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# Terrestrial Protected Areas Conservation Management Plan *2025 – 2029*

Aruba Conservation Foundation

Together for *Nature.*

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# 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, fishers, 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 terrestrial ecosystems are vital to the island's biodiversity, cultural heritage, and ecological resilience. The **ACF's Terrestrial Protected Areas Conservation Management Plan (PACMP) 2025–2029** sets out a strategic framework to safeguard these ecosystems while addressing emerging threats and ensuring sustainable management. This plan aligns with national policies, such as Aruba's Spatial Development Plan (ROP) and Nature Conservation Ordinance, as well as global frameworks, including the Kunming-Montreal Global Biodiversity Framework and the UN Sustainable Development Goals.

This Terrestrial PACMP outlines clear conservation objectives to address the island's most pressing challenges:

- **Protect and Restore Xeric Ecosystems:** Implement habitat restoration, invasive species control, and vegetation management to safeguard Aruba's arid landscapes and endemic species, such as the Aruba rattlesnake and burrowing owl.
- **Enhance Terrestrial Water Management:** Improve water retention and restore natural systems like rooi and tanki to support biodiversity and mitigate the impacts of climate change.
- **Promote Nature-Inclusive Urban Development:** Integrate green and blue infrastructure, native species gardens, and biodiversity corridors into urban areas to balance development with conservation goals.
- **Strengthen Species Recovery Programs:** Develop and implement targeted recovery plans for key species, including the Shoco (burrowing owl), Lora (yellow-shouldered amazon), and native amphibians and reptiles.
- **Mitigate Threats from Invasive Species and Free-Roaming Grazers:** Implement eradication and control programs for invasive plants, animals, and feral domestic species to protect native biodiversity.
- **Foster Community Engagement and Education:** Increase public awareness of conservation issues through outreach, advocacy, and educational initiatives, ensuring community participation in conservation efforts.
- **Enhance Partnerships and Research:** Collaborate with local, regional, and international stakeholders and integrate scientific research into conservation strategies to address knowledge gaps and inform decision-making.

The plan identifies **Key Conservation Actions and Targets**, including:

- Establishing ecological networks to enhance habitat connectivity.
- Restoring native vegetation through comprehensive mapping and botanical initiatives.
- Managing urban impacts on biodiversity through sustainable urban planning.
- Developing a robust Monitoring and Evaluation (M&E) framework to track progress and adapt management strategies.
- By 2029, the plan aims to achieve measurable outcomes, such as the restoration of 50% of degraded habitats, the elimination of free-roaming grazers in all protected areas, and the implementation of recovery plans for at least five endangered species.

**Monitoring and Evaluation:** A comprehensive M&E framework will track ecosystem health, species populations, water resource management, and the socio-economic impacts of conservation actions. Data collection tools, such as GIS mapping, biodiversity surveys, and community engagement metrics, will provide critical insights to guide adaptive management.

**Threats and Challenges:** Aruba's terrestrial ecosystems face threats from climate change, invasive species, urbanization, and unsustainable land use. Overgrazing by non-native grazers and habitat fragmentation pose additional risks to biodiversity. Addressing these challenges requires a collaborative, multi-stakeholder approach and a commitment to evidence-based conservation practices.

In conclusion, this Terrestrial PACMP 2025–2029 provides a roadmap to secure the island's ecological future. Through strategic conservation actions, innovative management, and active stakeholder participation, this plan seeks to preserve Aruba's unique biodiversity, enhance ecosystem resilience, and promote sustainable development. By implementing this plan, Aruba reaffirms its dedication to protecting its natural heritage for future generations.

# Acknowledgements

This Terrestrial PACMP 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 Environment and is published through the official government channel *Landscourant* and on the website of the Aruba Conservation Foundation.

# Terrestrial Areas Conservation Management Plan 2025-2029

# 1. Introduction

## 1.1 Context

The Terrestrial Protected Areas Conservation Management Plan (PACMP) 2025–2029 builds upon the principles and objectives of the ACF Protected Areas Conservation Framework 2025–2034, focusing specifically on safeguarding Aruba's terrestrial 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 terrestrial 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, this plan adopts evidence-based, adaptive management principles to improve protected area management and develop ecosystem-based approaches for Aruba's terrestrial environments. The plan identifies two key focus areas: Fundamental Conservation, addressing ACF's core responsibilities in managing protected terrestrial 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 terrestrial 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 terrestrial protected areas, their ecosystems and associated biodiversity.

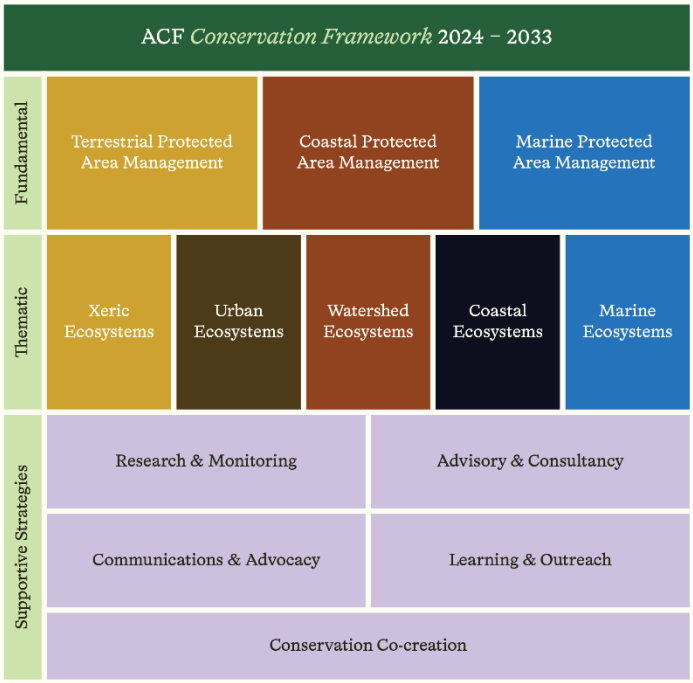


*Figure 1: ACF Conservation Framework 2024-2033*

## 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 the ACF Protected Areas Conservation Management Framework for 2025 – 2034. It is the agreed, stakeholder-generated output from workshops on both the terrestrial and coastal environments; it can therefore be applied generically to these ecosystems:

***By 2050 Aruba builds an inclusive society that respects and protects (at least 40%) 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 terrestrial 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 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. Green and Blue Infrastructure
2. Free-roaming non-native species
3. Urban Rewilding
4. Research and Monitoring
5. Policy and governance
6. Education and Awareness

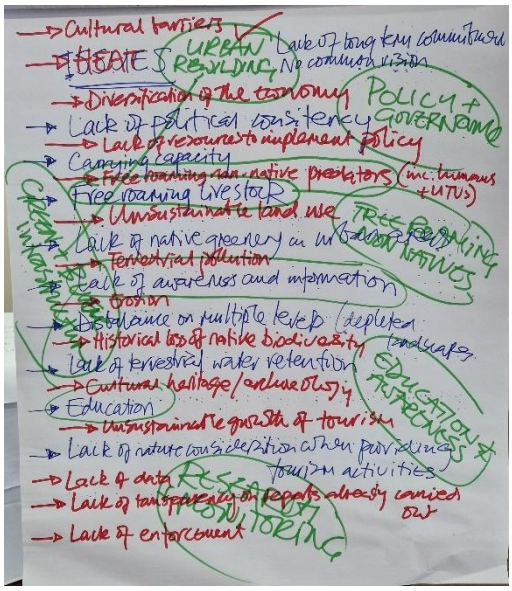


*Figure 2: Flipchart paper from the exercise to generate issues and, from those, key priorities.*

### *Objective 1: Protect, Rehabilitate and Manage Terrestrial Ecosystems*

*To protect rehabilitate, and manage Aruba's terrestrial species, habitats, and ecosystem resilience for sustainable ecosystem health, incorporating environmental, ecological and socio-economic data to identify and address knowledge gaps in terrestrial biodiversity.* This objective aims to ensure the long-term vitality and resilience of terrestrial ecosystems and their associated species, focusing on adaptive management practices that align with local policies, such as the Ruimtelijk Ontwikkelings plan Aruba 2019 (ROP, 2019), and international commitments, including the Convention on Biological Diversity (CBD, 1992 & 2022). It will include protocols for monitoring and evaluation, with indicators of management success, and will integrate measures for enforcement and recovery of key habitats and species. This will be achieved through improved management and protection, targeted restorative efforts, and the mitigation of threats and impacts.

