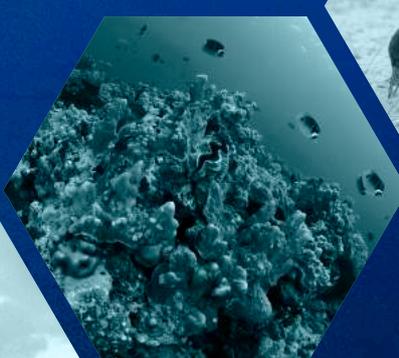


Aldabra Atoll Management Plan 2016





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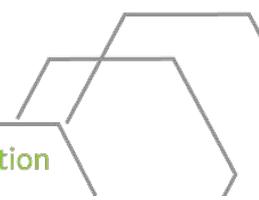
REPORT PREPARED BY





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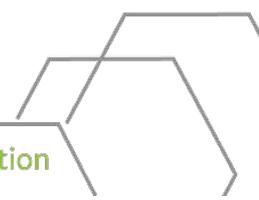
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1 Aldabra Atoll: one of the wonders of the world



Aldabra Atoll, located in the Aldabra Group of islands in the Western Indian Ocean and part of the Outer Islands of the Seychelles (Figure 1), is one of the most special places on earth. It has been described as ‘one of the wonders of the world’ by Sir David Attenborough (Aldabra Marine Programme undated).

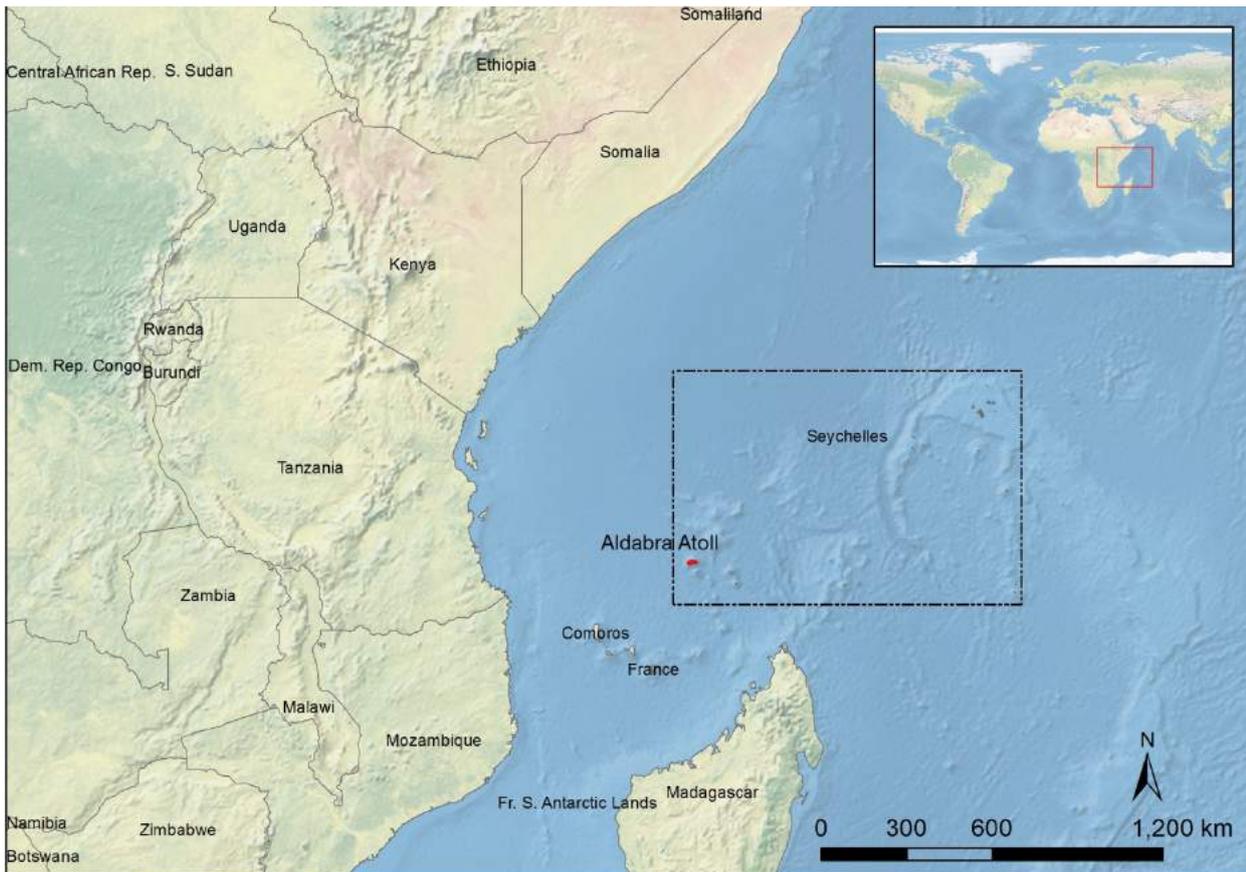


Figure 1 Location of Aldabra Atoll

The world’s second largest coral atoll by dry land area, Aldabra Atoll comprises four islands around a shallow lagoon scattered with islets and encircled by fringing coral reef. Washed by the westward flowing South Equatorial Current (Stobart et al 2005), the Atoll is subjected predominantly to southeast trade winds, with north-westerly monsoon winds from November to March (the wet season) (Farrow 1971). Temperature ranges are small with winter minimums and summer maximums averaging 22 and 32 degrees Celsius respectively. Annual rainfall is variable with an average rainfall of 890mm per annum in the period 1991-2009 (Duhec et al, 2010) with December, January and March generally being the wettest months and August to October the driest months.

Aldabra Atoll’s uniqueness lies not only in its outstanding geomorphology but also in the array of flora and fauna which have evolved in the context of small island ecology. Aldabra is home to the world’s largest population of Aldabra giant tortoises, one of the largest tortoises in the world and which is listed as vulnerable on the IUCN Red List of Threatened Species. It has also been listed on CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) Appendix II since 1975.



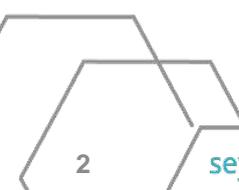
Green and hawksbill turtles breed on the Atoll. The Atoll is also a breeding ground for thousands of seabirds including the largest breeding population of greater and lesser frigate birds in the Indian Ocean. Land birds are a feature of the Atoll with an endemic species (the Aldabra drongo) and a number of subspecies including the Aldabra white-throated rail and Aldabra red-headed fody. There are high levels of biodiversity and endemism found amongst the plants and insects on Aldabra.

The marine environment is highly diverse with mangroves, seagrasses and coral reefs supporting an abundance of fish and other marine life. The lagoon is a feature of the Atoll and may support the last remaining population of dugongs in the Seychelles.

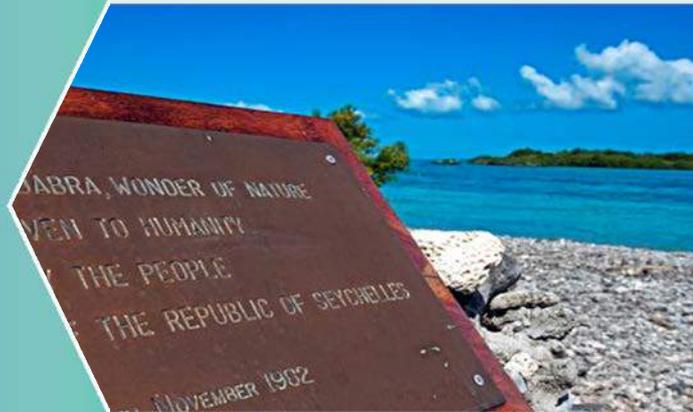
The combination of unique geomorphology, high biodiversity and intact ecological processes found at Aldabra Atoll contribute to its status as a World Heritage Site.



Plate 1: Aerial view of the Aldabra Atoll



2 Management Context



2.1. World Heritage

Aldabra Atoll was listed as a United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Site in 1982. Under the *Convention concerning the Protection of World Cultural and Natural Heritage* adopted in 1972, UNESCO seeks to identify, protect and preserve the world's cultural and natural heritage considered to be of outstanding value to humanity (UNESCO undated a).

In 2010 a retrospective Statement of Outstanding Universal Value was adopted by the World Heritage Committee for Aldabra Atoll which is defined as follows:

'Brief synthesis

Located in the Indian Ocean, the Aldabra Atoll is an outstanding example of a raised coral atoll. Due to its remoteness and inaccessibility, the atoll has remained largely untouched by humans for the majority of its existence. Aldabra is one of the largest atolls in the world, and contains one of the most important natural habitats for studying evolutionary and ecological processes. It is home to the largest giant tortoise population in the world. The richness and diversity of the ocean and landscapes result in an array of colours and formations that contribute to the atoll's scenic and aesthetic appeal.

Criterion (vii): Aldabra Atoll consists of four main islands of coral limestone separated by narrow passes and enclosing a large shallow lagoon, providing a superlative spectacle of natural phenomena. The lagoon contains many smaller islands and the entire atoll is surrounded by an outer fringing reef. Geomorphologic processes have produced a rugged topography, which supports a variety of habitats with a relatively rich biota for an oceanic island and a high degree of endemism. Marine habitats range from coral reefs to seagrass beds and mangrove mudflats with minimal human impact.

Criterion (ix): The property is an outstanding example of an oceanic island ecosystem in which evolutionary processes are active within a rich biota. Most of the land surface comprises ancient coral reef (~125,000 years old) which has been repeatedly raised above sea level. The size and morphological diversity of the atoll has permitted the development of a variety of discrete insular communities with a high incidence of endemism among the constituent species. The top of the terrestrial food chain is, unusually, occupied by an herbivore: the giant tortoise. The tortoises feed on grasses and shrubbery, including plants which have evolved in response to its grazing patterns. The atoll's isolation has also allowed the evolution of endemic flora and fauna. Due to minimal human interference, these ecological processes can be clearly observed in their full complexity.

Criterion (x): Aldabra provides an outstanding natural laboratory for scientific research and discovery. The atoll constitutes a refuge for over 400 endemic species and subspecies (including vertebrates, invertebrates and plants). These include a population of over 100,000 Aldabra Giant Tortoise. The tortoises are the last survivors of a life form once found on other Indian Ocean islands and Aldabra is now their only remaining habitat. The tortoise population is the largest in the world and is entirely self-sustaining: all the elements of its intricate interrelationship with the natural environment are evident. There are also globally important breeding populations of endangered green turtles, and critically endangered hawksbill turtles are also present. The property is a significant natural habitat for birds, with two recorded endemic species (Aldabra



Brush Warbler¹ and Aldabra Drongo), and another eleven birds which have distinct subspecies, amongst which is the White-throated Rail, the last remaining flightless bird of the Western Indian Ocean. There are vast waterbird colonies including the second largest frigatebird colonies in the world and one of the world's only two oceanic flamingo populations. The pristine fringing reef system and coral habitat are in excellent health and distinguished by their intactness and the sheer abundance and size of species contained within them.

Integrity

The property includes the four main islands which form the atoll plus numerous islets and the surrounding marine area. It is sufficiently large to support all ongoing biological and ecological processes essential for ensuring continued evolution in the atoll. The remoteness and inaccessibility of the atoll limit extensive human interference which could otherwise jeopardize ongoing processes. As such, Aldabra displays an almost intact ecosystem, sustaining naturally viable populations of all key species.

Protection and management requirements

The property is legally protected under national legislation and is managed by a public trust, the Seychelles Islands Foundation, with daily operations guided by a management plan. Boundaries are ecologically viable but the extension of the seaward boundary some 20 km into the sea would provide additional protection to the marine fauna. While the remoteness of the property has limited human interference, thus contributing for the protection of the biological and ecological processes, it also poses tremendous logistical challenges. Tourism is limited and carefully controlled. Whilst the property displays an almost intact ecosystem, protection and management need to address the constant threats posed by invasive alien species, climate change and oil spills, particularly in the event that oil exploration increases in the wider region.’
(UNESCO undated b)

¹ The Aldabra brush warbler is now extinct



2.2. Ramsar Wetland of International Importance

The Convention on Wetlands of International Importance (known as the Ramsar Convention), is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources (Ramsar undated a). The Convention's mission is "*the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world*" (Ramsar undated b). Aldabra Atoll was recognised as a Wetland of International Importance under the Ramsar Convention on 2 February 2010.

The description of Aldabra Atoll as a Wetland of International Importance is:

*The Aldabra Atoll is part of the Seychelles Archipelago in the Western Indian Ocean, some 1150km southwest of the main island, Mahé. As the largest raised coral atoll² in the world, it is widely recognized as one of the most remarkable oceanic islands on Earth. It comprises seven wetland types, including permanent shallow marine waters, coastal saline lagoon area, marine subtidal aquatic seagrass beds and mangrove swamps. The numerous habitat types allow for the support of many different species at different stages of their life cycles. This includes endangered and vulnerable species such as the green turtle *Chelonia mydas* and the Aldabra giant tortoise *Aldabrachelys gigantea*³; endemic species of flora (40 species) and fauna such as the Madagascar sacred ibis *Threskiornis aethiopicus abbotti* and 100% of the populations of two species of endemic insectivorous bat (*Chaerephon pusillus* and *Triaenops pauliani*). Land use on Aldabra is extremely low with the only uses being research, an education outreach programme, and minimal tourism as tourists are not allowed to stay overnight. The main threats facing the site are potential oil spills from a nearby tanker route, alien invasive species introduction and establishment, and, as with other low-lying islands, climate change (Ramsar Sites Information Service 2009).*

The Aldabra Atoll Ramsar site includes seven of the Ramsar Classification System Wetland Types, being marine subtidal aquatic seagrass beds, coral reefs, rocky marine shores, sandy shores, sand bars and dune systems, intertidal mud and sand flats, intertidal forested wetlands – mangrove swamps, coastal brackish/saline lagoons with several connections to the ocean, permanent saline/brackish pools, seasonal saline/brackish pools and seasonal freshwater pools in coral/limestone holes (Seychelles Islands Foundation 2009).

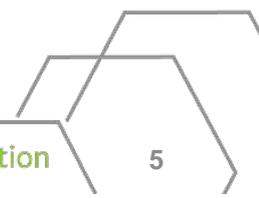
2.3. International Bird and Biodiversity Area

International Bird and Biodiversity Areas (IBAs) designated by Birdlife International represent the largest global network of important sites for biodiversity. They are identified using internationally agreed criteria applied by local experts. IBAs are the sites needed to ensure the survival of viable populations of most of the world's bird species (Birdlife International 2014a). Aldabra Atoll has been a designated IBA since 2001 (Birdlife International 2014b).

In addition, Aldabra Atoll is a designated Endemic Bird Area (EBA) on the basis of its two endemic extant (Aldabra drongo and Aldabra fody) and one endemic extinct species (Aldabra brush warbler), as well as the occurrence of two additional (extant) restricted-range species. In addition to the restricted-range species, there are ten endemic subspecies (Birdlife International 2016)

² Aldabra Atoll is the second largest coral atoll by dry land area in the world

³ The species name of the Aldabra giant tortoise has changed to *Aldabrachelys gigantea*



2.4. National context and legislative framework

The Seychelles has a strong legal and policy framework for environmental management, guided by the provisions of Article 38 of the Seychelles Constitution (1993) which declares that:

'the State recognises the right of every person to live in an enjoy a clean, healthy and ecologically balanced environment and with a view to ensuring the effective realisation of this right the State undertakes.....to ensure a sustainable socio-economic development of Seychelles by a judicious use and management of the resources of the Seychelles' (Ministry of Environment and Energy, 2013).

The Seychelles is a signatory to several international environmental conventions (in addition to The World Heritage and Ramsar Conventions described in Section 2.1) and has a suite of national legislation regarding establishment of protected areas and environmental management (Figure 2). These international commitments and national legislation, as well as the *Seychelles Protected Area Policy* (2013) inform the development of this protected area management plan. The specific policies and procedures detailed in the appendices guide how the management plan will be implemented.



Plate 2: Black tip sharks amongst the Seychelles' Reefs

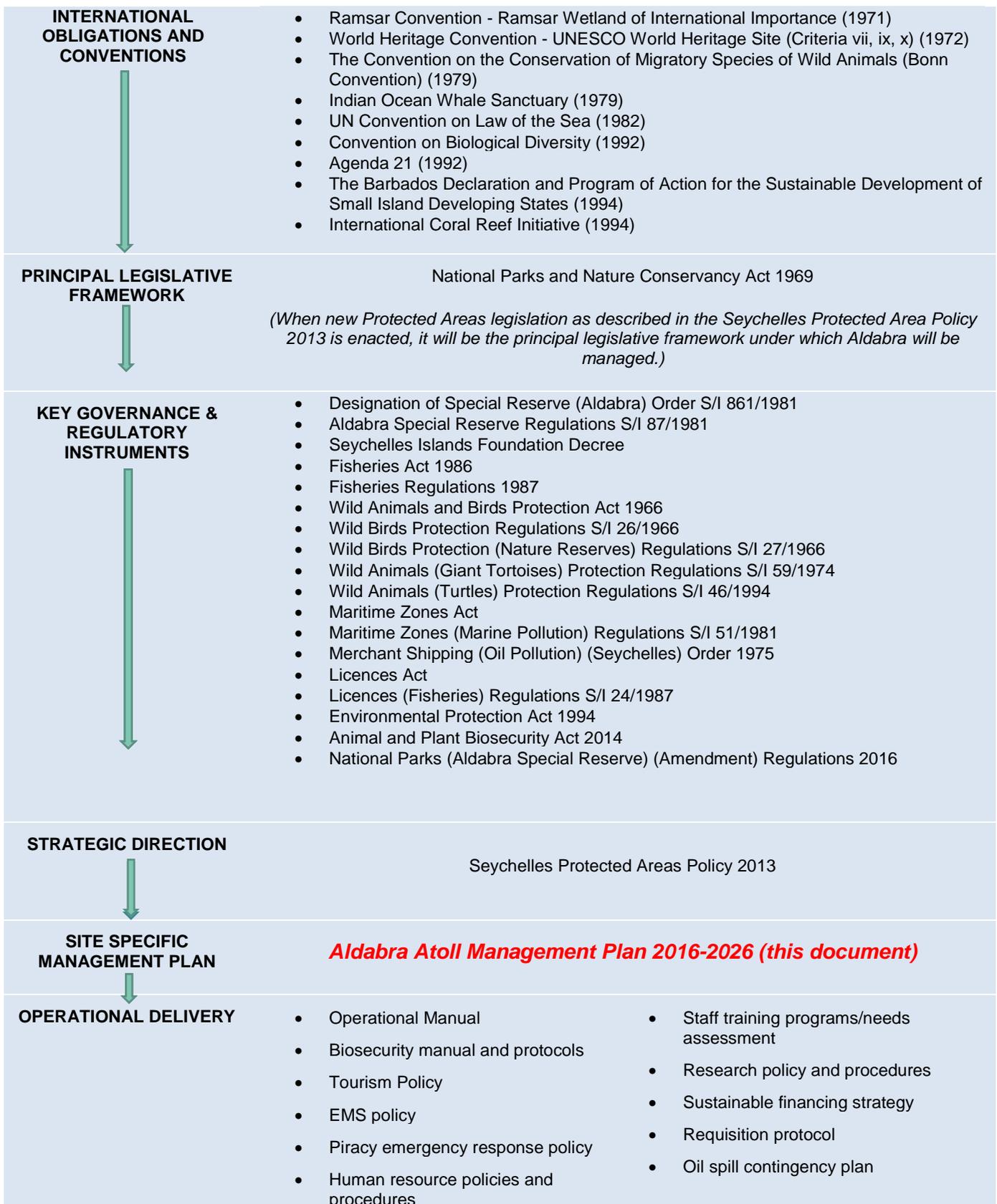
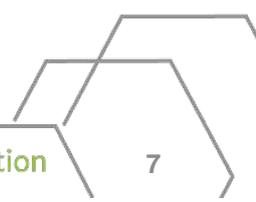


Figure 2: Management context for Aldabra Atoll



2.5. Responsibilities of Seychelles Islands Foundation and Government agencies

Aldabra Atoll is managed and protected by the Seychelles Islands Foundation (SIF), the first environmental organisation in the Seychelles. SIF (which also manages the Seychelles other World Heritage Site, Vallée de Mai) is a government statutory body which was established in 1979 by presidential decree and has the mandate to *'manage and conserve the natural life of the group of islands comprising the atoll of Aldabra in the Republic and to initiate and instigate scientific research into such natural life'* (Beaver and Gerlach 1998).

The SIF has an executive structure for day to day management based in Victoria, Mahé, and up to 18 staff based on Aldabra Atoll responsible for operational matters. The staffing structure is shown in Appendix 1.

While SIF is responsible for day to day management of Aldabra Atoll, the Seychelles Department of Environment is responsible for the property and the Government has an ongoing responsibility for development of legislation and policy related to protected area management, fisheries management, wildlife protection, marine pollution prevention, tourism promotion and national security. In addition, it is the Seychelles President, who is also Patron of the SIF who appoints the SIF Board of Trustees.

