitats and impede the natural flow of water between saliñas and the sea. These pressures are compounded by climate change, with rising temperatures and altered precipitation patterns intensifying droughts and disrupting saliña hydrology. Additionally, poorly planned road and urban infrastructure have exacerbated erosion and disrupted water movement, accelerating water runoff and reducing the natural filtration and retention functions of the wetlands, as seen at Malmok and Cerca. Balancing the growing demand for development with the need for ecological restoration presents a major challenge. Comprehensive management strategies, regulatory frameworks, and community engagement are essential to address these threats and safeguard the saliñas for future generations.

Table 2: Key Conservation Actions and Targets for Aruba's Saliñas

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Nutrient Management	Address nutrient overloading caused by wastewater discharge from the Bubali treatment plant.	Reduce nutrient inflow to saliñas by 30% through infrastructure upgrades.	Upgrade Bubali treatment plant capacity; establish regular monitoring of effluent quality.	Government of Aruba, Utilities Aruba NV, ACF, international water quality experts.
Invasive Species Control	Mitigate the impact of invasive flora and fauna, such as Water Hyacinth and Nile Tilapia, on native ecosystems.	Eradicate invasive species from 70% of affected saliñas and restore native biodiversity.	Implement removal programs for invasive plants and fish; monitor recovery of native species.	ACF, NGOs, volunteers, marine biologists, local universities.
Hydrological Restoration	Restore natural water flow and filtration functions of saliñas impacted by urban development and poor infrastructure.	Re-establish natural hydrological connectivity in 50% of degraded saliñas.	Repair damaged infrastructure (e.g., pipes at Santo Largo); implement watershed management strategies.	DOW Aruba, ACF, hydrology specialists, private developers, local communities.
Biodiversity Protection	Enhance habitat quality to support native and migratory species, including terns and endemic fish species.	Increase population sizes of key species by 20% through habitat restoration efforts.	Restore degraded nesting sites; establish no-disturbance zones and seasonal restrictions during breeding periods.	ACF, BirdLife International, Vogelbescherming Nederland, local and international conservation groups.
Community Engagement	Foster awareness and active participation in saliña conservation among local communities and stakeholders.	Achieve 75% community participation in conservation activities by 2029.	Develop educational programs, citizen science initiatives, and volunteer opportunities for habitat restoration.	Schools, local NGOs, ACF, Aruba National Park Foundation, local businesses.
Climate Resilience	Build resilience against climate change impacts, including sea-level rise and altered precipitation patterns, to safeguard	Establish climate adaptation measures in 70% of saliñas by 2029.	Implement mangrove restoration projects; design and test adaptive infrastructure to mitigate flooding and erosion.	ACF, climate scientists, international conservation organizations, government agencies.

	saliñas and their biodiversity.			

2.2 Beaches and Dunes

Aruba's beaches and dunes represent fragile yet invaluable ecosystems that play a pivotal role in the island's coastal and broader ecological integrity. These habitats are crucial for providing ecosystem services such as shoreline stabilization, storm protection, and erosion control. Healthy dune systems act as natural barriers, buffering the impacts of storm surges, high tides, and rising sea levels, which are becoming increasingly severe due to climate change (Martínez et al., 2004). The preservation of these natural features is essential for enhancing resilience to climate change across the Caribbean, making them a critical component of sustainable coastal management strategies (UNEP, 2020).

The beaches serve as critical nesting sites for endangered sea turtles such as the Leatherback (*Dermochelys coriacea*), Green (*Chelonia mydas*), and Hawksbill (*Eretmochelys imbricata*) turtles. Migratory birds, including species such as the Sanderling (*Calidris alba*) and Ruddy Turnstone (*Arenaria interpres*), use these habitats as stopover points during their long migratory journeys (BirdLife International, 2023). Furthermore, these environments are home to unique and salt-tolerant vegetation, including native dune grasses such as *Uniola paniculata*, which stabilize dunes and support ecological balance. Preserving these habitats is vital for maintaining Aruba's biodiversity and ensuring the survival of both resident and migratory species.

Table 3: Key Pressures, Threats, and Drivers for the Beaches and Dunes of Aruba

Threat	Pressure	Driver
Habitat Loss	Coastal development encroaching on beaches and dunes	Economic reliance on tourism, weak land-use planning
Vegetation Degradation	Trampling of native dune vegetation by tourists and vehicles	Lack of enforcement of sustainable tourism practices
Erosion and Hydrological Disruption	Construction of jetties, piers, and other infrastructure altering sand recharge and sedimentation patterns	Insufficient integration of hydrological considerations in coastal development planning
Wildlife Disturbance	Unregulated tourism causing disruption to nesting sea turtles and migratory birds	Lack of public awareness and limited regulatory oversight
Invasive Species	Spread of non-native plants outcompeting native dune-stabilizing vegetation	Insufficient invasive species management
Pollution	Littering and debris from beachgoers and nearby developments	Unregulated waste disposal and inadequate public education
Climate Change Impacts	Rising sea levels, intensified storms, and altered sediment dynamics	Global greenhouse gas emissions, limited local adaptation measures
Ecosystem Fragmentation	Urbanization creating fragmented and isolated dune and beach ecosystems	Lack of comprehensive coastal zoning and habitat connectivity planning
Loss of Ecosystem Services	Reduced storm buffering and shoreline stabilization due to degraded dunes	Cumulative effects of development, erosion, and vegetation loss

The beaches and dunes face many threats that jeopardize their ecological and protective functions. Coastal development continues to encroach upon these fragile ecosystems, leading to habitat loss, vegetation degradation, and increased vulnerability to erosion. Jetties and piers can disrupt coastal hydrology, patterns of sedimentation and sand recharge. Unregulated tourism further exacerbates these issues, with trampling, littering, and disturbance of key wildlife such as nesting sea turtles. Additionally, invasive plant species outcompete native vegetation, weakening dune stability and ecological integrity. Climate change amplifies these challenges, driving sea level rise, intensifying storms, and altering sediment dynamics. Addressing these threats requires a multifaceted approach that combines strict regulatory protections, active restoration of native vegetation, sustainable tourism practices, and robust community

engagement. Without immediate and coordinated action, the resilience of Aruba's beaches and dunes—and the vital ecosystem services they provide—will be at significant risk.

Table 4: Key Conservation Actions and Targets for Aruba's Beaches and Dunes

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Habitat Restoration	Restore degraded dune and beach habitats to enhance biodiversity and ecosystem services.	Rehabilitate 70% of degraded dune and beach areas through vegetation restoration.	Replant native dune grasses such as *Uniola paniculata* and remove invasive plant species.	ACF, local communities, UNEP, Vogelbescherming Nederland, schools, and volunteer groups.
Erosion Control	Implement measures to reduce beach and dune erosion caused by natural and human-induced factors.	Stabilize 50% of vulnerable dune systems using natural and engineered solutions.	Use sand fencing, vegetation planting, and controlled sand replenishment programs.	DOW Aruba, ACF, coastal engineers, environmental NGOs.
Sustainable Tourism	Minimize impacts of recreational activities and tourism on sensitive dune and beach ecosystems.	Achieve 80% compliance with sustainable tourism practices by tour operators.	Establish visitor guidelines, enforce no-entry zones, and promote eco-friendly tourism certifications.	ATA, local tourism operators, ACF, government regulators.
Wildlife Protection	Protect nesting sites for endangered sea turtles and migratory birds from disturbance and habitat degradation.	Increase sea turtle and migratory bird nesting success rates by 25%.	Create protected nesting zones, enforce seasonal restrictions, and conduct public awareness campaigns.	ACF, BirdLife International, sea turtle conservation groups, Aruba National Park Foundation.
Community Engagement	Foster local stewardship and public awareness to promote conservation of beaches and dunes.	Engage 75% of local communities in conservation programs and activities.	Develop educational materials, organize workshops, and initiate citizen science projects.	Schools, NGOs, local businesses, Aruba Tourism Authority, cultural heritage groups.
Climate Resilience	Enhance resilience of beaches and dunes to climate change impacts, including sea level rise and storm surges.	Implement adaptive management strategies in 60% of beaches and dunes.	Conduct vulnerability assessments, restore natural barriers, and integrate coastal defences.	Climate scientists, ACF, Wageningen University, government planners, UNEP.

2.3 Coastal Mangroves

Aruba's coastal mangroves in are vital ecosystems that provide essential services to both biodiversity and local communities. These habitats play a critical role in supporting the island's ecological integrity by acting as nurseries for fish, crustaceans, and molluscs, many of which are key to local fisheries and the health of adjacent coral reefs (Nagelkerken et al., 2008). They also filter nutrients and sediments, protecting coastal waters from pollution and contributing to the overall resilience of Aruba's marine ecosystems. However, mangroves have been significantly reduced due to unregulated coastal development, habitat fragmentation, and the growing impacts of climate change (Hamilton & Casey, 2016), highlighting the urgent need for conservation and restoration efforts.

Spaans Lagoen, Mangel Halto, and Isla di Oro represent the remaining strongholds of Aruba's mangrove ecosystems, connecting through seagrass meadows to coral reefs (the latter two

ecosystems are covered in the Marine PACMP) – providing an interconnected 'power of three' that sustains a diversity of species, including commercially interesting fishes. Spaans Lagoen, annexed to Parke Nacional Arikok, is a biodiversity hotspot, containing four mangrove species - *Rhizophora mangle*, *Avicennia germinans*, *Laguncularia racemosa*, and *Conocarpus erectus,* and extensive areas of open mud and silt, subject to tidal inundation, which together provide habitat for thousands of fiddler crabs, migratory birds, and diverse marine life. This area, rich in cultural and natural heritage, has long been integral to Aruba's identity and ecological health (Silliman et al., 2012).

Mangel Halto, known for its scenic beauty and ecological richness, exemplifies the interconnectedness of mangroves with coral reefs and seagrass meadows. Together, these habitats support the entire life cycle of numerous species, including commercially significant fish and ecologically important organisms. This area also holds significant cultural value as a location for traditional fishing, family gatherings, and recreational activities such as kayaking and snorkelling (Howard et al., 2014). The increasing popularity of Mangel Halto underscores the need for sustainable management practices to balance its ecological and cultural significance with tourism.

The mangrove areas of Spaans Lagoen and Mangel Halto, are historically significant, having supported local communities for generations through fisheries and natural resources. Their continued conservation is essential not only for maintaining biodiversity but also for preserving Aruba's cultural heritage. These areas highlight the deep interdependence between healthy ecosystems and cultural practices, as they provide a foundation for livelihoods, food security, and traditional activities such as artisanal fishing.

Further along the coast, from San Nicolas to the Oranjestad Reef Islands in the Area di Cay, mangroves play a critical role in maintaining the ecological health of reef islands and seagrass meadows. These areas are rich in biodiversity and provide crucial habitat for marine species while supporting recreational activities. However, unregulated tourism, illegal construction, and climate change threaten these delicate ecosystems. Protecting these habitats is essential not only for their ecological value but also for the cultural identity and natural beauty they contribute to Aruba (Alongi, 2012).

Across all these areas, mangroves also contribute to mitigating climate change by sequestering carbon in their biomass and sediments, offering a natural solution to global challenges (Donato et al., 2011). Their restoration and protection are fundamental to maintaining ecological balance, supporting biodiversity, and preserving cultural values that are deeply intertwined with Aruba's natural environment. ACF's efforts, in collaboration with organizations such as the University of Wageningen and ScubbleBubbles, focus on innovative restoration strategies such as hydrological improvements and sediment management. These efforts aim to ensure that mangroves continue to provide critical services for biodiversity, local livelihoods, and cultural heritage.