### *Objective 2: Control and Manage Invasive Species*

*To control and manage invasive species that threaten Aruba's terrestrial ecosystems and native biodiversity, reducing their impact on habitats and species.* Invasive species such as buffelgrass and feral goats disrupt ecological balance by outcompeting native flora and degrading habitats. This objective prioritizes research-driven control strategies, habitat restoration, and public awareness campaigns to mitigate the impacts of invasive species. Actions will align with national frameworks, such as the Natuurbeschermingsverordening (Government of Aruba, 2017), and incorporate evidence-based approaches to ensure long-term ecosystem resilience and biodiversity protection (Van den Oever, 2000; CBD, 1992 & 2022).

[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.

### *Objective 3: Promote Ecosystem Connectivity*

*To enhance ecological connectivity by linking fragmented habitats and increasing population viability through the creation and management of ecological corridors*. Habitat fragmentation caused by urbanization and land-use changes reduces biodiversity and ecological resilience. This objective supports the implementation of the Aruba Ecological Network Plan, facilitating wildlife movement and genetic diversity through targeted habitat restoration and corridor creation. Evidence-based research and monitoring will guide these efforts, integrating best practices from global conservation strategies (Government of Aruba, 2019; Hilty et al., 2020).

### *Objective 4: Enhance Biodiversity Conservation*

*To protect and restore populations of endemic and native species while ensuring the conservation of critical habitats*. This objective focuses on endemic species such as the Aruban burrowing owl (*Athene cunicularia arubensis*), the Aruba rattlesnake (*Crotalus unicolor*) and the Aruba whiptail lizard (*Cnemidophorus arubensis*), emphasizing habitat restoration, species monitoring, and threat mitigation. Conservation efforts will align with international biodiversity commitments, including the Convention on Biological Diversity, and leverage adaptive management strategies to ensure ecological sustainability (Van den Oever, 2000; Secretariat of the CBD, 1992 & 2022).

### *Objective 5: Implement Sustainable Water Management*

*To optimize water retention and improve the management of water resources critical for sustaining terrestrial ecosystems and biodiversity*. Limited water availability in Aruba's arid landscape underscores the need for effective management of rooi systems and tankis. This objective promotes sustainable water management practices, incorporating nature-based solutions to enhance water retention and ecosystem resilience. Strategies will draw on traditional knowledge and contemporary research to address the impacts of climate change and human activity (Government of Aruba, 2019; Mitsch & Gosselink, 2015).

### *Objective 6: Integrate Conservation into Urban Planning*

*To incorporate green and blue infrastructure into urban landscapes, promoting biodiversity while minimizing habitat fragmentation*. Urban development often leads to the loss of critical habitats and reduced ecological connectivity. This objective supports the integration of native species gardens, green corridors, and biodiversity hotspots into urban planning, aligning with Aruba's Ruimtelijk Ontwikkelingsplan (ROP) and global urban sustainability goals (Gill et al., 2007; Government of Aruba, 2019).

### *Objective 7: Advocate for Conservation Awareness*

*To increase public understanding and support for conservation through education, outreach, and stakeholder engagement at all levels*. Raising awareness about Aruba's unique biodiversity and the value of its terrestrial ecosystems is critical for building community and stakeholder commitment to conservation. This objective focuses on inclusive educational programs, workshops, and campaigns targeting diverse audiences, including schools, local communities, and policymakers. By fostering environmental stewardship, promoting responsible behaviours, and integrating conservation into cultural and societal norms, advocacy efforts aim to drive behavioural change and policy support for sustainable practices. These initiatives align with

global frameworks such as the EU Biodiversity Strategy for 2030 and broader sustainability goals (Miller, 2005; United Nations, 2015; European Commission, 2020).

### *Objective 8: Build Partnerships and Collaboration*

*To strengthen collaborations with government agencies, NGOs, research institutions, and local communities to leverage expertise and resources for conservation*. Effective conservation requires a multi-stakeholder approach that pools resources, aligns priorities, and promotes shared responsibility. This objective focuses on building partnerships with national bodies such as the Directie Natuur en Milieu (DNM), local NGOs, educational institutions, and international conservation organizations. Collaborative frameworks will align conservation efforts with regulatory and research priorities, integrating global best practices and innovations. These partnerships also support frameworks like the UN Decade on Ecosystem Restoration (2021–2030) to enhance ecosystem management and resilience (Government of Aruba, 2019; Hilty et al., 2020; United Nations, 2020).

### *Objective 9: Adapt to Climate Change*

*To implement adaptive strategies to mitigate the impacts of climate change on Aruba's ecosystems, focusing on enhancing ecological resilience and maintaining ecosystem services*. Aruba's terrestrial ecosystems face significant risks from climate change, including rising temperatures, altered rainfall patterns, increased aridity, and extreme weather events. This objective emphasizes integrating climate-resilient approaches into conservation planning, such as habitat restoration, soil stabilization, erosion control, and water retention systems. Nature-based solutions, including reforestation and ecosystem-based adaptation, will be prioritized to enhance resilience and ensure ecosystem service delivery. These actions align with international frameworks such as the Paris Agreement, the European Green Deal, and the IPCC's Climate Adaptation Guidelines, ensuring Aruba's conservation efforts remain globally relevant (Mitsch & Gosselink, 2015; IPCC, 2022; European Commission, 2019; UNFCCC, 2015).

### *Objective 10: Promote Sustainable Tourism*

*To integrate nature-based tourism practices that support conservation while minimizing environmental impacts, fostering a sustainable relationship between tourism and nature*. Tourism is vital to Aruba's economy but also places significant pressure on its ecosystems. This objective emphasizes developing sustainable tourism practices, including ecotourism initiatives, habitat protection, and visitor education, to balance economic benefits with ecological stewardship. By aligning with the Global Sustainable Tourism Council (GSTC) Criteria and incorporating regional best practices, these efforts aim to minimize the environmental footprint of tourism while fostering community engagement and sustainable economic development. Eco-tourism initiatives will serve as a critical funding source for conservation and promote awareness of Aruba's unique biodiversity (Gössling et al., 2012; Smith et al., 2017; GSTC, 2022).

# 2. Biodiversity Value and Other Characteristics of the Terrestrial Ecosystems on Aruba

Aruba's terrestrial protected areas are primarily composed of xeric (dry) ecosystems characterized by hills, limestone cliffs, and volcanic rock formations that reflect the island's semi-arid climate. These landscapes are home to many sensitive areas, harboring unique biodiversity and cultural heritage. They form part of the ecological and cultural identity of the island, supporting species well-adapted to these harsh conditions and contributing to Aruba's natural and cultural landscape. Notably, features such as caves adorned with petroglyphs underscore the deep connection between Aruba's natural environment and the cultural heritage of its indigenous people.