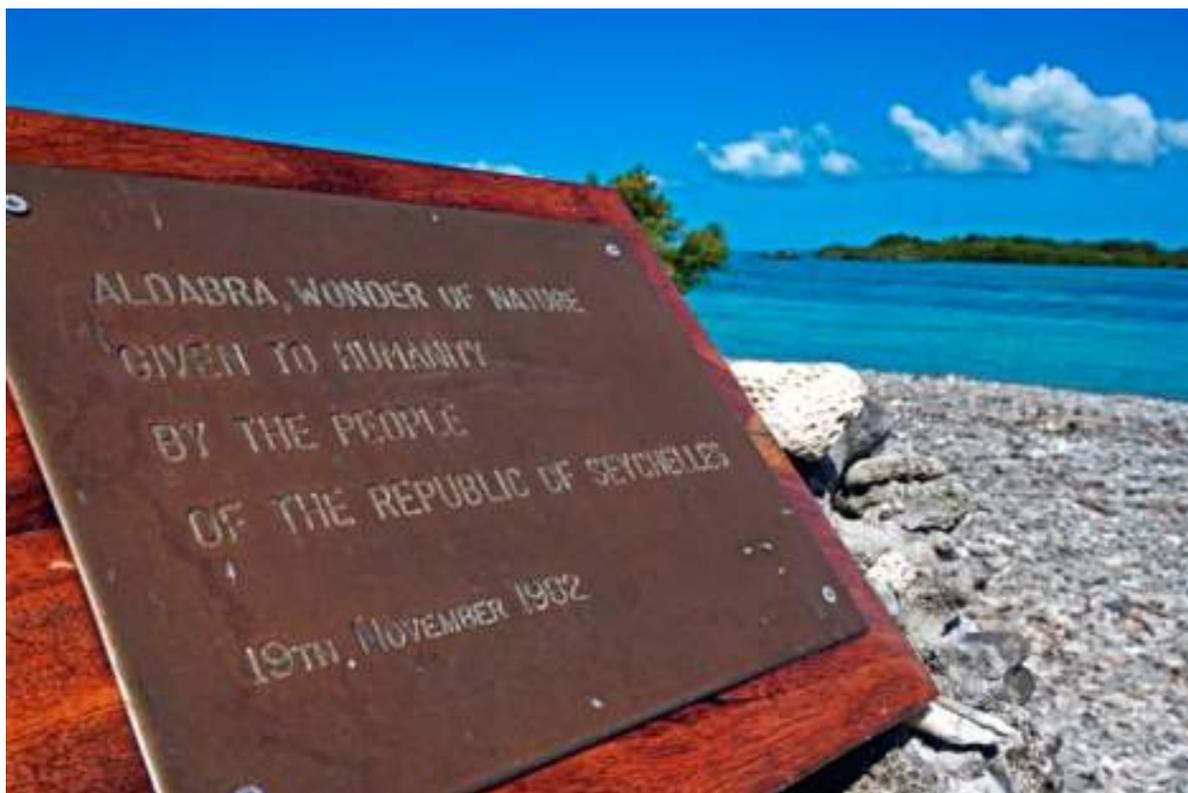


Plate 3: Aldabra Commemorative Plaque



2.6. Outcome-based management

The conservation of biodiversity and sustainable management of human activities at Aldabra Atoll are achieved through a number of complementary mechanisms that include protected area designation, fisheries regulations, wildlife management regulations, pollution control regulations, environmental protections regulations, and maritime safety regulations. The management of the protected area employs both generic (Section 5) and specific strategies (Sections 6 and 7) to ensure sustainable management for optimum conservation outcomes.

The objectives, strategies, performance measures and management targets outlined in Sections 5, 6 and 7 reflect an outcome-based 'best practice' approach from which the effectiveness of management can be assessed. This model has been adopted to maximise conservation and management outcomes and allow for a more objective and effective approach to assessing management performance.

The management of Aldabra Atoll aims to conserve the biodiversity of the protected area, while maintaining opportunities for research and ecotourism at an appropriate level where these activities are compatible with maintaining the values of the protected area. While protected areas reflect a pro-active and precautionary approach to conserving biodiversity, an important step in determining management priorities is to undertake a risk assessment by considering the likelihood of existing and potential pressures affecting the ecological and social values and their associated ecological and social consequences.

The relative level of risk posed by existing and/or potential pressures on values can be assessed by considering the following factors:

- the biological intensity of the pressure - pressures that impact lower trophic levels (i.e. primary producers such as coral and mangrove communities) are often of greater concern than pressures on higher trophic levels
- the temporal scale of the pressure - ongoing pressures are generally of greater management concern than pressures that are short-lived
- the spatial scale of the pressure - pressures that occur over a greater spatial extent are often of greater management concern than localised pressures
- the social consequence - acknowledges that different pressures have different social and political consequences. A high socio-economic/political consequence is often of greater management concern
- the probability of a pressure occurring within the timeframe of the management plan.

The natural attributes and the uses of Aldabra Atoll are well known. For the purposes of developing management priorities, pressures on the values are confined to current pressures and pressures likely to occur during the life of the management plan and considered to be manageable within the protected area's context. By definition, this excludes global pressures such as climate change. The potential impact of these global pressures is however considered in the development of the strategies for the management of the protected area. The vision and strategic objectives of the plan (Section 4) provide the longer term (>ten years) direction for management of Aldabra Atoll.

Ecological and Social Values

As a World Heritage Area, Aldabra has a statement of Outstanding Universal Value (OUV) (Section 2.1) which provides a broad description of the values of the protected area. To be able to manage and report on the OUV, the ecological and social values have been further defined to allow measurement of management effectiveness and to better report on the status of the OUV.



The conservation of ecological integrity, facilitating research, and education is the major thrust of management. Low level nature based tourism will be permitted but only where this promotes nature appreciation and is compatible with conservation of the Atoll. These generic terms need to be defined operationally to be useful in a management context. This is achieved by identifying the key ecological and social values of Aldabra Atoll and setting management objectives, strategies and targets in relation to these values.

‘Ecological values’ are used to describe the intrinsic physical, chemical, geological and biological characteristics of an area. For convenience, the major ecological values are listed individually in this plan. However, in reality the environment of Aldabra Atoll is a structurally and functionally complex array of relationships between the plants and animals interacting with their physical environment.

The ecological values should (where appropriate) include:

- species and communities that have special conservation status
- key species endemic to the protected area
- key structural components of the ecosystem
- exploited species and communities
- key physical-chemical components of the ecosystem.

The term ‘social values’ is used in this plan to define the major cultural, aesthetic, recreational and economic attributes of the area.

Management Objectives

Management objectives identify what the primary aims of management are and reflect the statutory responsibilities detailed under relevant legislation. Objectives have been developed for all of the ecological and social values of Aldabra Atoll. Where a significant pressure/s on an ecological value has been identified, the management objective addresses the specific pressure/s. When there is not an obvious existing pressure or threat, the management objective provides broader direction to management in relation to protecting the value from the most likely future pressures.

Management Strategies

Management strategies provide specific direction on how the management objective/s for each value might be achieved. All strategies outlined in this plan have been defined as high (H), medium (M) or lower (L) priority to provide an indication of their relative importance. The (H) strategies considered to be critical to achieving the long-term objectives of Aldabra Atoll are also designated as key management strategies (H – KMS). These strategies also form part of the performance assessment of the management of Aldabra Atoll, particularly during the initial years of implementing the management plan for the area (see Section 9 – Performance Assessment). It should be noted that management priorities are likely to alter in response to changes in usage patterns or to new knowledge acquired during the life of the management plan.



Performance Measures

Performance measures are indicators of management effectiveness in achieving the objectives and targets of Aldabra Atoll. They are developed for all of the ecological values, plus those social values that are non-activity based and have intrinsic societal worth (e.g. aesthetic value).

Performance measures should be quantitative, representative and, where possible, simple and cost-effective. Performance measures for indirect (e.g. nutrient enrichment impacts on coral reef communities) and direct (e.g. anchoring impacts on coral reef communities) impacts should focus on surrogate (e.g. changes in phytoplankton biomass and species composition) and direct (e.g. changes in biodiversity and coral cover) measures of the value respectively.

It should be noted that all performance measures are indicative only and will be reviewed and, if appropriate, revised during the development of monitoring programs for Aldabra Atoll.

In regard to those social values that have the potential to negatively impact on the ecological values of the Aldabra (e.g. tourism), a different approach to performance assessment is required. This has been termed 'reporting', and incorporates information on the status and level of the human activity. This information is important in monitoring human activities to assist in determining trends in use, and to assist in assessing impacts of these uses on the ecological values of Aldabra Atoll.

Management Targets

Management targets represent the desired end points of management. Targets should be measurable, time bound and expressed spatially. Ecological targets are set as either the "natural state" or some acceptable departure from the "natural state". The target provides a specific benchmark to assess the success or otherwise of management action within the life of the management plan or within a specified time period. The targets for 'active' social values are process-based and are generally stated as "Implementation of management strategies within agreed timeframes". This ensures that strategies for the social values are implemented in accordance with the management objectives.

Key Performance Indicators

Key performance indicators (KPIs) are a measure of the overall effectiveness of management in relation to the strategic objectives for Aldabra Atoll. Key performance indicators relate specifically to the management targets for key ecological and social values and reflect the highest conservation (from biodiversity and ecosystem integrity perspectives) and management (social) priorities. KPIs are a key element of the management audit process.

3 Values and Definition of the Aldabra Atoll



3.1. Definition of the area

Aldabra Atoll has a land area of 153 km², but together with the lagoon and the channels occupies a total area of 346 km². The Atoll is 34 km long and 14.5 km wide at its widest point.

The existing boundary of the protected area circles the atoll at a distance of one kilometre from the mean high water mark. A proposed extension to the size of the protected area will see a square boundary that approximates the 3km depth contour line and increase the size of the protected area to 2,559.019 km². The proposed boundary of the protected area is shown in figure 3. As at August 2015, the extension had been approved by Cabinet and the legal processes to gazette a Designation Order under the *National Parks and Conservancy Act 1969* were underway.

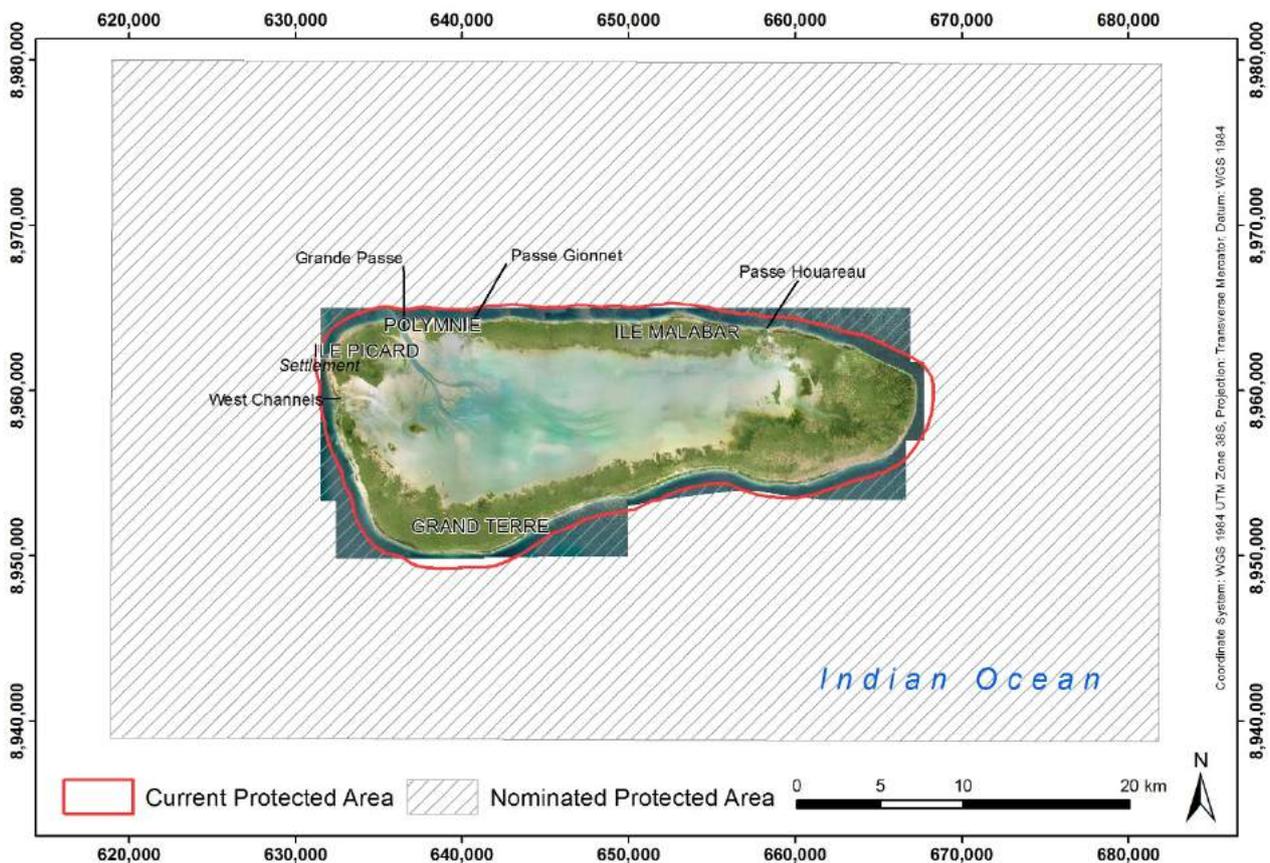


Figure 3: Proposed extension to the Aldabra Reserve



3.2. Values of the Aldabra Atoll

The ecological and social values of Aldabra Atoll and their relationship to World Heritage criteria are shown in tables 1 and 2 below.

Table 1 Ecological values of Aldabra Atoll

| Marine values | Terrestrial values | Marine and terrestrial values |
|---|--|------------------------------------|
| Marine water quality | Aldabra Giant Tortoise (KPI, WHC ix, x) | Geomorphology (WHC vii, ix) |
| Mangrove communities (KPI, WHC vii) | Terrestrial vegetation (KPI, WHC ix, x) | Sandy beaches |
| Marine mammals | Land Birds (KPI, WHC ix, x) | Sea and shorebirds (KPI, WHC x) |
| Intertidal mudflats (WHC vii, x) | Other Terrestrial Fauna (Invertebrates-WHC x) | |
| Coral communities (KPI, WHC vii, x) | Freshwater and brackish pools | |
| Seagrass and macroalgal communities (WHC vii, x) | | |
| Fish (KPI) | | |
| Marine Turtles (KPI, WHC x) | | |

* KPI = Key performance indicator, WHC= World Heritage criteria

Table 2 Social Values of Aldabra Atoll

| Social values |
|--------------------------------|
| Historic use |
| Research opportunities (WHC x) |
| Ecotourism |
| Subsistence fishing |
| Aesthetic value (WHC vii) |
| Remoteness |

4 Vision and strategic objectives



The vision for Aldabra Atoll is;

Aldabra will serve as an inspiration for all, for the successful stewardship of the natural world

The strategic objectives for management of the Aldabra Atoll are to:

- *Protect and enhance the ecological integrity of the unique Aldabra Atoll*
- *Facilitate research that will inform management and enhance the understanding of integrated ecological systems and global environmental change*
- *Use Aldabra's ongoing conservation success story to inform, educate, and inspire the local and international community*
- *Promote and facilitate tourism to Aldabra where activities are closely supervised, do not impact on the values and generate financial support for ongoing conservation programs.*



Plate 4: Aldabra has a range of important marine habitats

5 Management programs



This Chapter covers management activities that apply across the protected area or are not directly related to protecting a specific ecological or social value.

The management objectives, strategies and targets outlined in this section provide the framework for the development of specific management actions designed to conserve the ecological values and manage the social values of the protected area. These actions can be categorised into one or more of the following generic management programs:

- management frameworks
- education and interpretation
- public participation
- surveillance and enforcement
- infrastructure management
- management of invasive alien species
- research
- monitoring

Chapters 6 and 7 contain specific management objectives, strategies, performance measure and targets, and strategies that are identified as necessary for the specific ecological and social value.

5.1. Management frameworks

The development of an appropriate management framework is essential to ensure that Aldabra Atoll is managed effectively over the long term. The management framework includes statutory considerations such as the development of a management plan, protected area boundary, a suitable zoning scheme, appropriate regulations and policies, as well as human and financial resources.

5.1.1. Protected areas legislation and policy

The Aldabra Atoll Special Reserve was declared under the *National Parks and Nature Conservancy Act 1969*. The *Seychelles Protected Area Policy (2013)* states that the current suite of legislation and regulations that directly or indirectly apply to protected area management are mostly out of date, incomplete and sometimes contradictory. This Policy proposes the development of new protected areas legislation to replace or combine some of the existing legislation pertaining to management of protected areas, as well as specific regulations which will include, amongst others, five new protected area categories, some of which may allow spatial or temporal zoning. In anticipation of the enactment of this new protected area legislation, this management plan has been prepared applying the arrangements outlined in the Policy, however once the new protected areas legislation is enacted, Aldabra Atoll should be re-gazetted under that legislation and new protected area categories applied. The categories of protected area that will be applied are ecological reserve and strict nature reserve.



Under the *Seychelles Protected Area Policy* (2013) a strict nature reserve is defined as ‘An area set aside for the strict protection of biodiversity and/or geological or landform features, where human visitation, use and impacts are strictly controlled and limited to ensure the protection of the area. All other interests and activities are subordinated to this end. Such reserves may serve for scientific research and long term monitoring’ (Ministry of Environment and Energy 2013).

The *Seychelles Protected Area Policy* (2013) defines an ecological reserve as ‘An area set aside for the protection of a particular species or habitats, normally subject to regular active interventions to address the requirements of particular species or to maintain habitats’ (Ministry of Environment and Energy 2013).

This management plan provides the direction and guidance for the development of policies which will support management plan implementation. A range of policy documents have been prepared, some of which need updating and the development of new policy documents is also required. A list of relevant policies is documented and where available, have been included as appendices to this management plan.

Aldabra is currently listed as an “Area of avoidance owing to sensitivity” on navigational charts to deter oil tankers from coming within 30 NM of the Atoll. This is advisory only and to enforce special restrictions would require designation of the area as a *Particularly Sensitive Sea Area* (PSSA). This is an area that is designated by the International Maritime Organisation because of its significance for recognized ecological or socio-economic or scientific reasons and which may be vulnerable to damage by international maritime activities (International Maritime Organisation undated). Guidelines for designation of a PSSA apply and if designated, stricter environmental measures may be applied to shipping in the area. Given Aldabra’s proximity to a major shipping route that extends down the east coast of Africa, designation of the protected area as a PSSA should be investigated.

5.1.2. Zoning

Under the proposed new protected areas legislation, the ecological reserve category can be zoned for conservation purposes or to allow sustainable activities that are compatible with the conservation purpose of the protected area. A zoning scheme has been developed for the Aldabra Atoll ecological reserve and is shown in Figure 3 and the activities permitted in those zones shown in Table 3.

Conservation Zone

Conservation zone covers the majority of the reserve lands, and the majority of the lagoon and marine waters. The priority for management in this zone is the protection of flora and fauna. The only activities permitted will be management activities necessary for the protection of the Atoll such as research and maintenance of management facilities.

Land based tourism activities are only allowed on Picard Island where there is a staff presence. No other land based tourism will be permitted on the other islands, where disturbance will be kept to essential management activities only.

Areas with special features like the Aldabra banded snail (critically endangered) and the oceanic breeding flamingos, and sensitive reef areas are only to be visited for research purposes with approval from the Aldabra Science Coordinator. Visitor access by boat will not be permitted in the lagoon waters except for the areas zoned *Tourism and Recreation Zone-Marine* and zoned as ‘*Tourism pathways*’. Boat access through the seaward waters of this zone by visitors may be permitted subject to local controls but tourism activities within these waters will generally not be permitted.



Tourism and Recreation Zone

Some specific areas within the lagoon, the seaward waters and the Islands will be designated as '*Tourism and Recreation Zone*' to provide opportunities for nature based tourism. These areas will allow compatible nature based activities such as diving and snorkelling but will not permit the take of any marine or terrestrial life. Diving is allowed in designated areas to minimise damage to the reef, and avoid diver effects on reef fish in monitored sites. Visitation to frigatebird colonies around the Atoll is limited to the Grand Poche colony to minimise disturbance to other colonies less suitable for visitation. This colony offers the opportunity to view bird colonies from a distance that does not disturb the birds and hence not impact on breeding success. The entire Atoll is a no-fly zone to negate impacts on seabirds and flamingos.

Marine Food Security Zone

Six seaward areas have been designated to allow for fishing to support the Aldabra management presence. The *Marine Food Security Zone* will differ from the conservation zone only in respect to the allowance of controlled and managed fishing by SIF staff. Fishing is used to supply the staff with protein on the Island. The area near to the Research Station is predominantly used for fishing, and other areas have been set aside to allow for sustainable extraction and allow for safe access in a variety of weather conditions. No fishing will be permitted by any other persons (e.g. for commercial, recreational or tourism pursuits). The ongoing allowance of this activity is subject to fishing being sustainable and not impacting on the conservation values of the Atoll.