Table 5: Key Pressures, Threats, and Drivers for the Coastal Mangroves of Aruba

Threat	Pressure	Driver
Habitat Loss	Unregulated coastal development and illegal construction	Weak enforcement of zoning and development regulations
Pollution	Runoff and waste disposal introducing contaminants into mangrove ecosystems	Inadequate waste management infrastructure and oversight
Hydrological Alteration	Changes in water flow due to infrastructure projects and sediment disruption	Poor integration of hydrological considerations in development planning
Climate Change Impacts	Rising sea levels, intensifying storms, and altered precipitation patterns	Global greenhouse gas emissions and insufficient local adaptation measures
Invasive Species	Spread of non-native vegetation disrupting natural regeneration	Lack of invasive species management strategies

Recreational Pressures	Overuse of mangrove areas for activities such as kayaking and snorkelling	Insufficient regulation of tourism and recreational activities
Biodiversity Decline	Habitat degradation reducing nurseries for marine life and breeding sites for birds	Habitat fragmentation and increased disturbance
Cultural and Historical Loss	Destruction of areas of cultural and archaeological significance	Inadequate integration of cultural heritage preservation in conservation strategies
Loss of Ecosystem Services	Decline in shoreline stabilization, carbon sequestration, and fisheries support	Cumulative impacts of development, climate change, and habitat degradation

Coastal mangroves face numerous interconnected threats that endanger their ecological and cultural significance. Unregulated coastal development, pollution, habitat fragmentation, and the impacts of climate change, such as rising sea levels and increasing storm intensity, are primary drivers of mangrove loss. The growing popularity of recreational activities and tourism in areas like Mangel Halto further exacerbates pressures on these sensitive ecosystems, leading to habitat degradation and disturbance of wildlife. Invasive species and alterations to natural hydrology also hinder the health and regeneration of mangroves. Addressing these challenges requires a comprehensive approach that includes enforcing sustainable development regulations, implementing effective restoration projects, and promoting community engagement to foster stewardship. The loss of mangroves would not only diminish biodiversity and ecosystem services but also erode the cultural heritage and natural resilience that these habitats provide to the people of Aruba.

Table 6: Key Conservation Actions and Targets for Aruba's Coastal Mangroves

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Habitat Restoration	Restore degraded mangrove ecosystems to enhance biodiversity, hydrological functions, and carbon sequestration.	Rehabilitate 60% of degraded mangrove habitats through replanting and sediment management.	Replant mangrove species (*Rhizophora mangle*, *Avicennia germinans*); improve sediment conditions and hydrological flow.	ACF, DOW Aruba, local communities, Wageningen University, UNEP, volunteer groups.
Hydrological Management	Address disruptions to natural water flow that impact mangrove health and regeneration.	Restore natural hydrological connectivity in 70% of impacted mangrove systems.	Repair damaged infrastructure (e.g., crushed pipelines at Santo Largo); implement watershed management strategies.	Hydrology experts, DOW Aruba, ACF, private developers, local communities.
Biodiversity Protection	Enhance critical habitat for marine species, migratory birds, and native wildlife dependent on mangroves.	Increase population sizes of key species by 20% through habitat improvements.	Establish protected areas, enforce no-disturbance zones during breeding seasons, and remove invasive species.	ACF, BirdLife International, marine biologists, Aruba National Park Foundation.
Sustainable Tourism	Manage tourism activities to reduce impacts on sensitive mangrove ecosystems while promoting eco-tourism.	Achieve 85% compliance with sustainable tourism guidelines in mangrove areas.	Develop and enforce visitor guidelines, restrict high-impact recreational activities, and promote eco-friendly practices.	Aruba Tourism Authority, ACF, local tourism operators, UNEP.
Community Engagement	Engage local communities in mangrove	Involve 75% of local communities in mangrove-related	Develop educational programs, organize	Schools, NGOs, local businesses, ACF, cultural heritage organizations.

	conservation to foster stewardship and awareness of their ecological importance.	conservation initiatives.	clean-up events, and establish citizen science monitoring programs.	
Climate Resilience	Build resilience to climate change impacts, including sea level rise and increased storm intensity.	Implement adaptive measures in 70% of mangrove areas to enhance climate resilience.	Conduct vulnerability assessments, restore degraded areas, and protect mangroves as natural buffers against climate impacts.	Climate scientists, ACF, Wageningen University, government planners, UNEP, UNESCO.

2.4 Reef Islands

Aruba's reef islands are unique in the world for hosting breeding populations of ten tern species (Fundacion Parke Nacional Aruba, 2022). This remarkable diversity underscores the global importance of these habitats for avian biodiversity. Notably, the San Nicolas Bay Reef Islands and the Oranjestad Reef Islands have been designated as Important Bird Areas[2][3] (IBAs) by BirdLife International (2007) due to their importance as breeding sites for terns and, since 2023, the reef islands fall within the East Point[4] and South Coast[5] Ramsar sites. Research led by Dr. Adrian Delnevo has been instrumental in highlighting the global significance of these colonies. His studies indicate that approximately 20% of the world's Cayenne Terns (*Thalasseus sandvicensis eurygnatha*) breed in Aruba, with the majority nesting on these reef islands (Delnevo, 2009). Beyond their significance for seabirds, some of Aruba's reef islands feature mangrove vegetation, providing essential nesting and roosting habitats for various bird species. The dense mangroves offer safe roosting sites for raptors such as the Peregrine Falcon (*Falco peregrinus*), and the surrounding lagoons serve as hunting grounds for Ospreys (*Pandion haliaetus*). These habitats are crucial for maintaining the island's avian biodiversity and supporting migratory bird populations.

However, Aruba's reef islands and adjacent coastal zones are facing a multitude of challenges. A significant concern is the lack of clear legal frameworks and enforcement mechanisms governing these areas. The ambiguous legal status of traditional structures, known as Ranchos, and piers, coupled with insufficient sustainable management practices and public awareness, has led to the unchecked commercialization of sites like Glass Beach. Human activities further exacerbate the degradation of these ecosystems. Infrastructure development, including construction projects, disrupts natural habitats, while runoff pollution from inadequate waste management systems, such as the Bubali wastewater treatment plant, introduces harmful nutrients and contaminants into marine environments. Industrial activities around harbours and refineries contribute additional pollutants, and practices like dredging alter seabed structures, negatively affecting coral health. The accumulation of both biodegradable and non-biodegradable waste, notably plastic litter, along with human bodily waste, contaminates these fragile ecosystems (de Scisciolo, et al. 2016). Unregulated recreational activities, including kayaking and boating, cause physical damage to coral structures and disturb wildlife. These combined factors have led to significant habitat loss for species such as terns.

[2] https://datazone.birdlife.org/site/factsheet/oranjestad-reef-islands-iba-aruba-%28to-netherlands%29?utm_source=chatgpt.com
[3] https://datazone.birdlife.org/site/factsheet/san-nicolas-bay-reef-islands-iba-aruba-(to-netherlands)
[4] https://rsis.ramsar.org/ris/2525
[5] https://rsis.ramsar.org/ris/2526

Finally, climate change compounds these issues by accelerating vegetation loss, including critical mangrove areas, and intensifying coastal erosion, particularly in regions like San Nicolas and Oranjestad. Rising sea levels and increased frequency of storm surges threaten the very existence of reef structures, leading to a vicious cycle of degradation. The deterioration of coral reefs diminishes natural coastal defences, making the islands more susceptible to erosion and further habitat loss (IPCC, 2014; World Bank Group, accessed 2025).

Table 7: Key Pressures, Threats, and Drivers for the Reef Islands of Aruba

Threat	Pressure	Driver
Habitat Loss	Infrastructure development and unregulated construction on reef islands	Lack of legal frameworks and enforcement mechanisms
Pollution	Runoff from wastewater treatment plants, industrial discharges, and littering	Inadequate waste management infrastructure and insufficient regulation
Coral Reef Degradation	Dredging and physical damage from recreational activities such as kayaking and boating	Lack of sustainable tourism practices and poor enforcement of regulations
Vegetation Loss	Loss of mangroves and critical coastal vegetation	Climate change impacts, such as rising sea levels and storm surges
Wildlife Disturbance	Poaching and habitat disruption impacting species like terns	Insufficient public awareness and limited conservation resources
Coastal Erosion	Accelerated erosion due to coral reef degradation and rising sea levels	Climate change and reduced natural coastal defenses
Waste Accumulation	Accumulation of plastic, human waste, and other debris on reef islands	Lack of infrastructure for proper waste disposal and recycling
Climate Change Impacts	Increased storm intensity, rising sea levels, and altered weather patterns	Global greenhouse gas emissions and limited local climate adaptation measures
Unregulated Tourism	Overuse of sensitive reef areas for recreational purposes	Lack of sustainable tourism guidelines and enforcement
Resource Limitations	Limited equipment, personnel, and funding for conservation initiatives	Insufficient governmental support and reliance on under-resourced NGOs like ACF

Aruba's reef islands face significant threats from human activities, environmental degradation, and climate change, which collectively jeopardize their ecological integrity and global significance. Rising sea levels and intensified storms inundate nesting sites for ground-nesting birds like terns, while coral reef degradation undermines the natural replenishment of these islands. Human impacts, including infrastructure development, runoff pollution, industrial discharges, dredging, and unregulated recreational activities, further destabilize these fragile ecosystems. Invasive species, such as the Hottentot fig, overgrow critical nesting areas, exacerbating habitat loss for tern populations. Climate change accelerates coastal erosion, vegetation loss, and reef degradation, creating a vicious cycle of habitat decline. Addressing these issues requires integrated conservation strategies, including habitat restoration, stricter pollution controls, sustainable management practices, and active community engagement to safeguard these vital biodiversity hotspots.

Table 8: Key Conservation Actions and Targets for Aruba's Reef Islands

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Habitat Restoration	Restore degraded reef island habitats to support biodiversity and enhance coastal resilience.	Rehabilitate 60% of degraded reef island habitats through targeted restoration.	Replant native vegetation, stabilize eroded areas, and establish no-disturbance zones.	ACF, local communities, UNEP, Wageningen University, coastal restoration specialists.
Pollution Mitigation	Reduce pollution from runoff, industrial discharges, and	Achieve a 30% reduction in pollution entering reef ecosystems.	Improve waste management infrastructure, enforce industrial	ACF, DOW Aruba, local municipalities, NGOs, international waste

	waste accumulation on reef islands.		discharge regulations, and conduct regular clean-ups.	management organizations.
Sustainable Tourism	Minimize impacts of recreational activities and tourism on reef island ecosystems.	Ensure 80% compliance with sustainable tourism guidelines for reef islands.	Develop and enforce visitor guidelines, restrict access to sensitive areas, and promote eco-friendly tourism certifications.	ATA, local tourism operators, ACF, UNEP, cultural heritage organizations.
Wildlife Protection	Protect critical habitats for species such as terns, migratory birds, and coral-associated fauna.	Increase tern nesting success rates by 25% and protect critical reef areas.	Establish protected nesting zones, enforce seasonal restrictions, and monitor key wildlife populations.	ACF, BirdLife International, local and international conservation groups, Aruba National Park Foundation.
Climate Resilience	Enhance resilience to climate change impacts, including sea-level rise and increased storm intensity.	Implement adaptive management measures in 70% of reef islands to mitigate climate risks.	Conduct vulnerability assessments, restore coral reefs, and establish mangroves as natural buffers.	Climate scientists, ACF, Wageningen University, UNEP, government planners.
Community Engagement	Foster local stewardship and awareness to support long-term conservation of reef islands.	Engage 75% of local communities in reef island conservation activities.	Develop educational campaigns, citizen science initiatives, and community-based restoration projects.	Schools, NGOs, local businesses, ACF, Aruba Tourism Authority.
Legal and Regulatory Frameworks	Strengthen legal frameworks and enforcement mechanisms to protect reef islands from unregulated activities.	Establish clear legal status and enforce regulations for 100% of reef islands.	Draft new legislation, train enforcement personnel, and increase monitoring of reef island activities.	Government of Aruba, ACF, legal experts, NGOs, international environmental organizations.