The xeric landscape and its associated biodiversity face significant challenges, including habitat degradation due to human activities, pollution, invasive species, and climate change. Additionally, some protected areas contain private and long-lease properties that predate their designation, presenting ongoing management and conservation challenges.

Three recent studies provide critical insights into these issues. Mücher et al. (2024) analysed historical land cover changes since 1900, offering a comprehensive understanding of land use trends and their implications for current management. Henkens et al. (2024) conducted a baseline study which, whilst it focusses on Aruba's coastal wetlands, highlights many of the terrestrial pressures and threats related to water management. Lastly, Verweij et al. (2024) explored future scenarios for Aruba, envisioning sustainable solutions that balance the needs of people and nature. Together, these publications contribute significantly to understanding and addressing the complexities of land use, management, and conservation on the island.

## 2.1 Arid (Xeric) Ecosystems

Arid ecosystems, such as those in Aruba, are uniquely adapted environments and biodiversity hotspots that host a wide range of species and ecological interactions despite harsh climatic conditions characterized by low rainfall, high evaporation rates, and nutrient-poor soils. While these ecosystems support species evolved to thrive in extreme environments, they are fragile and require targeted conservation efforts to protect their biodiversity and the vital ecosystem services they provide.

### 1. High Levels of Endemism

Arid ecosystems, particularly on islands like Aruba, often have high levels of endemism, where species evolve in isolation and develop unique traits suited to their environment. For example, Aruba is home to species such as the Aruban whiptail lizard (*Cnemidophorus arubensis*), the Aruban burrowing owl (*Athene cunicularia arubensis*), and the Aruba rattlesnake (Crotalus unicolor). The Aruba rattlesnake is critically endangered, with its range restricted to the island's arid landscapes. These species have adapted to survive in the island's arid climate, with behaviours and physiological traits that help them conserve water and tolerate heat (Whitford, 2002; Morton et al., 2011).

### 2. Adaptation to Extreme Conditions

Species in arid environments often develop specialized strategies to cope with water scarcity and extreme temperatures. These adaptations can include nocturnal behaviour (to avoid the daytime

heat), water storage capabilities in plants and animals, and highly efficient nutrient cycling systems within ecosystems (Whitford, 2002). In Aruba's dry ecosystems, cacti and drought-resistant shrubs, such as the Divi-Divi tree (*Caesalpinia coriaria*), play a crucial role in providing habitat and food for animals during dry periods (Valiente-Banuet et al., 1996; Van Andel, 2000).

### 3. Importance of Keystone Species

Certain species in arid ecosystems act as keystone species, meaning they have a disproportionately large impact on their environment relative to their abundance. For example, cacti and other succulent plants provide food and shelter for a range of animals, from birds and reptiles to invertebrates (Nassar et al., 2003). In Aruba's arid regions, columnar cacti provide essential nectar and fruit for species like bats and birds, playing a critical role in pollination and seed dispersal (Whitford, 2002; Nassar et al., 2003).

### 4. Ecological Interactions and Resilience

Arid ecosystems, while fragile, demonstrate remarkable resilience through ecological interactions that maintain biodiversity. The scarcity of water leads to unique predator-prey dynamics, as species must balance energy use with the search for water and food. This creates intricate food webs and interdependencies, where disruptions can have far-reaching effects (Barrows et al., 2005). For instance, the introduction of non-native species like goats in Aruba has had a severe impact on native vegetation, underscoring the delicate balance of these ecosystems (Van Andel, 2000; Sharifi et al., 2010).

### 5. Ecosystem Services

Despite being arid, these ecosystems provide critical ecosystem services, such as soil stabilization, carbon sequestration, and the regulation of water cycles (Whitford, 2002; Smith et al., 2017). In Aruba, the arid landscapes help prevent soil erosion and support microclimates that are essential for the survival of both wildlife and human communities (Morton et al., 2011). Additionally, they serve as cultural and recreational spaces, contributing to local economies through eco-tourism (Smith et al., 2017).

### 6. Threats and Conservation Challenges

Arid ecosystems are highly vulnerable to external pressures, such as climate change, overgrazing, habitat loss, and invasive species. In Aruba, non-native grazers like goats, coupled with the impacts of tourism and development, pose significant threats to the integrity of these ecosystems (Van Andel, 2000; Sharifi et al., 2010). Conservation efforts in these regions must focus on habitat restoration, invasive species control, and sustainable land management practices to maintain biodiversity (Brooks et al., 2004; Morton et al., 2011).

## 2.2 Watershed Ecosystems

In Aruba's arid landscape, water is a critical resource for sustaining biodiversity and ecosystem functions. Despite the scarcity of freshwater, strategic water management is essential for maintaining the island's ecological resilience. Terrestrial water bodies, such as rooi systems and tankis, support diverse flora and fauna, provide vital ecosystem services, and mitigate the impacts of extreme weather events. Ensuring that water is retained on land and that these water systems are maintained or expanded is pivotal to enhancing biodiversity and supporting ecological sustainability. Additionally, integrating Nature-Based Solutions offers promising strategies for sustainable management, addressing climate change challenges while preserving the island's unique ecosystems.

## 1. Water as a Critical Resource for Biodiversity

Water is a limiting factor for biodiversity in arid environments like Aruba. Many species rely on small, scattered water bodies for drinking, foraging, and breeding. These water bodies also support riparian vegetation that provides critical habitats for a range of species, including insects, amphibians, and birds (Dudgeon et al., 2006). In the case of Aruba, tankis—small freshwater reservoirs—play a significant role in the survival of terrestrial wildlife, creating "mini wildlife hotspots" where species congregate during dry periods (Morton et al., 2011). Freshwater availability is crucial for maintaining ecological balance, even in regions where it is scarce, supporting not only biodiversity but also human communities (Palmer et al., 2008). Arid island ecosystems like Aruba are especially vulnerable to changes in water availability due to climate change, which may further stress freshwater resources and threaten biodiversity (IPCC, 2014).

## 2. Rooi Systems and Water Retention

Rooi systems are natural drainage channels that collect and transport water during rainfall events. Proper management of these systems is essential for reducing soil erosion, slowing down water flow, and increasing water absorption into the ground. This enhances the availability of water for both plants and animals, supporting biodiversity across the island. By integrating traditional methods, such as the reintroduction of riparian zones, these systems can become more effective in retaining water and promoting ecosystem health (Barrows et al., 2005). Riparian zones around water bodies are essential for preventing erosion, improving water quality, and supporting a rich biodiversity of species (Naiman et al., 2005). The preservation and restoration of such zones can be especially critical in arid island environments, where even minor changes in water flow or vegetation cover can lead to rapid degradation (Lambers et al., 2008).

## 3. The Ecological Importance of Tankis

Tankis, which are small, artificial or natural freshwater reservoirs, play a crucial role in Aruba's arid environment. They support a wide range of biodiversity, including birds, reptiles, and invertebrates, by providing critical freshwater resources. Tankis also contribute to the connectivity of habitats, allowing species to migrate between areas in search of water and food (Van Andel, 2000). As part of Aruba's ecological network, tankis not only help conserve water but also serve as important biodiversity refuges during dry seasons (Whitford, 2002). The strategic creation and restoration of these water bodies can enhance water availability and provide significant ecological benefits (Bunn & Arthington, 2002). In addition, tankis provide essential ecosystem services such as groundwater recharge and water filtration, both of which are crucial for maintaining freshwater supplies in arid islands (Mitsch & Gosselink, 2015).

