British Indian Ocean Territory Ecosystem Action Plan (EAP)
MANGROVE FOREST

Figure 1. *Lumnitzera racemosa* Willd.. Mangrove Forests are only found on two islands of the Chagos Archipelgo and cover less than 1% of the terrestrial land mass. On Moresby Island above it is an important habitat for breeding red-footed booby (*Sula sula*), on both islands mangrove forests provide nationally important Odonata sites.

SUMMARY

IUCN habitat classification: 1.7 Forest - Subtropical/tropical mangrove vegetation above high tide level. 12.7 Marine intertidal – Mangrove submerged roots

Description: Mangrove habitat is comprised of a single species in the Chagos Archipelago, *Lumnitzera racemosa* [1]; though developing fruits of *Avicennia marina* (Forsk.) Vierh. have been recorded [2] but have not established. Mangrove Forest is limited to two islands, Moresby Island in Peros Banhos (3 ha. of mangrove) and Eagle Island on the western Great Chagos Bank (9.2 ha. of mangrove) [3]. In total, Mangrove covers less than 1% of the terrestrial landmass of the archipelago. It provides important platforms for nesting red-footed booby [4] and nationally important habitat for Odonata [5]. Both mangrove systems are land-locked above the high-tide level. The mangrove forest on Eagle Island is in a

degraded condition and requires active management to prevent further demise, the mangrove forest on Moresby is healthier but also requires management intervention to conserve the habitat.

Threats: Many of the threats to mangroves globally do not apply in the Chagos Archipelago; residential and coastal development, agriculture and aquaculture and biological resource use [6] do not occur. Invasive native [7] and alien [8] species and plastic pollution constitute the most immediate threat to the ecological integrity of the mangrove forest, with climate change and associated sea-level rise posing a potentially significant, but unpredictable, long-term threat. Research is required to understand the ecology of mangrove ecosystems in the Chagos Archipelago.

DISTRIBUTION

Distribution Total Extent: *c* 0.1 km^2

There is a mangrove forest on Moresby Island, Peros Banhos and a drier mangrove forest on Eagle Island, Great Chagos Bank [7]. Suitable environments for mangrove to colonise exist elsewhere in the archipelago, e.g. the barachois of Diego Garcia, though there is no evidence to suggest they existed anywhere else.

ECOLOGY

Ecosystem characteristics – Physical: The ecology of mangroves in the Chagos Archipelago has not been studied to date. Both mangrove stands are above the high-tide level and are not directly impacted by tides. Storm surges periodically inundate the mangrove forest on Moresby Island as evidenced by the mass of plastic pollution in its brackish waters. It is possible that the depth of the water in the Moresby Island mangrove forest increases with high tide, though how this occurs is unclear at present. The mangroves on Eagle Island are drier with no permanent water associated with it and this ecosystem appears to rely on precipitation to maintain its flooded nature, or possibly, rewetting at high water through the freshwater lens.

Ecosystem characteristics – Biological: The two mangrove ecosystems in the Chagos have similarities; they are both composed of a single species *Lumnitzera racemosa* [7], both are key sites within the Territory for Odonata [5] and neither is directly tidal influenced. They also differ; Moresby Island is permanently flooded and is host to approximately 550 pairs of breeding red-footed booby *per annum* [4]. The drier mangrove forest on Eagle Island has ephemeral wet areas after heavy precipitation, is dark and encroached upon by abandoned coconut *Cocos nucifera* L. plantations and holds no breeding seabirds [4]. The brackish waters beneath the mangroves on Moresby Island will be nutrient rich from bird droppings and has a layer of decaying organic matter laying above the coral substrate, though the only macro-organisms living in it that have been recorded to date are Odonata larva [5].

CONSERVATION STATUS

Both islands hosting mangroves are within the Category 1 Strict No-Take Chagos Marine Protected Area (MPA) that prohibits resource extraction. The MPA is patrolled and has enforcement carried out by the BIOT Patrol Vessel. Eagle Island is a Strict Nature Reserve from which it is prohibited for any person to approach within three nautical miles. Penalties for infringement of the regulations are severe [9].