2.5 Barancas

The coastal baranca habitats of Aruba represent a unique and vital component of the island's natural landscape. These rocky outcrops and cliffs, predominantly found along the limestone plateaus and coastal zones, are integral to Aruba's biodiversity and ecological resilience. Their rugged terrain provides specialized microhabitats that support a variety of endemic and native species, many of which are adapted to the harsh conditions of this habitat. In these areas, vegetation such as Beishi di baranca, Seida, Funfun, and Cadushi thrive, forming a distinct ecosystem well-suited to the rocky substrate and exposure to salty sea spray. This vegetation not only stabilizes the fragile soils but also serves as critical shelter and food sources for wildlife. Endemic reptiles like the Aruban whiptail lizard (*Cnemidophorus arubensis*) and the Aruba rattlesnake (*Crotalus unicolor*) rely on these habitats for survival, as do numerous bird and insect species adapted to the baranca's challenging conditions.

Costa Sero Colorado, stretching from Bachelor's Beach to Boca Grandi, provides a unique blend of ecological and cultural value. The coastal strip is home to breeding colonies of tern species and protected birds of prey, while its cultural significance is marked by pre-Columbian artifacts, phosphate mines, cannons, and historic rainwater collection tunnels (UNESCO, 2014). Conservation efforts in this area must balance the need to preserve its biodiversity with safeguarding its cultural and historical heritage.

These coastal baranca systems also act as a natural buffer, protecting inland ecosystems from the erosive forces of wind and waves. Their cliffs and rock formations provide nesting sites for birds and contribute to the island's geological diversity, revealing layers of limestone and coral rock that chronicle Aruba's geological history.

Table 9: Key Pressures, Threats, and Drivers for the Coastal Barancas of Aruba

Threat	Pressure	Driver
Habitat Degradation	Unsustainable coastal development and quarrying	Economic reliance on construction and lack of enforcement of land-use regulations
Soil Erosion	Off-road vehicle activity and vegetation loss	Weak regulation of recreational activities and insufficient habitat protection measures
Vegetation Loss	Invasive species outcompeting native baranca vegetation	Lack of invasive species management strategies
Wildlife Disturbance	Habitat disruption affecting endemic species like the Aruba rattlesnake and whiptail lizard	Recreational activities, unregulated tourism, and habitat fragmentation
Climate Change Impacts	Rising sea levels, intensified storms, and altered weather patterns accelerating erosion	Global greenhouse gas emissions and limited adaptation measures
Recreational Pressures	Overuse of baranca areas for tourism and off-road recreational activities	Insufficient public awareness and regulation of tourism activities
Geological Damage	Quarrying and physical destruction of limestone and coral rock formations	Unregulated extraction activities and lack of geological conservation policies
Loss of Ecosystem Services	Reduced buffering capacity against coastal erosion and storm surges	Cumulative impacts of development, erosion, and vegetation loss
Invasive Species Spread	Non-native plants altering baranca microhabitats	Insufficient early detection and control mechanisms

The baranca habitats of Aruba face significant pressures and threats that jeopardize their ecological integrity, biodiversity, and geological value. Unsustainable coastal development, off-road vehicle activity, and quarrying contribute to habitat degradation, causing soil erosion, vegetation loss, and disruption of wildlife. Invasive species, such as non-native plants, further threaten the stability of these ecosystems by outcompeting endemic vegetation. Climate change exacerbates these challenges, with rising sea levels, increased storm intensity, and shifting weather patterns accelerating erosion and undermining the natural resilience of barancas. Recreational use also places added strain on these fragile environments, further compounding the threats they face. Without sustained action, Aruba risks losing much of the ecological and geological value of its barancas, along with their critical role in supporting endemic species, protecting coastal landscapes, and preserving the island's natural beauty for future generations.

Table 10: Key Conservation Actions and Targets for Aruba's Coastal Barancas

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Habitat Restoration	Restore degraded baranca habitats to support endemic species and stabilize fragile soils.	Rehabilitate 50% of degraded baranca areas through vegetation restoration and erosion control.	Replant native vegetation (*Beishi di baranca*, *Seida*, *Funfun*), control invasive species, and stabilize soil using natural barriers.	ACF, local communities, UNEP, Wageningen University, Aruba National Park Foundation.
Erosion Control	Implement measures to reduce soil erosion caused by off-road vehicle activity and vegetation loss.	Stabilize 60% of erosion-prone baranca slopes with natural and engineered solutions.	Establish off-road vehicle restrictions, replant vegetation, and build erosion-control barriers.	DOW Aruba, ACF, environmental engineers, NGOs, local authorities.

Wildlife Protection	Protect critical habitats for endemic species like the Aruba rattlesnake and whiptail lizard.	Increase populations of key endemic species by 25% through targeted habitat protection.	Create wildlife corridors, enforce no-disturbance zones, and monitor populations of key species.	ACF, BirdLife International, local conservation groups, Aruba National Park Foundation.
Sustainable Tourism	Minimize the impact of recreational activities on baranca habitats while promoting eco-tourism.	Ensure 80% compliance with sustainable tourism practices in baranca areas.	Develop and enforce visitor guidelines, restrict access to sensitive areas, and promote eco-friendly tourism certifications.	Aruba Tourism Authority, ACF, local tourism operators, cultural heritage organizations.
Climate Resilience	Enhance resilience of baranca ecosystems to climate change impacts such as sea-level rise and storm intensity.	Implement adaptive measures in 70% of baranca areas to mitigate climate risks.	Conduct climate vulnerability assessments, restore native vegetation, and integrate adaptive infrastructure.	Climate scientists, ACF, Wageningen University, UNEP, government planners.
Community Engagement	Foster local stewardship and awareness to support long-term conservation of baranca habitats.	Engage 70% of local communities in baranca conservation initiatives.	Develop educational campaigns, organize community clean-ups, and establish citizen science projects.	Schools, NGOs, local businesses, ACF, cultural heritage organizations.
Geological Conservation	Protect baranca geological formations and prevent quarrying and physical destruction of limestone features.	Establish protected geological zones covering 50% of baranca areas.	Enforce regulations on quarrying, monitor geological features, and integrate geological preservation into land-use planning.	Government of Aruba, ACF, geological experts, environmental NGOs.

2.6 Generic Threats, Pressures, Drivers, conservation actions and targets

Based on the above, it is possible to identify a number of generic threats, pressures, drivers and to link these to a set of conservation actions and targets.

Table 11: Generic Threats, Pressures, and Drivers in Aruba's Coastal Ecosystems

Threat	Pressure	Driver
Habitat Loss	Coastal development, urbanization, and unregulated construction encroaching on dunes, mangroves, and reef islands	Economic reliance on tourism, weak land-use planning, and lack of enforcement mechanisms
Pollution	Runoff from wastewater treatment plants, industrial discharges, and plastic and human waste accumulation	Inadequate waste management infrastructure and insufficient regulation
Vegetation Degradation	Trampling of dune vegetation, loss of mangroves, and spread of invasive species competing with native plants	Lack of public awareness, weak regulation, and insufficient invasive species management
Wildlife Disturbance	Habitat disruption impacting nesting sea turtles, migratory birds, and endemic species	Unregulated recreational activities, poaching, and habitat fragmentation
Soil Erosion	Erosion of dune systems and coastal cliffs due to vegetation loss and off-road vehicle activity	Poor erosion control measures and lack of sustainable recreational guidelines
Coastal Erosion	Accelerated by coral reef degradation, rising sea levels, and storm surges	Climate change impacts and reduced natural coastal defences
Coral Reef Degradation	Dredging, physical damage from recreational activities, and sedimentation from runoff	Lack of sustainable tourism practices and insufficient enforcement of marine protection

Hydrological Disruption	Altered water flow in mangrove and saliña systems due to infrastructure projects and sediment disruption	Poor integration of hydrological considerations in coastal development planning
Climate Change Impacts	Rising sea levels, intensified storms, altered precipitation patterns, and increased temperatures	Global greenhouse gas emissions and insufficient local adaptation measures
Invasive Species	Spread of non-native plants like Hottentot fig and Water Hyacinth, and fauna like Nile Tilapia	Lack of early detection, control mechanisms, and management strategies
Geological Damage	Quarrying and physical destruction of limestone and coral rock formations	Unregulated extraction activities and lack of geological conservation policies
Loss of Ecosystem Services	Decline in natural buffers against storms, shoreline stabilization, and biodiversity support	Cumulative impacts of habitat degradation, pollution, and climate change
Recreational Pressures	Overuse of mangroves, beaches, and reef islands for tourism and recreational activities	Insufficient public awareness and lack of sustainable tourism guidelines

Table 12: Key Generic Conservation Actions and Targets for Aruba's Coastal Ecosystems

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Habitat Restoration	Restore degraded coastal habitats such as mangroves, dunes, and reef islands to enhance biodiversity and ecosystem resilience.	Rehabilitate 60% of degraded coastal habitats through targeted restoration and replanting.	Replant native vegetation, restore mangroves, stabilize dunes, and rehabilitate coral reefs.	ACF, DOW Aruba, UNEP, local communities, Wageningen University, international NGOs.
Pollution Mitigation	Reduce pollution entering coastal ecosystems from runoff, industrial discharge, and waste accumulation.	Achieve a 30% reduction in pollutants affecting coastal ecosystems.	Upgrade wastewater treatment plants, enforce industrial discharge regulations, and conduct regular clean-ups.	Government of Aruba, ACF, Utilities Aruba, NGOs, waste management organizations.
Wildlife Protection	Protect critical habitats and species, including sea turtles, terns, and endemic flora and fauna.	Increase populations of key species by 20% through targeted protection and habitat enhancement.	Establish protected areas, enforce no-disturbance zones, and monitor wildlife populations.	ACF, BirdLife International, Aruba National Park Foundation, marine biologists, local NGOs.
Sustainable Tourism	Minimize the impact of tourism and recreational activities on sensitive coastal ecosystems.	Ensure 80% compliance with sustainable tourism practices across coastal areas.	Develop and enforce visitor guidelines, restrict access to sensitive areas, and promote eco-tourism certifications.	Aruba Tourism Authority, ACF, local tourism operators, UNEP.
Erosion Control	Implement measures to reduce soil and coastal erosion affecting dunes, cliffs, and mangroves.	Stabilize 50% of erosion-prone areas using natural and engineered solutions.	Replant vegetation, install erosion control barriers, and regulate off-road vehicle access.	ACF, environmental engineers, DOW Aruba, local authorities.
Hydrological Management	Restore natural water flow in mangroves and saliñas disrupted by infrastructure and sedimentation.	Re-establish hydrological connectivity in 70% of affected systems.	Repair damaged hydrological infrastructure and implement watershed	ACF, DOW Aruba, hydrology specialists, local developers, community organizations.

			management strategies.	
Climate Resilience	Enhance resilience of coastal ecosystems to climate change impacts such as sea-level rise and storm surges.	Implement adaptive measures in 70% of coastal ecosystems to mitigate climate risks.	Conduct vulnerability assessments, restore natural buffers, and integrate adaptive infrastructure.	Climate scientists, ACF, UNEP, Wageningen University, government planners.
Community Engagement	Foster local stewardship and public awareness of the importance of conserving coastal ecosystems.	Engage 75% of local communities in conservation initiatives.	Develop educational programs, organize community clean-ups, and establish citizen science projects.	Schools, NGOs, ACF, local businesses, cultural heritage groups.
Invasive Species Control	Eradicate invasive species threatening native biodiversity and ecosystem stability.	Remove invasive plants and animals from 70% of affected coastal areas.	Conduct invasive species removal campaigns, monitor recovery, and promote native species reintroduction.	ACF, NGOs, Wageningen University, local communities, conservation volunteers.
Legal and Regulatory Frameworks	Strengthen legal protections and enforcement mechanisms to safeguard coastal ecosystems.	Establish clear legal status and enforce regulations for 100% of critical coastal areas.	Develop new legislation, increase enforcement capacity, and conduct regular monitoring.	Government of Aruba, ACF, legal experts, international conservation organizations.