## 4. Nature-Based Solutions for Water Management

Implementing Nature-Based Solutions (NbS) in terrestrial water management, such as the restoration of natural water bodies and the creation of riparian zones, is key to supporting biodiversity and improving ecosystem services. These solutions provide multiple benefits, including biodiversity support, water purification, and climate regulation. Incorporating NbS into Aruba's water management strategies ensures a holistic approach that balances ecological health with human needs (Valiente-Banuet et al., 1996). NbS, such as enhancing natural water retention in landscapes, also contribute to mitigating climate impacts by improving the resilience of ecosystems (Cohen-Shacham et al., 2016). For arid islands, integrating NbS can provide cost-effective and sustainable methods for managing limited freshwater resources while supporting biodiversity (Seddon et al., 2020).

## 5. Ecosystem Services Provided by Water Bodies

In addition to supporting biodiversity, terrestrial water bodies in Aruba provide essential ecosystem services, including the regulation of local climate, soil stabilization, and water purification (Mitsch & Gosselink, 2015). These services are especially critical in preventing erosion and runoff during extreme weather events. By maintaining and enhancing water bodies such as tankis and rooi systems, Aruba can promote both ecological sustainability and improve water availability for local communities (Smith et al., 2017). Given the challenges of water scarcity on arid islands, the role of water bodies in supporting local economies and ecosystem services is particularly significant (Gössling et al., 2012).

## 6. The Impact of Water Management on Species

Effective water management directly impacts species that depend on water for survival. For instance, birds and reptiles are known to congregate around tankis and other water bodies, especially during the dry season, when water is scarce elsewhere. These water sources are vital for maintaining species diversity and supporting populations of endemic species, such as the Aruban burrowing owl and Aruban whiptail lizard (Van Andel, 2000; Barrows et al., 2005). Research and management interventions are essential for ensuring that these water sources remain viable and continue to support the island's biodiversity (Postel & Thompson, 2005). Furthermore, in the context of climate change, the availability of freshwater resources is likely to become increasingly strained on islands like Aruba, making adaptive water management strategies essential for conserving biodiversity (Palmer et al., 2008; IPCC, 2014).

## 7. Threats and Conservation Challenges

Aruba’s terrestrial water systems face numerous threats that jeopardize their ability to sustain biodiversity and provide critical ecosystem services. Overgrazing by free-roaming livestock, deforestation, and urban development contribute to soil erosion and reduced water infiltration, degrading rooi systems and riparian zones. Additionally, invasive plant species, such as buffelgrass, outcompete native vegetation, further reducing the effectiveness of natural water retention areas. Climate change exacerbates these challenges by increasing the frequency and severity of droughts and altering rainfall patterns, placing further strain on freshwater availability (IPCC, 2014).

The degradation of tankis and the loss of riparian vegetation due to human activities limit their role as biodiversity refuges and disrupt the connectivity of habitats. Unregulated use of water resources and a lack of integrated management strategies exacerbate these pressures, threatening endemic and native species that depend on limited freshwater resources. Addressing these threats requires robust conservation measures, such as the restoration of riparian zones, the expansion of water retention systems, and the integration of Nature-Based Solutions to enhance water resource management and ecosystem resilience (Mitsch & Gosselink, 2015; Cohen-Shacham et al., 2016). Only through concerted efforts to mitigate these pressures can Aruba safeguard its terrestrial water resources and the biodiversity they support.

# 2.3 Urban Ecosystems

Urban and metropolitan areas in Aruba, though primarily shaped by human activity, hold significant potential for supporting biodiversity. These spaces, when thoughtfully managed and integrated with nature, can serve as critical habitats for a variety of species, provide essential ecosystem services, and contribute to ecological resilience in the face of urbanization and climate change. By incorporating green and blue infrastructure, urban areas can mitigate

environmental pressures, enhance ecological connectivity, and foster a harmonious relationship between people and their natural surroundings. This approach not only benefits biodiversity but also improves the quality of life for Aruba's residents while aligning with broader sustainability goals.

## 1. Urban Habitats and Biodiversity Refuges

Urban areas in Aruba, despite being dominated by human activity, provide significant biodiversity value by supporting habitats for various species. Green and blue infrastructure, such as parks, gardens, water bodies, and urban trees, offer nesting sites, foraging grounds, and shelter for birds, reptiles, and insects. These spaces are particularly important for pollinators like bees and butterflies, which thrive in native species gardens that serve as ecological stepping stones for wildlife moving through developed landscapes (Aronson et al., 2017; Kowarik, 2011). The ability of urban areas to act as biodiversity refuges is vital in mitigating habitat loss caused by increasing urbanization (Beninde et al., 2015).

## 2. Environmental Benefits of Urban Green Spaces

Urban green spaces play a crucial role in addressing the environmental pressures of urbanization. They mitigate the urban heat island effect by regulating temperatures, reduce air pollution through vegetation, and manage water runoff by absorbing stormwater (Gill et al., 2007; Bowler et al., 2010). In Aruba, these benefits support both human well-being and ecological health, contributing to the resilience of urban ecosystems in the face of climate change.

## 3. Support for Environmental Education and Community Engagement

The presence of biodiversity in urban areas provides opportunities for environmental education and fosters community engagement. Urban green spaces raise awareness about Aruba's unique ecosystems and emphasize the importance of conserving nature in developed environments. These spaces can be used as living classrooms for schools and community groups, encouraging a deeper understanding of ecological processes and conservation needs (Miller, 2005). Community engagement through the creation and maintenance of urban green spaces also promotes a sense of ownership and stewardship (Peters et al., 2010).

## 4. Green Corridors and Connectivity

Incorporating green corridors and blue infrastructure into urban planning enhances ecological connectivity, allowing species to move freely between fragmented habitats (Hilty et al., 2020). In Aruba, creating interconnected green spaces can reduce habitat isolation and promote genetic diversity among urban wildlife populations. This strategy aligns with global conservation practices to integrate biodiversity into urban planning for greater ecosystem resilience (Beatley, 2016).

## 5. Alignment with Sustainability Goals

Integrating nature into urban landscapes supports broader sustainability goals by fostering a harmonious relationship between people and their natural surroundings. In Aruba, this approach includes protecting existing natural areas, enhancing biodiversity through native species gardens, and promoting green infrastructure. These efforts contribute to ecological resilience, improve the quality of life for residents, and align with global frameworks such as the UN Sustainable Development Goals (United Nations, 2015).

## 6. Threats and Conservation Challenges

Despite their potential to support biodiversity and enhance ecosystem resilience, urban and metropolitan areas in Aruba face significant threats and conservation challenges. Habitat loss due to urban sprawl and infrastructure development is a primary concern, often leading to the fragmentation of natural habitats and reduced ecological connectivity (Beninde et al., 2015). Invasive species, such as free-roaming predators like cats and dogs, further disrupt urban ecosystems, threatening native wildlife populations. Additionally, pollution, including air, noise, and light pollution, exacerbates the pressures on urban biodiversity, impacting species behaviours and reducing habitat quality (Kowarik, 2011).

Climate change poses additional challenges, with increasing temperatures intensifying the urban heat island effect and unpredictable weather patterns straining urban ecosystems. Limited awareness among residents and policymakers about the ecological significance of urban green spaces can also hinder conservation efforts. To address these challenges, targeted strategies are required, including stricter urban planning regulations, community-led green space initiatives, and the integration of native species into urban landscapes. Such measures are essential to mitigate threats, foster ecological resilience, and ensure the sustainability of urban biodiversity in Aruba's metropolitan areas (Gill et al., 2007; Hilty et al., 2020).

