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Mangroves of the Gulf of Guinea - South VU

Abraham O. Ekperusi[1] & Ena L. Suárez[2]

[1] *Department of Environmental Management and Pollution, Faculty of Environmental Management, Nigeria Maritime University, Okerenkoko, 332105, Delta State, Nigeria*
[2] *International Union for Conservation of Nature IUCN, Gland*, Switzerland.

Abstract

The Mangroves of the Gulf of Guinea - South is a regional ecosystem subgroup (level 4 unit of the IUCN Global Ecosystem Typology). It includes the Angolan, Gulf of Guinea Central, Gulf of Guinea Islands and Gulf of Guinea South marine ecoregions. The biota is characterized by six species of true mangroves with several associated mangrove species. The majority of the mangroves are found in the deltas within this region and mainly restricted to coastal estuaries and lagoons along the North-East Atlantic coast. The Gulf of Guinea - South mangrove province mapped extent in 2020 was 12,956.4 km^2, representing 8.8% of the global mangrove area. The main threats to mangroves are pollution from oil and gas exploration and production, overexploitation, urbanisation, coastal development, agriculture, land conversion, coastal flooding, sea-level rise and the spread of invasive alien species.

Today, the Gulf of Guinea - South mangroves cover 33% less than our broad estimation for 1970. If this trend continues, the mangrove cover would decrease by a further 4.2% by 2070. Furthermore, under a high sea-level rise scenario (IPCC RCP8.5) ≈-26.3% of the Gulf of Guinea - South mangroves would be submerged by 2060. Moreover, 1.3% of the province's mangrove ecosystem is undergoing degradation, with the potential to increase to 3.8% within a 50-year period, based on a vegetation index decay analysis. This is a conservative estimate given the lack of data to measure the true extent of environmental degradation impacting mangrove ecosystems in the province. Overall, the Gulf of Guinea - South mangrove ecosystem is assessed as **Vulnerable (VU)**.

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Corresponding author:
Email: ena.suarez@iucn.org

Keywords:
Mangroves; Red List of ecosystems; ecosystem collapse; threats, vulnerable.

Ecosystem classification:
MFT1.2 Intertidal forests and shrublands
Assessment's distribution:
Gulf of Guinea - South province
Summary of the assessment:

Criterion	A	B	C	D	E	Overall
Subcriterion 1	**VU**	**LC**	**DD**	**DD**	**NE**	
Subcriterion 2	**LC**	**LC**	**NT**	**LC**	**NE**	**VU**
Subcriterion 3	**DD**	**LC**	**DD**	**DD**	**NE**	

VU= Vulnerable, NT= NearThreatened, LC= Least Concern, DD= Data Deficient, NE= Not Evaluated

Mangroves of the Gulf of Guinea - South VU

1. Ecosystem Classification

IUCN Global Ecosystem Typology (version 2.1, Keith *et al.* 2022):

Transitional Marine-Freshwater-Terrestrial realm

MFT1 Brackish tidal biome

MFT1.2 Intertidal forests and shrublands

MFT1.2_4_MP_17b Mangroves of the Gulf of Guinea - South

IUCN Habitats Classification Scheme (version 3.1, IUCN 2012):