2.7 Socio-Economic Context

Aruba's economy is deeply intertwined with its coastal biodiversity, which underpins the island's natural heritage and tourism sector. Coastal habitats, including beaches, dunes, mangroves, reef islands, and barancas, are vital not only for their ecological services but also for their cultural and economic significance. These ecosystems contribute to shoreline stabilization, carbon sequestration, and storm protection while supporting iconic wildlife and endemic species, such as the Aruba burrowing owl (Athene cunicularia arubensis) and the Aruba whiptail lizard (Cnemidophorus arubensis). Arikok National Park, which covers approximately 18% of the island, protects diverse coastal habitats and provides opportunities for recreation, education, and ecological tourism (Polaszek et al., 2018).

With a population density among the highest globally—112,803 inhabitants as of June 2022, averaging 585 people per square kilometer—Aruba's coastal ecosystems face mounting pressures. Urban expansion, infrastructure development, and the influx of nearly 2 million tourists annually contribute to habitat loss, degradation, and increased demand for natural resources. Key coastal areas, such as the mangroves of Mangel Halto and the reef islands in San Nicolas Bay, are particularly vulnerable to these impacts. Sustainable management of these resources is crucial to mitigate these pressures and ensure the long-term resilience of Aruba's coastal ecosystems.

The cultural significance of Aruba's coastal environments further highlights their importance. Sites like coastal caves and barancas hold historical and spiritual value, reflecting the island's rich cultural heritage. The public strongly supports conservation efforts, with surveys indicating that 80% of residents advocate for increased government investment in protecting Aruba's unique species and habitats (Polaszek, et al., 2018).

Aruba's coastal ecosystems harbour diverse flora and fauna, providing critical ecological services such as soil stabilization, carbon storage, and habitat for migratory and endemic species. However, urbanization, climate change, and overuse pose significant threats, necessitating comprehensive conservation strategies. Integrating coastal biodiversity values into policy frameworks and fostering sustainable practices will be essential to balancing economic growth with ecological preservation, ensuring that Aruba's coastal heritage is safeguarded for future generations.

2.8 Knowledge gaps in data collection and strategies to address them

Aruba's coastal ecosystems, encompassing beaches, dunes, mangroves, reef islands, and barancas, are central to the island's biodiversity, cultural heritage, and ecological services. However, significant knowledge gaps hinder effective management and conservation of these habitats. Current assessments offer valuable insights into some ecosystems, such as xerophytic shrublands and key biodiversity areas like Arikok National Park, but critical deficiencies remain in understanding the long-term dynamics and resilience of coastal habitats. For instance, limited data exists on species population dynamics and the health of endemic and threatened species, such as the Aruba burrowing owl (*Athene cunicularia arubensis*) and the Aruba island rattlesnake (*Crotalus unicolor*), that also frequent coastal areas.

There is also a lack of comprehensive studies on the impacts of invasive species, such as buffelgrass, feral goats, and water hyacinth, which threaten native vegetation and ecosystem stability in dune systems, mangroves, saliñas and other coastal zones. Habitat connectivity, particularly between mangroves, reef islands, and adjacent marine environments, remains poorly understood. Additionally, human-induced pressures, including urban expansion, coastal development, and tourism, require further investigation to quantify their effects on vegetation cover, soil stability, and biodiversity in sensitive areas such as beaches, dunes, and reef islands.

To address these gaps, a long-term coastal monitoring program is essential. Such a program should include regular biodiversity surveys, habitat quality assessments, and socio-economic studies focused on key indicators like species population trends, ecosystem service provision, and the impacts of human activity. Integrating findings from annual evaluations would support adaptive management and inform evidence-based policy interventions.

A targeted research agenda is also needed to assess climate change impacts on coastal ecosystems. Studies on increased aridity, rising sea levels, and altered rainfall patterns could enhance understanding of resilience in habitats such as mangroves and dune systems. By addressing these knowledge gaps, Aruba can develop more effective conservation strategies, improve ecosystem management, and ensure the long-term sustainability of its coastal biodiversity and natural heritage.

3. Coastal Protected Areas & Ramsar Sites

3.1 Protected Areas

The Coastal protected areas included in this plan represent vital habitats for Aruba's unique biodiversity and are integral to the island's ecological network. These areas are protected and managed under the framework of Aruba's Spatial Development Plan (ROP, Ruimtelijk Ontwikkelingsplan) and the Nature Conservation Ordinance - Landsverordening Natuurbeheer (Government of Aruba 1995, most recently amended to enhance the protection of native flora

and fauna in 2017). These regulations establish the legal basis for safeguarding Aruba's natural heritage and ensure that land use and development align with conservation priorities.

Figure 3: Areas, including coastal sites, protected under the national ordinance referenced above.

Table 13: Aruba's Coastal Protected Areas, including Threats and Challenges

Name	Description
Duinen Sasarawichi & Arashi	Vulnerable dune area with calcareous soils, supporting characteristic vegetation and fauna, including 4 species of sea turtles, various birds of prey, and protected flora such as Cadushi and Tuna.
Saliña Druif	A 2-hectare saliña surrounded by a golf course, hosting diverse waterbirds including the Caribbean Coot and migratory shorebirds, and bordered by desert scrub with salt-tolerant vegetation.
Saliña Malmok	Extensive salt flat with mangroves, migratory birds, waterfowl, and archaeological findings from the pre-Columbian period, used as a nesting and foraging site for birds.
Saliña Cerca	Part of a larger continuous salt flat system divided by development, supporting mangrove forests and diverse flora and fauna.
Saliña Palm Beach	Located in a wetland area rich in mangrove forests and biodiversity, forming part of a larger salt flat system critical for bird and aquatic life.
Saliña Bubali	A 53-hectare wetland with a permanent water reservoir, supporting migratory birds, crustaceans, and insects, and significant for Caribbean Coots and Neotropic Cormorants.
Parke Nacional Arikok	Includes barancas, beaches, dunes, and the Natural Pool, with sites such as Daimari, Moro, and Dos Playa, supporting diverse landscapes and wildlife.
Spaans Lagoen	High biodiversity area annexed to Parke Nacional Arikok, featuring mangroves, a lagoon, and a saliña, home to fiddler crabs, birds, and four mangrove species.
Mangel Halto	Ecologically rich area with mangroves, coral reefs, and abundant wildlife, increasingly popular and in need of sustainable management.
Area di Mangel	Historically significant mangrove areas supporting diverse wildlife and fisheries, requiring integrated protection with seagrass meadows and corals.
Area di Cay	Special cays and reef islands with unique biodiversity, supporting marine life but impacted by tourism, illegal construction, and climate change.
Costa Sero Colorado	Coastal strip with tern breeding sites, birds of prey, and cultural-historical significance, including pre-Columbian artifacts and phosphate mines.

Table 14: Key Pressures, Threats, and Drivers for Coastal Protected Areas of Aruba

Site Name	Threat	Pressure	Driver
Duinen Sasarawichi & Arashi	Habitat degradation, invasive species, and tourism pressures	Unregulated activities and loss of native biodiversity	Insufficient management and weak enforcement of conservation regulations
Saliña Druif	Urban encroachment, pollution, and invasive species	Runoff from urban areas, water management challenges, and habitat fragmentation	Increasing urbanization and inadequate invasive species control
Saliña Malmok	Habitat loss from tourism and development, pollution, and invasive species	Tourism-driven infrastructure expansion and lack of mangrove restoration	Weak land-use planning and inadequate protection of archaeological sites
Saliña Cerca	Habitat degradation and fragmentation due to development	Pollution and loss of connectivity within the salt flat system	Limited ecosystem connectivity management
Saliña Palm Beach	Habitat fragmentation, pollution, and tourism-driven development	Urban sprawl and poor waste management impacting biodiversity	Unregulated tourism and weak ecological zoning
Saliña Bubali	Nutrient influx from wastewater, invasive species, and tourism impacts	Untreated wastewater and weak habitat restoration measures	Inadequate wastewater infrastructure and tourism pressures
Parke Nacional Arikok	Climate change, habitat degradation, and tourism-related pressures	Increased visitor impact and changing climate affecting ecosystems	Balancing tourism with conservation and managing climate resilience
Spaans Lagoen	Pollution, sedimentation, and invasive species	Recreational overuse and disrupted water flow in mangrove ecosystems	Insufficient restoration efforts and sediment control measures
Mangel Halto	Habitat degradation, unregulated visitor activities, and tourism pressures	Overuse of mangroves and coral reefs for recreational purposes	Lack of sustainable tourism strategies and visitor education
Area di Mangel	Coastal development, mangrove loss, and insufficient management practices	Weak integrated habitat management impacting mangroves and adjacent seagrass meadows	Poor enforcement of coastal development regulations
Area di Cay	Habitat destruction from illegal construction, tourism, and climate change impacts	Unregulated tourism and loss of reef island biodiversity	Weak enforcement against illegal activities and lack of adaptive climate measures
Costa Sero Colorado	Sea level rise, habitat destruction, and invasive species impacts	Coastal erosion and loss of nesting sites for terns and other wildlife	Balancing cultural preservation with ecological conservation

Table 15: Key Conservation Actions and Targets for Coastal Protected Areas of Aruba

Duinen Sasarawichi & Arashi

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Habitat Protection	Safeguard dune ecosystems and native biodiversity from degradation and invasive species.	Restore 50% of degraded dunes and control invasive species spread.	Implement dune restoration projects, remove invasive plants, and establish no-disturbance zones.	ACF, DOW Aruba, UNEP, local community groups.
Sustainable Tourism	Balance tourism activities with conservation of vulnerable dune habitats.	Achieve 80% compliance with sustainable tourism guidelines.	Develop visitor management plans, install signage, and provide eco-tourism training.	Aruba Tourism Authority, ACF, local tourism operators.

Saliña Druif

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Water Quality Management	Improve water quality and reduce pollution affecting the saliña ecosystem.	Reduce nutrient inflow by 30% through improved waste management practices.	Enhance wastewater treatment infrastructure and enforce pollution controls.	Government of Aruba, ACF, Utilities Aruba, local developers.
Wildlife Conservation	Protect habitats for waterbirds and migratory species from urban encroachment.	Increase bird population diversity by 20%.	Establish buffer zones, monitor bird populations, and manage invasive species.	BirdLife International, ACF, local conservation groups.

Saliña Malmok

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Mangrove Restoration	Restore mangroves and salt flats to support biodiversity and stabilize habitats.	Rehabilitate 60% of degraded mangrove and salt flat areas.	Replant mangroves, manage sedimentation, and protect archaeological findings.	ACF, DOW Aruba, UNEP, archaeologists.
Tourism Management	Mitigate the impacts of tourism on sensitive habitats.	Limit tourism impacts in 70% of vulnerable areas.	Implement visitor access restrictions, establish eco-tourism practices, and provide education.	ACF, Aruba Tourism Authority, local businesses.

Saliña Cerca

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Ecosystem Connectivity	Protect interconnected saliña ecosystems from fragmentation and degradation.	Maintain 80% connectivity between saliñas.	Implement land-use zoning, replant native vegetation, and control invasive species.	ACF, DOW Aruba, local NGOs.
Pollution Mitigation	Reduce contamination affecting saliña flora and fauna.	Achieve a 25% reduction in pollutant levels.	Monitor water quality, enforce waste regulations, and engage communities in clean-ups.	Government of Aruba, ACF, Utilities Aruba.

Saliña Palm Beach

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Habitat Restoration	Restore mangrove forests and wetlands to enhance biodiversity and ecological functions.	Restore 50% of degraded wetland areas.	Conduct mangrove planting, manage hydrology, and reduce habitat fragmentation.	ACF, DOW Aruba, Wageningen University, local communities.
Sustainable Tourism	Manage tourism to minimize its impact on critical habitats.	Ensure 75% compliance with sustainable tourism guidelines.	Establish visitor guidelines, restrict access to sensitive areas, and promote eco-tourism.	Aruba Tourism Authority, local tourism operators, ACF.

Saliña Bubali

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Wastewater Management	Reduce nutrient loading from wastewater to protect water quality and biodiversity.	Decrease nutrient influx by 40% through improved treatment systems.	Upgrade Bubali wastewater treatment plant and monitor effluent quality.	Utilities Aruba, ACF, DOW Aruba, local government.
Biodiversity Protection	Protect migratory bird habitats and enhance ecological connectivity.	Increase migratory bird populations by 25%.	Establish buffer zones, monitor key species, and implement habitat restoration.	BirdLife International, ACF, Aruba National Park Foundation.