# 2.4 Description of the Terrestrial Protected Areas

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

The protected areas highlighted here, such as the Arikok National Park and ecological corridors like Rooi Lamunchi, are key to maintaining the island's ecological integrity. They provide critical habitats for endemic and native species, support biodiversity connectivity, and contribute to Aruba's broader conservation goals. These areas also play an essential role in climate adaptation and ecosystem resilience, offering refuge for species and supporting vital ecosystem services. Each area's unique characteristics—from xeric landscapes to fertile rooi and cultural heritage sites—underscore the importance of their protection and management in ensuring a sustainable future for Aruba's terrestrial environment.

*Table 1: Aruba's Terrestrial Protected Areas, including threats and challenges*

| Name | Description | Threats | Challenges |
|---|---|---|---|
| **Sero Grandi, Muskita & Tres Cabes** | The highest hill in this area is Sero Grandi (50 m), giving a good view of the undulating rugged, windswept salt spray landscape leading up to the coast. This area is frequented by reptiles (snakes, lizards), numerous species of birds (including birds of prey such as the Caracara Cheriway), and the elusive Aruban cottontail. This area is directly | Habitat fragmentation due to development; disturbance to wildlife from human activity; invasive plant species altering native ecosystems. | Managing high levels of human activity. Protecting critical habitats for reptiles, birds, and the Aruban cottontail. Maintaining connectivity with Saliña Druif, in context of built and infrastructure development. |

| | | | |
|---|---|---|---|
| | connected to Saliña Druif (see coastal protected areas). | | |
| **Ser'i Teishi** | This hilly area with a diversity of vegetation types and protected indigenous plant species has historically been a habitat for populations of breeding ospreys and bats, among others. The area is strategically located relative to the adjacent and nutrient-rich wetland Spaans Lagoen. | Degradation of indigenous vegetation from overgrazing by non-native grazers; habitat loss due to urban encroachment. | Preserving breeding habitats for ospreys and bats; maintaining the ecological link with Spaans Lagoen. |
| **KBA Parke Nacional Arikok** | This first protected area of Aruba was officially ratified by the government in 1997 and is since 2003 under the management of ACF. The Arikok National Park covers approximately 18 percent of the island, with 34 $km^2$ of natural xeric area, located in the northeastern part of Aruba. It contains unique and characteristic elements for Aruba, such as the island's highest rugged hills formed by volcanic solidified lava, batholithic quartz diorite, and tonalite rocks, as well as limestone rocks formed by petrified coral. There are also various bays (boca's) along the rugged north coast and several dune areas. Furthermore, there is a large diversity of drought-resistant cacti, trees, and plants, as well as Amerindian drawings, gold mines, and ruins from the Gold Rush period, old plantation buildings, and a typical rural adobe house. The park is a refuge for various birds, reptiles, and mammals, such as the endemic Aruba burrowing owl (Shoco), Brown-throated parakeet (Prikichi), Aruba whiptail lizard (Cododo), Aruba-island rattlesnake (Cascabel), and the Hummelinck's vesper mouse. | Tourism pressure leading to habitat degradation; overgrazing and invasive species impacting native plants and animals. | Managing diverse ecosystems within the park; protecting endemic species such as the Aruba rattlesnake and burrowing owl; preserving cultural heritage sites and unique geological formations. |
| **Rooi Lamunchi** | Rooi Lamunchi functions as an ecological corridor or connecting zone between Arikok and Spaans Lagoen, including the mangrove area at Isla de Oro and Santo Largo. This is an important area for migrating land crabs to complete their reproductive cycle. | Disruption of ecological corridors from urban development; pollution affecting the mangrove areas and wetland ecosystems. | Maintaining its function as a critical ecological corridor for migrating land crabs and other species; mitigating habitat degradation. |
| **Rooi Bringamosa** | Both Rooi Bringamosa and Rooi Taki, as well as Rooi Frances, lead to the salt flats of Spaans Lagoen. Rooi Bringamosa and Rooi Taki are connected to Arikok Park. Rooi contain fertile soil with shallow groundwater, making them an ideal habitat for various fruit-bearing trees. Sheltered parts of the rooi can retain water for extended periods, | Soil erosion due to overgrazing; contamination of shallow groundwater from nearby urban and agricultural activities. Damage to hydrological functions due to | Protecting water retention areas and fertile soil for fruit-bearing trees; conserving habitats for species like dragonflies, bees, frogs, and the Aruba cottontail. Maintaining effective working relationships |

| | | | |
|---|---|---|---|
| | attracting various animal species, including dragonflies, bees, and frogs. The Aruba cottontail (Conew) typically inhabits the Rooi. | activities of landowners and farmers. | with owners and occupiers of adjacent land. |
| **Rooi Taki** | See above. | Similar threats to Rooi Bringamosa, including soil erosion, groundwater contamination, and loss of biodiversity. | Similar challenges to Rooi Bringamosa. Maintaining its ecological role within the larger system of connected rooi leading to Spaans Lagoen. |
| **Rooi Manonchi** | Rooi Manonchi functions as an ecological corridor and "oasis" in the middle of the capital city and adjacent areas, providing shelter and habitats for protected native flora and fauna. | Urbanization and infrastructure expansion reducing habitat size and quality; invasive species impacting native flora and fauna. | Ensuring its role as an "oasis" for biodiversity in a heavily urbanized area; protecting its ecological integrity amid increasing human pressures. |

## 2.5 Physical Description

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 terrestrial species.

## 2.6 Socio-Economic Context

Although Aruba's economy relies heavily on tourism, terrestrial biodiversity plays an essential role in supporting its natural heritage. Cultural and natural sites, such as Arikok National Park, combine historical and ecological significance. The park, covering approximately 18% of the island, protects habitats for endemic species, including the Aruba burrowing owl (*Athene cunicularia arubensis*) and Aruba whiptail lizard (*Cnemidophorus arubensis*). These areas provide significant non-market ecological services and opportunities for recreation and education (Wolfs et al., 2018).

Aruba's population density is one of the highest globally, with 112,803 inhabitants (as of June 2022) and an average of 585 people per square kilometer. This density exerts pressure on the island's limited terrestrial ecosystems. Additionally, the influx of nearly 2 million annual tourists underscores the importance of sustainable management of terrestrial resources to mitigate habitat loss and degradation.

Aruba's terrestrial environment is valued not only for its ecological services but also for its cultural significance. Key sites like the cave systems hold deep historical and cultural importance, fostering a sense of identity and continuity. Surveys reveal widespread public support for conserving species and habitats, with 80% of residents advocating increased government investment in nature conservation (Wolfs et al., 2017).

Aruba's terrestrial ecosystems support diverse flora and fauna adapted to its arid climate, offering critical services such as carbon sequestration, soil stabilization, and cultural enrichment. However, these ecosystems face threats from urbanization and overuse, necessitating robust conservation strategies and greater integration of biodiversity values into policy frameworks.

## 2.7 Existing knowledge gaps in data collection and strategies to address them

While Aruba's terrestrial ecosystems are integral to the island's biodiversity and cultural heritage, significant knowledge gaps remain in understanding their long-term dynamics and resilience. Current assessments provide valuable insights into habitats such as xerophytic shrublands, rooi systems, and key biodiversity areas like Arikok National Park, but critical gaps persist in areas such as species population dynamics, ecosystem health indicators, and the impacts of climate change. For example, data on the distribution and abundance of endemic and threatened species like the Aruban burrowing owl (*Athene cunicularia arubensis*) and the Aruba rattlesnake (*Crotalus unicolor*) is limited, impeding effective management and recovery efforts.

