American Samoa Mangroves

Climate Change Vulnerability Assessment Summary

An Important Note About this Document: *This document represents an initial evaluation of vulnerability for mangroves based on workshop input and existing information. The aim of this document is to expand understanding of habitat vulnerability to changing climate conditions, and to provide a foundation for developing appropriate adaptation responses.*

Habitat Description

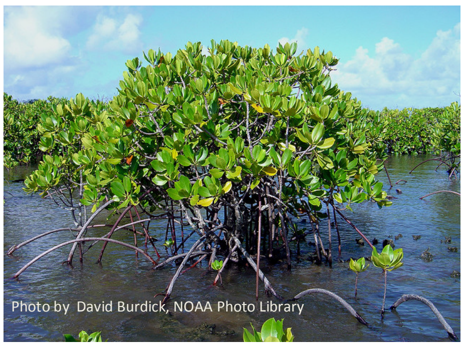
Photo by David Burdick, NOAA Photo Library

Mangrove forests in American Samoa are found only on Tutulia and Aunu'u Islands, and include tidal fringing and interior/partially enclosed basin forests. They are typically found in sheltered coastal lagoons and protected areas near stream mouths.[1] Three mangrove species occur: oriental mangrove (*Bruguiera gymnorrhiza*) is the dominant species, red mangrove (*Rhizophora mangle*) can be found along seaward margins, and the puzzlenut tree (*Xylocarpus moluccensis*) is quite rare. Other mangrove forest associates include beach hibiscus (*Hibiscus tiliaceus*), fish-poison tree (*Barringtonia asiatica*), and Tahitian chesnut (*Inocarpus fagifer*).[2] Mangrove forests thrive in brackish water conditions, and provide critical habitat for a variety of fish, invertebrate, and mollusk species.[3]

Habitat Vulnerability

Low-Moderate Vulnerability

Low → High

High Confidence

Workshop participants evaluated American Samoan mangroves to have a low-moderate relative vulnerability to climate change due to moderate sensitivity to climate and non-climate stressors, moderate exposure to projected future climate changes, and moderate adaptive capacity. Mangrove forests are sensitive to coastal erosion and sea level rise, which cause landward retreat, potentially leading to habitat extirpation if retreat is impossible. Earthquakes contribute to sea level changes and tsunami risk; tsunamis can severely damage mangrove systems and cause high tree mortality. Non-climate stressors play the largest role in American Samoan mangrove decline. Land use change leads to direct habitat loss, and combines with dredging and harvest to alter mangrove hydrology and sediment, nutrient, and pollutant dynamics. Additionally, roads/armoring can block landward mangrove migration, increasing habitat vulnerability to sea level rise. Significant portions of mangrove forests have been lost to human land use in American Samoa; only five stands across two islands remain, encompassing roughly 52 hectares. Mangroves may not recover from extensive alteration or mortality; when stands do recover naturally, recovery time ranges from 15-30 years. Facilitated rehabilitation has experienced varying success. As the key functional group, low mangrove diversity increases habitat vulnerability to climate change, although diversity amongst affiliate tree species is higher. Mangroves provide a variety of ecosystem services (e.g., biodiversity, fish nursery habitat, coastal protection), although there is low cultural recognition of these services. Mangroves are protected through several regulatory mechanisms, but a lack of enforcement undermines this legal protection.

Sensitivity

Moderate Sensitivity

Low → High

High Confidence

Mangrove forests are sensitive to several climate stressors, including sea level rise and coastal erosion, which contribute to tree mortality and force landward retreat of mangrove systems.[4,5] Disturbance regimes like tsunamis also contribute to tree mortality,[4] and earthquakes increase tsunami risk[6] and alter relative sea levels.[7] Non-climate stressors have contributed to extensive mangrove loss in American Samoa, and can exacerbate climate change impacts by blocking landward migration and altering hydrological, sediment, nutrient, and pollutant dynamics.[1-5]

SENSITIVITY FACTORS AND IMPACTS*	
CLIMATE STRESSORS	Low-moderate sensitivity; Moderate confidence
FACTOR	**IMPACT**
Coastal erosion	• Alters mangrove sediment surface elevation, potentially increasing vulnerability to sea level rise.[4] • Weakens root structures and can cause tree fall.[4]
Sea level rise	• If mangrove sediment surface elevation does not keep pace with sea level rise, resultant shifts in hydroperiod, salinity, and erosion likely to cause retreat of seaward and landward mangrove margins, or lateral expansion to higher elevations. Mangrove sediment surface elevation dynamics and feedbacks with sea level rise are poorly understood.[4,5] • Inland/upland migration success is dependent on suitable hydrology and soil conditions in new site, water-borne seedling availability, competition with established vegetation, and presence of migration barriers (e.g., seawalls).[4] • If retreat isn't successful, sea level rise can drastically reduce mangrove area and/or lead to local extirpation,[4] increasing coastal hazard risk for human communities and reducing water quality, nursery habitat, and biodiversity.[5,8]
DISTURBANCE REGIMES	Low-moderate sensitivity; Moderate confidence
FACTOR	**IMPACT**
Tsunamis	• Can severely damage mangrove systems; mass mortality with minimal tree and sapling survival can lead to ecosystem conversion.[4]
Earthquakes	• Can alter local land surface elevation, altering relative sea levels.[7] • Can cause tsunamis.[6]

* Factors presented are those ranked highest by workshop participants.