Parke Nacional Arikok

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Integrated Conservation	Protect diverse landscapes and wildlife while preserving cultural heritage.	Ensure 80% of park ecosystems are in good ecological condition.	Implement landscape-scale restoration, monitor wildlife populations, and protect cultural sites.	ACF, Aruba National Park Foundation, cultural heritage organizations.
Climate Resilience	Address climate change impacts on coastal and terrestrial ecosystems.	Integrate adaptive measures into 70% of park management strategies.	Conduct climate vulnerability assessments, restore natural barriers, and enhance resilience.	Climate scientists, ACF, UNEP, Wageningen University.

Spaans Lagoen

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Water Flow Restoration	Restore natural hydrology and mitigate sedimentation in mangroves and lagoon systems.	Improve water flow in 70% of affected areas.	Repair damaged hydrological infrastructure, manage sediment, and replant mangroves.	ACF, DOW Aruba, Wageningen University, UNEP.
Sustainable Recreation	Balance recreational use with conservation of biodiversity.	Ensure 75% compliance with sustainable recreation practices.	Develop visitor guidelines, establish no-disturbance zones, and conduct public awareness campaigns.	ACF, Aruba Tourism Authority, local community groups.

Mangel Halto

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Habitat Protection	Safeguard mangroves and coral reefs from tourism and development pressures.	Protect 60% of critical habitats from degradation.	Enforce no-disturbance zones, regulate visitor activities, and enhance monitoring.	ACF, DOW Aruba, local NGOs, Aruba Tourism Authority.
Community Engagement	Foster local stewardship for the conservation of Mangel Halto's ecosystems.	Engage 80% of local communities in conservation initiatives.	Organize clean-ups, conduct educational campaigns, and establish citizen science projects.	Schools, NGOs, ACF, local businesses.

3.2 Ramsar Sites

On November 10, 2023, the scope of protected wetland areas under the Ramsar Convention of Wetlands significantly expanded in Aruba[6]. The Aruban Minister of Nature announced the official designation of four new Ramsar sites, and an extension of Spaans Lagoen[7]. The total area now safeguarded under the Ramsar Convention is 14,408 hectares and all of the sites contain significant coastal components, described below:

1. West Point (https://rsis.ramsar.org/ris/2527)

West Point has a diverse array of coastal habitats including beaches, limestone terraces, sand dunes, coral reefs, seasonal wetlands, and seagrass beds. The beaches are nesting grounds for four sea turtle species: leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), loggerhead (Caretta caretta), and green turtles (Chelonia mydas). Limestone terraces provide breeding sites for the migratory least tern (*Sternula antillarum*). Seasonal marshes and mudflats transform during flooding periods into critical stopover sites for migratory birds. Sand dunes, including the Sasarawichi dunes, are key to coastal stabilization, while arid landscapes and baranca formations at Tera Cora support endemic reptiles like the Aruba island rattlesnake (*Crotalus durissus unicolor*). The combination of habitats supports both biodiversity and essential ecosystem services, though they face threats from recreational activities and development.

2. Western Wetlands (https://rsis.ramsar.org/ris/2528)

This site includes five saliñas, or coastal wetlands, which are non-tidal and influenced by sporadic mixing of seawater and freshwater. The saliñas are bordered by salt-tolerant vegetation, including sea-purslane (*Sesuvium portulacastrum*) and whorled dropseed (*Sporobolus pyramidatus*). These wetlands are vital for flood control, acting as catchments for rainwater. They provide habitat for a range of species, including the endemic Aruba whiptail (*Cnemidophorus arubensis*) and the globally vulnerable Curaçaoan long-nosed bat (*Leptonycteris curasoae*). Mudflats within the saliñas support crustaceans and insects, forming a critical food web that attracts migratory and resident birds. Despite their ecological importance, these wetlands face threats from pollution, invasive species, and urban encroachment.

3. South Coast (https://rsis.ramsar.org/ris/2526)

This Ramsar site features Aruba's largest mangrove forest, beaches, and reef islands. The beaches provide nesting habitat for green, hawksbill, and loggerhead turtles. Reef islands in this area are globally unique, supporting breeding colonies of at least 10 tern species, including the Cayenne tern (*Thalasseus sandvicensis eurygnatha*). Coral reefs within the site are critical for coastal protection. The mangrove forests protect the shoreline from erosion and provide critical ecosystem services. Threats include climate change, pollution, and unsustainable tourism practices, though restoration efforts are underway, including the construction of artificial reefs and mangrove replanting.

4. Spaanse Lagoen (https://rsis.ramsar.org/ris/198)

Spaanse Lagoen is a natural inland bay fringed by mangroves, tidal mudflats, and a narrow coastal inlet. Its mangroves (*Rhizophora mangle*, *Avicennia germinans*) play a crucial role in carbon sequestration and shoreline stabilization. Tidal mudflats and mangrove roots provide essential nursery habitats for reef fish, crustaceans, and birds, including the globally vulnerable hogfish (*Lachnolaimus maximus*), Cubera snapper (*Lutjanus cyanopterus*), and Atlantic tarpon (*Megalops atlanticus*). The site is also home to the Aruba island rattlesnake and a range of migratory birds. Restoration initiatives in 2017 and 2023 have enhanced bird and fish habitats through mangrove planting and sediment trap installations. Recreational activities such as

[6] Summary of Ramsar legislation: https://www.dcceew.gov.au/water/wetlands/ramsar

[7] Note that the open water body of Spaans Lagoen is included in the Marine PACMP; mangroves and wetlands are included in this PACMP.

birdwatching and snorkeling are popular, though increased tourism poses management challenges.

5. East Point (https://rsis.ramsar.org/ris/2525)

East Point is primarily a marine site encompassing reef islands, mangroves, coral reefs, and seagrass beds. It includes part of Arikok National Park, representing the water catchment of Fontein, Aruba's only substantial freshwater source. Reef islands within the site support breeding colonies of at least 10 tern species, making this area globally significant for seabird conservation. Mangroves along the coastline protect the site from erosion and support juvenile fish and crustaceans. This site also serves as a key area for turtle nesting and as a feeding ground for migratory birds. Despite its biodiversity value, threats from climate change, invasive species, and increased recreational use highlight the need for enhanced management and conservation measures.

Figure 4: Aruba's five Ramsar sites, covering 14,408 hectares in total.

Table 16: Key Pressures, Threats, and Drivers for Coastal Elements of Ramsar Sites in Aruba

Ramsar Site	Threat	Pressure	Driver
West Point	Habitat loss for sea turtles, migratory birds, and endemic reptiles due to recreational activities and development	Increased human activity on beaches, limestone terraces, and seasonal wetlands	Insufficient regulation of tourism and land-use planning
Western Wetlands	Habitat degradation and biodiversity loss in saliñas due to pollution, invasive species, and urban encroachment	Contamination from runoff, spread of non-native vegetation, and infrastructure expansion	Weak enforcement of waste management and lack of invasive species control
South Coast	Mangrove and reef island degradation, loss of turtle nesting	Pollution, unsustainable tourism practices, and climate	Lack of sustainable tourism management and global greenhouse gas emissions

	habitats, and declining coral reef health	change impacts such as sea-level rise	
Spaans Lagoen	Degradation of mangroves and tidal mudflats, loss of fish nurseries, and disturbance from recreational activities	Sedimentation, habitat fragmentation, and increasing tourism-related disturbance	Inadequate visitor management and lack of long-term hydrological and sediment control
East Point	Loss of reef island biodiversity, mangrove degradation, and erosion due to recreational overuse and invasive species	Increased tourism, spread of non-native species, and climate change impacts such as storm intensity	Insufficient management of recreational activities and inadequate invasive species control

Table 17: Key Conservation Actions and Targets for Coastal Elements of Aruba's Ramsar Sites

West Point

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Habitat Protection	Safeguard sea turtle nesting beaches, limestone terraces, and seasonal wetlands from recreational and developmental pressures.	Protect 80% of key habitats from recreational and construction impacts.	Designate no-disturbance zones, enforce land-use regulations, and establish regular monitoring.	ACF, local government, UNEP, NGOs, and coastal ecologists.
Wildlife Conservation	Enhance protection for nesting sea turtles, migratory birds, and endemic reptiles like the Aruba rattlesnake.	Increase nesting success of sea turtles and migratory birds by 25%.	Install nest protection measures, reduce recreational disturbances, and conduct educational campaigns.	ACF, BirdLife International, marine biologists, Aruba National Park Foundation.
Sustainable Tourism	Manage tourism activities to reduce impacts on critical habitats while supporting eco-tourism.	Ensure 80% compliance with sustainable tourism guidelines in key areas.	Develop visitor management plans, provide eco-tourism training, and enforce guidelines.	Aruba Tourism Authority, local tour operators, ACF.

Western Wetlands

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Pollution Mitigation	Reduce pollution in saliñas to restore water quality and biodiversity.	Achieve a 30% reduction in pollutant levels across saliñas.	Improve wastewater management, enforce industrial discharge regulations, and conduct clean-ups.	Government of Aruba, ACF, Utilities Aruba, local communities.
Invasive Species Control	Eradicate invasive plants threatening native saliña vegetation and food webs.	Remove invasive species from 70% of affected saliñas.	Conduct invasive species removal programs and monitor recovery of native vegetation.	ACF, NGOs, Wageningen University, local volunteers.
Habitat Restoration	Restore degraded saliña habitats to enhance biodiversity and flood control.	Rehabilitate 50% of degraded saliñas through vegetation and sediment restoration.	Replant native vegetation and manage sedimentation to improve hydrology and biodiversity.	ACF, DOW Aruba, UNEP, coastal restoration specialists.

South Coast

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Mangrove Restoration	Restore degraded mangroves to protect shoreline, support biodiversity, and enhance ecosystem services.	Rehabilitate 60% of degraded mangrove forests.	Conduct mangrove replanting, manage sedimentation, and improve hydrological flow.	ACF, UNEP, DOW Aruba, Wageningen University.
Reef Island Protection	Safeguard reef islands as globally significant breeding sites for terns and other seabirds.	Protect 80% of reef islands through habitat management and monitoring.	Establish no-access zones during breeding seasons and enforce strict tourism guidelines.	BirdLife International, ACF, Aruba National Park Foundation, local NGOs.
Climate Resilience	Implement measures to mitigate the impacts of sea-level rise and storm surges on beaches and coral reefs.	Increase adaptive measures in 70% of vulnerable areas.	Install artificial reefs, enhance dune stabilization, and restore coral reef health.	Climate scientists, ACF, Wageningen University, UNEP.

Spaanse Lagoen

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Habitat Restoration	Restore mangroves and tidal mudflats to enhance their role as nurseries and carbon sinks.	Restore 70% of degraded mangrove and mudflat habitats.	Replant mangroves, manage sedimentation, and improve water flow to reduce fragmentation.	ACF, DOW Aruba, Wageningen University, UNEP.
Biodiversity Protection	Protect fish nurseries and migratory bird habitats from disturbance and degradation.	Increase fish and bird populations by 20%.	Establish protected zones, monitor key species, and enforce restrictions on recreational activities.	BirdLife International, marine biologists, ACF, local communities.
Community Engagement	Raise awareness of the ecological and cultural value of Spaanse Lagoen to promote stewardship.	Involve 75% of local communities in conservation programs.	Develop educational programs, organize clean-ups, and promote eco-tourism.	Schools, NGOs, ACF, local businesses.