Additionally, long-term studies on the effects of invasive species, such as buffelgrass and feral goats, are lacking, as are comprehensive assessments of habitat connectivity and ecosystem service provision. Human-induced pressures, including urban expansion and tourism, also require further investigation to quantify their impact on soil health, vegetation cover, and overall biodiversity.

To address these gaps, it is proposed to implement a long-term monitoring program that includes regular biodiversity surveys, habitat quality assessments, and socio-economic studies. This program would track key indicators such as species population trends, vegetation health, and human activity impacts. Annual evaluations would integrate these findings to inform adaptive management strategies and policy interventions. Furthermore, a targeted research agenda focusing on climate change impacts, such as increased aridity and altered rainfall patterns, is essential to enhance the resilience of Aruba's terrestrial ecosystems. This approach aims to fill critical data gaps, improve ecosystem management, and ensure the long-term sustainability of Aruba's terrestrial biodiversity.

# 3. Key Pressures, Threats and Drivers for the Terrestrial Ecosystems and Protected Areas of Aruba

Based on the section above, the stakeholder workshop and other relevant ACF documents, Table 2 sets out and summarizes the key pressures, threats, and drivers for the terrestrial ecosystems and protected areas of Aruba. The key concerns for these areas are therefore comprehensive, reflecting both environmental challenges and socio-economic factors. Pressures refer to direct human activities or natural processes that stress the ecosystem; threats encompass the

resulting impacts of these pressures on marine ecosystems; and drivers are the underlying socio-economic, political, and cultural factors that perpetuate these pressures and threats.

*Table 2: Generic Threats, Pressures, and Drivers*

| Threat | Pressure | Driver |
|---|---|---|
| **Habitat loss** | Urbanization | Economic reliance on tourism |
| **Invasive species** | Tourism expansion | High population density |
| **Pollution** | Infrastructure development | Lack of integrated management strategies |
| **Overgrazing** | Degradation of vegetation and soil | Insufficient regulation of grazing activities, free-roaming livestock practices |
| **Climate change** | Extreme weather events, altered rainfall patterns, increased aridity, sea level rise | Global greenhouse gas emissions, fossil fuel dependency, deforestation |

*Table 3: Threats, Pressures, and Drivers in Arid/Xeric Ecosystems*

| Threat | Pressure | Driver |
|---|---|---|
| **Overgrazing by non-native species (e.g., goats)** | Soil erosion | Agricultural practices |
| **Habitat degradation** | Loss of native vegetation | Urban encroachment |
| **Invasive plant species (e.g., buffelgrass)** | Climate change-induced aridity | Insufficient regulation of grazing activities |

*Table 4: Threats, Pressures, and Drivers in Watershed Ecosystems*

| Threat | Pressure | Driver |
|---|---|---|
| **Degradation of rooi systems** | Overuse of water resources | Limited freshwater availability |
| **Contamination of water bodies** | Pollution from urban runoff | Unregulated water use |
| **Reduced water retention capacity** | Invasive vegetation disrupting hydrological functions | Inadequate watershed management strategies |

*Table 5: Threats, Pressures, and Drivers in Urban Ecosystems*

| Threat | Pressure | Driver |
|---|---|---|
| **Habitat fragmentation** | High population density | Economic development |
| **Pollution (air, noise, light)** | Increasing urban sprawl | Lack of green urban planning |
| **Invasive species (e.g., cats, dogs)** | Infrastructure expansion | Insufficient awareness of biodiversity's role in urban areas |

*Table 6: Threats, Pressures, and Drivers in Protected Areas*

| Protected Area | Threat | Pressure | Driver |
|---|---|---|---|
| **Sero Grandi, Muskita & Tres Cabes** | Habitat fragmentation, human activity, invasive species | Development projects, recreational use | Urban expansion, insufficient connectivity with adjacent ecosystems |
| **Ser'i Teishi** | Overgrazing, loss of indigenous vegetation, urban encroachment | Agricultural activities, proximity to urban areas | Land-use changes, insufficient management of grazing practices |
| **Parke Nacional Arikok** | Tourism pressure, invasive species, overgrazing | Visitor impacts, habitat degradation | Tourism economy, inadequate enforcement of conservation regulations |

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| **Rooi Lamunchi** | Urban development, pollution of mangrove and wetland ecosystems | Habitat disruption, reduced ecological connectivity | Land-use priorities favouring development, limited environmental oversight |
| **Rooi Bringamosa and Rooi Taki** | Soil erosion, groundwater contamination, habitat loss | Agricultural runoff, unregulated land use | Expansion of farming activities, lack of conservation-focused policies |
| **Rooi Manonchi** | Urbanization, invasive species, habitat degradation | Infrastructure expansion, human encroachment | Urban growth, limited recognition of its biodiversity value |

# 4. Key Conservation Actions and Targets

This section outlines the priority conservation actions and targets necessary to safeguard Aruba's unique terrestrial ecosystems and protected areas. These actions focus on addressing the specific threats and challenges faced by xeric, watershed, and urban ecosystems, as well as individual protected areas. Each table highlights critical focus areas, concise descriptions of their significance, operational targets, and the associated actions and partnerships required to achieve conservation goals. Together, these initiatives aim to enhance ecosystem resilience, protect biodiversity, and ensure the long-term sustainability of Aruba's natural heritage.

## 4.1 Arid-Xeric Ecosystems

*Table 7: Summary of Key Conservation Actions and Targets for Arid-Xeric Ecosystems presents the strategic priorities to safeguard Aruba's unique dryland environments and their biodiversity. The actions focus on restoring native habitats, managing threats from invasive species and free-roaming grazers, and implementing species recovery programs for endemic and vulnerable fauna. These efforts aim to maintain ecological integrity, enhance habitat connectivity, and promote community engagement through advocacy and educational initiatives. Collaboration with stakeholders and integration with ecological network plans are essential to achieving long-term sustainability and resilience for Aruba's xeric ecosystems.*

| Conservation focus area | Summary | 5-Year Operational Target | Action | Key Stakeholders/Partners |
|---|---|---|---|---|
| **Ecological Networks** | Establish and maintain ecological corridors as per the DNM ecological network plan to support habitat connectivity. | Integrate ecological corridors into all spatial plans and restore key connectivity zones. | Collaborate with stakeholders to adopt and execute the ecological network plan. | ACF, DNM, research institutions, local NGOs, urban planners. |
| **Plants & Vegetation Management** | Manage and restore vegetation to protect endangered native plant species and habitats through | Complete vegetation map, establish botanical gardens, and restore native vegetation in priority areas. | Develop restoration programs, establish nurseries, and monitor vegetation health. | ACF, Stimaruba, Ban Lanta y Planta, local universities, DNM. |