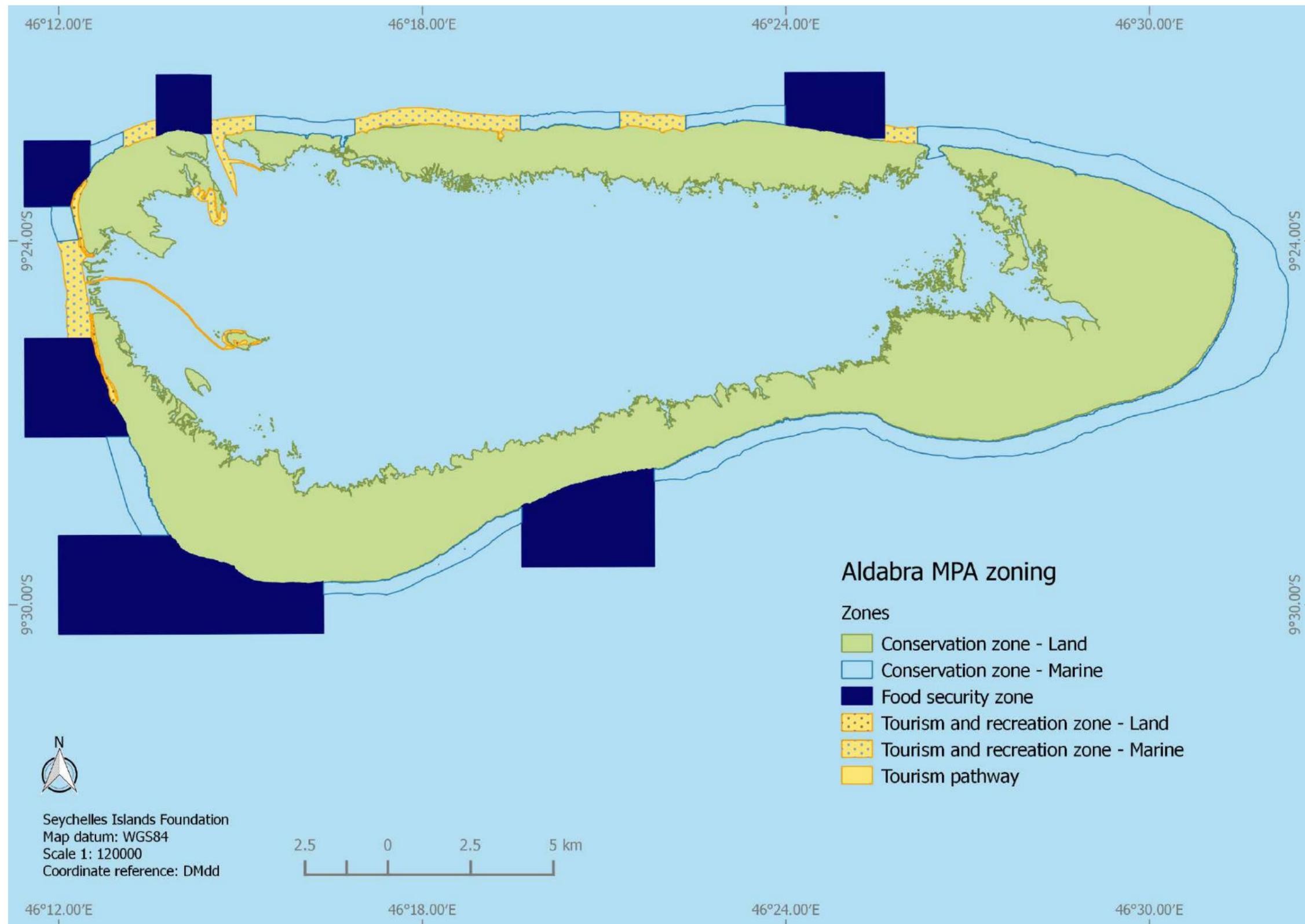


Figure 4 Proposed management zoning for the Aldabra Reserve





Table 3: Activities permitted in the Management Zones of the Aldabra Atoll Strict Nature Reserve and Ecological Reserve

| Activity | Conservation Zone | Tourism and Recreation Zone | Food Security Zone | Comment |
|---|--------------------|-----------------------------|--------------------|---|
| Research and management access | ✓ | ✓ | ✓ | <i>Special restrictions may apply for access to important breeding and other sites</i> |
| Transect Maintenance | ✓ | ✓ | ✓ | <i>Special restrictions may apply for access to important breeding and other sites</i> |
| Hut Maintenance | ✓ | N/A | N/A | <i>Special restrictions may apply for access to important breeding and other sites</i> |
| Tourism | Picard Island only | ✓ | ✓ | |
| Recreational diving and snorkelling | ✗ | ✓ | ✓ | |
| Recreational fishing | ✗ | ✗ | ✗ | <i>The take of any animal for recreational purposes is not permitted anywhere in the reserve</i> |
| Island staff subsistence fishing | ✗ | ✗ | ✓ | <i>Fish stocks in this zone will be monitored closely to ensure sustainability</i> |
| Visitor access by foot | Picard Island only | N/A | N/A | |
| Visitor access by boat (lagoon) | Special | ✓ | N/A | <i>Access within the lagoon is restricted to visitors viewing the Grand Poche frigate breeding colony and access within the associated tourism zone</i> |
| Visitor access by boat (seaward waters) | ✓ | ✓ | ✓ | |
| International shipping | ✗ | ✗ | ✗ | <i>Area of avoidance-advisory only</i> |
| Aircraft | ✗ | ✗ | ✗ | <i>Landing or flyover not permitted anywhere in the reserve</i> |
| Commercial fishing | ✗ | ✗ | ✗ | <i>Not permitted anywhere in the reserve</i> |



5.1.3. Human resources

Management of human resources on Aldabra Atoll provides a unique set of challenges. There is no doubt that staff are in a privileged position to be able to live and work on a World Heritage Site. However, the remoteness and limited accessibility of the Atoll, as well as the requirements on staff to be flexible in working hours (for example to undertake necessary monitoring) and undertake duties outside their core job description (e.g. unloading supply boats or assisting cruise ships) and short contracts (from less than three months to 2 years) (Seychelles Islands Foundation 2007) are unusual but necessary working conditions. This kind of work environment requires that staff have a high level of team work and interpersonal skills, as well as a commitment to the conservation, education and scientific research goals of the Seychelles Islands Foundation. Selection of staff to work on Aldabra needs to take into account and assess the personal characteristics of applicants to ensure that they not only meet the technical specifications of the position for which they are applying, but also are the right ‘fit’ for the team.

All new staff will be provided with a job description, relevant human resource policies and procedures for Aldabra, and a comprehensive orientation and induction, including the Operational Manual for Aldabra Atoll (Appendix 2). While the logistics of travel to and from Aldabra Atoll are difficult, a staff training needs assessment should be undertaken and opportunities identified for staff to participate in not only on-the-job but formal training courses off Aldabra Atoll.

Piracy is a regional issue and in addition to affecting tourism to Aldabra Atoll, is a safety issue for staff of the protected area. A Piracy Emergency Response Protocol (Appendix 3) has been developed and is distributed to all staff.

5.1.4. Licensing and permits

To be able to better manage and control research activities in the protected area, consideration should be given to development of a research permitting system, which lays out the requirements for researchers and would be a legal document. Such a permitting system would expand on the project proposal and bimonthly reporting requirements and would allow SIF to formalise reporting arrangements and provide access to unpublished data.

Licensing of tourism operations with specific conditions is a mechanism by which better control of tourism activities in the protected area could be achieved. It would also deliver the opportunity to provide education material to visitors via tourism operators. Although repeat visitation by tourism operators has historically been low and would not warrant such a licensing system at the time of writing, consideration could be given to tourism licensing in the future if demand for tourism in the protected area increases.

5.1.5. Finance management

The generation of sustainable financing options for Aldabra Atoll is an ongoing challenge. The Aldabra site is able to raise few funds (approximately SCR600,000 – 3.5 million annually), through tourism vessel landing fees, research fees and fees for professional photographers. The main source of income to SIF is entrance fees to Vallée de Mai, the other World Heritage Site managed by SIF. As such, the revenue generated from one high visitation World Heritage Site subsidises another remote World Heritage Site. This arrangement is highly dependent on tourism numbers remaining stable (Seychelles Islands Foundation 2007).



During the Aldabra 30th anniversary celebrations in December 2013, the SIF Board Chairman announced the Aldabra House Project. This project is designed to bring some of the Aldabra experience to Mahé. The SIF headquarters will be designed to serve as a visitor attraction featuring outdoor and indoor exhibits, displays and activities designed to recreate the magic of Aldabra on Mahé, bridging the 1000km gap between the inner islands and Aldabra (Seychelles Islands Foundation 2012). This could provide opportunities to generate revenue for Aldabra’s management through merchandise, entry fees etc.

A Sustainable Financing Strategy and a Requisition Protocol have been prepared for the protected area. These documents are at Appendix 5 and 6 respectively.

Table 4: Legal, administrative, financial and human resource framework

| | |
|-----------------------|---|
| Management Objective | To ensure that the protected area has appropriate legal, administrative, financial and human resource frameworks in place to support management. |
| Management strategies | <p><i>Protected area creation and zoning</i></p> <ol style="list-style-type: none"> 1. Gazette the protected area as a strict nature reserve and ecological reserve under new Protected Area Legislation when that legislation is enacted. (H-KMS) 2. Ensure that the necessary legislative mechanism is in place to implement zoning of the ecological reserve. (H-KMS) 3. Ensure that necessary orders under other relevant legislation are in place to give effect to management arrangements in the protected area (e.g. fisheries and wildlife protection notices). (H-KMS) 4. Investigate the designation of Aldabra Atoll as an International Maritime Organisation Particularly Sensitive Sea Area (PSSA). (M) <p><i>Policy development</i></p> <ol style="list-style-type: none"> 5. Develop and/or update required policies pertaining to management of the protected area and review these policies on a three yearly basis. This includes but is not restricted to: <ul style="list-style-type: none"> • Biosecurity manual and protocols • Tourism Policy • EMS policy • Piracy emergency response policy • Human resource policies and procedures • Staff training programs/needs assessment • Research policy and procedures • Sustainable financing strategy • Requisition protocol • Oil spill contingency plan. (H) |





| | |
|--------|---|
| | <p><i>Work plans</i></p> <p>6. Ensure the preparation of annual work plans based on the operational schedule in Appendix seven and report on these. (H-KMS)</p> <p><i>Human resource management</i></p> <p>7. Develop and implement innovative staff selection processes to ensure the best 'fit' of staff to the unusual and challenging conditions of living and working on Aldabra Atoll. (H)</p> <p>8. Undertake a review of staffing levels on Aldabra to ensure these are appropriate. (H)</p> <p>9. Ensure all staff members receive a comprehensive induction and orientation to living on Aldabra, including relevant human resource policies, operational manual, piracy emergency response protocol and components on environmental awareness. (H)</p> <p>10. Undertake a staff training needs assessment and implement a training schedule, including formal training courses and on-the-job training to address skill and knowledge gaps. (H)</p> <p><i>Licensing and permits</i></p> <p>11. Develop a legally binding research permitting system which details reporting requirements for researchers in the protected area and gives SIF ownership of research data. (H)</p> <p>12. If tourism demand increases in the protected area, consider developing a permitting system for tourism operators. (M)</p> <p><i>Financial management</i></p> <p>13. Investigate and implement a sustainable financing strategy for the Aldabra Atoll protected area. (H)</p> <p>14. Undertake annual budget reporting. (H)</p> |
| Target | Implementation of strategies according to the operational schedule (See Appendix 10). |





5.2. Education and interpretation

Although the level of staffing and visitation to Aldabra Atoll is low, development of an education and interpretation program is essential. Voluntary compliance by staff and visitors with management controls in the protected area will be directly related to the level of understanding of the outstanding values of the protected area, zoning and the reasons for regulating activities. In addition, increased understanding amongst staff and visitors will help to develop a sense of community stewardship which will subsequently lead to better protection of the area's ecological values and social values. Education programs for staff will be structured to improve staff knowledge and understanding of the protected area's values.

Education and interpretation programs focussed on visitors to the protected area will be broader and encompass the values of the area and appropriate behaviours in the protected area. Opportunities should be sought to provide information to visitors prior to their arrival (for example information made available to cruise vessel passengers) as well as on arrival through development of a toolkit of interpretive material that can be exhibited when tourists arrive.

SIF should also continue to provide education and interpretation material about Aldabra Atoll at Vallée de Mai and at public events attended by SIF to enhance broader community understanding and stewardship of Aldabra Atoll.

Table 5: Education and interpretation

| | |
|-----------------------|--|
| Management Objective | Implement education and interpretation programs to enhance staff and visitor understanding of Aldabra Atoll by means of accurate and entertaining interpretation of the natural and cultural features of the Atoll. |
| Management strategies | <ol style="list-style-type: none"> 1. Develop and implement an education program for staff of Aldabra Atoll to raise awareness and understanding of the values of the protected area, the purposes of the management zones and regulations and the reasons for these controls. (H) 2. Develop and implement an education and interpretation program for visitors to Aldabra Atoll, including information disseminated pre-arrival and at the protected area, to raise awareness and understanding of the values of the protected area and appropriate behaviours while on the Atoll. (M) 3. Continue to provide education and interpretive material about Aldabra Atoll at Vallée de Mai, as well as at other community events as the opportunity arises. (H) 4. Complete the Aldabra House project and maximise its potential for education purposes. (H) |
| Target | Implementation of strategies according to the operational schedule (See Appendix 10). |



5.3. Surveillance and enforcement

This plan details a range of strategies relating to the management of particular human activities on Aldabra Atoll, however the effectiveness of these strategies will be dependent on the extent to which the users of the protected area abide by these restrictions. The education program is critical to achieving a high level of voluntary compliance as in most cases staff and visitors will abide by controls where they are clearly aware of what they are and why they have been implemented. However, given the rare and unusual fauna of Aldabra Atoll, as well as the remote nature of the Atoll, there will, always be a need to monitor the level of illegal poaching on and around the Atoll and this will require a surveillance and enforcement program.

Compliance on the Islands is largely the responsibility of management staff who maintain surveillance of people and activities on the Island. It is important that structured programs are established to manage surveillance on the Island that take advantage of other staff management programs (e.g. monthly visits to field huts). This should be supported by appropriate staff training and recording of surveillance effort and non-compliance.

Compliance and enforcement in the offshore waters surrounding Aldabra relies on close cooperation between a number of authorities and groups. Aldabra falls within the Seychelles Fishing Authority’s Vessel Monitoring Area. In the case of non-compliance being suspected the Coast Guard would be notified. The Coast Guard is the maritime arm of Seychelles People's Defence Forces (SPDF) with a multi-mission and multi-skilled maritime force. However the remoteness of Aldabra limits the capacity to respond quickly to events in the area, and enforcement capacity against illegal activities will remain limited.

SPDF has established a new enforcement base on Assumption Island incorporating a radar station, and at the time of writing the radfar station was being operated remotely. This radar station will significantly improve the capacity to monitor and enforce regulations on and around Aldabra.

Table 6: Compliance with regulations

| | |
|-----------------------|--|
| Management Objective | To maximise compliance with regulations for the Aldabra Atoll. |
| Management strategies | <ol style="list-style-type: none"> 1. Develop and implement a surveillance and enforcement program to ensure an adequate level of compliance with protected area regulations. (H-KMS) 2. Facilitate training and authorisation of Aldabra Atoll rangers to enforce appropriate national legislation and regulations as appropriate. (H) 3. Develop and implement procedures to ensure effective cooperation and coordination between government agencies to maximise efficiency and effectiveness of surveillance and enforcement activities. (H) |
| Target | Implementation of strategies according to the operational schedule (See Appendix 10). |



5.4. Infrastructure management

The main infrastructure is located on the western end of Picard Island along the Station and Settlement beaches (Beaver and Gerlach 1998). There are also field huts located around the Atoll to support field operations.

The combined old and new infrastructure extends for approximately 1.2 km and comprises:

- A research block
- Accommodation for Island Manager, Aldabra Science Coordinator, rangers and logistics staff, visiting scientists or tourists
- Mess, kitchen and recreation building
- Service buildings including store/shop, workshop, solar power battery, generator and storage facility and, Fish shed, Boat shed and dive store, washing room and old generator house
- Rainwater collection facilities
- Fuel storage shed and fuel tank enclosures
- Waste management
- Solar panels
- Green house
- Desalination plant



Plate 5: Aldabra Research Station



Due to the prevailing harsh climatic conditions on Aldabra, ongoing active maintenance of infrastructure is necessary to protect the substantial investment that has been made in facilities and allow SIF to continue to carry out its management activities. SIF has a maintenance schedule in place which facilitates planning for capital expenditure and supply of spare parts (Seychelles Islands Foundation 2007).

In addition to existing infrastructure, consideration should be given to direct management interventions required to alleviate existing and minimise future human impacts on the protected area’s ecological values. Moorings have been installed in four locations in the protected area in the past (two in front of the field station, one in front of Passe Gionnet and one in front of the East Channel, Passe Houareau). At the time of writing only one small vessel mooring in front of the field station was operational. If tourism demand increases in the protected area, there is a designated anchoring area over a sandy rubble bottom in the vicinity of the field station to minimise impacts from anchoring which has been surveyed and placed to minimise coral damage. There is an Environmental Management System Policy for Aldabra Atoll which is attached at Appendix 7.

Table 7: Management of infrastructure

| | |
|-----------------------|---|
| Management Objective | <ul style="list-style-type: none"> To ensure that existing infrastructure on the Atoll is maintained. To prevent and/or mitigate potential or existing impacts on the Atoll’s ecological values. |
| Management strategies | <ol style="list-style-type: none"> Identify existing or potential impacts on the ecological values of the protected area and where appropriate, develop infrastructure to mitigate or prevent these impacts. (H-KMS) Continue to undertake and report on the infrastructure maintenance schedule. (H) Where necessary upgrade existing environmental sustainability measures already implemented for power, water and waste management. (M) Where new environmental sustainability technology becomes available consider its implementation on Aldabra Atoll. (M) Repair and reinstate moorings in the protected area if tourism demand in the protected area increases. (M) |
| Target | Implementation of strategies according to the operational schedule (See Appendix 10). |



5.5. Research

Research is a key strategy critical for the effective management of Aldabra Atoll. Research provides key information on the values of the protected area, an improved understanding of what is “natural” as a benchmark for monitoring programs, and facilitates a better understanding of the short and long-term impacts of human activities. Research programs should ideally be focussed on filling key gaps in knowledge of most benefit to management. However, any increase in knowledge is beneficial and as such, research should be encouraged. To ensure that research undertaken in the protected area does not necessarily impact on the values of the protected area, a research policy and permitting system should be developed. Proactive planning to identify knowledge gaps and prioritise research programs is essential to channel limited funds to addressing key information requirements.

Research on the atoll should have an over-arching goal that strives to improve the conservation, management and understanding of the Atoll and its biota. Research should be non-damaging, or have negligible effects on the ecology of Aldabra.



Plate 6: Research being conducted on land birds on Aldabra





All research carried out needs to be initiated with a *Research Proposal* in which the following are addressed:

1. Objectives
2. Methods
3. Likely outputs and benefits to management of the atoll
4. Responsible persons
5. Data sharing agreements where applicable
6. Impact on ecology
7. Risks and mitigation
8. All research proposals need to be assessed and approved by the Aldabra Science Coordinator, Science and Projects Programme Coordinator and CEO
9. External proposals to the organisation requires a research agreement in which the terms and conditions are specified

Table 8: Research

| | |
|-----------------------|--|
| Management Objective | <ul style="list-style-type: none"> • To obtain an appropriate understanding of the biodiversity and ecological processes of the Atoll. • To promote research that improves knowledge and informs management of the Atoll. |
| Management strategies | <ol style="list-style-type: none"> 1. Develop a research policy and permitting system for researchers in the protected area. (H) 2. Undertake a gap analysis and determine priority areas for research on the Atoll. (H) 3. Develop and progressively implement a coordinated and prioritised research program into key values, ecosystem processes and to address knowledge gaps for effective management. (H) 4. Communicate high priority ecological research projects to appropriate research organisations. (M) 5. Develop and maintain a database of historical and ongoing research in the protected area. (M) 6. Facilitate research relevant to management in the protected area conducted by research, academic and educational institutions, by providing financial and logistical assistance where possible. (M) |
| Target | Implementation of strategies according to the operational schedule (See Appendix 10). |





5.6. Monitoring

Monitoring is a critical strategy for measuring the effectiveness of management in the protected area. Monitoring programs should ensure the early detection of detrimental changes and provide the trigger for management action to ameliorate potential impacts before they lead to undesirable changes in the values of the protected area. Where changes have occurred and remediation measures have been implemented, a monitoring program should determine the rate of recovery of an affected area or value.

There is an existing extensive program of monitoring of the terrestrial ecological values of the protected area which has been undertaken for some years and which has resulted in a sound base of information. Between 1999-2008 the Aldabra Marine Program undertook coral and fish surveys in the waters of Aldabra following the 1998 mass coral bleaching event..

It would be timely to review the existing monitoring program to identify whether there are gaps in the program (especially in regard to the marine values given the increase in marine area of the protected area) and whether the existing monitoring adequately meets management audit requirements.



Plate 7: Research to assess the status of fauna is a critical management component of Aldabra



As the protected area is also a World Heritage Area, monitoring also informs reporting on the maintenance of the areas Outstanding Universal Value through UNESCO’s periodic reporting and the IUCN World Heritage Conservation Outlook Assessments.

Specific monitoring strategies are detailed for ecological and social values and are outlined in Section 6 and 7. A summary of the generic monitoring objectives, strategies and targets is outlined below.

Table 9: Monitoring of Aldabra Atoll

| | |
|------------------------------|---|
| Management Objectives | <ul style="list-style-type: none"> • To determine the status and trends in the condition of, and the threats to, the ecological values of the Atoll and the effectiveness of management responses. • To provide the necessary information for audit of the management plan. • To promote monitoring in the Atoll that can detect changes to the ecological values and aid management decision making. |
| Management strategies | <ol style="list-style-type: none"> 1. Undertake a review of the existing monitoring program to: <ul style="list-style-type: none"> • identify any gaps in the monitoring program • ensure the monitoring program fulfils audit requirements. (H-KMS) 2. Develop and progressively implement an integrated and prioritised ecological monitoring program for the protected area with a particular emphasis on management audit requirements. (H-KMS) 3. Implement a long-term monitoring program, commencing with baseline studies, to assess the effectiveness of the zoning scheme in the ecological reserve. (H) 4. Maintain, and where required further develop long-term reference sites to better understand natural variability and key ecological processes (e.g. coral recruitment) in the protected area. (H) 5. Monitor changes in key values within the protected area against adequate baseline data. (H) |
| Target | Implementation of strategies according to the operational schedule (See Appendix 10). |



5.7. Biosecurity

Invasive alien species (IAS) can have dramatic effects on isolated island ecosystems and are a leading cause of species extinction. Islands are more susceptible to IAS due to a lack of natural predators to control invasive species and difficulties in recolonisation from adjacent natural populations. Invasive species of animals, plants and disease-causing microorganisms are a particular threat to island birds and small island bird species are at most risk (Convention on Biological Diversity undated).



Plate 8: The prevention of the introduction of alien species is a key management priority

IAS are present on Aldabra Atoll as a result of deliberate introductions, through bringing cargo and supplies onto the Atoll and as a result of Aldabra's proximity to other islands, such as Assumption Island, where IAS are already established. IAS are the largest and most likely threat to the ecological values of the protected area.

Biosecurity has two key management areas. Firstly, the control and/or eradication of invasive alien species (IAS) that are established in the protected area is a critical management action to limit the impacts of these species on the natural values of Aldabra. The second important management area is the prevention of the future establishment of IAS on the Island.