East Point

Conservation Focus Area	Summary	5-Year Operational Target	Action	Key Stakeholders/Partners
Reef Island Conservation	Protect reef islands as critical habitats for seabird colonies and coral reef biodiversity.	Safeguard 80% of reef islands from human and environmental impacts.	Monitor seabird populations, enforce no-disturbance zones, and restore degraded habitats.	BirdLife International, ACF, Aruba National Park Foundation, marine biologists.
Sustainable Tourism	Manage recreational activities to reduce impacts on reef islands and surrounding ecosystems.	Ensure 85% compliance with sustainable tourism guidelines.	Develop visitor management plans, limit access to sensitive areas, and train eco-tourism operators.	Aruba Tourism Authority, ACF, UNEP, local tourism operators.

Mangrove Protection	Enhance mangrove health and resilience to protect the coastline and support marine biodiversity.	Rehabilitate 50% of degraded mangrove areas.	Conduct mangrove planting, monitor health, and manage invasive species impacting mangroves.	ACF, Wageningen University, DOW Aruba, local communities.

4. Stakeholder Roles and Responsibilities

Effective governance is critical to the success of this plan, as it ensures that all stakeholders are aligned, responsibilities are clearly defined, and efforts are coordinated efficiently. The roles and responsibilities of each stakeholder, along with clear mechanisms for coordination, will ensure that no overlaps occur, and the program is managed effectively. The roles and responsibilities of stakeholders in the plan are therefore outlined below. This includes details on their specific duties, areas of contribution, and associated funding sources to promote transparency and avoid duplication of efforts.

Stakeholder	Role & Responsibility	Funding Sources
Government (National/Regional)	Provide overall policy direction, regulatory frameworks, and coordination across different sectors. Ensure local implementation of programs, resource allocation, and community engagement.	National budget, international aid, EU funding
Private Sector	Facilitate technology transfer, investments, and innovation in sustainable practices.	Private investments, corporate partnerships
NGOs and Civil Society	Support community-based initiatives, advocacy, and capacity-building for sustainable practices.	Donations, grants, partnerships
Academia & Research Institutions	Conduct research, provide expertise, and monitor the effectiveness of implemented strategies.	Research grants, academic funding
International Organizations	Provide technical assistance, capacity-building, and potential funding support for large-scale projects.	Multilateral funding, donor agencies

To ensure effective coordination and avoid overlapping roles or duplication of efforts, the following mechanisms for Stakeholder Coordination will be implemented:

1. **Stakeholder Sounding Board:** A stakeholder sounding board will be formed with representatives from each stakeholder group. This group will meet twice a year to assess progress, address any challenges, and advice changes to the implementation strategies as needed.
2. **Clear Communication Channels**: Regular workshops, meetings, and a shared online platform will be used to ensure that all stakeholders are well-informed about developments, funding opportunities, and responsibilities.
3. **Annual Review Process**: An annual review of the governance structure and stakeholder roles will be conducted to ensure that coordination remains efficient and that roles are still relevant to the program's goals.
4. **Conflict Resolution Mechanism**: A conflict resolution protocol will be established to address any disputes regarding roles, responsibilities, or resource allocation, ensuring that all stakeholders can voice concerns and find solutions in a timely manner.

A clear transition phase is crucial to ensure stakeholders are informed and prepared for the implementation of new regulations. The transition plan includes:

- **Stakeholder Consultations**: Engage with local communities, tourism operators, and other relevant stakeholders through workshops and meetings to discuss proposed zoning and enforcement measures.
- **Public Awareness Campaigns**: Launch educational programs to inform the public about the importance of Coastal ecosystems and protected areas, the benefits of conservation, and the specifics of any regulations.
- **Feedback Mechanisms**: Establish channels for stakeholders to provide feedback and express concerns, ensuring their perspectives are considered in finalizing the plan.
- **Implementation Support**: Offer resources and support to help stakeholders adapt to new regulations, including training programs and assistance with compliance.

5. Monitoring and evaluation

Regular monitoring and evaluation are essential to assess the effectiveness of conservation actions, track changes in ecosystem health and biodiversity, and identify emerging threats. To support the Coastal Areas Conservation Management Plan 2025–2029, a robust Monitoring and Evaluation (M&E) framework will be established. This framework will include clearly defined indicators, methodologies, and data collection tools tailored to Aruba's Coastal ecosystems and protected areas. The structured approach is outlined below:

1. Biodiversity Monitoring

Indicator	Methodology	Data Collection Tools
Species Richness and Abundance	Conduct regular biodiversity surveys using standardized transects and plots.	Field surveys, camera traps, eDNA sampling.
Population Trends of Key Species	Implement mark-recapture studies and population modelling.	GPS tagging, acoustic monitoring, and photo ID.
Habitat Condition and Coverage	Perform habitat mapping and assess quality using field assessments and remote sensing.	GIS mapping, drone surveys, and vegetation indices.

2. Physical characteristics

Indicator	Methodology	Data Collection Tools
Water Retention Efficiency	Measure water flow and retention in rooij systems and tanki during rainfall events.	Flow meters, soil moisture sensors, and visual inspection.
Water Quality	Test for pollutants, sedimentation, and nutrient levels in water bodies.	Water testing kits, spectrophotometers, and turbidity meters.
Habitat Connectivity	Monitor habitat connectivity in terms of continuous habitat corridors, stepping stones and buffer zones.	Field surveys, satellite imagery, and species movement tracking.

3. Visitor Use and Urban Encroachment

Indicator	Methodology	Data Collection Tools

Visitor Numbers and Behaviour	Conduct surveys and install counters at key access points.	Visitor counters, questionnaires, and tracking apps.
Urban Encroachment	Measure changes in land use and assess the impact on adjacent ecosystems.	GIS mapping, land-use change analysis.
Impact on Sensitive Habitats	Assess physical damage and disturbances from visitor activities.	Habitat condition assessments, drone imagery.

4. Socio-Economic Assessments

Indicator	Methodology	Data Collection Tools
Community Involvement	Evaluate community participation in conservation activities.	Surveys, participation records, and stakeholder interviews.
Economic Benefits of Nature	Measure contributions from eco-tourism and related activities.	Economic surveys, financial records.
Local Perceptions	Assess public awareness and attitudes toward conservation.	Pre- and post-outreach program surveys.

5. Management Actions and Enforcement

Indicator	Methodology	Data Collection Tools
Compliance with Regulations	Conduct regular patrols and inspections in protected areas.	Patrol logs, compliance checklists.
Effectiveness of Restoration	Monitor ecological indicators before and after restoration efforts.	Baseline and post-restoration vegetation surveys.
Outreach Impact	Measure the success of educational campaigns and materials.	Attendance records, feedback forms.

6. Threat Identification and Adaptive Management

Indicator	Methodology	Data Collection Tools
Invasive Species Presence	Conduct surveys to identify and monitor invasive species spread.	Camera traps, field surveys, eDNA sampling.
Climate Change Impacts	Analyse long-term data on vegetation, temperature, and rainfall changes.	Weather stations, climate models, and satellite data.
Adaptive Management Effectiveness	Review the success of management actions and make necessary adjustments.	Performance reviews, stakeholder consultations.

6. Supporting strategies

Research & Monitoring

A key supporting strategy, research and monitoring will focus on continuously gathering data on Coastal biodiversity, habitat conditions, and species health to inform adaptive management practices. This strategy is essential for tracking progress, detecting emerging threats, and ensuring evidence-based decision-making in conservation efforts.

Communications & Advocacy (incl. Sustainable Fisheries)

Communication involves effectively conveying information and raising awareness about the importance of protecting and preserving Aruba's Coastal environments and biodiversity fostering

a deeper understanding and appreciation for nature. Advocacy efforts will promote policies and practices that align with sustainable land management, emphasizing the protection of ecosystems and the sustainable use of resources. These efforts will focus on influencing local and international policies to support conservation objectives while engaging with the tourism industry and other key stakeholders to minimize harmful practices.

Learning & Outreach

This strategy aims to raise public awareness about biodiversity conservation through educational programs, workshops, and community engagement initiatives. Learning and outreach efforts will target schools, local communities, and tourists to foster environmental stewardship and inspire support for protection of biodiversity.

Conservation Co-creation

Co-creation involves collaboration with stakeholders such as local communities, NGOs, and government to develop and implement conservation solutions. By involving stakeholders in decision-making and planning processes, this strategy ensures that conservation efforts are inclusive, locally relevant, and more likely to succeed.

Conservation Advisory & Consultancy

Consultancy services and advice will be offered to support sustainable development practices across various sectors, including tourism. ACF will provide expert advice to local businesses and government agencies, ensuring that their activities align with conservation goals and promote the long-term health of Coastal ecosystems.

7. Resources

Effective implementation of the Coastal Protected Areas Conservation Management Plan (PACMP) for 2025–2029 will require a strong foundation of human and financial resources to support its objectives. The resources required to protect and manage Coastal protected areas and species effectively encompass not only technical skills and expertise but also robust financial mechanisms that can sustain conservation actions over time. By addressing existing gaps in staffing, skills, and funding, the ACF aims to strengthen the foundation for adaptive management, stakeholder engagement, and community outreach—core pillars of the plan's success.

Human Resources, Staff Development and Capacity Building

Building the necessary human resources for a successful Coastal strategy involves both staff development and targeted recruitment. Skills in Coastal biology, ecological monitoring, environmental law, and adaptive management are essential to support conservation efforts. Staff should also be trained in stakeholder engagement, conflict resolution, and community outreach to ensure effective collaboration with local communities and partners. Recruitment should focus on bringing in specialists in areas like habitat restoration, invasive species management, and climate resilience. Building a strong team with expertise in research methodologies, GIS mapping, and data analysis will also enhance the effectiveness of the monitoring and adaptive management strategies.

Financial Resources and Sustainability

Developing sustainable finance mechanisms is critical for the long-term viability of all conservation efforts. A diversified funding strategy should include government grants,

international conservation funds, and partnerships with private sectors. Additionally, income streams could be generated through eco-tourism initiatives, such as conservation-based tourism, as well as eco-certifications for businesses that support sustainable practices. Establishing an environmental trust fund or implementing eco-levies on tourism-related activities can provide a consistent financial reserve to fund protection and restoration projects, ensuring ongoing support for the management of Coastal areas.

8. References

Alongi, D.M. (2012). Carbon Sequestration in Mangrove Forests. Carbon Management, 3(3), 313–322. https://doi.org/10.4155/cmt.12.20

BirdLife International. (2007) *Oranjestad Reef Islands*. Retrieved from https://datazone.birdlife.org/site/factsheet/oranjestad-reef-islands-iba-aruba-%28to-netherlands%29?utm_source=chatgpt.com

BirdLife International. (2007) San Nicolas Bay Reef Islands. Retrieved from https://datazone.birdlife.org/site/factsheet/san-nicolas-bay-reef-islands-iba-aruba-(to-netherlands)

J.A. De Freitas, A.C. Rojer, E.A.T. Houtepen and A.O. Debrot (2023) Landscape ecological vegetation map of Aruba (Southern Caribbean) https://www.dcbd.nl/reposerver/api/file/4138?utm_source=chatgpt.com

Delnevo, A.J. (2009) An Assessment of Nesting Seabirds within San Nicolas Bay, Aruba, 2009. Pp1-53. Applied Ecological Solutions Inc., Kansas USA, November 13, 2009. https://www.dcnanature.org/wp-content/uploads/2013/01/ATP-2009-REPORT-FINAL.pdf

Directie Infrastructuur en Planning, Ministerie van Ruimtelijke Ontwikkeling, Infrastructuur en Milieu. (2019). *Ruimtelijk Ontwikkelingsplan Aruba 2019 (ROP)*. Afkondigingsblad van Aruba (AB) 2019, No. 79. Retrieved from https://www.gobierno.aw/nl/ruimtelijk-ontwikkelingsplan-2019plan-di-desaroyo-espacial-2019spatial-development-plan-2019

Directie Natuur en Milieu (2022). Results and Best Practices for Wastewater Management in Aruba. https://dnmaruba.org/wp-content/uploads/2023/08/AHATA_Waste-Water-Survey-2022_20230628.pdf?utm_source=chatgpt.com

Donato, D.C., Kauffman, J.B., Murdiyarso, D., Kurnianto, S., Stidham, M., & Kanninen, M. (2011). Mangroves Among the Most Carbon-Rich Forests in the Tropics. Nature Geoscience, 4, 293–297. https://doi.org/10.1038/ngeo1123