CURRENT THREATS

It has been identified that the mangroves on Eagle Island are in a degraded state and require intervention management for their survival [7]. This mangrove habitat is surrounded by abandoned coconut plantations that are towering over and blocking out light and encroaching through nut dispersal into the shrinking mangrove area. In addition, two native plants, *Cassytha filiformis* L. and *Ipomoea violacea* L. are overtopping the mangroves [7], in some cases causing death. The mangroves on Moresby Island are healthier [7] though the brackish waters under these trees have an accumulation of plastic debris present, thought to be deposited there from the shoreline during storm surges. The depth of plastic in some areas could prevent germination of new plants and the decaying plastic pollutes the organic benthic layer. Moresby Island mangrove forest is also being encroached by abandoned coconut plantations on its landward side. In both mangrove tracts, it is uncertain what impact the lack of regular water exchange, being landlocked, is having. It is presumed that at some point they must have had a direct exchange route with the sea for the mangroves to have initially colonised. Both islands hosting mangroves are rat-infested [8] and these will have a deleterious impact upon the mangrove ecosystem [10]. On a global scale, climate change and associated sea level rising potentially will have dire consequences for mangrove ecosystems, but the exact extent and impact is uncertain. The lack of research into the mangroves of the Chagos Archipelago is an impediment to the conservation of these ecosystems.

Native Plant Interactions:

***Cocos nucifera* L.**: Coconut is a naturally occurring tree in the Chagos Archipelago [1] that is essential to the stability of beach-crests. It is present on every island with a substrate capable of supporting a sprouting nut. Historically, throughout the entire archipelago, native habitat was cleared to make way for coconut plantations [11, 12] and it is assessed that, excluding Diego Garcia, 63% of island cover is now coconut dominated [4]. Abandoned Coconut plantations are present on Moresby and Eagle Island and abut the mangrove stands. On both islands, coconut is reducing the extent of the mangrove habitat through encroachment - falling nuts coming ever closer to the mangroves, shading out their growth and drying the substrate. Coconut has the capacity to encroach and outcompete mangrove ecosystems. **Impact –- Medium (Historic – High)**

***Cassytha filiformis* L.**: This native, obligate parasitic vine occurs on 32 of the 55 islands of the Chagos Archipelago [1]. On these islands it regularly parasitises and kills stands of *Scaevola taccada* (Gaertn.) Roxb. On Diego Garcia, where *S. taccada* provides essential

shoreline protection in areas with critical military assets, *C. filiformis* is controlled [13]. In both mangroves, though especially on Eagle Island [7], *C. filiformis* is detrimentally impacting the growth of plants by parasitising them. On Eagle Island this parasitism has resulted in the death of plants. **Impact – Medium**

***Ipomoea violacea* L.**: This native climbing vine is found on 38 of the 55 islands of the Chagos Archipelago [1]. Though not listed as an invasive species, like related species it has the capacity to smother vegetation, thereby altering ecosystems and reducing biodiversity [e.g. 14]. On Eagle Island it is overtopping the mangroves and altering the ecosystem [7]. **Impact - Low**

Alien Invasive Species

Black Rat (*Rattus rattus*): Invasive rats detrimentally impact all tropical oceanic island ecosystems on invasion [10]. Their impact upon mangroves has not been studied in the Chagos Archipelago but like other island ecosystems, their predation of seeds, flowers and pollinators will be causing an unnatural and negative ecosystem shift. **Impact – High**

Anthropogenic Impacts

Plastic Pollution: Many of the dangers from plastic pollution to the marine environment are known and have and are being researched [e.g. 18, 19]. Plastic pollution has been identified by the BIOT Administration as one of the most pressing threats which could have the greatest impact on BIOT's unique and diverse environment [17]. However, little is known of the direct threats from plastic pollution to mangrove systems above the high-tide level where there is no flushing out of the debris. It is assumed that the plastic in the flooded swamp on Moresby Island is being degraded by the sun from which micro-particles are settling in the mangrove benthic layer – the consequences of which are unknown. On the surface where the plastic pollution is stranded in layers, this is preventing germination of seeds and growth of seedlings. As there is no route out for plastic pollution once a storm surge has taken it over the beach crest and into the mangrove ecosystem, the accumulation will only grow larger unless managed.