There has been a high priority on IAS control on Aldabra. Goats were present on all main islands of Aldabra however a successful goat eradication program was concluded on 3 August 2012 when the last feral goat was shot (Bunbury *et al* 2013a). In 2013, a single red-whiskered bulbul (*Pycnonotus jocosus*), apparently self-introduced from Assumption Island was removed from the Takamaka region of Grande Terre (Bunbury *et al* 2013b). IAS still present on Aldabra Atoll comprise:

- At least ten species of plants.
- Black rats *Rattus rattus*: known to have been on Aldabra for at least 130 years but probably introduced by Arab traders in the 9th century
- Cats *Felis catus*: found only on Grande Terre and present since at least the late nineteenth century
- Madagascar fody *Foudia madagascariensis*: found in the Takamaka region of Grande Terre, and were apparently self-introduced from Assumption Island but are close to being eradicated.
- Four-clawed gecko *Gehyra mutilata*: recorded on Picard Island since 2008.
- Mealy bugs *Icerya seychellarum*: apparently introduced in the late 1960s and reached very high numbers within 10 years.
- Other insects: wasp *Eumenes maxillosa*, a stored products beetle *Oryzaephilus surinamensis*, and a stick-tight flea *Echidnophaga gallinacean* (Seychelles Islands Foundation 2014a).



Plate 9: Feral goats on Aldabra in 2006-this species was successfully eradicated by 2012. Eradication of feral cats is a key future priority.

SIF is undertaking research toward the eradication of cats and rats from the protected area. Removal of sisal is ongoing with the aim of eradicating this species in the near future.



Prevention of future establishment of IAS on Aldabra is the second key management focus. The Aldabra Atoll Biosecurity Plan (Seychelles Islands Foundation 2014a) is attached at Appendix 8 details a range of strategies to achieve effective quarantine controls to prevent future spread of unwanted species. This document details:

1. Establishment of a biosecurity system for the servicing of Aldabra Atoll
2. Maintaining surveillance for IAS that may circumvent the biosecurity system
3. Initiating emergency procedures for an IAS incursion on Aldabra

The implementation of this Plan is a key management strategy for the future protection of Aldabra's natural values.

Given the proximity of the protected area to Assumption Island, SIF should continue work with the Islands Conservation Society and Islands Development Company to complete the eradication of the Madagascar fody and red-whiskered bulbul from Assumption Island. This will greatly reduce the risk of opportunistic colonisation of Aldabra by these invasive alien species.

Table 10: Biosecurity management

| | |
|-----------------------|---|
| Management Objective | <ul style="list-style-type: none"> • To prevent further invasion of alien flora and fauna species to the Atoll. • To eradicate or manage existing alien species to reduce impact to the Atoll's flora and fauna. |
| Management strategies | <ol style="list-style-type: none"> 1. Implement the provisions of the Aldabra Atoll Biosecurity Plan, 2014, particularly in relation to surveillance and incursion response. (H-KMS) 2. Undertake feral cat and rat eradication programs in the protected area. (H-KMS) 3. Complete eradication of introduced sisal . (H-KMS) 4. Undertake other invasive weed removal, where required. (H-KMS) 5. Continue efforts to eradicate and confirm eradication of the Madagascar fody from the protected area. (H-KMS) 6. Undertake research to evaluate the potential impacts, spread and potential control of Casuarina. (H) 7. Undertake monitoring of other IAS as resources permit. (H) 8. Continue to collaborate with the Islands Conservation Society and the Islands Development Company to confirm the eradication of of Madagascar fody and red-whiskered bulbul from Assumption Island. (H) 9. Develop and implement a marine invasive species biosecurity plan. (M) |
| Target | <ol style="list-style-type: none"> 1. No new Invasive Alien Species established on Aldabra. 2. Eradication of cats and rats by 2022. 3. Eradication of sisal by end of 2016. 4. Eradication of Madagascan Fody by 2018. |

6 Management of Ecological Values



6.1. Geomorphology (WHC vii, ix)

Aldabra Atoll is the world's second largest coral atoll by dry land area and the highest raised coral atoll (19m elevation at its highest point highpoint) in the world. Aldabra is situated on the summit of a mountain approximately 4000m high, which has risen from the flat sea floor through volcanic activity (Stoddart *et al.* 1971). The Atoll is comprised of four main islands, namely Picard, Malabar, Grande Terre and Polymnie, which are separated by channels and which surround a shallow central lagoon.

The Atoll is surrounded by fringing platform reef and a steep seaward slope (< 40 metres) (Stobart *et al.* 2005).



Plate 10: The Aldabra coastline is characterised by low undercut limestone cliffs

There are 40 islets clustered on the western and eastern sides of the lagoon, which vary from simple rock formations to small islands. These islands are nesting grounds for a variety of resident and migrant shorebirds and waders.

Due to the influence of prevailing south-west currents, the exposed south west of the Atoll is characterised by undercut limestone cliffs. A unique feature of the island is the champignon rock which formed through the weathering of limestone, producing holes and pits. The northern and south-eastern coast is characterised by perched beaches and sand dunes.



Aldabra Atoll hosts fossil sites from 125, 000-100 000 years B.C. These sites are found at the Bassin Cabris Calcarenes and cavity fillings in the Aldabra limestone at Point Hodoul.

The soils of Aldabra are generally shallow (10-20 cm) with patchy distributions of organic matter or biogenic mineral detritus (Trudgill 1979). Organic soils occur under well-established *Casuarina* stands, originating from leaf litter and faecal material. The mineral soils occur on the floor of rock basins and are primarily carbonate and are derived mechanically from carbonate rocks. Soils can be slightly acidic but are generally neutral.

There are several potential threatening processes that could impact geomorphology. The mass coral mortality of 1998 is believed to have reduced the integrity of the fringing coral reef, therefore leading to localised erosion of sandy beaches (Stobart *et al.* 2005). Human activities may also pose potential problems for geomorphology.

The geomorphology of Aldabra is protected under the *Aldabra Special Reserve Regulations SIF 87/1981*. Management will focus on educating staff and visitors of the important ecological role of geomorphology and the potential impacts of human activities on this ecological value.

Table 11: Management of Geomorphology

| | | | |
|---|--|----------------------|---|
| Current condition | Geomorphology is in a very good condition | | |
| Existing and potential pressures | <ul style="list-style-type: none"> • Human disturbance • Climate change. | | |
| Current major pressure/s | No current major pressures | | |
| Management objective | To ensure that the geomorphology of the protected area is not disturbed as a result of human activities. | | |
| Management strategies | <ol style="list-style-type: none"> 1. Educate staff and visitors about the ecological importance of the protected area's geomorphology. (M) 2. Undertake research to map and classify the terrestrial and seabed geomorphology of the protected area. (M) 3. Undertake research to improve knowledge of the interaction between freshwater pools and their connectivity with the reef system. (M) 4. Monitor the impact of climate change on the geomorphology of the protected area and where feasible, implement adaptive management strategies. (M) | | |
| Performance measures | <ol style="list-style-type: none"> 1. Area of seabed disturbance (ha) 2. Area of land degradation (ha). | Desired trend | <ol style="list-style-type: none"> 1. No increase (except for anchorage area) 2. Decreasing (i.e. rehabilitate past disturbance). |
| Target/s | No further change to geomorphology due to anthropogenic pressures. | | |

6.2. Marine water quality

Aldabra Atoll is surrounded by pristine water due to its isolation from human activity. Aldabra Atoll is situated in the South Equatorial Current (SEC) of the West Indian Ocean and is influenced by prevailing south west winds (Heywood *et al.* 1996). A trapped eddy has been observed on the lee side of the Atoll, causing localized upwelling of chlorophyll.

The water quality of Aldabra Atoll is protected under the *Aldabra Special Reserve Regulations SIF 87/1981*. Due to the isolation of the island, there are few direct anthropogenic pressures affecting the quality of water. There is localised sewage leaching from the research base septic tank although this is low and believed to be insignificant and there is also accumulation of marine debris.

The greatest risk to the Aldabra is potential pollution of its pristine waters due to a shipping accident. There is a 30NM shipping avoidance area around Aldabra Atoll which pertains to oil tanker movements in this sensitive area.

To monitor water quality accurately, an appropriate baseline will need to be determined to measure changes. Management will focus on educating staff and visitors of the important ecological role of water quality and the potential impacts of human activities on this ecological value.



Plate 11: Aldabra has pristine water quality



Table 12: Management of Marine Water Quality

| | | | |
|---|--|----------------------|------------------|
| Current condition | The marine water quality is in a very good condition. However localised nutrient enrichment from septic tanking leaching may be occurring and marine debris is of concern. | | |
| Existing and potential pressures | <ul style="list-style-type: none"> • Marine debris • Localised water quality impacts from field station (septic tank leaching) • Localised water quality impacts from field station (fuel transfer and storage, toxic chemical storage and disposal) • Oil spill from shipping. | | |
| Current major pressure/s | <ul style="list-style-type: none"> • Marine debris • Localised water quality impacts from field station (septic tank leaching). | | |
| Management objective | To ensure that the protected area's high water quality is maintained at a level that supports the area's ecological and social values. | | |
| Management strategies | <ol style="list-style-type: none"> 1. Determine appropriate baseline measures from which changes in marine water quality can be measured. (H-KMS) 2. Investigate potential impacts of leaching from the field station septic tank and take action if necessary to mitigate these impacts. (H) 3. Map the ecological values of the protected area that are highly sensitive to oil and chemical spills and ensure that this informs the Seychelles National Oil Spill Contingency Plan. (H) 4. Prohibit discharge of raw and treated sewage from vessels within the protected area. (H) 5. Continue efforts to reduce the amount of floating, submerged and beached marine debris in the protected area. (M) 6. Investigate the option for the listing of the marine park with the International Maritime Organisation as a 'Particularly sensitive sea area' to minimise risks associated with shipping. (H) 7. Develop an appropriate understanding and predictive capacity of the circulation and mixing of the protected area's waters and broader oceanographic processes, particularly in relation to key ecological processes (e.g. nutrient supply and productivity, recruitment, connectivity). (M) | | |
| Performance measures | To be developed. | Desired trend | To be developed. |
| Target/s | No change in the water quality of all of the protected area's marine waters from measured baseline levels. | | |



6.3. Coral communities (KPI, WHC vii, x)

Aldabra Atoll is characterised by a shallow lagoon (<8 m), surrounded by fringing reef with a steep seaward slope (>40 metres deep). The Atoll has high coral species richness with an estimate of 118 species.

The mass coral bleaching event of 1998 is considered the most severe on record, affecting 16% of the world's coral reefs. This was particularly severe in the Indian Ocean, with 50–90% coral mortality within shallow reefs of the Seychelles (Souters *et al.* 2000). The coral of Aldabra was not extensively studied until after the mass coral mortality, with sparse information below snorkelling depth before that time.

In response to the mass coral bleaching, the Aldabra Marine Programme (AMP) was formed in 1999 to conduct long term monitoring of the outcome of bleaching (Stobart *et al.* 2005). Results for long term monitoring demonstrated that corals in less than eight metres were seriously affected with a reduction of up to 40% and 20% loss in deeper waters (P.Haupt, pers comm). Bleaching affected species of the *Acroporidae* and *Fungiidae* families, transforming the coral reef to an assemblage dominated by *Porites spp.* and faviids.

The Aldabra lagoon contains a large amount of coral reef unaffected by the 1998 bleaching episode which decimated corals across the Seychelles region. The lagoon's corals are therefore likely to act as a spawning source of coral larvae for other sites in the area (Buckley *et al.* 2005).



Plate 12: The Atoll has high coral species richness with an estimate of 118 species



A current threatening pressure for the coral of Aldabra is invasive marine pests. *Terpios hoshinota* is a grey-black coloured sponge that encrusts both live and dead corals. It grows symbiotically with several cyanobacteria and is known for occasional massive outbreaks where it smothers and kills coral. It originates from Guam but has expanded in the Pacific region and recently to Indonesia and the Great Barrier Reef (De Voogd et al. 2013). Other threatening processes included localised water quality impacts from field station (septic tank leaching), and damage from trampling, anchoring and divers.



Plate 13: Coral reefs support a diverse tropical fish fauna

Corals of Aldabra Atoll are protected under the *Aldabra Special Reserve Regulations SIF 87/1981*. The management of coral will continue to focus on monitoring coral cover, health, and recovery post the 1998 bleaching event. Monitoring will also focus on assessing the distribution and abundance of *Terpios hoshinota* in the protected areas. Installing permanent moorings in highest risk areas will be undertaken to prevent anchoring damage if tourist visitation increases.



Table 13: Management of Coral Reef Communities

| | |
|---|--|
| Current condition | Coral reef communities are in a good condition |
| Existing and potential pressures | <ul style="list-style-type: none"> • Invasive marine pests • Localised water quality impacts from field station (septic tank leaching) • Coral bleaching/mass mortality due to SST elevation • Trampling • Localised damage from small boats • Mooring damage • Anchoring damage • Diver damage • Localised water quality impacts from field station (fuel transfer and storage, toxic chemical storage and disposal) • Oil spill from shipping. |
| Current major pressure/s | <ul style="list-style-type: none"> • Invasive marine pests • Localised water quality impacts from field station (septic tank leaching) • Trampling • Mooring and anchoring. |
| Management objective | To ensure the diversity and abundance of coral communities are not significantly impacted by invasive marine pests or human activities in the protected area. |



| | | | |
|------------------------------|---|----------------------|---|
| Management strategies | <ol style="list-style-type: none"> 1. Assess the nature, level and potential impacts of human activities, on coral communities within the protected area. (H-KMS) 2. Undertake research to develop a cost-effective monitoring protocol to estimate annual coral recruitment within the protected area and investigate the implications for coral reef resilience and connectivity. (H-KMS) 3. Educate staff and visitors about the ecological importance of coral communities and the potential detrimental effects of trampling, anchoring and boating activities on these communities. (M) 4. Continue to undertake research to characterise the coral species and distribution within the protected area. (M) 5. Monitor the distribution and abundance of <i>Terpios hoshinota</i> in the protected area at least every three years. (H) 6. Continue to monitor coral cover and health, recruitment, as well as coral recovery post the 1998 major coral bleaching event. (H) 7. Install permanent moorings in areas of highest risk of anchoring damage and if necessary restrict anchoring activities in these areas. (H) | | |
| Performance measures | <ol style="list-style-type: none"> 1. Diversity 2. Abundance. | Desired trend | <ol style="list-style-type: none"> 1. Constant 2. Constant. |
| Target/s | <ol style="list-style-type: none"> 1. No loss of coral diversity as a result of human activity in the protected area. 2. No loss of coral abundance as a result of human activity in the protected area. | | |



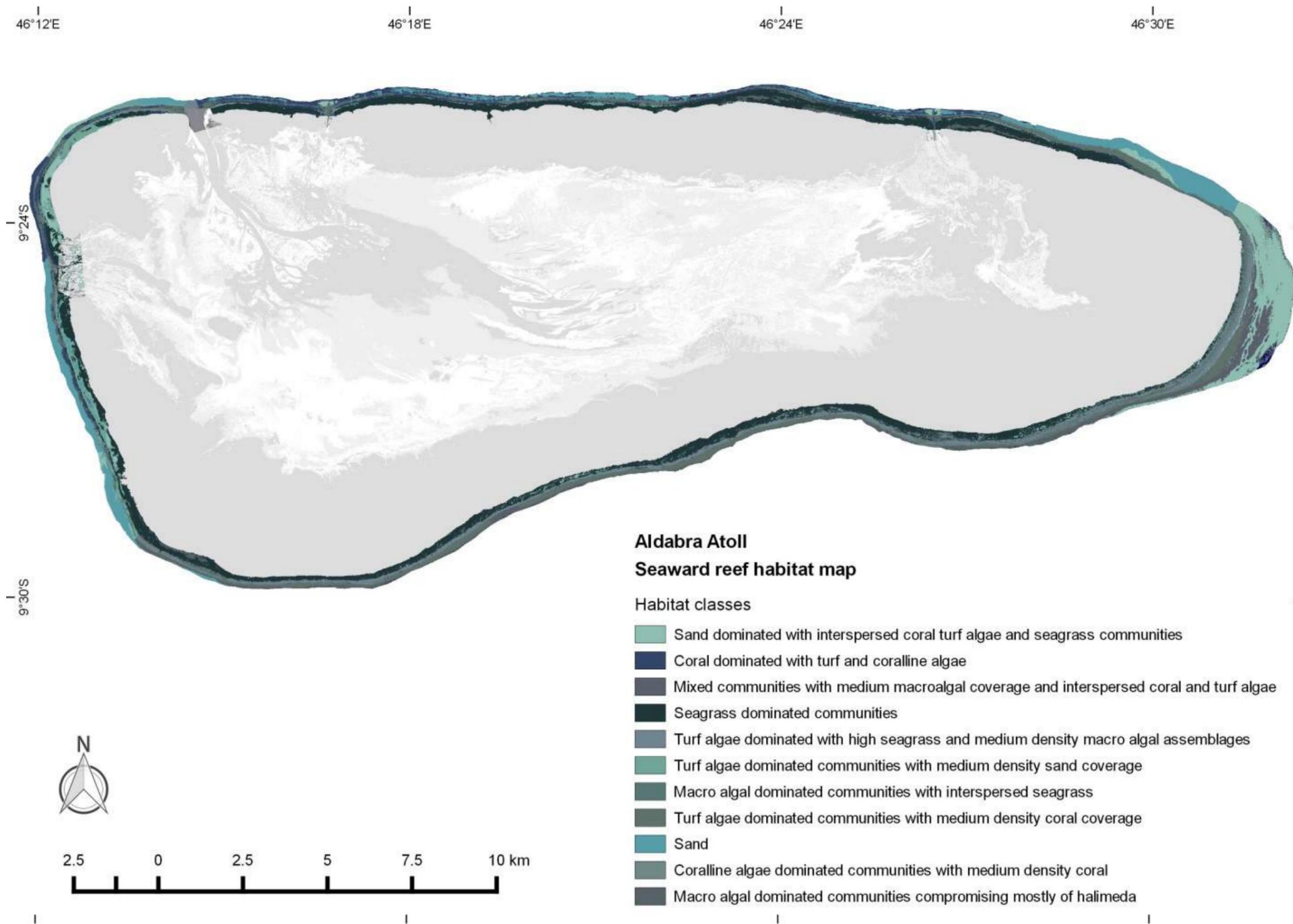


Figure 5 Marine habitats of Aldabra (Source: SIF)





6.4. Mangrove communities (KPI, WHC vii)

The edge of Aldabra's lagoon is lined with extensive mangrove forests. There are seven species that make up this community (Macnae 1971). These include: *Avicennia marina*, *Bruguiera gymnorhiza*, *Ceriops tagal*, *Rhizophora mucronata*, *Lumnitzera racemosa*, *Sonneratia alba* and *Xylocarpus granatum*. Mangroves occur on most shores of the lagoon but show no patterns of zonation. Patterns of density are most likely the result of soil accumulation which acts as the limiting factor to mangrove growth on the islands. Soil characteristics on the edges of the lagoon is controlled by factors such as current as well as the erosion of rock and production of peat within dense areas of mangrove forests.

This habitat has a complex ecological and physical structure which provides important refuge sites for juvenile green and hawksbill turtles along with many species of fish which shelter and forage among the mangrove roots. Mangroves are an important breeding ground for many bird species including the red-footed booby (*Sula sula*) and flamingos (*Phoenicopterus roseus*) (Burger & Betts 2001).



Plate 14: Mangroves are a very important habitat of the Atoll with seven species found on Aldabra



There are several potential threats that may affect the mangrove community. Human trampling from staff or visitors on the island is a potential threat but is spatially restricted and minimised through education and access control. There is also a potential for fires and oil spills which could damage the mangrove community.

Mangrove communities of Aldabra are protected under the *Aldabra Special Reserve Regulations SIF 87/1981*. Mangrove forests have also been identified as important wetland types under the RAMSAR convention. Management will focus on educating staff and visitors of the important ecological role of mangrove communities and the potential impacts of human activities, particularly trampling, on these communities. Monitoring of the areal extent and health of mangroves will help assess the status of mangrove communities in the protected area.

Table 14: Management of Mangrove Communities

| | | | |
|---|--|----------------------|---|
| Current condition | The mangrove communities are in a very good condition. | | |
| Existing and potential pressures | <ul style="list-style-type: none"> • Trampling • Oil spill from shipping • Fire • Invasive marine pests. | | |
| Current major pressure/s | No current major pressures | | |
| Management objective | To ensure that mangrove communities within the protected area are not significantly impacted as a result of human activities. | | |
| Management strategies | <ol style="list-style-type: none"> 1. Educate staff and visitors of the important ecological role of mangrove communities and the potential impacts of human activities, particularly trampling, on these communities. (H) 2. Undertake research to map the distribution of the mangrove communities within the protected area. (H) 3. Monitor the areal extent and health of mangrove communities in the protected area. (H) | | |
| Performance measures | <ol style="list-style-type: none"> 1. Area (by remote sensing) 2. 'Health indicator' to be determined (e.g. leaf density, Leaf chlorophyll content, Sapling emergence). | Desired trend | <ol style="list-style-type: none"> 1. Constant 2. To be determined. |
| Target/s | <ol style="list-style-type: none"> 1. No loss of mangrove extent as a result of human activity in the protected area. 2. No decrease in mangrove health as a result of human activity in the protected area. | | |



6.5. Seagrass and macroalgal communities (WHC vii, x)

Aldabra Atoll hosts large seagrass meadows, found generally off Picard Island. Based on outer/seaward reef map (Haupt 2015 – Aldabra Seaward Reef mapping report 2013) the area of seagrass includes; seagrass dominated communities (14 km²); turf algae dominated with high seagrass and medium density macroalgae (1km²); macroalgal dominated communities with interspersed seagrass (1.5 km²). In addition to being important for primary production and providing a critical ecosystem function, these areas are of particular importance for dugongs and turtles in the area, being a significant food source (Hamylton *et al.* 2012, Mortimer *et al.* 2011).

Macroalgae is the most common habitat type around the Atoll's lagoon reef, and is an important marine habitat of Aldabra. Macroalgae also grows within the seagrass beds in varying densities.



Plate 15: Seagrass beds provide important food source for dugong and nursery habitat for a range of marine fauna

There has been no research on the health of these habitats, but they are assumed to be in a good condition due to lack of anthropogenic pressures such as pollution. Threatening processes included localised water quality impacts from the field station (septic tank leaching), and damage from trampling, anchoring and divers.



Seagrass communities of Aldabra are protected under the *Aldabra Special Reserve Regulations SIF 87/1981*. Research is needed to characterise seagrass and macroalgal species and distribution, as well as assess the nature, level and potential impacts of human activities on these communities within the protected area. Continued education of staff and visitors about the ecological importance of seagrass and macroalgal communities and the potential detrimental effects of anchoring and boating activities on these communities is required.