Fox, H.E., & Caldwell, R.L. (2006). Recovery from Coral Bleaching on a Caribbean Reef Islands. Marine Ecology Progress Series, 306, 205–218. https://doi.org/10.3354/meps306205

Fundacion Parke Nacional Aruba (2022) Tern Mating Grounds Action Plan: Baby Beach, San Nicolas. https://www.vogelbescherming.nl/docs/0722d5c1-5212-40d2-ac1a-6bb827656613.pdf?utm_source=chatgpt.com

Government of Aruba. (1995). *Landsverordening van 13 februari 1995 houdende bepalingen ter bescherming van inheemse flora en fauna (Natuurbeschermingsverordening)*. Afkondigingsblad van Aruba (AB) 1995, No. 2. Retrieved from https://www.dip.aw/wp-content/uploads/2021/07/Natuurbeschermingsverordening.pdf

Government of Aruba. (2017). *Landsbesluit Bescherming Inheemse Flora & Fauna*. Afkondigingsblad van Aruba (AB) 2017, no. 48. Retrieved from https://dnmaruba.org/nl/wetgeving/

Hamilton, S.E., & Casey, D. (2016). Creation of a High Spatio-Temporal Resolution Global Database of Continuous Mangrove Forest Cover for the 21st Century (CGMFC-21). Global Ecology and Biogeography, 25(6), 729–738. https://doi.org/10.1111/geb.12449

Hoegh-Guldberg, O., Mumby, P.J., Hooten, A.J., Steneck, R.S., Greenfield, P., Gomez, E., ... & Hatziolos, M.E. (2007). Coral Reefs Under Rapid Climate Change and Ocean Acidification. Science, 318(5857), 1737–1742. https://doi.org/10.1126/science.1152509

Howard, J., Hoyt, S., Isensee, K., Telszewski, M., Pidgeon, E. (eds.) (2014). Coastal Blue Carbon: Methods for assessing carbon stocks and emissions factors in mangroves, tidal salt marshes, and seagrasses. Conservation International, Intergovernmental Oceanographic Commission of UNESCO, International Union for Conservation of Nature. Arlington, Virginia, USA. https://www.cifor-icraf.org/publications/pdf_files/Books/BMurdiyarso1401.pdf

IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp. https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf

IPCC. (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. https://www.ipcc.ch/report/ar6/wg1/

Jones-Walters, L.M. (1917) Report and recommendations in relation to the mangrove dieback at Santo Largo salt pond, Aruba: site visit and meetings with key stakeholders, Aruba. Wageningen Research, 17 October 2017

Jones-Walters, L.M. (2017) A management plan for Spaans Lagoen, Aruba. Wageningen Research, 17 October 2017

María Luisa Martínez, Norbert P Psuty, Roy A Lubke (2004) A perspective on coastal dunes. Pp. 3-10 *In* Martínez, M.L. and Psuty, N.P. (2004). Coastal Dunes: Ecology and Conservation. Ecological Studies, Vol. 171 Berlin: Springer. https://scholar.google.ca/citations?view_op=view_citation&hl=es&user=jQxxQuYAAAAJ&citation_for_view=jQxxQuYAAAAJ:W7OEmFMy1HYC

Nagelkerken, I., Blaber, S.J.M., Bouillon, S., Green, P., Haywood, M., Kirton, L.G., ... & Somerfield, P.J. (2008). The Habitat Function of Mangroves for Terrestrial and Marine Fauna: A Review. Aquatic Botany, 89(2), 155–185. https://doi.org/10.1016/j.aquabot.2007.12.007

Nature Today (2023). 'Turning the Tide' for mangrove and coral in Aruba. Retrieved from https://www.naturetoday.com/intl/en/nature-reports/message/?msg=30637&utm_source=chatgpt.com

Nature Today. (2023). 'Turning the Tide' for mangrove and coral in Aruba. Retrieved from https://www.naturetoday.com/intl/en/nature-reports/message/?msg=30637&utm_source=chatgpt.com

Mücher, S., Henkens, R., & van Proosdij, A. (2024). Historical Land Cover Change in Aruba: Trends, Drivers, and Implications for Conservation Management. Wageningen: Wageningen Environmental Research. https://research.wur.nl/en/publications/land-cover-classification-2020-and-analysis-historical-land-cover

Polaszek, T., Lacle, F., van Beukering, P. and Wolfs, E. (2018) The Economics of Ecosystems and Biodiversity, Aruba January 2018 Updated version. Wolfs Company, Sarphatistraat 370, Amsterdam. https://www.wolfscompany.com/wp-content/uploads/2018/04/TEEB-Aruba-Main-Report.pdf

Ramsar Secretariat. (2021). The Ramsar Convention and Wetland Conservation: A Guide for Site Managers. Ramsar Convention on Wetlands. https://www.ramsar.org/sites/default/files/documents/library/wurc_mgt_planning2008.pdf

Richardson, D.M., & Rejmánek, M. (2011). Trees and Shrubs as Invasive Alien Species: A Global Review. Diversity and Distributions, 17(5), 788–809. https://doi.org/10.1111/j.1472-4642.2011.00785.x

de Scisciolo, T., Mijts, E., Becker, T. and Eppinga, M., (2016). 'Beach debris on Aruba.' In Bionews Issue 24, p. 1-2. Retrieved from https://www.semanticscholar.org/paper/Beach-debris-on-Aruba%2C-Southern-Caribbean%3A-to-local-Scisciolo-Mijts/12aaed68a0585f9e4a6c1206f5c994f84c932b1e

Silliman, B.R., van de Koppel, J., McCoy, M.W., Diller, J., Kasoar, T., Earl, K., ... & Fougeres, E.M. (2012). Degradation and Resilience in Louisiana Salt Marshes After the BP–Deepwater Horizon Oil Spill. Proceedings of the National Academy of Sciences, 109(28), 11234–11239. https://doi.org/10.1073/pnas.1204922109

Spalding, M., Kainuma, M., & Collins, L. (2014). World Atlas of Mangroves. London: Earthscan. https://doi.org/10.4324/9781849776608

United Nations Environment Programme, Caribbean Environment Programme, Caribbean Natural Resources Institute (CANARI) (2020). Regional Strategy and Action Plan for the Valuation, Protection and/or Restoration of Key Marine Habitats in the Wider Caribbean 2021 – 2030: Technical Report No.2. https://www.unep.org/cep/resources/report/regional-strategy-and-action-plan-valuation-protection-andor-restoration-key/ https://wedocs.unep.org/20.500.11822/36347

UNESCO (2014). Safeguarding Precious Resources for Island Communities. World Heritage Papers 38. Paris: UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000228833

Vermeij, M.J.A., Marhaver, K., Estep, A. & Sandin, S.A. (2019). Coral Reefs Baseline Study for Aruba 2019. Unpublished report. https://www.dcbd.nl/reposerver/api/file/3566

Verweij, P., Henkens, R., Thomas, D., & Jones-Walters, L. (2024). Future Scenarios for Sustainable Development in Aruba: Balancing Human and Ecological Needs. Wageningen: Wageningen Environmental Research.

World Bank Group (Accessed January 2025) Climate Change Knowledge Portal Country: Aruba https://climateknowledgeportal.worldbank.org/country/aruba/vulnerability?utm_source=chatgpt.com

Polaszek, T., Lacle, F., van Beukering, P. and Wolfs, E. (2018) The Economics of Ecosystems and Biodiversity, Aruba January 2018 Updated version. Wolfs Company, Sarphatistraat 370, Amsterdam. https://www.wolfscompany.com/wp-content/uploads/2018/04/TEEB-Aruba-Main-Report.pdf

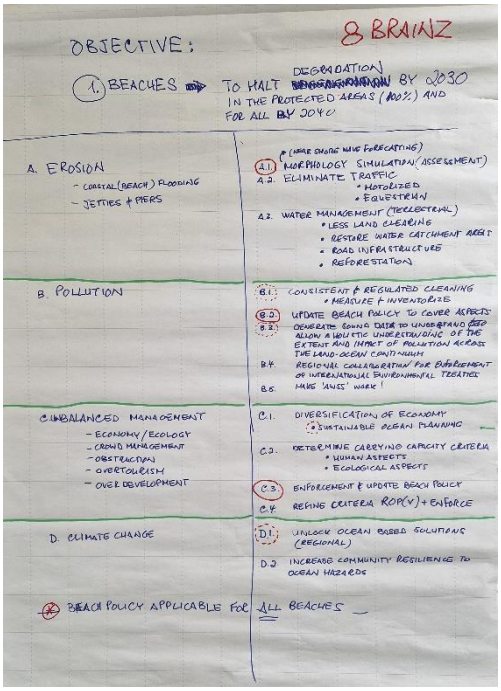
Appendix 1: Coastal Stakeholder Workshop - Outcomes

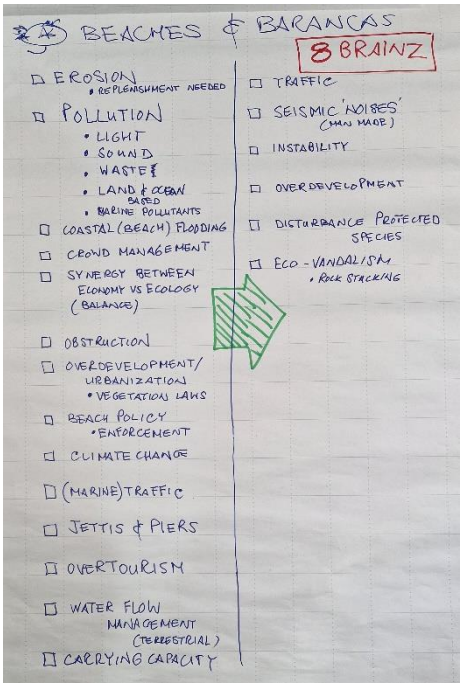
A stakeholder workshop was held on the island (xx/November/2024) to develop an overall vision for coastal habitats, set out in section 1 of the report, and to define specific objectives for the key habitats identified by the group, associated issues and potential actions. The priority ecosystems identified by the stakeholders were:

1. Beaches and Barancas
2. Saliñas
3. Mangroves
4. Reef Islands
5. Dunes

The following tables capture the outcomes from the flip charts (which are also shown for reference).