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| | comprehensive programs. | | | |
| **Species Recovery Programs** | Recover populations of endangered species through targeted actions like habitat restoration and reintroduction. | Develop and implement recovery plans for at least five key species, including Shoco and Cascabel. | Conduct reintroduction programs, establish monitoring protocols, and rehabilitate habitats. | ACF, World Parrot Trust, Vogelpark Avifauna, Toledo Zoo, local and international experts. |
| **Invasive Species Control** | Control invasive species threatening native biodiversity in xeric and urban ecosystems. | Eradicate or manage invasive species in at least 50% of targeted areas. | Conduct eradication programs, implement border controls, and raise awareness. | ACF, DNM, local NGOs, border security, local government agencies. |
| **Free-Roaming Grazers** | Eliminate free-roaming non-native grazers like goats to protect xeric landscapes and native flora. | Restrict grazing in 100% of protected areas and introduce island-wide control measures. | Enforce grazing restrictions, establish alternative livestock systems, and educate owners. | ACF, DNM, DLVVM (Department of Agriculture, Livestock, and Fisheries), local farmers, NGOs. |
| **Feral Cats & Dogs** | Address the impact of feral domestic animals on native biodiversity in protected areas. | Develop and implement a feral animal management plan for 100% of protected areas. | Conduct population control measures, engage in public education, and enforce pet regulations. | ACF, DLVVM, BCI, local animal welfare organizations, government agencies. |
| **Communications & Advocacy** | Raise public awareness of xeric ecosystem conservation and garner support for initiatives. | Conduct at least 10 public campaigns and 20 workshops targeting different stakeholders. | Develop educational campaigns, engage with media, and organize community events. | ACF, local NGOs, schools, community organizations, policymakers. |
| **Learning & Outreach** | Enhance understanding of xeric ecosystems through education and outreach initiatives. | Establish school programs and community workshops involving at least 50% of schools and local communities. | Develop teaching materials, hold workshops, and create citizen science programs. | ACF, educational institutions, local NGOs, government agencies, community leaders. |
| **Partnerships & Collaboration** | Strengthen partnerships for conservation with local and international organizations. | Form partnerships for all major conservation projects, including ecological networks and species recovery programs. | Create MoUs, establish joint research initiatives, and coordinate conservation actions. | ACF, DNM, DOW, international research institutions, local universities, NGOs, community organizations. |

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| **Links to Research** | Fill knowledge gaps through targeted research and integrate findings into conservation strategies. | Initiate at least 5 major research projects addressing xeric ecosystems and invasive species. | Commission research, develop monitoring frameworks, and apply findings to conservation actions. | ACF, universities, research institutions, international experts, local NGOs. |

## 4.2 Watershed Ecosystems

*Table 8: Key Conservation Actions and Targets for Terrestrial Water Management outlines the strategic priorities and operational goals necessary to enhance water retention, ecosystem resilience, and biodiversity conservation in Aruba's arid environment. These actions aim to mitigate water scarcity challenges, restore critical habitats such as rooi systems, and integrate sustainable practices through Nature-Based Solutions and multi-use management approaches. By addressing invasive species, promoting community engagement, and fostering regional and international collaboration, the outlined measures seek to ensure long-term sustainability and ecological health for the island's terrestrial ecosystems. [Note: Saliñas are covered in the Coastal Conservation Management Plan.]*

| Conservation focus area | Summary | 5-Year Operational Target | Action | Key Stakeholders and Partners |
|---|---|---|---|---|
| **Retaining Water on Land** | Strategic focus on maximizing water retention to support ecosystems and mitigate extreme weather impacts. | Develop and restore 5 water retention systems, including dams and tankis, across key locations. | Restore existing dams and tankis, implement innovative water retention solutions. | DOW, DNM, local communities, conservation NGOs. |
| **Managing Rooi Systems** | Enhance water flow management in natural drainage channels (rooi) to reduce erosion and increase water absorption. | Introduce riparian zones and improve water retention in 3 rooi systems. | Conduct field experiments and traditional restoration methods to enhance rooi functionality. | DOW, DNM, research institutions, local landowners. |
| **Dams and Tanki Management** | Comprehensive management of freshwater bodies, integrating them into ecological networks and planning. | Maintain and restore 5 existing dams and tankis; create 2 new ones within protected areas. | Implement habitat restoration and create water bodies acting as mini wildlife hotspots. | ACF, DOW, local conservation NGOs, universities. |
| **Multi-Use Management** | Leverage ecosystem services and Nature-Based Solutions for holistic water management strategies. | Incorporate multi-use management in all major water management projects by 2028. | Develop plans emphasizing ecosystem services, including recreation and biodiversity conservation. | DNM, local government, NGOs, private sector stakeholders. |
| **Native Species Conservation** | Develop species action plans for watershed-associated species, | Complete baseline studies and initiate action plans for at least 3 native species. | Carry out habitat restoration linked to water management for these species. | Research institutions, ACF, local NGOs. |

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| | including frogs and mollies. | | | |
| **Invasive Species Management** | Address the impact of invasive species such as boa constrictors, cane toads, and invasive plants on water ecosystems. | Develop and implement control measures for 3 priority invasive species. | Conduct research and initiate management programs to mitigate invasive species' impact on water bodies. | DNM, international NGOs, local government. |
| **Communications & Advocacy** | Raise public awareness of the importance of terrestrial water management for biodiversity and resilience. | Run 3 major public campaigns and 10 workshops targeting policymakers and communities by 2028. | Develop and disseminate advocacy materials, host events, and engage with policymakers. | Local media, educational institutions, DNM, conservation NGOs. |
| **Learning & Outreach** | Enhance public understanding of water management issues through education and knowledge sharing. | Organize 15 community workshops and launch an educational program in schools by 2028. | Collaborate with schools and communities to deliver targeted educational activities. | Schools, universities, local communities, NGOs. |
| **Partnerships & Collaboration** | Strengthen collaborations with regional and international partners to adopt best practices for water management. | Formalize 5 new partnerships with institutions from Aruba, Curaçao, Bonaire, and beyond. | Initiate joint research and conservation projects with regional stakeholders. | DNM, DOW, international conservation organizations. |
| **Research Integration** | Align terrestrial water management with evidence-based approaches through targeted research initiatives. | Complete studies on the ecological significance of 3 key water systems and integrate findings into policy and planning. | Conduct research into the role of dams, tankis, and saliñas in the ecological network; share findings to inform broader conservation policy. | Universities, DNM, conservation NGOs, international researchers. |

## 4.3 Urban Ecosystems

*Table 9: Key Conservation Actions and Targets for Terrestrial Water Management highlights the critical strategies for integrating biodiversity conservation into Aruba's urban landscapes. This objective focuses on enhancing ecological connectivity, creating biodiversity hotspots, and fostering native species through green and blue infrastructure. It aims to balance urban development with sustainable practices by advocating for nature-positive principles, managing invasive species, and establishing native gardens. Through education, outreach, and partnerships with key stakeholders, these actions will ensure the resilience of urban ecosystems, promote biodiversity, and improve the quality of life for Aruba's communities while aligning with global sustainability goals.*

| Conservation focus area | Summary | 5-Year Operational Target | Action | Key Stakeholders and Partners |
|---|---|---|---|---|