Table 15: Management of Seagrass and Macroalgal Communities

| | | | |
|---|--|----------------------|---|
| Current condition | The seagrass and macroalgal communities are in a very good condition. | | |
| Existing and potential pressures | <ul style="list-style-type: none"> • Mooring damage • Anchoring damage • Oil spill from shipping • Invasive marine pests. | | |
| Current major pressure/s | No current major pressures | | |
| Management objective | To ensure that seagrass and macroalgal communities within the protected area are not significantly impacted as a result of human activities. | | |
| Management strategies | <ol style="list-style-type: none"> 1. Assess the nature, level and potential impacts of human activities, on seagrass communities within the protected area. (H) 2. Educate staff and visitors about the ecological importance of seagrass and macroalgal communities and the potential detrimental effects of anchoring and boating activities on these communities.(M) 3. Undertake research to characterise the seagrass and macroalgal species and distribution within the protected area. (M) 4. Monitor the diversity and areal extent of seagrass and macroalgal communities in the protected area. (M) | | |
| Performance measures | <ol style="list-style-type: none"> 1. Diversity 2. Areal extent. | Desired trend | <ol style="list-style-type: none"> 1. Constant 2. Constant or positive. |
| Target/s | <ol style="list-style-type: none"> 1. No loss of seagrass and macroalgal diversity as a result of human activity in the protected area. 2. No permanent loss of seagrass and macroalgal habitats as a result of human activity in the protected area. | | |



6.6. Sandy beaches

There are 50 beaches along the outer coastline of Aldabra Atoll, predominantly on the sheltered north and south west coasts. There are also various smaller beaches within the lagoon, interspersed between the mangroves. Sandy beaches are important habitat as they provide nesting areas for green and hawksbill turtles (Mortimer *et al.* 2011). Outer beaches are the preferred nesting area for green turtles while hawksbills prefer smaller beaches inside the lagoon.

The accumulation of marine debris is a threat to the beaches as it pollutes the beach and entangles nesting turtles. There have also been erosion issues due to the loss of reef structure following the mass coral mortality of 1998 (Stobart *et al.* 2005). Changing sea levels due to global climate change is a potential process that could affect sandy beaches of Aldabra Atoll.

A monitoring program was established in 1995 to quantify beach loss and accretion. The study began by focusing primarily on key turtle nesting beaches to help researchers quantify any correlation or causal relationships with seasonal and long-term shifts in nesting activity around the Atoll.

Sandy beaches of Aldabra are protected under the *Aldabra Special Reserve Regulations SIF 87/1981*. There will be a continuation of marine debris removal, focussing efforts on times immediately prior to and during turtle nesting season. Monitoring of beach accretion and erosion will be used to inform turtle research and assist in understanding effects of sea level rise.

Table 16: Management of Sandy Beaches

| | | | |
|---|--|----------------------|-----------------------|
| Current condition | Sandy beaches are in a good condition, but are subject to accumulation of marine debris and erosion. | | |
| Existing and potential pressures | <ul style="list-style-type: none"> • Marine debris • Erosion. | | |
| Current major pressure/s | <ul style="list-style-type: none"> • Marine debris • Erosion. | | |
| Management objective | To ensure sandy beaches are not significantly impacted by marine debris and erosion in the protected area. | | |
| Management strategies | <ol style="list-style-type: none"> 1. Continue to undertake marine debris removal, focussing efforts on times immediately prior to and during turtle nesting season. (M) 2. Continue to undertake monitoring of beach accretion and erosion to: <ul style="list-style-type: none"> • inform turtle research and monitoring • assist in understanding effects of sea level rise. (M) | | |
| Performance measures | Area of beach available for nesting. | Desired trend | Constant or positive. |
| Target/s | No net loss of area of sandy beaches. | | |



6.7. Intertidal mudflats (WHC vii, x)

Extensive intertidal mudflats fringe the edge of the lagoon on Aldabra Atoll. These have been estimated to cover a total area of 12.6 km² (Hamylton *et al* 2012). The depth of the lagoon varies between 2-3 m at low tide, with many exposed sand and seagrass beds. There has been limited research on the importance of intertidal mudflats, with work focussed on areas surrounding Grande Terre. Intertidal mudflats are productive feeding grounds for resident and migratory shorebirds and waders. These areas are typically lined with mangroves on the landward side and are influenced by tidal flow (Taylor 1971).

The accumulation of marine debris is a current threat to the intertidal mudflats as it poses an entanglement issue for foraging birds.

Intertidal mudflats of Aldabra are protected under the *Aldabra Special Reserve Regulations SIF 87/1981*. The intertidal mudflats of Aldabra Atoll are also listed as important wetland types of the RAMSAR Classification System. Research should be undertaken or supported to characterise the extent in faunal composition and productivity of intertidal mudflats in the protected area. Monitoring of intertidal mudflats will focus on the abundance of key infauna species. There will be a continuation of marine debris removal where possible.

Table 17: Management of Intertidal Mudflat Communities

| | | | |
|---|---|----------------------|-----------------------|
| Current condition | Intertidal mudflat communities are in a very good condition. | | |
| Existing and potential pressures | <ul style="list-style-type: none"> • Marine debris • Oil spill from shipping • Invasive marine pests. | | |
| Current major pressure/s | <ul style="list-style-type: none"> • Marine debris | | |
| Management objective | To ensure that intertidal mudflats within the protected area are not significantly impacted as a result of human activities. | | |
| Management strategies | <ol style="list-style-type: none"> 1. Undertake research to characterise the extent, infauna composition and productivity of intertidal mudflats in the protected area. (M) 2. Undertake monitoring of intertidal mudflats focussing on abundance of key infauna species. (M) 3. Continue efforts to collect marine debris where possible. (M) | | |
| Performance measures | Abundance of key indicator species. | Desired trend | Constant or positive. |
| Target/s | No loss of abundance of key indicator species. | | |



6.8. Terrestrial vegetation (KPI, WHC x)

Aldabra is rich in flora, hosting 273 angiosperms and ferns, 19 of which are endemic to Aldabra Atoll and 22 of which are only found on Aldabra Atoll and neighbouring islands (Hnatiuk & Merton 1979). Most of the endemic species and those found on Aldabra Atoll and neighbouring islands are considered to be threatened species.

Much of the land is covered with dense *Pemphis acidula* thicket and mixed shrubs (Renvoize 1971). The mixed scrub type is extremely heterogeneous and includes areas of 'tortoise turf', which is made up of 22 species, eight of which are endemic to Aldabra and 12 of which are 'genetically dwarfed'. Mangroves grow around the edge of the lagoon. On flat limestone, there is a mixed growth of low trees, shrubs, herbs and grasses, interspersed with grassy openings, bare and flooded rocks, and silt flats. The vegetation patterns are controlled by a variety of influences such as annual rainfall and tortoise grazing (Fosberg 1971). Terrestrial habitats of the Atoll Islands are shown on Figure 5.

There are several pressures on the plants of Aldabra, the most immediate being the introduced coccid (*Ilerya seychellarum*) (Hill & Newberry 1980). This scale insect was discovered on the islands in 1968 and is a prolific breeder that can penetrate all leaf surfaces. Unfortunately, little can be done to remediate this pressure. Rats are an important additional pressure on native plants. There is often extensive rat damage on plants in the dry season, particularly to fruits and flowers and rats also eat plant seeds).

Introduced flora poses a possible threat to native species with at least ten introduced plant species recorded on Aldabra Atoll. The most threatening is sisal (*Agave sisalana*), an aggressive introduced species which can outcompete local species. It occurred on Back Path Picard, Île Michel and Anse Polymnie. These populations have been controlled through the removal of roots, flowering stems and new plants to prevent spread of this species.

Biosecurity protocol pathways have been an effective mechanism in the prevention of introduced species in the last decade. These protocols will be continued so as to prevent the introduction of other invasive alien species that could affect the local vegetation such as yellow crazy ants, white-footed ants and fagot (*Tribulus terrestris*).

Vegetation of Aldabra is protected under the *Aldabra Special Reserve Regulations SIF 87/1981*. There will be a continuation of vegetation monitoring in the protected area, with consideration given to the monitoring of species diversity and areal extent of vegetation community types. Removal of invasive alien species is one of the primary requirements for island restoration, and aligns with requirements set by the IUCN for managements of nature reserves and UNESCO World Heritage sites.

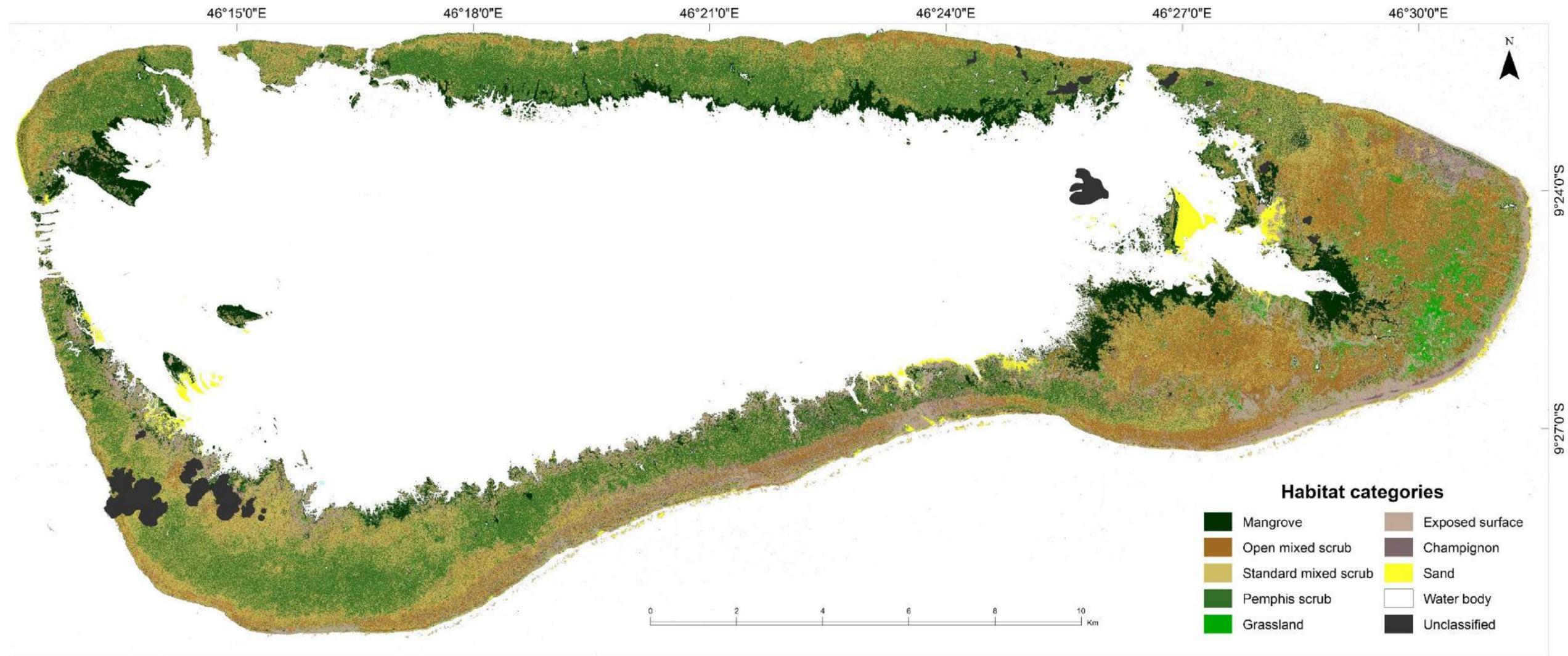


Figure 6 Terrestrial Habitats of the Aldabra Islands (Source⁴)

⁴ Produced by Rowana Walton (SIF) in 2015 as part of MSc project 'Habitat use and preference of the Aldabra giant tortoise (*Aldabrachelys gigantea*) on Aldabra Atoll, Seychelles'





Table 18: Management of Terrestrial Vegetation

| | | | |
|---|---|----------------------|---|
| Current condition | Terrestrial vegetation is in a good condition. | | |
| Existing and potential pressures | <ul style="list-style-type: none"> • Coccids • Alien species introduction, e.g. crazy ants, rats • Other invasive plant introduction (including from staff vegetable gardens) • Introduced plant diseases or pests • Sisal re-introduction • Trampling • Fire • Other pest introduction • Unauthorised trail cutting • Climate change • Bioprospecting. | | |
| Current major pressure/s | <ul style="list-style-type: none"> • Coccids • Risk of alien invertebrate introduction, e.g. crazy ants • Other invasive plant introduction (including from staff vegetable gardens). | | |
| Management objective | To ensure that terrestrial vegetation is not significantly impacted by invasive alien species. | | |
| Management strategies | <ol style="list-style-type: none"> 1. Continue to undertake vegetation monitoring, including phenology monitoring, in the protected area, with consideration given to monitoring of species diversity and areal extent of vegetation community types. (H) 2. Ensure adherence to the biosecurity plan to prevent the introduction of new invasive plants or plant diseases. (H) 3. Continue removal programs for invasive alien plant species. (H) | | |
| Performance measures | <ol style="list-style-type: none"> 1. Area of vegetation types 2. Species diversity 3. Leaf coverage 4. Fruit presence/absence. | Desired trend | <ol style="list-style-type: none"> 1. Constant 2. Constant 3. Constant 4. Constant. |
| Target/s | <ol style="list-style-type: none"> 1. No loss of species diversity or vegetation extent as a result of impacts from invasive alien species. 2. No loss of vegetation health as a result of impacts from invasive alien species. | | |



6.9. Freshwater and brackish pools

Freshwater and brackish pools are an important feature of Aldabra due to the arid environment and the deep dissection of the champignon rock preventing the formation of large freshwater bodies. There are 20 intermittent freshwater and brackish pools on the dimpled plain surface across the Atoll which vary from a thin lens over saline pools; to shallow depressions holding water for only a few hours; to pools that are permanent throughout the wet season. The largest of these is Bassin Flamant which has a dry season diameter of about 300 m, but this and other pools increase markedly in size during the wet season (Stoddart *et al.* 1971). Most pools are brackish and many are linked with the sea through underground passages.

The chemistry of the freshwater pools is dominated by dissolved phosphate and ammonia which is presumably from the excreta of animals such as crabs, birds and tortoise (Donaldson & Whitton 1977 a). This enters the pool from the surrounding environment from run off during the wet season. The presence of ammonia rather than nitrite or nitrate indicates an apparent absence of anaerobic activity from bacteria within the pools.

The freshwater pools provide habitat for fish and crabs. They also host a variety of algae, the most widespread species being *Lyngbya sp.*, *Calothrix parietina*, *Phormidium mucicola*, *Lyngbya nordgardhii*, *Oscilla toria*, *Pseudogeminata sp.*, and *Phacus orbicularis* (Donaldson & Whitton 1977 b). Several of these species are restricted to Picard Island, while others are restricted to Malabar Island and Grande Terre.

As well as providing habitat for various algal species, these pools are an important source of food and water for tortoises, birds and land crabs.

Freshwater pools of Aldabra are protected under the *Aldabra Special Reserve Regulations SIF 87/1981*. Management will focus on educating staff and visitors of the important ecological role of freshwater pools and the potential impacts of human activities.



Table 19: Management of Freshwater and Brackish Pools

| | | |
|---|--|--|
| Current condition | Freshwater and brackish pools are in a very good condition. | |
| Existing and potential pressures | <ul style="list-style-type: none"> None identified | |
| Current major pressure/s | No current major pressures | |
| Management objective | To ensure that freshwater and brackish pools within the protected area are not significantly impacted as a result of human activities. | |
| Management strategies | <ol style="list-style-type: none"> Undertake research to determine the ecological importance, baseline water quality and annual variability. (H) Establish monitoring of the lakes based on the outcomes of baseline research. (M) | |
| Performance measures | Water quality measures (to be determined). | Desired trend To be determined. |
| Target/s | Water quality is maintained in the freshwater and brackish pools within the range of natural variability. | |

6.10. Aldabra Giant Tortoise (KPI, WHC ix)

Aldabra Atoll hosts the only surviving wild population of giant tortoises in the Indian Ocean (Palkovacs *et al.* 2002). This species was harvested close to extinction for eggs, meat and other products and was at very low densities in all parts of Aldabra, and extinct on some islands, by the end of the nineteenth century. Tortoises were relocated around the Atoll to re-establish populations. The estimated size of the population is about 100,000 individuals, with the majority of tortoises found at south-eastern Grande Terre. Lower density subpopulations also occur on Malabar and Picard Islands.

Within Grande Terre the tortoises are split into subpopulations by topographical barriers. Growth rate of individuals is strongly dependent on individual size and subpopulation density. Breeding occurs from February to May where clutch size and frequency vary inversely with population density and annual variations are influenced by rainfall (Swingland 1989). Therefore, in low density subpopulations the tortoises are large, have many young, low relative reproductive effort and a short generation time. In high density sub-populations, they are small, have few young, high relative reproductive effort, and a long generation time (Gibson & Hamilton 1984).

Aldabra Atoll is the only place in the world where a reptile is the dominant herbivore which has a significance influence on the ecosystem. The tortoise's diet is estimated to comprise 61% 'tortoise turf', a grassy area in which *Panicum sp.* is often dominant (Grubb 1971, Gibson & Hamilton 1983).

Tortoise turf is developed under conditions of heavy selective grazing and has resulted in genetically dwarfed grasses, sedges and herbs. Experimental plots of turf where tortoise grazing was eliminated or reduced for a year were rapidly encroached by invasive sedges like *Cyperus ligularis* indicating that tortoise grazing controls competitive species in the ecosystem (Merton *et al.* 1976).

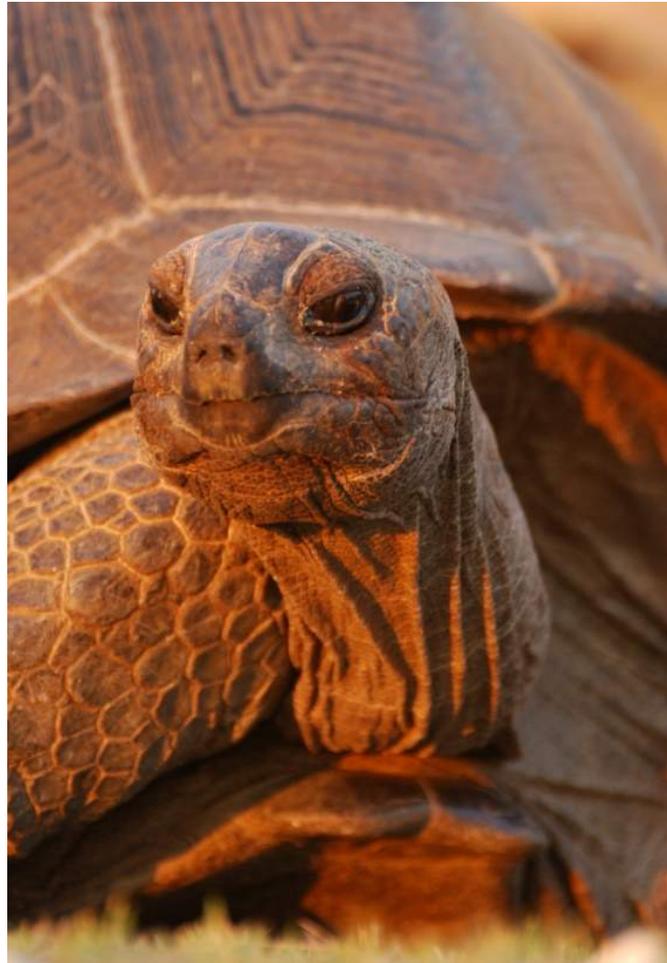


Plate 16: Aldabra giant tortoise

As well as selectively grazing on species that have competitive advantages, it has been demonstrated that 28 species of native plants can germinate from tortoise dung and that tortoises are responsible for local dispersal of seed across the islands (Hnatiuk 1978).

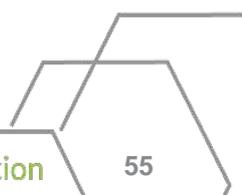
Historical poaching of tortoises has skewed the age structure of Picard Island's population, however the taking of tortoises is illegal and has been controlled in recent years. The most significant current pressure is the predation of eggs and hatchlings by rats and cats affecting tortoise recruitment. There is a potential for the introduction of disease such as Tortoise Upper Respiratory Tract Disease but the risk is low.

The Aldabra giant tortoise is protected under the *Aldabra Special Reserve Regulations SIF 87/1981*, and the *Wild Animals (Giant Land Tortoise) Protection Regulations S/I 59/1974*. Management of the Aldabra Giant Tortoise will focus on measures to control and reduce cats and rats on the Atoll to prevent predation on eggs and hatchlings. There will be a continued focus on monitoring and research of tortoises.



Table 20: Management of Aldabra giant tortoises

| | | | |
|---|---|----------------------|--|
| Current condition | Aldabra giant tortoise populations are in a good condition. | | |
| Existing and potential pressures | <ul style="list-style-type: none"> • Egg and hatchling predation by rats. • Hatchling predation by cats (Grande Terre). • Poaching (also skews age structure as juveniles taken- Picard). • Climate change • Disease introduction (e.g. Tortoise Upper Respiratory Tract Disease). | | |
| Current major pressure/s | <ul style="list-style-type: none"> • Egg and hatchling predation by rats. • Hatchling predation by cats (Grande Terre). | | |
| Management objective | To ensure that the Aldabra giant tortoise populations within the protected area are not significantly impacted by rat and cat predation. | | |
| Management strategies | <ol style="list-style-type: none"> 1. Undertake feral cat and rat eradication programs in the protected area. (H-KMS) 2. Continue to undertake research to: <ul style="list-style-type: none"> • obtain better baseline data for monitoring • better characterise population dynamics, age structure and genetics • investigate the extent of nesting areas • investigate links between tortoise densities and behaviour to vegetation dynamics • better understand the impact of rat and cat predation on the tortoise population • better inform the development of appropriate management strategies for Aldabra giant tortoises in the protected area. (H) 3. Improve the Aldabra giant tortoise monitoring program, including transect monitoring, size and breeding success.(H) | | |
| Performance measures | <ol style="list-style-type: none"> 1. Size of individuals 2. Number of tortoises 3. Breeding success. | Desired trend | <ol style="list-style-type: none"> 1. Increasing 2. Increasing 3. Increasing. |
| Target/s | <ol style="list-style-type: none"> 1. No reduction in the population of Aldabra giant tortoises. 2. An increase in breeding success and juveniles (as a result of reduced rat and cat predation of eggs and hatchlings). | | |



6.11. Land Birds (KPI, WHC x)

A total of 12 land bird species have been recorded as resident on Aldabra Atoll, with the Aldabra drongo (*Dicrurus aldabranus*) (Crommenacker 2012) and Aldabra fody (*Foudia aldabrana*) being the last two remaining endemic species. All other bird species are currently considered to be subspecies of Madagascar populations.