Figure 2. Plastic pollution accumulating in the Moresby Island mangrove forest. As this ecosystem is above the high water and over the beach crest, once the plastic has entered the ecosystem, it cannot leave. If not removed, it degrades and leaves particles in the mangrove benthic layer – the impact of which is unknown.

Global Mean Sea Level Rise (GMSLR): Projected GMSLR for 1.5°C of global warming has an indicative range of 0.26 – 0.77m, relative to 1986–2005 [15], though a short series of sea level data from the Chagos indicates a rise currently of 5.5 mm per year [16]. All islands in the Chagos Archipelago are those of typical atolls, with a low elevation of generally < 2m (11, 12). Based upon the above figures, with an even rise in global temperature of 1.5°C, most of the archipelago would be submerged in *c*. 360 years. Many models of global warming predict higher temperature rises in shorter timeframes that would bring forward the date the archipelago would disappear underwater. **Impact – Unknown**

Climate Change: Research on the effect of climate change on oceanic island ecosystems is lacking, though it certainly will impact and alter them to some extent. Research on a global scale is required to address these uncertainties. **Impact – Unknown**.

General – Lack of information on ecosystem functionality of mangroves: Despite mangrove being a rare biome in the Chagos Archipelago and an important breeding habitat for red-footed booby and Odonata, very little research has been conducted in to how this ecosystem functions. The lack of information on, for example, nutrient flow through the ecosystem and their exchange with other ecosystems on and around the island is a cause for concern, especially when changes to the ecosystem by climate change are expected in the future. **Impact** - **Unknown**.

RELEVANT POLICIES AND LEGISLATION

International: Both islands that contain mangroves in the Chagos Archipelago are within the Category 1 (Strict No-Take) Marine Protected Area [9].

Local: Eagle Island is protected under the Strict Nature Reserve Regulations 1998. Under these Regulations, it is an offence to be within three nautical miles of the island. Access to the entire Chagos Archipelago is restricted with access to the northern atolls being granted by permit to limited anchorages and islands [9].

ACTION NEEDED

Management Plan for Mangroves: Along with other sensitive and critical terrestrial ecosystems, e.g. native forest and savanna, management plans are required for their protection, preservation and enhancement. These plans should include the management and/or the eradication of native and alien invasive species, mitigation of short-term anthropogenic impacts especially plastics incursion, the possible expansion of the ecosystem including to other islands and, ecosystem functionality.

Engage in climate monitoring: "Climate change is a key stressor in BIOT, one which must be carefully monitored with a view to identifying the implications it may have on conservation management. As BIOT has almost none of the usually common, localised impacts such as sewage discharge, overfishing and shoreline alteration, it is a very valuable location where the effects of climate change can be understood separately from those caused by local stressors, thereby providing a point of comparison for the rest of the world" [17]. The BIOT Administration has recognised the value of the Chagos Archipelago as a global research centre for climate change and is encouraging academic institutions, independent researchers and NGOs to engage in climate science within the Territory. One of the objectives of the environmental focus of BIOTA is "Understanding and mitigating against the effects of global climate change where possible" [17]. The call for climate research by BIOTA requires broadcasting to as wide a net as possible and research supported where possible and practical at the earliest opportunity.

Conduct research: Synergistic to both the previous Action Needed points, the BIOT Administration has recognised the requirement to better understand the delicate ecosystems of the terrestrial environment and have as an environmental objective **"**Understanding more about BIOT's unique terrestrial environment" [17]. Research at the ecosystem level is required to counter future threats at the global scale e.g. climate change and at the local scale, e.g. invasive species, plastic pollution and, is key to the production of coherent, realistic management plans that are essential for the immediate protection, preservation and enhancement of critical terrestrial habitat.

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