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|---|---|---|---|---|
| **Creation of Corridors and Biodiversity Hotspots** | Connective features to sustain ecological processes, facilitate wildlife movement, and mitigate urban fragmentation. Includes water bodies, parks, and green spaces. | Establish 5 new green corridors and 10 biodiversity hotspots across urban areas. | Design and implement green and blue infrastructure projects with habitats like birdhouses, bat boxes, and insect hotels. | Urban planners, DOW, DNM, environmental NGOs, and community groups. |
| **Principles for Management Agencies** | Integrate nature-positive conservation principles into urban area development and management, including hotel developments. | Incorporate nature-positive principles in all new urban developments by 2028. | Collaborate with management agencies to revise policies ensuring sustainable urban design. | Management agencies, urban planners, DOW, DNM, and private developers. |
| **Native Species Gardens** | Establish public and private native species gardens to support pollinators and native fauna while fostering education and advocacy. | Develop 15 native species gardens in urban areas by 2028. | Partner with NGOs to design and implement native gardens, focusing on pollinators, the four-eyed frog (Dori), and Aruba cat-eyed snake (Santanero). | Ban Lanta Y Planta, StimAruba, local NGOs, schools, and businesses. |
| **Managing Invasive and Feral Domestic Species** | Address the impact of free-roaming predators like boas, dogs, cats, and nuisance feral chickens on urban biodiversity. | Reduce invasive predator populations in urban areas by 30% by 2028. | Implement trapping, monitoring, and removal programs for invasive species; raise public awareness to reduce exotic pet abandonment. | DNM, DLVVM, environmental NGOs, and community stakeholders. |
| **Communications & Advocacy** | Promote sustainable practices in urban development, such as green and blue infrastructure and reduced pollution. | Conduct 20 advocacy campaigns and workshops targeting urban sustainability by 2028. | Develop clear position statements and run campaigns to advocate for sustainable urban planning and increased native plant landscaping in public areas. | Media organizations, NGOs, urban planners, DOW, and local government. |
| **Learning & Outreach** | Educate communities and professionals about urban biodiversity, green infrastructure, and conservation principles. | Deliver 25 educational workshops and 10 community restoration events by 2028. | Organize citizen science programs, awareness campaigns, and professional training sessions on urban biodiversity and conservation. | Schools, universities, NGOs, community organizations, and regional conservation experts. |
| **Partnerships & Collaboration** | Foster partnerships with governmental bodies, NGOs, and international organizations to implement urban conservation initiatives. | Establish 5 new partnerships for urban biodiversity projects by 2028. | Collaborate with expert NGOs, urban planners, and international conservation organizations to adopt best practices and share knowledge. | Ban Lanta Y Planta, StimAruba, international conservation organizations, and local government agencies. |
| **Links to Research** | Research ecological impacts of urbanization, the role of green | Complete 5 research projects on urban conservation and | Integrate research findings into urban planning and implement | Universities, research institutions, DNM, and international |

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|---|---|---|---|---|
| | infrastructure, and effectiveness of connectivity measures. | green infrastructure by 2028. | evidence-based biodiversity enhancement projects. | conservation organizations. |

## 4.4 Protected Areas

*Table 10: Sero Grandi, Muskita & Tres Cabes*

| Conservation Focus Area | Summary | 5-Year Operational Target | Action | Key Stakeholders/Partners |
|---|---|---|---|---|
| **Ecological Networks** | Preserve and enhance connectivity between this rugged coastal landscape and nearby ecosystems, including Saliña Druif. | Integrate connectivity corridors in all spatial plans and enhance habitat protection. | Collaborate to restore key corridors and mitigate development impacts. | ACF, DNM, local government, NGOs, community groups. |
| **Habitat Management** | Protect critical habitats for species like the Caracara Cheriway and Aruban cottontail. | Restore degraded habitats and reduce human disturbance by 50%. | Implement monitoring programs, enforce habitat protection, and reduce anthropogenic impacts. | ACF, DLVVM, wildlife experts, local NGOs. |

*Table11: Ser'i Teishi*

| Conservation Focus Area | Summary | 5-Year Operational Target | Action | Key Stakeholders/Partners |
|---|---|---|---|---|
| **Species Recovery Programs** | Protect breeding habitats for ospreys and bats and enhance vegetation diversity in this hilly area. | Establish 2 new habitat restoration projects and monitor breeding populations. | Conduct habitat restoration, install artificial nesting sites, and monitor species recovery. | ACF, Stimaruba, DNM, bird conservation groups, local universities. |
| **Ecological Connectivity** | Maintain its ecological link with Spaans Lagoen. | Strengthen ecological corridors and reduce urban encroachment by 30%. | Implement ecological corridor restoration projects and engage with local stakeholders. | ACF, urban planners, local government, conservation NGOs. |

*Table 12: KBA Parke Nacional Arikok*

| Conservation Focus Area | Summary | 5-Year Operational Target | Action | Key Stakeholders/Partners |
|---|---|---|---|---|
| **Species Recovery Programs** | Safeguard endemic species like the Aruba burrowing owl, Aruba rattlesnake, and brown-throated parakeet (and Lora). | Implement recovery programs for at least 5 endemic species. | Conduct habitat restoration, species monitoring, and public education campaigns. | ACF, Toledo Zoo, Vogelpark Avifauna, international experts. |
| **Cultural Heritage** | Preserve Amerindian drawings, Gold Rush ruins, and adobe houses. | Document and restore 70% of identified cultural heritage sites. | Conduct cultural site restorations and integrate into park education programs. | ACF, local archaeologists, cultural NGOs, government heritage bodies. |

*Table 13: Rooi Lamunchi*

| Conservation Focus Area | Summary | 5-Year Operational Target | Action | Key Stakeholders/Partners |
|---|---|---|---|---|
| **Ecological Networks** | Enhance its role as a critical ecological corridor for migrating species like land crabs. | Restore degraded areas and ensure habitat connectivity between Arikok and Spaans Lagoen. | Remove obstructions, mitigate pollution, and restore mangrove ecosystems. | ACF, DNM, community groups, local environmental NGOs. |

*Table 14: Rooi Bringamosa*

| Conservation Focus Area | Summary | 5-Year Operational Target | Action | Key Stakeholders/Partners |
|---|---|---|---|---|
| **Water Management** | Protect water retention areas and fertile soil for fruit-bearing trees. | Restore 50% of degraded water retention areas and enhance shallow groundwater protection. | Implement erosion control measures, restore riparian vegetation, and enforce sustainable land use. | ACF, DOW, DLVVM, local farmers, research institutions. |

*Table 15: Rooi Taki*

| Conservation Focus Area | Summary | 5-Year Operational Target | Action | Key Stakeholders/Partners |
|---|---|---|---|---|
| **Ecological Role** | Maintain its function as a critical ecological corridor leading | Ensure 80% of its ecological role remains intact by mitigating erosion and habitat loss. | Strengthen ecological monitoring programs and collaborate with local landowners. | ACF, landowners, DNM, community stakeholders. |

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| | to Spaans Lagoen. | | | |

*Table 16: Rooi Manonchi*

| Conservation Focus Area | Summary | 5-Year Operational Target | Action | Key Stakeholders/Partners |
|---|---|---|---|---|
| **Urban Biodiversity** | Act as an ecological "oasis" in urbanized areas, providing habitats for native flora and fauna. | Increase biodiversity by 20% through habitat restoration and invasive species management. | Restore degraded habitats, create biodiversity-friendly urban features, and engage local communities. | ACF, urban planners, community groups, environmental NGOs. |

## 4.5 Stakeholder Roles and Responsibilities

Effective governance is critical to the success of the PACMP, 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 PACMP 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.<br><br>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 terrestrial 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.

## 4.6 Funding and Financial Management

The ACF structure will also ensure transparent management of funding sources. A central database will track the allocation and utilization of funds across different components of the PACMP and, by detailing roles, responsibilities, and funding sources in this manner, the PACMP will improve overall governance for more effective program implementation.

# 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 Terrestrial 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 terrestrial 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. Water Resource Monitoring*

| Indicator | Methodology | Data Collection Tools |
|---|---|---|
| **Water Retention Efficiency** | Measure water flow and retention in rooi 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 water availability to assess its role in habitat connectivity. | Field surveys, satellite imagery, and species movement tracking. |

*3. Visitor Use and Urban Impact Monitoring*

| 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 urban and 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 terrestrial 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 terrestrial 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 terrestrial ecosystems.

# 7. Resources

Effective implementation of the Terrestrial 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 terrestrial 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 terrestrial strategy involves both staff development and targeted recruitment. Skills in terrestrial 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 terrestrial areas.

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