These comprise:

- Aldabra white-throated rail (*Dryolimnas cuvieri*)
- Comoro blue pigeon (*Alectroenas sganzi*)
- Madagascar bulbul (*Hypsipetes madagascariensis*)
- Madagascar coucal (*Centropus toulou*)
- Pied crow (*Corvus albus*)
- Aldabra fody (*Foudia aldabrana*)
- Sacred ibis (*Threskiornis aethiopicus*)
- Madagascar kestrel (*Falco newtoni*)
- Madagascar white-eye (*Zosterops maderaspatanus*)
- Madagascar turtle-dove (*Nesoenas picturata*)
- Souimanga sunbird (*Cinnyris sovimanga*)



Plate 17 The Aldabra white-throated rail

Of these species, the white-throated rail has the highest conservation significance as it is the last remaining flightless bird species in the Western Indian Ocean (Collar 1993). There are approximately 10,000 breeding pairs of white-throated rail (Šúr *et al.* 2013b), distributed between the islands of Malabar, Polymnie, Île au Cèdres and Picard.



They are an omnivorous species, with a preference for insects found within leaf litter. Rails are opportunistic and have been recorded eating turtle hatchlings, lizards, and crabs. Rails occupy most habitats, with a preference for dense scrub.

Rails are monogamous, pairing prior to the nesting season in November. Males build the nest generally on the ground, but have been known to build nests in low shrubs or natural cavities in trees. The female produces 2-4 eggs per clutch on Picard Island and 1-3 eggs per clutch on Malabar Island depending on conditions such as annual rainfall. Young are invariably evicted from natal territory between the 8th to 10th week, when they have attained full plumage (Hamblen *et al.* 1993).

Until 1999, the white-throated rail survived on only three islands of Aldabra, namely Malabar, Polymnie and Île au Cèdres, having been extirpated from the islands of Grande Terre and Picard due to predation by cats and human interference. In 1999, 18 individual rails were translocated and released on Picard Island. In 2011 a survey was undertaken to assess the long-term effectiveness of the re-introduction (Šúr *et al.* 2013b). Survey results showed that twelve years after reintroduction the rail population on Picard is almost 3,000 individuals, which is well above the predicted carrying capacity of the island and demonstrates the effectiveness of reintroduction for this species (Šúr *et al.* 2013b).

A significant pressure on all species is the predation of eggs and hatchlings by rats and cats (Grande Terre) (Crommenacker 2012). Although the predation of rails by cats has never been documented, the disjunct distribution of rails strongly suggests that cats were responsible for local extinctions on Picard and Grande Terre (Benson & Penny 1971, Hamblen *et al.* 1993). Introduction of other invasive species such as the Madagascar fody (*Foudia madagascariensis*) pose another possible threat to native species and hybridisation has already been confirmed between the Madagascar fody and the Aldabra fody (van de Crommendacker *et al.* 2015). There is also a potential for human disturbance and poaching to act as pressures but the risk is low due to the isolation of the Atoll and small population of inhabitants.

The land birds of Aldabra are protected under the *Aldabra Special Reserve Regulations SIF 87/1981*, *Wild Animals and Birds Protection Act 1966*, *Wild Birds Protection Regulations S/me 26/1966*, and the *Wild Birds Protection (Nature Reserves) Regulations S/me 27/1966*. Aldabra Atoll is listed as an Important Bird and Biodiversity Area by Birdlife international (Birdlife International 2014b). Current management of land birds has included genetic research to determine the genetic status of Aldabra birds with priority given to the Aldabra forest fody, white-throated rail and Madagascar bulbul. Monitoring of nest success has been conducted on Picard Island. This monitoring began in November 2011 and demonstrated that nesting success rate is relatively low on Aldabra Atoll (44%), particularly for drongos, fodies, sunbirds and turtle-doves.

The management of land birds will continue to focus on measures to control and reduce cats on the Atoll. There have been no detailed studies of the impact of rats on nesting success on Aldabra which would need to be addressed in future monitoring. There will be a continued focus on research and population monitoring.

Table 21: Management of Land Birds

| | | | |
|---|---|----------------------|--|
| Current condition | Land bird populations are in a very good condition and some are increasing (van de Crommenacker <i>et al</i> 2015). | | |
| Existing and potential pressures | <ul style="list-style-type: none"> • Egg and hatchling predation by rats. • Other invasive alien species introduction. • Madagascar Fody invasion. • Hybridisation from introduced birds • Disease or parasite introduction from introduced, domestic and migratory birds. • Fire. • Poaching. • Cat introduction to islands where white-throated rails are found. | | |
| Current major pressure/s | <ul style="list-style-type: none"> • Egg and chick predation by rats. • Other invasive alien species introduction. • Madagascar fody invasion and subsequent hybridisation and disease transmission risks. | | |
| Management objective | To undertake control of invasive alien species to protect and enhance land bird populations in the protected area. | | |
| Management strategies | <ol style="list-style-type: none"> 1. Undertake feral cat and rat eradication programs in the protected area. (H-KMS) 2. Continue to undertake research to: <ul style="list-style-type: none"> • obtain better baseline data for monitoring • investigate land bird genetics for taxonomic analyses • investigate the extent of nesting areas and success • better understand the impact of rat and cat predation • better inform the development of appropriate management strategies for land birds in the protected area. (H) 3. Continue to undertake land bird transect point counts and monitoring of bird nesting success. (H) 4. Continue to undertake eradication of Madagascar fody. (H) 5. Continue to opportunistically monitor for new alien bird species introductions in areas of highest risk of invasion. (M) | | |
| Performance measures | <ol style="list-style-type: none"> 1. Abundance 2. Nesting success 3. Diversity. | Desired trend | <ol style="list-style-type: none"> 1. Positive 2. Positive 3. Constant. |
| Target/s | <ol style="list-style-type: none"> 1. No loss of species diversity or abundance. 2. Increase in nesting success as a result of invasive alien species control. | | |



6.12. Other terrestrial fauna (WHC x-invertebrates)

While the Aldabra giant tortoise and land birds are probably the best known of the terrestrial fauna of the protected area, there are also invertebrates, bats, land crabs and lizards. The invertebrate fauna is highly diverse and all groups except land crabs display a high degree of endemism.

Aldabra Atoll hosts a high abundance of insects with a total number exceeding 1000 species (Cogan & Hutson 1971). There are 116 known endemic species of insects on Aldabra Atoll and 74 species only found on the Aldabra Islands group (Aldabra, Assumption, Astove and Cosmoledo) (Frith 1979). The terrestrial invertebrates are included in the World Heritage Statement of Outstanding Universal Value under criteria x.

The most iconic of the endemic species to Aldabra Atoll is the Aldabra banded snail (*Rhachistia aldabrae*). This snail was locally abundant in the 1970s but due to a rapid decline in number and difficulty locating individuals, it was concluded in 2006 that the species was extinct. This was attributed to climate change, with suggestion that an increase in dry years had led to neonatal mortality and recruitment failure (Gerlach 2007). In August 2014, they were rediscovered on Malabar Island and monitoring is being undertaken into the population status of this species (Seychelles Islands Foundation 2014c).

Terrestrial invertebrates are found in greater density on the eastern side of the Atoll and during the wet months from December to April (Frith 1979). Insects occupy various habitats but are in higher abundance in areas of high floral diversity, such as mixed scrub rather than *Pemphis* thickets and mangrove forests.

Aldabra Atoll hosts various freshwater pools across the islands which vary from permanent pools to a lens over saline water (Cognan & Hutson 1971). Due to the high variability in chemical and biology in pools, there is rich aquatic insect fauna on Aldabra Atoll in comparison with other island groups.

There are 11 species of land crabs on Aldabra Island, including three types of hermit crabs (*Coenobita rugosus*, *Coenobita perlatus* and *Coenobita clypeatus*), Coconut or robber Crab (*Birgus latro*), *Geograpsus stormi*, *Geograpsus grayi*, *Grapsus tenuicrustatus*, *Cardisoma carnifex*, *Cardisoma frontalis*, *Ocypode cordimana* and *Ocypode ceratophthalma*.

Cardisoma carnifex are the most abundant species and are believed to play a significant role as scavengers and detritus feeders in the Aldabra ecosystem (Grubb 1971). The species is commonly seen underneath tortoises, feeding on faeces.

Coconut crabs have been surveyed twice per month since 2006. Monitoring has demonstrated season changes in populations, with more males seen between February and March and less crabs encountered at the end of the dry season.

There are three known species of lizards on Aldabra Atoll, comprising two gecko species, *Phelsuma abbotti* and *Hemidactylus mercatorius*, and the skink, *Cryptoblepharus boutonii* (Arnold 1976). The gecko *Phelsuma abbotti* is endemic to the Atoll. Although little research has been done on these species, it is believed their population status is stable.

Bats are the only mammals on Aldabra Atoll with four species found in the protected area. Three of these species are endemic to Aldabra Atoll.

Pteropus aldabrensis is a small flying fox endemic to the island which is assessed as vulnerable on the IUCN Red list of Threatened Animals. This species occurs on all islands of Aldabra Atoll, seen around small lagoon islets and coconut trees. *P. aldabrensis* never roosts in large colonies,

with the densest group recorded at less than 100 individuals (Hill 1971). Captured specimens have shown a general lack of ectoparasites which may be the result of not roosting in large dense colonies. There is little information on the breeding patterns of this species. It has been recorded to be breeding in March, June, October and November. Females have been observed carrying young in December and January. They consume a variety of fruits and flowers across the Atoll.

Triaenops pauliani is a leaf-nosed bat that was only discovered in 2008 after previously being misidentified as the cave dwelling *T. furculus*, which inhabits Madagascar (Goodman & Ranivo 2008). The species is only known to inhabit Picard Island. No information is available on the habitat, breeding patterns or diet of this species.

Chaerophon pusilla is a very small free-tailed bat endemic to Aldabra and is listed as vulnerable on the IUCN Red list of Threatened Animals (Hill 1971). This species is closely related to *Chaerophon pumilus*, a species common across Madagascar and Africa. This species has been recorded foraging and roosting in coconut and casuarina 'parkland.' *C. pusilla* hosts an endemic ectoparasite bat bug (*Hypoctenes hutsoni*). Monitoring for this species has been possible as they readily captured in mist nets and can be surveyed using bat detectors.



Plate 18 Coconut crabs are common on Aldabra

Taphozous mauritius is a middle sized sheath tailed bat which is widely distributed from Mauritius to Madagascar and much of sub-Saharan Africa (Hill 1971). The bats roost in any sites offering shelter from sun and rain, including dead palm leaves. They have also been recorded roosting in quite exposed areas. Their status is unknown and monitoring is hampered due to indistinctive echolocation and high flying preventing capture in mist nests.



Introduced fauna poses a significant threat to native terrestrial invertebrate species on Aldabra Atoll. Rats and cats are both potential predators of invertebrates.

A significant pressure on invertebrates, lizards, crabs and bats is predation by introduced predators such as rats and cats (Grande Terre). The four-clawed gecko (*Gehyra mutilata*) has been introduced to Picard Island, which may compete with the native species of the Atoll.

The invertebrates, lizards, crabs and bats of Aldabra Atoll are protected under the *Aldabra Special Reserve Regulations SIF 87/1981* and the *Wild Animals and Birds Protection Act 1966*. The management of these groups will focus on measures to control and reduce predation by rats and cats. Research and monitoring of the Aldabra banded snail is needed to further understand population status.

Table 22: Management of Terrestrial Fauna

| | | |
|---|--|--|
| Current condition | Terrestrial fauna populations are in a very good condition. | |
| Existing and potential pressures | <ul style="list-style-type: none"> • Rat predation • Predation by cats (Grande Terre) • Alien invertebrate introduction, e.g. crazy ants • Alien reptiles • Disease and/or parasite introduction | |
| Current major pressure/s | <ul style="list-style-type: none"> • Rat predation • Cat predation (Grand Terre). | |
| Management objective | To ensure that terrestrial fauna populations are not significantly impacted by invasive alien species. | |
| Management strategies | <ol style="list-style-type: none"> 1. Undertake feral cat and rat eradication programs in the protected area. (H-KMS) 2. Undertake a review of these 'other' fauna groups to identify the importance, level of threat and information needed to support future management. (H) 3. Through the above review, determine priorities for future monitoring of these other fauna groups. (H) | |
| Performance measures | To be determined. | Desired trend To be determined. |
| Target/s | To maintain or improve terrestrial fauna populations from 2016 levels. | |

6.13. Marine Turtles (KPI, WHC x)

Aldabra Atoll is the second largest rookery in the Western Indian Ocean for green turtles (*Chelonia mydas*) and also supports hawksbill turtle nesting (*Eretmochelys imbricata*). Loggerhead turtles (*Caretta caretta*) are occasionally sighted at the Atoll but do not nest there (Mortimer *et al.* 2011).

Green turtles are endangered due to historical global over exploitation of eggs, meat and other products (Wallace *et al.* 2010). Since protection for turtles was implemented in Aldabra in 1968, the population of green sea turtles has increased (Mortimer *et al.* 2011). Reproductive output for the Atoll rose from a mean annual estimated 2000–3000 clutches in the late 1960's up to approximately 15,600 during 2004–2008. This is equivalent to about 3100–5225 females nesting annually (assuming an average of 3–5 egg clutches per female) (Seabrook 1991).

Green turtles nest all year round with a preference for nesting on sandy beaches on the outside of the Atoll. Monitoring has shown a high intra and inter-annual variation in turtle nesting numbers. From 1995–2011 nesting activity was greatest during February to September, peaking during April to June, and lowest in November–December (Mortimer *et al.* 2006). Nesting occurs on around 50 beaches on the Atoll with females demonstrating strong site fidelity (Mortimer *et al.* 2003). Females lay 150-200 eggs in nest holes dug in open areas at the top of the beach. Eggs hatch after 55-70 days and emerge at night.



Plate 19: Green turtle nesting on Aldabra



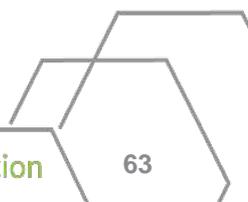
Hawksbill turtles are listed as critically endangered on the IUCN Red list of threatened animals, with historical and recent publications indicating extensive subpopulation decline in all major oceans over the last three hawksbill turtle generations (Wallace *et al.* 2010). This is a result of over-exploitation of adult females and eggs at nesting beaches, degradation of nesting habitats, take of juveniles and adults in foraging areas, incidental mortality relating to marine fisheries, and degradation of marine habitats

Hawksbill turtles are unique in the Western Indian Ocean as they nest primarily during the day (Bowler 2006). Hawksbills nest on the platform of sandy beaches in the lagoon, preferentially in the shade. It remains unknown why hawksbills nest in the lagoon but possible reasons could be to avoid competition with green turtles for nesting areas or due to differences in sand structure in the lagoon compared to the outside beaches. Their nesting season is from September to March, when females will lay 3-5 clutches of about 170 eggs. The eggs take 55-70 days to incubate before hatchlings emerge at dusk to race to the sea.



Plate 20: Turtle returning to the ocean

Historically, poaching of eggs, meat and other products has been the major threatening process for turtles on the island, however the take of turtles is illegal and has been controlled in recent years (Mortimer *et al.* 2011). The most significant current pressure on turtles is the predation of eggs and hatchlings by rats and cats (Grande Terre) affecting turtle recruitment.



Sea turtles are protected under the *Aldabra Special Reserve Regulations SIF 87/1981*, and the *Wild Animals (Turtles) Protection Regulations S/I 46/1994*. Monitoring of turtle populations has been ongoing since 1980, focusing predominantly on green turtles and has included track counts of species as well as tagging and satellite tagging. The management of marine turtles will focus on measures to control and eradicate cats and rats to prevent predation on eggs and hatchlings. Monitoring of turtle tracks will continue to determine the location and relative significance of turtle aggregation sites and rookeries within the protected area. Tagging studies will continue to determine turtle migration paths and foraging areas, as well as to identify turtle re-sightings. This research hopes to determine the status and trends of the turtle populations in the protected area in relation to historical populations and in relation to other turtle nesting sites in the region.

Table 23: Management of Marine Turtles

| | | | |
|---|--|----------------------|---|
| Current condition | Marine turtle populations are healthy and appear to still be increasing | | |
| Existing and potential pressures | <ul style="list-style-type: none"> • Egg and hatchling predation by invasive alien species (eg rats and cats). • • Poaching. • Light horizon disturbance from field station affecting hatchlings. | | |
| Current major pressure/s | <ul style="list-style-type: none"> • Egg and hatchling predation by rats. • Hatchling predation by cats (Grande Terre). | | |
| Management objective | To ensure turtles in the protected area are not significantly impacted by egg and hatchling predation by rats and cats. | | |
| Management strategies | <ol style="list-style-type: none"> 1. Undertake feral cat and rat eradication programs in the protected area. (H-KMS) 2. Determine the location and relative significance of turtle aggregation sites and rookeries within the protected area. (H) 3. Continue to undertake tagging studies to determine turtle migration paths and foraging areas, as well as to identify turtle re-sightings. (M) 4. Continue turtle monitoring programs within the protected area. (H) 5. Undertake research to determine the status and trends of the turtle populations in the protected area in relation to historical populations. (M) | | |
| Performance measures | <ol style="list-style-type: none"> 1. Number of nesting turtles 2. Nesting success. | Desired trend | <ol style="list-style-type: none"> 1. Increasing 2. Increasing. |
| Target/s | <ol style="list-style-type: none"> 1. No loss of turtle diversity in the protected area. 2. Increase in turtle abundance in the protected area. | | |



6.14. Sea and shorebirds (KPI, WHC x)

Aldabra Atoll has abundant sea and shorebird populations, with a variety of resident and migratory terns, frigates and waders.

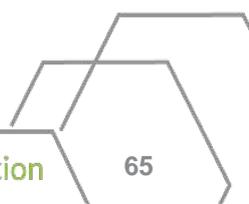
Aldabra Atoll supports the largest breeding population of frigatebirds in the Indian Ocean, and the second largest in the world, with 6,000 pairs of lesser frigatebird (*Fregata ariel*) and, 4,000 pairs of great frigatebird (*Fregata minor*) (Šúr *et al.* 2013a). Frigatebirds nest on the north side of the lagoon in four separate colonies (Grand Poche, Passe Gionnet, Camp Frigate and Middle Camp)

Aldabra also supports a large breeding population of red-footed boobies (*Sula sula*) estimated at 6,000-7,000 breeding pairs (Birdlife International 2014b). Red-footed boobies nest in the mangroves on the fringe of the lagoon but are also known to nest in the *Pemphis acidula* shrubs. All species nest on the lee shores, sheltered from south east winds. The species exclusively nest in areas not used by frigate population, possibly due to competition for area (Burger & Betts 2001).



Plate 21: Frigatebird nesting on the north side of the lagoon

There are 12 waders on Aldabra with two species, crab plover (*Dromas ardeola*) and ruddy turnstone (*Arenaria interpres*), comprising the bulk (over 80%) of the summer population. The crab plover population numbers about 2,800 individuals (about 5% of the global population) between November-April with a large drop off in May. The main arrival of ruddy turnstones is in September with the numbers remaining high at 500-1000 individuals until December. There is a drop in population in January and February.



The world's largest tern, the Caspian tern (*Hydroprogne caspia*) breeds on Aldabra (Seychelles Islands Foundation 2013b). The Aldabra population is notable for being the only oceanic breeding population of this species. Only 6-10 pairs are thought to nest around the Atoll so sightings of juveniles are uncommon, however each breeding season, two or three juvenile Caspian terns are typically observed on the Atoll. Aldabra Atoll also hosts one of two of the only oceanic breeding population of flamingos in the world, the other being at the Galapagos Islands.



Plate 22: Aldabra hosts one of the world's two oceanic flamingo populations

Historically, poaching and hunting has had major effects on the population of sea birds on the Island. Frigatebirds were frequently hunted during the 1960's, however take of birds is illegal and has been controlled in recent years (Šúr *et al.* 2013a). The most significant current pressure is the predation of eggs and birds by rats and cats affecting bird recruitment and populations. Cats are considered to have had a significant effect on distribution of frigatebirds and smaller seabird species on Grande Terre. Tourism can potentially disturb breeding and foraging sea and shorebirds and minimum approach distances are enforced.

Sea and shorebirds of Aldabra are protected under the *Aldabra Special Reserve Regulations SIF 87/1981*, *Wild Animals and Birds Protection Act 1966*, *Wild Birds Protection Regulations S/me 26/1966*, and the *Wild Birds Protection (Nature Reserves) Regulations S /me 27/1966*. Aldabra Atoll has been identified as an Important Bird Area by Birdlife International (Birdlife International 2104b) and has seven important wetland types under the RAMSAR convention. Current management of seabirds has involved population monitoring and restriction of visitor access to nesting areas. The management of seabirds will continue to focus on measures to control and reduce cats and rats on the Atoll to prevent predation on eggs and juveniles. There will be a continued focus on research to determine baseline population and nesting success to better inform the development of appropriate management strategies for sea birds in the protected area.