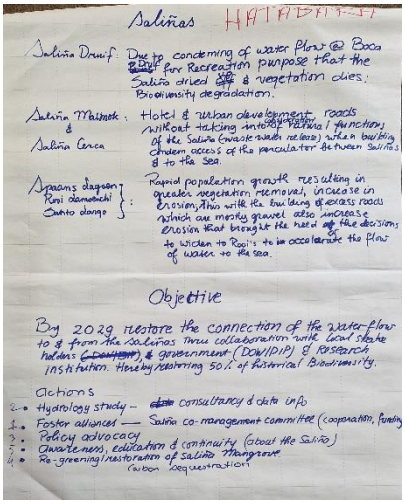
1. Beaches and Barancas – Objective, Issues and Actions





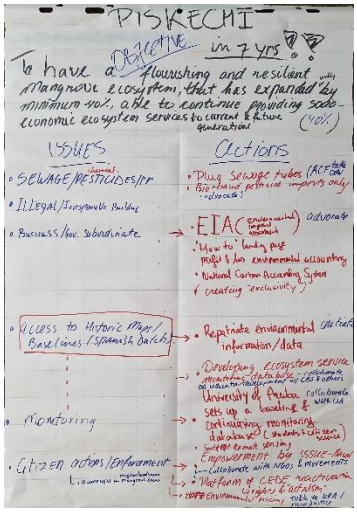
Beaches (Barancas were not considered by the group due to time constraints)		
Objective	**Issues**	**Actions**
To a halt degradation by 2030 in the protected areas (100%) and for all by 2040	Erosion • Coastal (beach) flooding • Jetties and piers	1. Nearshore wave forecasting, morphology simulation (assessment). 2. Water management (terrestrial) • Less land clearing • Restore water catchment areas • Road infrastructure • Reforestation
	Pollution	1. Consistent and regulated cleaning • Measure • Inventorise 2. Update beach policy to cover issues 3. Generate sound data to understand/allow a holistic understanding of the extent and impact of pollution across the land-ocean continuum 4. Regional collaboration for enforcement of international environmental treaties 5. Have 'AWSS 'work!
	Unbalanced management • Economy/ecology • Crowd management • Obstruction • Over tourism • Over development	1. Diversification of economy • Sustainable ocean planning 2. Determine carrying capacity criteria • Human aspects • Ecological aspects 3. Enforcement and update beach policy 4. Refine criteria ROP(V) and enforce
	Climate change	1. Unlock ocean-based solutions (regional) 2. Increase community resilience to ocean hazards.
	Policy	Beach policy applicable for *all* beaches

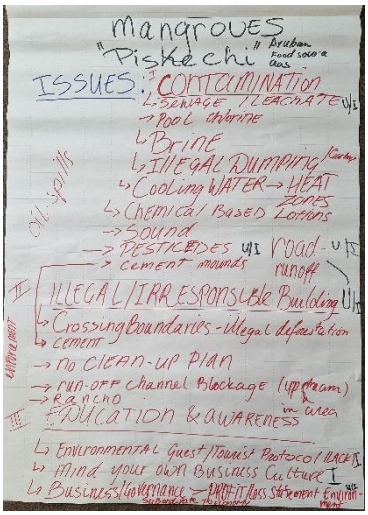
2. Salinas

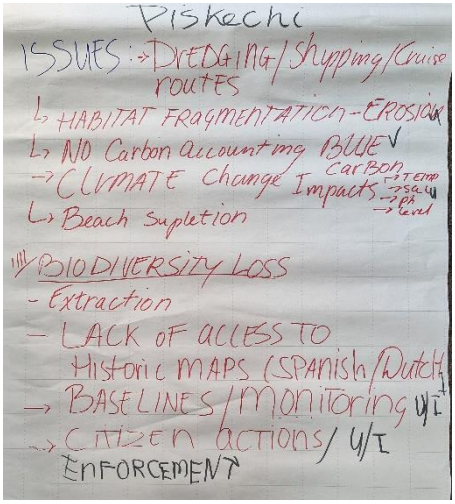


Saliñas		
Objective	**Issues**	**Actions**
By 2029 restore the connection of the water flow to and from the saliñas years, through collaboration with local stakeholders and government (DFW/DIP) and research institutions; thereby restoring 50% of historical biodiversity.	Saliña Druif Due to blocking of water flow at Boca Druif, for recreational purposes, the saliña dries up and vegetation dies, leading to biodiversity degradation.	No site-specific actions were proposed; however, a list of five prioritised general actions were put forward: 1. Foster alliances - saliña Cope management committee (cooperation, funding) 2. Hydrology study - consultancy and data information 3. Policy advocacy 4. Re-greening/restoration of saliña mangrove, also to increase carbon sequestration
	Saliña Malmok and Saliña Cerca Hotel and urban development, and associated road infrastructure takes/has taken place without taking into account the natural functions of the saliñas (management of water); causing the movement of water between saliñas and the sea to be impeded and/or blocked.	
	Spaans Lagoen, Rooi Lamoenchi and Santo Largo Rapid population growth resulting in greater vegetation removal, increase in erosion; this with the building of access roads and other transport infrastructure, which are mostly gravel, also increases erosion, resulting in decisions to widen the roois in order to accelerate the flow of water to the sea.	

3. Mangroves

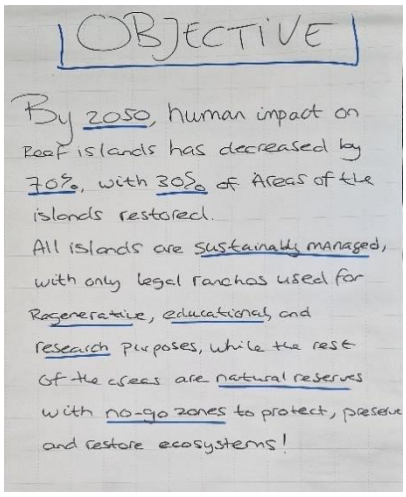


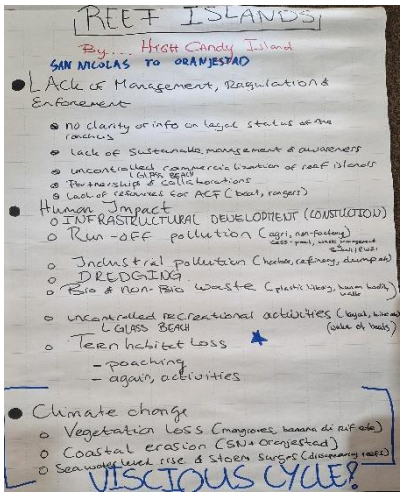


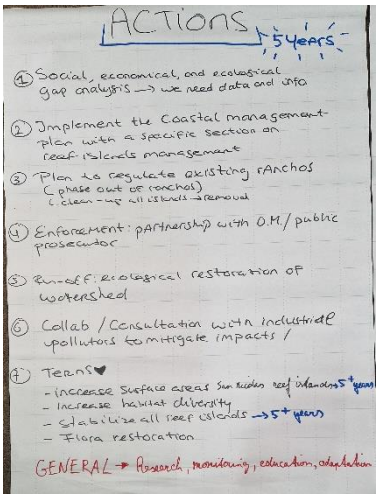


Mangroves		
Objective	**Issues**	**Actions**
In seven years, to have a flourishing and resilient mangrove ecosystem, that has expanded by a minimum of 40%, and which is able to continue providing socio-economic ecosystem services to current and future generations.	Sewage/chemical pesticides/RR	1. Plug sewage tubes brackets ACF backs DOW) 2. bio-based pesticide imports only (advocate)
	Illegal/irresponsible building Business/government subordinate	1. EIA - Environmental Impact Assessment - advocate 2. 'How to' landing page, profit and loss environmental accounting 3. National Carbon Accounting System (4. Creating "exclusivity")
	Access to historic maps/baselines/Spanish-Dutch	1. Repatriate environmental information/data (initiate)
	Monitoring	1. Developing ecosystem service monitoring database - collaborate on indicator development with CBS and others 2. University of Aruba sets up a baseline of continuing monitoring data (students and citizen science 3. Increase collaboration with UA 4. Satellite remote sensing
	Citizen actions/enforcement (awareness of neighbourhood issues in mangrove areas)	1. Empowerment by issue-based - collaborate with NGOs and movements 2. Platform of CEDE reactivation - rights and "activism" 3. Environmental policing (talk to KPA/Ministry of Justice)

4. Reef Islands



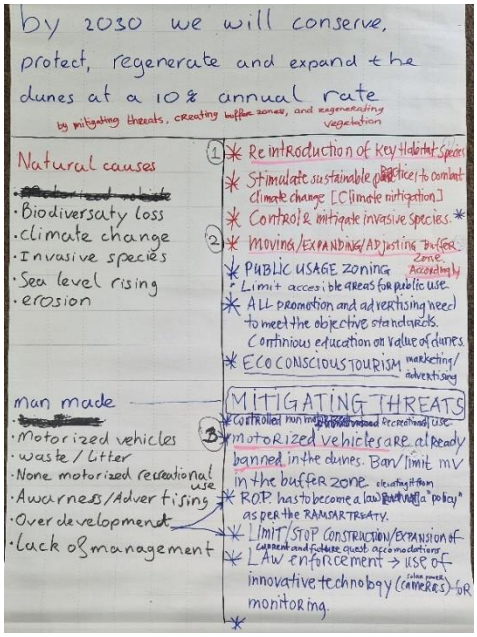


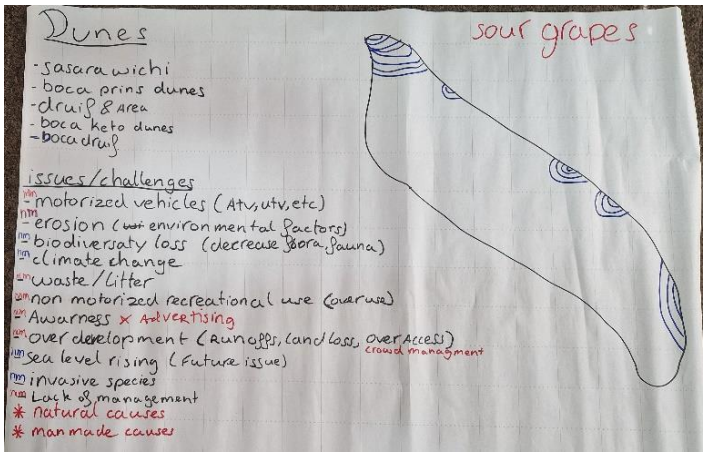


Reef Islands		
Objective	**Issues**	**Actions**
By 2050, human impact on reef islands has decreased by 70%, with 30% of areas of the islands restored. All islands are sustainably managed, with only legal ranchos used for regenerated, educational, and research purposes, while the rest of the areas are natural reserves with no-go zones to protect, preserve and restore ecosystems!	Lack of management, regulation and enforcement: • No clarity or information on legal status of the Ranchos • Lack of sustainable management and awareness • Uncontrolled commercialisation of reef islands (Glass Beach) • Partnership and collaborations • Lack of resources for ACF (boat, Rangers) Human impact • Infrastructural development (construction) • Run-off pollution (angry, non-factory cesspool, waste management (Bubali/RWZI) • Industrial pollution (harbour, refinery, dump, et cetera) • Dredging • Bio and non-bio waste (plastic littering, human bodily waste) • Uncontrolled recreational activities (kayak, kite, wake of boats, et cetera)	General -> research, monitoring, education, adaptation 1. Social, economic, and ecological gap analysis -> we need data and information. 2. Implement the coastal management plan with a specific section on reef islands management. 3. Plan to regulate existing ranchos (phase-out of ranchos; cleanup all islands and remove waste) 4. Enforcement: partnership with OM/public prosecutor 5. Run-off: ecological restoration of watershed. 6. Collaboration/consultation with industrial polluters to migrate impacts 7. Terns • Increase surface areas San Nicolas reef islands (5+ years) • Increase habitat diversity • Stabilise all reef islands (5+ years) • Flora restoration

	• Tern habitat loss (poaching, many of above activities)	
	Climate change • Vegetation loss (mangroves, Banana di Rif, et cetera) • Coastal erosion (SN and Oranjestad) • Seawater level rise and storm surges (disappearing reefs) [Vicious Cycle!]	

5. Dunes





Dunes specifically: Sasarawichi, Boca Prins dunes, Druif and adjacent area, Boca Keto dunes, Boca Druif		
Objective	**Issues**	**Actions**
By 2030 we will conserve, protect, regenerate and expand the dunes at a 10% annual rate; by mitigating threats creating buffer zones and regenerating vegetation.	Natural causes: • Biodiversity loss • Climate change • Invasive species • Sea level rising • Erosion	1. Reintroduction of key habitat species 2. Stimulate sustainable practices to combat climate change (climate mitigation) 3. Control and mitigate invasive species 4. Moving/ expanding/ adjusting buffer zone - zone accordingly 5. Public usage zoning - limit accessible areas for public use 6. All promotion and advertising needs to meet the objective standards 7. Continuous education on value of dunes 8. Eco-conscious tourism, marketing/ advertising
	Man-made causes: • Motorised vehicles • Waste/litter • Non-motorised recreational use • Awareness/ advertising • Over development • Lack of management	[Mitigating threats] 1. Controlled non-motorised recreational use 2. Motorised vehicles are already banned in the dunes; Ban/limit motorised vehicles in the buffer zone 3. ROP has to become a law elevating it from a "policy", as per the Ramsar treaty 4. Limit/ stop construction/ expansion of current and future guest accommodations 5. Law enforcement -> use of innovative technology (solar power cameras) for monitoring