SENSITIVITY FACTORS AND IMPACTS*	
NON-CLIMATE STRESSORS	Moderate-high sensitivity; High confidence
FACTOR	**IMPACT**
Land use change	• Significant mangrove area has been lost and filled for development and agriculture;[2] several remaining forests are adjacent to villages, making them vulnerable to encroachment and conversion.[1] • Upland land use change may alter water, sediment, and pollutant delivery dynamics to mangrove systems, affecting productivity, mangrove health, and sediment surface elevation.[1,5]
Harvest	• Affects sediment surface elevation dynamics.[4]
Roads/ armoring	• Seawalls, erosion control structures, and coastal development can block landward mangrove migration[3,4] and increase erosion and scouring of fronting and down current mangroves.[4]
Dredging	• Historic dredging occurred to develop airport runways[5] and in Nu'uuli Pala Lagoon. • Alters mangrove hydrology, sediment, nutrient, and pollutant dynamics.[5] • Dredge spoils could potentially be used to enhance mangrove sediment accretion.[4]

Exposure†

Moderate Exposure

Low → High

High Confidence

Under future climate conditions during the next 20 years, mangroves in American Samoa are likely to be exposed to less frequent but more intense tropical storms. Although exact impacts are uncertain, increased tropical storm intensity may affect mangrove survival, health, and landscape position by altering factors such as storm surge, extreme high water levels, and precipitation patterns.[8]

PROJECTED CLIMATE AND CLIMATE-DRIVEN CHANGES	
CLIMATE STRESSOR	**PROJECTED CHANGES**
Tropical storms	Potential reduction in cyclone activity in American Samoa as storm tracks shift toward the Central North Pacific, but potential increases in storm intensity over the next 70 years.

† Relevant references for regional climate projections can be found in the Climate Impacts Summary Table.

Adaptive Capacity

Moderate Adaptive

Low → High

High Confidence

Mangrove forest distribution is limited and declining in American Samoa, largely due to conversion to human land uses.[1-3] Mangrove recovery from disturbance takes a long time and is quite variable,[8] even when facilitated by planting.[9] Mangroves are the foundational species in this habitat, but mangrove diversity is low with only three species.[2] Mangroves provide many ecosystem services,[4,8] although recognition of these services varies. A lack of enforcement undermines regulatory protection afforded to this habitat.[1,3,10]

ADAPTIVE CAPACITY FACTORS AND CHARACTERISTICS[‡]	
FACTOR	**HABITAT CHARACTERISTICS**
Extent, integrity, & continuity Moderate adaptive capacity High confidence	• Mangroves occur only on Tutuila and Aunu'u Islands, with largest forests in Leone Pala Lagoon, Nu'uuli Pala Lagoon, and on south side of Tutuila.[1,3] • Low and declining abundance; only 5 significant stands of varying integrity remain, encompassing roughly 52 hectares as of 2007.[1-3] • American Samoa represents the eastern boundary of mangrove forest distribution in the Indo-Pacific.[3,8]
Resistance & recovery Low-moderate adaptive capacity High confidence	• Mangroves are more resistant to natural stressors than non-climate stressors; non-climate stressors (e.g., development/fill) are leading cause of mangrove decline.[2,3] • Once disturbed, mangrove recovery time is long (15-30 years).[8] • Recovery depends on waterborne seed availability, removal/minimization of non-climate stressors,[8] and extent of habitat loss and alteration.[9] • Recovery may be facilitated by planting.[8,9]
Habitat diversity Low-moderate adaptive capacity High confidence	• Low mangrove diversity: three foundational species – oriental mangrove (dominant), red mangrove (seaward margins), puzzlenut tree (rare).[2] • Higher diversity when considering other tree associates. • Mangroves provide critical habitat for a variety of fish, crustacean, and mollusk species;[3] fish and invertebrates that utilize this habitat are more sensitive to climate change than mangroves themselves.

‡ Please note that the color scheme for adaptive capacity has been inverted, as those factors receiving a rank of "High" enhance adaptive capacity while those factors receiving a rank of "Low" undermine adaptive capacity.

ADAPTIVE CAPACITY FACTORS AND CHARACTERISTICS‡	
Management potential Moderate adaptive capacity High confidence	• Mangroves provide many ecosystem services (e.g., fish nursery habitat, coastal protection, water quality, traditional materials provisioning),[4,8] but services receive low social acknowledgement. • Protected under Federal Coastal Management Zone Acts (1972, 1990).[1,3] Nu'uuli Pala Leone Pala Lagoon also protected as Special Management Areas, which regulates shoreline activities and development.[3,10] • Although protected, protection enforcement varies.[3] • Mixed success in mangrove rehabilitation.[9] • Workshop participants identified the following management options for mangroves: replanting, removing trash, reducing stormwater, and enforcing protection.

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