Table 24: Management of Sea and Shorebirds

| | | | |
|---|--|----------------------|--|
| Current condition | Sea and shorebird populations are in a very good condition. | | |
| Existing and potential pressures | <ul style="list-style-type: none"> • Egg and hatchling predation by rats. • Predation by cats (Grande Terre). • Other alien invasive species introduction. • Human disturbance to nesting and roosting birds e.g. tourism. • Disease and/or parasite introduction from domestic and migratory birds. • Oil spill from shipping. • Poaching. | | |
| Current major pressure/s | <ul style="list-style-type: none"> • Egg and hatchling predation by rats. • Predation by cats (Grande Terre). • Tourism in years of high visitation | | |
| Management objective | To ensure that sea and shorebird populations in the protected area are not significantly impacted by invasive alien species or tourism. | | |
| Management strategies | <ol style="list-style-type: none"> 1. Undertake feral cat and rat eradication programs in the protected area. (H-KMS) 2. Continue to undertake research to: <ul style="list-style-type: none"> • obtain better baseline data for monitoring • investigate the extent of nesting and foraging areas • investigate nesting success on species other than tropicbirds and factors affecting this • better understand the impact of rat and cat predation • better inform the development of appropriate management strategies for sea and shorebirds in the protected area. (H) 3. Implement and/or continue to undertake seabird monitoring for key seabird populations. (M) 4. Undertake monitoring to ascertain the effectiveness of minimum approach distances to sea and shorebirds for visitors. 5. Continue to opportunistically monitor for new alien bird species introductions in areas of highest risk of invasion. (M) | | |
| Performance measures | <ol style="list-style-type: none"> 1. Abundance 2. Nesting success 3. Diversity. | Desired trend | <ol style="list-style-type: none"> 1. Positive 2. Positive 3. Constant. |
| Target/s | <ol style="list-style-type: none"> 1. No loss of species diversity as a result of impacts from invasive alien species. 2. An increase in abundance of species that have been historically impacted by invasive alien species. 3. No decrease in nesting success as a result of impacts from invasive alien species. | | |

6.15. Fish (KPI)

Aldabra Atoll is home to an abundant tropical fish and diverse fauna. There are 244 species of fish recorded in the areas surrounding Aldabra and in the lagoon, these include 10 species of shark. Blacktip reef (*Carcharinus melanopterus*) and sicklefin lemon (*Negaprion acutides*) are the most abundant species in the lagoon while silvertip shark (*Carcharhinus albimarginatus*) were the most common on the outer reef. Aldabra Atoll is a critical location for long-lived, large-bodied fish, such as groupers, as the protected environment allows for these species to attain full size, and such individuals are important for population recruitment (Buckley *et al.* 2005). The lagoon on Aldabra is an important nursery grounds for juvenile fish and sharks.

There have been quantitative surveys of finfish from 1998, following the mass coral bleaching, using rapid visual assessment techniques on permanently marked transects at 10 m and 20 m depth (Downing *et al.* 2005). Catch rates from subsistence fishing trips have also contributed to the knowledge of fish stocks (Pistorius & Taylor 2009). Although results from quantitative studies demonstrated insignificant change in fish assemblage, studies of catch rate from 1997-2007 has demonstrated a decline in piscivore abundance over this time period which could be attributable to coral bleaching and/or local fishing.



Plate 23: The waters of Aldabra have diverse fish fauna with 244 species of fish recorded at Aldabra

Fish populations of Aldabra are generally assumed to be in good condition due to the lack of anthropogenic and fishing pressure in the area. Subsistence fishing for Aldabra residents is permitted in some areas but has the potential to cause localised depletion of targeted fish and must therefore be managed carefully. The potential for further coral bleaching could have a major effect on habitat structure, therefore affecting fish populations. Illegal fishing is also a potential threat to local populations.

Fish of Aldabra are protected under the *Aldabra Special Reserve Regulations SIF 87/1981*, *Fisheries Act 1986*, *Fisheries Regulations 1987* and *Licences (Fisheries) Regulations S/I 24/1987*. Sharks are fully protected from fishing in the reserve. Research is needed to better characterise fish diversity and abundance in the protected area. Management will continue to monitor subsistence fishing by Aldabra staff, identifying species caught, measuring fishes and calculating catch per unit effort and supported by fish monitoring (i.e. SCUBA and BRUVs surveys). An assessment of the effectiveness of zoning arrangements in regard to species caught by subsistence fishing should be undertaken.



Table 25: Management of Finfish Assemblages

| | | | |
|---|---|----------------------|---|
| Current condition | Finfish assemblages are in a very good condition. | | |
| Existing and potential pressures | <ul style="list-style-type: none"> • Marine debris • Localised depletion from subsistence fishing • Poaching • Localised water quality impacts from field station (septic tank leaching) • Coral bleaching, loss of habitat as a result of climate change • Localised water quality impacts from field station (fuel transfer and storage, toxic chemical storage and disposal) • Oil spill from shipping. | | |
| Current major pressure/s | <ul style="list-style-type: none"> • Marine debris • Localised depletion from subsistence fishing | | |
| Management objective | To ensure the species diversity and abundance of finfish species are not significantly impacted by fishing in appropriate zones of the protected area. | | |
| Management strategies | <ol style="list-style-type: none"> 1. Continue to monitor subsistence fishing by Aldabra staff, including species caught, measurements of fishes caught and catch per unit effort. (H-KMS) 2. Assess the effectiveness of zoning arrangements with regard to fish species most commonly targeted by subsistence fishing. (H-KMS) 3. Undertake monitoring of fish diversity and abundance (currently done using SCUBA and BRUVs). (H) 4. Undertake research to identify aggregation and spawning sites and times for key finfish species. (H) 5. Identify finfish species that require protection from fishing and provide the necessary legislative protection to achieve this. (H) 6. Undertake research to better characterise finfish diversity and abundance in the protected area. (M) | | |
| Performance measures | <ol style="list-style-type: none"> 1. Diversity 2. Abundance. | Desired trend | <ol style="list-style-type: none"> 1. Constant 2. Constant or positive. |
| Target/s | <ol style="list-style-type: none"> 1. No loss of finfish diversity as a result of human activity in the protected area. 2. No loss of protected finfish species abundance as a result of human activities in the protected area. 3. Abundance and size composition of finfish species and no-take areas of the ecological reserve to be at natural levels. 4. Management targets for abundance of target finfish species in all other areas to be 80% composition similarity, and 80% size similarity for indicator species. | | |



6.16. Marine mammals

There has been little research into the marine mammals of Aldabra Atoll and most records of marine mammals are from opportunistic observations (Hermans & Pistorious 2008). Humpback whales are the most commonly sighted marine mammals, being frequently seen from July to October when the species migrate to tropical waters to raise their calves. There are 15 species of marine mammals which include: Dugong (*Dugong dugon*)

- Spinner dolphin (*Stenella longirostris*)
- Bottlenose dolphin (*Tursiops truncatus*)
- Blainville's beaked whale (*Mesoplodon densirostris*)
- Short-finned pilot whale (*Globicephala macrorhynchus*)
- Sperm whale (*Physeter macrocephalus*)
- Killer whale (*Orcinus orca*)
- Cuvier's beaked whale (*Ziphius cavirostris*)
- Common dolphin (*Delphinus delphis*)
- Spotted dolphin (*Stenella attenuata*)
- False killer whale (*Pseudorca crassidens*)
- Risso's dolphin (*Grampus griseus*)
- Melon-headed whale (*Peponocephala electra*)
- Humpback whale (*Megaptera novaeangliae*)
- Southern minke whale (*Balaenoptera bonaerensis*)



Plate 24: Aldabra Atoll is the only location in the Seychelles where dugongs are still found

Dugongs are declared vulnerable by IUCN red list and were thought to be at Aldabra until 2001. Aldabra Atoll is the only location in the Seychelles that dugongs are still found with observation of breeding activity around the Atoll (Seychelles Islands Foundation 2013a). There are elevated sightings of dugongs between July and October. Observations are significantly clustered in the western end of lagoon, presumably due to the large seagrass meadows in the area, but also because the proximity to the research station increases opportunistic sightings (Hamylton *et al.* 2012).

Historically poaching of whales and dugongs have been the major threat to these species, however take of marine mammals is illegal and has been controlled in recent years.

Marine mammals are protected under the *Aldabra Special Reserve Regulations SIF 87/1981*. In addition, the Seychelles is a signatory to the International Whaling Commission's Indian Ocean Whale Sanctuary. Established in 1979, this area bans all types of commercial whaling. Opportunistic sightings and recording of cetaceans in and adjacent to the protected area will continue. Investigation into the distribution, abundance and critical habitats of dugong in the protected area is being conducted to increase regional understanding and to inform management strategies for the protected area. This project is funded by the Western Indian Ocean Marine Science Association under the Marine and Coastal Science for Management Programme, with activities spanned across several countries including Mozambique, Tanzania, Comoros and Kenya (Seychelles Islands Foundation 2014b).



Table 26: Management of Marine Mammals

| | | | |
|---|--|----------------------|--|
| Current condition | Marine mammals are in a very good condition. | | |
| Existing and potential pressures | <ul style="list-style-type: none"> Oil spill from shipping. | | |
| Current major pressure/s | No current major pressures within the protected area. but several of the species face pressures outside Aldabra's waters and may therefore decline elsewhere | | |
| Management objective | To ensure that marine mammals within the protected area are not significantly impacted as a result of human activities. | | |
| Management strategies | <ol style="list-style-type: none"> Continue opportunistic sightings and recording of cetaceans in and adjacent to the protected area. (H) Undertake research to: <ul style="list-style-type: none"> Investigate distribution and abundance of dugongs in the protected area identify critical habitat for dugongs in the protected area understand the status of dugongs in the region inform the development of appropriate management strategies for dugongs in the protected area. (H) | | |
| Performance measures | To be developed as required | Desired trend | |
| Target/s | No loss of dugong abundance as a result of human activity in the protected area. | | |

7 Management of the social values



Social values are the major cultural, aesthetic, recreational and economic attributes of the protected area. Striking the right balance between protecting the environment for future generations and allowing ongoing sustainable use is a key future challenge for management of Aldabra.

7.1. Ecotourism

While the value of Aldabra Atoll for ecotourism opportunity is high and it is a destination that is much sought after, in reality the remoteness of the Atoll and the cost to get there have been limiting factors for tourism. In addition, increases in piracy in the region between 2009 and 2012 resulted in large decreases in visitor numbers.

The draw for tourists to the area is the untouched nature of the Atoll and the unique and unusual wildlife found there. The acknowledgement of these natural values through designation of the Atoll as a World Heritage Area has further enhanced the protected area's marketability as a tourism destination. When visiting the protected area, tourists participate in wildlife viewing, snorkelling and SCUBA diving.



Plate 25 Nature-based activities are the focus for a low and sustainable level of ecotourism

Ecotourism activities have the potential to make an important contribution to protecting the Atoll's ecosystems by fostering a greater understanding and appreciation of the environment and financially supporting management. However, unless carefully managed, visitation has the potential to cause environmental damage, particularly if visitor numbers increase. This includes damage to marine environments through indiscriminate anchoring, impacts on fish stocks if fishing by tourists is permitted, disturbance of landforms through trampling, disturbance to nesting seabirds and land birds, and disturbance of nesting tortoises and turtles. In addition, increased visitation to the protected area brings a proportionately higher risk of biosecurity breaches. Increased visitation may also bring increased demand for additional infrastructure to service the tourism industry for example an airstrip, accommodation facilities, new vessel moorings or a jetty on the Atoll.



The decree that states the goals for Aldabra Atoll makes no mention of tourism, however in 1995 SIF endorsed the need to establish a tourism policy for strictly controlled and limited nature-based tourism, with the specific purpose of raising revenue for the protection and conservation of the Atoll (Beaver and Gerlach 1998). Seychelles Islands Foundation Tourism Regulations for Aldabra state that *'all vessels must have clearance in writing from SIF head office and the Seychelles Port Authority before visiting Aldabra'*. Tourist access is limited to appropriate zones and only the following operations are permitted:

- Cruise ship tourism
- Live aboard charter yachts and private yachts
- Live aboard dive boats
- Land based nature tourism limited to 12 persons at any time
- Educational expeditions limited to 12 participants including expedition leaders. (Beaver and Gerlach 1998)

While at 2015 the level of tourism demand was low due to piracy issues off East Africa, it is conceivable that in the future, tourism demand will increase. This may also bring requests for tourism infrastructure and for visitor access to additional areas. At this point this level of facilities is not considered compatible with the Vision for the Atoll. The Tourism Policy for Aldabra Atoll is attached at Appendix 4.

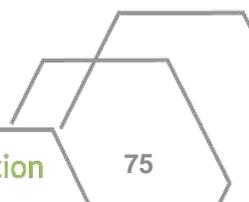
Tourism operations to the protected area require permission from SIF and a fee is payable. Tourism regulations apply which cover access, waste management, biosecurity and group sizes amongst others, and landing fees are charged. Tourism brings valuable revenue to sustain conservation on Aldabra, and will be promoted within an ecologically sustainable and manageable framework.

The objectives in relation to nature-based tourism are to manage tourism activities in the protected area in a manner that is consistent with maintaining the protected area's values, to maintain the values of the protected area on which the nature-based tourism industry depends, and assist in maintaining sustainable ecotourism in the protected area.



Table 27: Management of Ecotourism

| | |
|------------------------------|---|
| Requirements | <ul style="list-style-type: none"> • Clean beaches. • High water quality. • Healthy ecological communities. • High aesthetic quality of the environment. • Abundance of fauna. • Access to the natural values of the Atoll in appropriate areas. |
| Management objectives | <ol style="list-style-type: none"> 1. To ensure that eco-tourism activities are managed in a manner that is consistent with maintaining the ecological and social values of the protected area. 2. To maintain the ecological and social values of the protected area that are important to the tourism industry. |
| Management strategies | <ol style="list-style-type: none"> 1. Ensure all tourism activities are approved by SIF. (H-KMS) 2. Ensure that tour operators and visitors are aware of and comply with the SIF tourism policy, regulations and zoning legislation. (H) 3. Develop <i>Codes of Practice</i> for commercial marine tourism operations in the protected area including reporting requirements. (M) 4. Assess the nature, level and potential environmental impacts of tourism within the protected area. (H) 5. Consider licensing commercial tourism operations within the protected area with appropriate conditions including a requirement to report on their activities as part of the protected area's audit process. (M) |
| Reporting | Annual visitation report including numbers, origin, length of stay, activities and revenue generated. |
| Target/s | Implementation of strategies within agreed timeframes. |



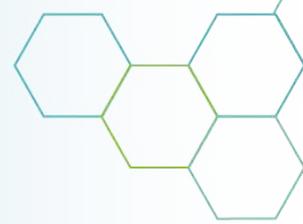
7.2. Subsistence fishing

Subsistence fishing is undertaken by SIF staff who reside on Aldabra Atoll to feed the Atoll's residents. Pelagic and demersal species are taken and accurate records are kept of species caught and the total weight of each species taken annually. The amount of fish caught by subsistence fishing varies dependent on the number of research staff and contractors residing on the island during the year. Total catches in recent years were 3893 kg in 2012 and 2888 kg in 2013.



Plate 26: Management staff on the remote research station rely on local fish to supplement food brought to Aldabra

While fresh fish is an important food source for those residing on Aldabra, taking these amounts of fish from a small area may cause localised depletion of some species. The ecological effects of subsistence fishing require investigation and it may be necessary to put additional management controls in place. A Fishing Policy for the protected area is at Appendix 9.



Management of this activity will involve restriction of fishing to approved zones, close monitoring of catch and effort and research to consider the impacts of this activity on the marine communities of the protected area.

Table 28: Management of Subsistence Fishing

| | |
|------------------------------|--|
| Requirements | <ul style="list-style-type: none"> • Access to appropriate areas of the protected area • Maintenance of habitat and fish stocks • High water quality. |
| Management objectives | <ol style="list-style-type: none"> 1. To provide the opportunity for local staff to source fresh fish to supplement their diet whilst working on the Atoll. 2. To ensure that subsistence fishing in the protected area is sustainable and does not impact on the protected area's values. |
| Management strategies | <ol style="list-style-type: none"> 1. Provide zones for sourcing fresh fish for management staff. (H) 2. Undertake research to support the development of management targets and performance measures for targeted finfish species that will ensure ecologically sustainable subsistence fishing in the protected area. (H-KMS) 3. Continue to monitor and report on subsistence fishing catch/effort within the protected area. (H) 4. Continue to undertake research and monitoring of the ecological effects of subsistence fishing in the protected area and review management controls as appropriate. (H) 5. Monitor the abundance of selected target finfish species to assess effectiveness of management strategies, with a particular emphasis on the effectiveness of sanctuary zones. (H) 6. Discourage the take of long lived slow growing species through education of staff on longevity and vulnerability of such species. (H) 7. Investigate barotrauma release methods to successfully return vulnerable species fish to sea. (M) |
| Reporting | Annual ASC report to include CPUE, and consider trends for indicator species. |
| Target/s | Sustainable take of target species from the Food Security Zones. |



7.3. Research opportunities (WHC x)

The protected area provides a unique opportunity for scientific research. The environment is undisturbed and there is existing infrastructure tailored to support field research. Aldabra is the second largest coral atoll in the World, home to an unusual assemblage of plants and animals and is largely free of anthropogenic disturbance. The protected area, therefore, is of great scientific importance and provides an unequalled opportunity to study island endemism, ecological processes and the effects of climate change.

A good understanding of how the ecology of the protected area functions is a fundamental requirement for effective management. In addition, studies on how the ecology of the protected area is affected by climate change provide broader benefits in understanding of climate change response in other areas. Research programs should, ideally, be designed to fill key gaps in existing knowledge and generate knowledge that directly contributes to management. However, other research will be encouraged where this adds to understanding of the values of Aldabra



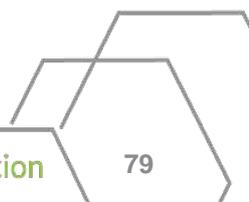
Plate 27 Turtle research



All research within the protected area requires the appropriate research permits and/or approvals from SIF. Scientific research is permitted in all zones of the protected area subject to assessment of proposed activities.

Table 29: Management of Scientific Research

| | |
|------------------------------|--|
| Requirements | <ol style="list-style-type: none"> 1. Access to representative sites free of major human influences as 'control sites'. 2. Access to representative sites covering the range of major human activities in the protected area as 'impact' sites. 3. Access to the protected area for ecological research opportunities in appropriate zones. 4. Use of Aldabra infrastructure and facilities. |
| Management objectives | <ol style="list-style-type: none"> 1. To promote the use of the protected area for ecological research. 2. To ensure ecological research is ethical and ecologically sustainable. 3. To maintain the ecological values of the protected area that are important for scientific research. |
| Management strategies | <ol style="list-style-type: none"> 1. Determine key priorities for future research to inform and contribute to the management of Aldabra. (H-KMS) 2. Provide facilities on the Atoll that encourage and facilitate researchers to come to Aldabra to undertake priority research projects. (H) 3. Seek partnerships and collaborations to maximise opportunities for research on Aldabra. (H) |
| Reporting | Annual number of current research and monitoring projects approved for Aldabra. |
| Target/s | <ol style="list-style-type: none"> 1. To increase knowledge and understanding of Aldabra 2. To increase number of scientific papers 3. To increase understanding of Aldabra's role within a regional and global conservation context |



7.4. Aesthetic values (WHC vii)

Aldabra has significant natural beauty which was recognised in its world heritage listing. The aesthetic value of the protected area is captured in the statement of Outstanding Universal Value which says

“The richness and diversity of the ocean and landscapes result in an array of colours and formations that contribute to the atoll’s scenic and aesthetic appeal” and under World Heritage Criteria vii which states *“Aldabra Atoll consists of four main islands of coral limestone separated by narrow passes and enclosing a large shallow lagoon, providing a superlative spectacle of natural phenomena”* (UNESCO undated b).

The aesthetic value of the protected area can be appreciated from the shoreline of the protected area, from the ocean or from other vantage points on the islands. Whilst there are some man-made structures on the Island, it is anticipated that new infrastructure will be minimised and designed to protect the aesthetic values. In designing new or replacement infrastructure, management should consider the siting, design, height, materials, and colours to minimise visual impacts to the natural environment.

Inappropriate structures along the coastline, on the islands and in the surrounding waters have the potential to degrade the aesthetic values of the protected area. Any infrastructure projects must therefore be planned with careful consideration of this issue.

Table 30: Management of Aesthetic Values

| | |
|------------------------------|--|
| Requirements | Generally uninterrupted natural vistas. |
| Management objectives | To ensure that the aesthetic values of the protected area are maintained. |
| Management strategies | <ol style="list-style-type: none"> 1. Review all proposals for new or replacement infrastructure to ensure installation of necessary terrestrial or marine infrastructure does not detract from the aesthetic value of the protected area. (H-KMS) 2. Where possible infrastructure should be designed and placed in such a way to minimise visual impacts. (H) 3. Determine propriety view sheds that should be maintained. (H) 4. Conduct regular beach clean ups to remove marine debris. (L) |
| Reporting | <ol style="list-style-type: none"> 1. Annual reporting of any new infrastructure developed on the Island. 2. Litter on beaches. |
| Target/s | No significant negative impacts on aesthetic values. |



7.5. Historic use

There are various historical features on Aldabra Atoll, most of which are clustered around the old settlement on Picard Island. A colony was established in 1888, which included the building of a church, cemetery, jail and a turtle bone crushing establishment at La Gigi (Beaver & Gerlach 1998). The relics of these buildings still remain today.

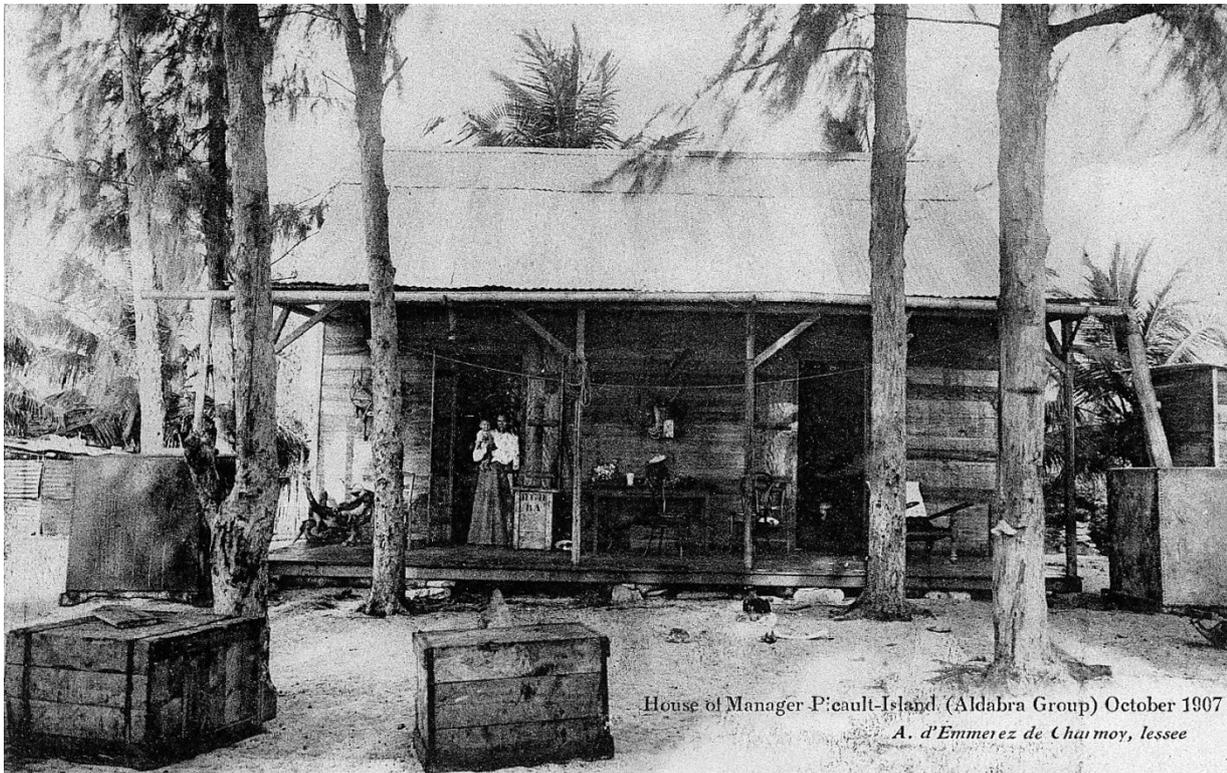


Plate 28: The Aldabra Manager's house 1907

Since the 1600s, the Portuguese collected Aldabra giant tortoises to eat on their sea voyages. Subsequently, a colony was established by the British to exploit the natural resources of the Atoll. The British continued to exploit tortoises as well as green turtles. They also brought Chinese workers to harvest sea cucumbers and attempted several other schemes such as guano and phosphate mining and mangrove logging which failed due to the difficult logistics of operating on Aldabra. The effects of these schemes left lasting damage with the introduction of alien species such as goats, rats, cats, coconuts and sisal onto the Atoll (Beaver & Gerlach 1998).

In 1962, the British military conducted surveys to evaluate Aldabra's potential as an Anglo-American military base which would have included construction of an airstrip. Following the public outcry and the withdrawal of plans to develop Aldabra as a military base, the Royal Society of London acquired the lease on the Atoll. The Royal Society planned and built the research station on Picard Island in 1971.

Management will focus on educating staff and visitors of the historical sites and traditional uses of Aldabra Atoll and the potential impacts of human activities on these historical sites. Cost effective monitoring of historical sites will be developed to ensure the maintenance of identified sites of importance .

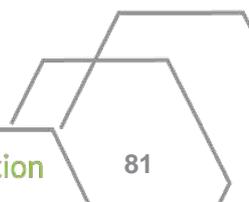


Table 31: Management of Historical Uses

| | |
|------------------------------|--|
| Requirements | NA |
| Management objectives | To ensure that human activities do not significantly impact historic sites in the protected area. |
| Management strategies | <ol style="list-style-type: none"> 1. Undertake an inventory of the condition of historic sites on Aldabra and, where necessary, undertake works to restore and maintain these sites. (H) 2. Develop a cost-effective monitoring strategy for the heritage sites within the protected area. (M) 3. Undertake to obtain oral histories of Aldabra from people who were involved in historical activities in the protected area. (M) 4. Prepare education materials for visitors to interpret and highlight the history of use and 'story' of Aldabra. (L) |
| Reporting | To be determined. |
| Target/s | Maintenance of listed historic sites. |

7.6. Remoteness

Aldabra Atoll is remote from population centres, difficult to access and has a low level of tourism visitation. Tourism pressures have also been kept low due to the threat of piracy in the region. Despite this isolation, it should be noted that the demand for adventure tourism is increasing and the industry is taking visitors to places originally thought inaccessible. A good example is the significant growth in tourism to Antarctica over the last two decades. There is potential for increases in visitation to impact on the feeling of remoteness and diminish the visitors' experience of Aldabra. This example highlights the need for a positive and proactive management approach where protected areas are recognised and valued for their 'wilderness' or 'remoteness' characteristics.

Feelings of 'remoteness' or 'wilderness' are subjective and a person's perception of remoteness will vary between individuals. However, remoteness is likely to have the following common elements;

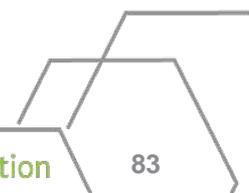
- An undisturbed and natural environment.
- No or few people.
- No or limited human infrastructure (i.e. undisturbed natural view sheds).
- No or limited human noise.
- No or few other signs of human activity, disturbance or presence.



This management plan deals with many of these aspects in other sections with strategies to manage impacts to the environment and protecting aesthetic values. The area that is not dealt with elsewhere is the issue of controlling visitor numbers to maintain the feeling of remoteness on Aldabra. To adequately maintain a perception of remoteness, it is proposed that only one tourism group is permitted at any one time and consideration be given to setting a maximum tour group size. It is proposed that there be a maximum tour group size of 100 persons applied for the Atoll. These targets should provide a starting point to guide management and can be revised in the future following further consultation with managers, visitors and other stakeholders.

Table 32: Management of Remoteness

| | |
|------------------------------|--|
| Requirements | <ul style="list-style-type: none"> • Uninterrupted seascapes and landscapes • Limited numbers of visitors and vessels • Low level of facilities/infrastructure (i.e. a natural setting) • Limited human noise and disturbance. |
| Management objective | To maintain the feeling of remoteness for visitors to Aldabra through limiting visitor/vessel numbers and maintaining visual values. |
| Management strategies | <ol style="list-style-type: none"> 1. Manage tourism on Aldabra to meet targets for maintaining 'remoteness' values. (H) 2. Review targets for remoteness after five years and amend if appropriate. (M) 3. Identify key view sheds/areas that are important to maintain free of human infrastructure and disturbance. (H) 4. Ensure aesthetic values (See 7.4) are managed to maintain 'remoteness' for visitors to the Atoll.(H) 5. Minimise unnatural noise on the Atoll, particularly in the key visitor sites. (L) |
| Reporting | Preparation and reporting/presentation of annual data on visitation to the Island. |
| Target/s | <ol style="list-style-type: none"> 1. Maximum of one visitor group (tourist vessel) at the Atoll at any one time. 2. Maximum cruise ship capacity of 800 people. 3. Maximum number of people permitted ashore at any one time of 100 people. 4. Maximum tour group size while walking on Picard of 20 visitors at any one time. 5. Maximum tour group size for sensitive activities, e.g. frigatebird viewing, diving, of 10 visitors at any one time (e.g. per boat, per dive). |



8 Performance assessment



There are various levels of performance assessments required to be undertaken by SIF to meet agency and World Heritage reporting requirements.

8.1. Assessment of management effectiveness

The effectiveness of the management plan will be reviewed every two years through a formal auditing and review process. The audits will include reports on the status of the key ecological values of the protected area and an assessment of the effectiveness of management strategies. Overall management performance will be audited via a status report assessing compliance against the stated key ecological and social management targets (i.e. outcome based approach) and against progress towards implementation of the key management strategies (i.e. activity based approach).

The annual review will include the identification of issues affecting implementation, resource allocation, progress in implementing the management plan strategies, and the condition of ecological and social values against performance measures and targets. Preparation of annual work plans and monitoring programs for the protected area's values will inform the audit process.

8.2. Assessment of the World Heritage Outstanding Universal Value

As the protected area is a World Heritage site, SIF has obligations to report on the maintenance of the Outstanding Universal Value (OUV) of the site (see statement of OUV Section 2.1.1). This reporting comprises UNESCO World Heritage Convention monitoring through periodic reporting every six years; and a three yearly IUCN World Heritage Conservation Outlook Assessment prepared by an IUCN expert panel in consultation with SIF. This management plan has been structured to reflect the OUV and therefore the values align with the IUCN reporting requirements. The intention, therefore, is that the annual management reviews and audit by SIF will provide the information to support the IUCN reporting requirements.

References



- Aldabra Marine Programme (undated). Atoll and other sites. Accessed 27 January 2015 [<http://www.aldabra.org>].
- Arnold, E. N. (1976). *Fossil reptiles from Aldabra Atoll, Indian Ocean*. Bull. of the British Museum (Zool.), Vol. 29, No. 2
- Beaver K. & R, Gerlach (1998). Aldabra Management Plan- A management plan for the Aldabra Atoll, Seychelles Natural World Heritage Site 1998-2005. Prepared for Seychelles Islands Foundation and GEF/World Bank
- Benson, C. W. & M.J. Penny (1971). The land birds of Aldabra. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 417-527.
- Birdlife International (2014a). Important Bird and Biodiversity Areas. Accessed 4 December 2014. [<http://www.birdlife.org>]
- BirdLife International (2014b) Important Bird Areas factsheet: Aldabra Atoll. Accessed 4 December 2014 [<http://www.birdlife.org>]
- Birdlife International (2016). Endemic Bird Area factsheet: Aldabra. Accessed 3 July 2016 [<http://www.birdlife.org>]
- Bowler, J. (2006). *Wildlife of Seychelles*. WILDGuides
- Buckley, R., N. Downing, B. Stobart & K. Teleki (2005). Aldabra Marine Programme Phase V. Report on the 2005 Aldabra Marine Program Research.
- Bunbury N., R. von Brandus, J. Currie, M. Jean Baptiste, W. Accouche, J. Souyave, P. Haupt & F. Fleischer-Dogley (2013a). Goats eradicated from Aldabra Atoll. *Aliens* 33: 18-22.
- Bunbury N., T. Mahoune, J. Raguain, H. Richards & F. Fleischer-Dogley (2013b). Red-whiskered bulbul eradicated from Aldabra. *Aliens* 33: 7-8.
- Burger, A. E., & M. Betts (2001). Monitoring populations of Red-footed Boobies *Sula* and frigatebirds *Fregata* spp. breeding on Aldabra Atoll, Indian Ocean. *BULLETIN-BRITISH ORNITHOLOGISTS CLUB*, 121(4): 236-246.
- Cogan, B. H. & A.M. Hutson (1971). Preliminary observations on the affinities and composition of the insect fauna of Aldabra. *Philosophical Transactions of the Royal Society of London. B, Biological Sciences*, 260(836): 315-325.
- Collar, N. J. (1993). The conservation status in 1982 of the Aldabra White-throated Rail *Dryolimnas cuvieri aldabranus*. *Bird Conservation International*, 3(04), 299-305.
- Convention on Biological Diversity (undated). Invasive Alien Species. Accessed on 4 December 2014 [<http://www.cbd.int>]



Crommenacker J, V, D, (2012) Aldabra Research Station Scientific Coordinator's Annual Report. Seychelles Islands Foundation.

de Voogd, N.J., D. F. R. Cleary & F. Dekker (2013) *The coral-killing sponge Terpios hoshinota invades Indonesia*. *Coral Reefs* 32 (3): 755

Donaldson, A., & B.A. Whitton (1977a) Chemistry of freshwater pools on Aldabra. *Atoll Research Bulletin (USA)*. no. 213

Donaldson, A., & B.A. Whitton (1977b). Algal flora of freshwater habitats on Aldabra. *Atoll Research Bulletin (USA)*. no. 215.

Downing, N., R. Buckley, B. Stobart, L. LeClair, & K. Teleki, K. (2005). Reef fish diversity at Aldabra Atoll, Seychelles, during the five years following the 1998 coral bleaching event. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 363(1826): 257-261.

Duhec, A., Balderson, S., & Doak, N. (2010) Climate Data Report for Aldabra Atoll: 1949-2009. Unpublished Report. Seychelles Islands Foundation.

Farrow, G.E. (1971). The Climate of Aldabra. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, Volume 260, Issue 836, pp. 67-91

Fosberg, F. R. (1971). Preliminary survey of Aldabra vegetation. *Philosophical Transactions of the Royal Society of London. B, Biological Sciences*, 260(836), 215-225.

Frith, D. W. (1979). A twelve month study of insect abundance and composition at various localities on Aldabra Atoll. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 119-126.

Gerlach, J. (2007). Short-term climate change and the extinction of the snail *Rachistia aldabrae* (Gastropoda: Pulmonata). *Biology Letters* 3:581–584

Gibson, C. W. D. & J. Hamilton (1983). Feeding ecology and seasonal movements of giant tortoises on Aldabra Atoll. *Oecologia*, 56(1), 84-92.

Gibson, C. W. D. & J. Hamilton (1984). Population processes in a large herbivorous reptile: the giant tortoise of Aldabra Atoll. *Oecologia*, 61(2), 230-240.

Goodman S. M. & J. Ranivo (2008). A new species of *Triaenops* (Mammalia, Chiroptera, Hipposideridae) from Aldabra Atoll, Picard Island (Seychelles). *Zoosystema* 30 (3) : 681-693

Grubb, P. (1971). Ecology of terrestrial decapod crustaceans on Aldabra. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 411-416

Hambler, C., J. Newing & K. Hambler (1993). Population monitoring for the flightless rail *Dryolimnas cuvieri aldabranus*. *Bird Conservation International*, 3(04):307-318.

Hamylton, S. M., A.B. Hagan & N. Doak (2012). Observations of dugongs at Aldabra Atoll, western Indian Ocean: lagoon habitat mapping and spatial analysis of sighting records. *International Journal of Geographical Information Science*, 26(5): 839-853



- Hermans, A., & P.A. Pistorius (2008). Marine mammal diversity in the remote waters of Aldabra Atoll, southern Seychelles. *Atoll Research Bulletin (USA)*. no. 5674
- Heywood, K. J., D.P. Stevens, & G.R. Bigg (1996). Eddy formation behind the tropical island of Aldabra. *Deep Sea Research Part I: Oceanographic Research Papers*, 43(4): 555-578.
- Hill, J. E. (1971). The bats of Aldabra Atoll, western Indian Ocean. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 573-576.
- Hill, M. G., & D. Newbery (1980). The distribution and abundance of the coccid *Icerya seychellarum* westward on Aldabra Atoll. *Ecological Entomology*, 5(2): 115-122.
- Hnatiuk, S. H. (1978). Plant dispersal by the Aldabran giant tortoise, *Geochelone gigantea* (Schweigger). *Oecologia*, 36(3), 345-350.
- Hnatiuk, R. J. & L.F.H. Merton (1979). A perspective of the vegetation of Aldabra. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 79-84.
- International Maritime Organisation (undated). Particularly Sensitive Sea Areas. Accessed 27 January 2015 [<http://www.imo.org>]
- Macnae, W. (1971). Mangroves on Aldabra. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 237-247.
- Merton, L. F. H., D. M Bourn, & R. J Hnatiuk (1976). Giant tortoise and vegetation interactions on Aldabra Atoll—part 1: inland. *Biological Conservation*, 9(4), 293-304.
- Ministry of Environment and Energy (2013). Seychelles Protected Area Policy. Mahé, Seychelles.
- Mortimer, J.A., T. Jupiter, J. Collie, R. Chapman, A. Liljevik, B. Betsy, R. Pimm, J. Stevenson, V. Laboudallon, M. Assary, D. Augeri & S. Pierce (2003). Trends in the Green Turtle (*Chelonia mydas*) Nesting Population at Aldabra Atoll, Seychelles (WIO) and their Implications for the Region. Proceedings of 23rd Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech Mem.
- Mortimer, J. A., R.G. Von Brandis, A. Liljevik, R. Chapman, R. & J. Collie (2011). Fall and rise of nesting green turtles (*Chelonia mydas*) at Aldabra Atoll, Seychelles: positive response to four decades of protection (1968-2008). *Chelonian Conservation and Biology*, 10(2): 165-176.
- Mortimer, J. A., T. Jupiter, J. Collie, R. Chapman, A. Liljevik, B. Betsy & S. Pierce. (2006). Trends in the green turtle (*Chelonia mydas*) nesting population at Aldabra Atoll, Seychelles (Western Indian Ocean) and their implications for the region. In *Pilcher, N.(compiler). Proceedings of the Twenty-third Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-536* (pp. 75-77).
- Mortimer, J. A., R.G. Von Brandis, A. Liljevik, R. Chapman, & J. Collie, J. (2011). Fall and rise of nesting green turtles (*Chelonia mydas*) at Aldabra Atoll, Seychelles: positive response to four decades of protection (1968-2008). *Chelonian Conservation and Biology*, 10(2): 165-176

- 
- Palkovacs, E.P., J. Gerlach, and A. Caccone (2002) "The evolutionary origin of Indian Ocean tortoises (Dipsoschelys)." *Molecular Phylogenetics and Evolution* 24.2 (2002): 216-227.
- Pistorius, P. A., & F.E. Taylor (2009). Declining catch rates of reef fish in Aldabra's marine protected area. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 19(S1): S2-S9.
- Ramsar (undated a). About Ramsar Accessed 4 December 2015 [<http://www.ramsar.org>].
- Ramsar (undated b). The Ramsar Convention and its Mission. Accessed 4 December 2015 [<http://www.ramsar.org>].
- Ramsar Sites Information Service (2009) Aldabra Atoll. Accessed 4 December 2015 [<https://rsis.ramsar.org/ris/1887>].
- Renvoize, S. A. (1971). The origin and distribution of the flora of Aldabra. *Philosophical Transactions of the Royal Society of London. B, Biological Sciences*, 260(836): 227-236
- Richards, H. (2013). Aldabra Research Station Scientific Coordinators Report 2013. Seychelles Islands Foundation.
- Seabrook, W. (1991). How many green turtles nest on Aldabra? *Oryx* 25(02): 96-98
- Seychelles Islands Foundation (2007). Final Assessment Aldabra Atoll Seychelles. August 2007
- Seychelles Islands Foundation (2009). Information Sheet on Ramsar Wetlands (RIS) – 2006-2008 version. Available for download from http://www.ramsar.org/ris/key_ris_index.htm.
- Seychelles Islands Foundation (2013a). Seychelles Islands Foundation Newsletter. December 2012.
- Seychelles Islands Foundation (2013a). Seychelles Islands Foundation Newsletter, Issue 4 February 2013.
- Seychelles Islands Foundation (2013b). Seychelles Islands Foundation Newsletter Issue 10 - September 2013
- Seychelles Islands Foundation (2014a). Aldabra Atoll Biosecurity Plan. Seychelles.
- Seychelles Islands Foundation (2014b). Seychelles Islands Foundation Newsletter, Issue 17 March 2014.
- Seychelles Islands Foundation (2014c). Seychelles Islands Foundation Newsletter, Issue 22 August 2014
- Souter, D., D. Obura & O. Lindén (eds) (2000) Coral reef degradation in the Indian Ocean: Status Report 2000. CORDIO, SAREC Marine Programme, Stockholm University
- Stobart, B., K. Teleki, R. Buckley, N. Downing, & M. Callow (2005). Coral recovery at Aldabra Atoll, Seychelles: five years after the 1998 bleaching event. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 363(1826): 251-255



- Stoddart, D. R., J.D. Taylor, F.R. Fosberg, & G.E. Farrow, G. E. (1971). Geomorphology of Aldabra Atoll. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 31-66
- Šúr, M., N. Bunbury & J. van de Crommenacker (2013a). Frigatebirds on Aldabra Atoll: population census, recommended monitoring protocol and sustainable tourism guidelines. *Bird Conservation International*, 23(02): 214-220
- Šúr, M., J. van de Crommenacker & N. Bunbury (2013b). Assessing effectiveness of reintroduction of the flightless Aldabra rail on Picard Island, Aldabra Atoll, Seychelles. *Conservation Evidence*, 10:80-84.
- Swingland, I. R. (1989). *Geochelone gigantea*: Aldabran giant tortoise. *The conservation biology of tortoises. Occasional Papers of the IUCN Species Survival Commission*, 5:105-110.
- Taylor, J. D. (1971). Intertidal zonation at Aldabra Atoll. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 173-21
- Trudgill, S. T. (1979). The soils of Aldabra. *Philosophical Transactions of the Royal Society of London. B, Biological Sciences*, 286(1011): 67-77.
- UNESCO (undated a). World Heritage. Accessed on 4 December 2014 [<http://whc.unesco.org>].
- UNESCO (undated b). Aldabra Atoll. Accessed on 4 December 2014 [<http://whc.unesco.org>].
- van de Crommenacker J, Richards H, Onezia C, Mahoune T, Accouche W, Fleischer-Dogley F & Bunbury N. (2015) Long-term monitoring of landbirds on Aldabra Atoll indicates increasing population trends. *Bird Conserv. Int.*
- Wallace BP, A.D. DiMatteo, B.J. Hurley, E.M. Finkbeiner, A.B. Bolten, M.Y. Chaloupka, B.J. Hutchinson, F.A. Abreu-Grobois, D. Amorocho D, K.A. Bjorndal, J. Bourjea, B.W. Bowen, R. Briseño Dueñas, P. Casale, B.C. Choudhury, A. Costa, P.H. Dutton, A. Fallabrino, A. Girard, M. Girondot, M.H. Godfrey, M. Hamann, M. López-Mendilaharsu, M.A. Marcovaldi, J.A. Mortimer, J.A. Musick, R. Nel, N.J. Pilcher, J.A. Seminoff, S. Troëng, B. Witherington, R.B. Mast RB (2010). Regional Management Units for Marine Turtles: A Novel Framework for Prioritizing Conservation and Research across Multiple Scales. *PLoS ONE*5(12): e15465. doi:10.1371/journal.pone.0015465.

Appendices



Appendix 1: Seychelles Islands Foundation staffing structure for Aldabra Atoll

Appendix 2: Operational Manual

Appendix 3: Piracy Emergency Response Policy

Appendix 4: Tourism Policy

Appendix 5: Sustainable Financing Strategy

Appendix 6: Requisition Policy

Appendix 7: EMS Policy

Appendix 8: Biosecurity Manual

Appendix 9: Fishing Policy

Appendix 10: Implementation schedule





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