1 Forest

1.7 Forest - Subtropical/tropical mangrove vegetation above high tide level**below water level*[1]

12 Marine Intertidal

12.7 Mangrove Submerged Roots

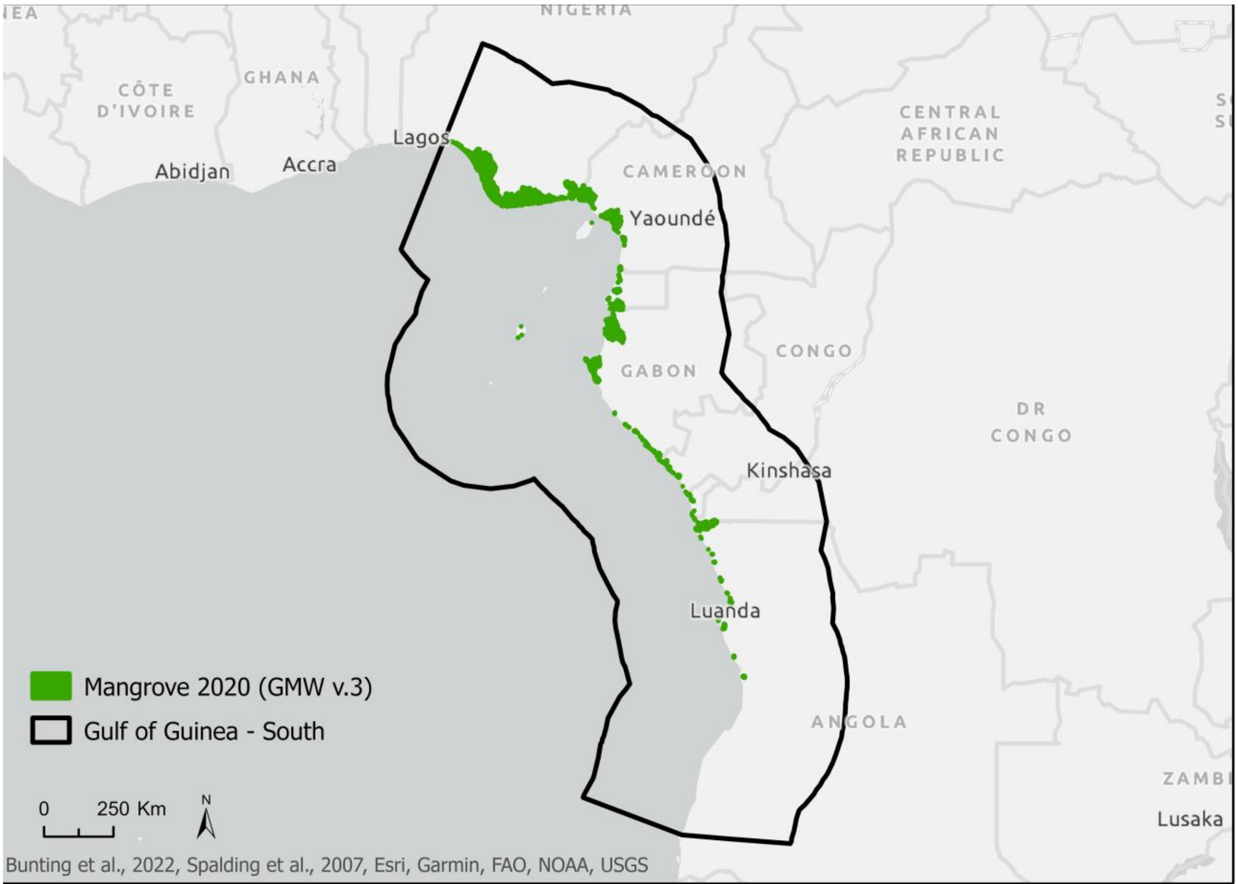


Figure 1. The mangroves of the Gulf of Guinea - South province

[1] Note on the original classification scheme. This habitat should include mangrove vegetation below water level. Mangroves have spread into warm temperate regions to a limited extent and may occasionally occur in supratidal areas. However, the vast majority of the world's mangroves are found in tropical/subtropical intertidal areas.

2. Ecosystem Description

Spatial distribution

The Mangroves of the Gulf of Guinea - South include intertidal forest, shrubs, wetlands or swamps of the Angolan, Gulf of Guinea Central, Gulf of Guinea Islands and Gulf of Guinea South marine ecoregions that extend across Angola, Cameroon, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Nigeria, Republic of Congo and São Tomé and Príncipe (Figure 1). Mangroves are mainly distributed in estuaries and lagoons along the Atlantic coast, while only a few are found along major river courses (NDES, 1997). Mangroves are concentrated in the deltas of this province, especially the Niger Delta, which is the second largest mangrove-fringed delta in the world after the Ganges-Brahmaputra Delta in India-Bangladesh.

The estimated extent of mangroves in this province was 12,956.4 km^2 in 2020, representing about 8.8% of the global mangrove area. There has been a -1.4 % net loss in mangrove area cover since 1996 (Bunting *et al.,* 2022).

Mangrove vegetation in the Niger Delta region of Nigeria (Photo credit: Abraham O. Ekperusi, 2023)

Biotic components of the ecosystem (characteristic native biota)

The mangroves of the Gulf of Guinea – South province are biologically diverse and comprise six true mangrove species in four families. They are *Avicennia germinans* (Acanthaceae), *Rhizophora racemosa*, *R. mangle* and *R. harrisonii* (Rhizophoracea), *Acrostichum aureum* (Pteridaceae), and *Laguncularia racemosa* (Combretaceae). According to the IUCN Red List of Threatened Species (IUCN, 2022), these true mangrove species are categorized as Least Concern (LC), except for *R. harrisonii*, which has not yet been assessed. Other flora closely associated with mangroves in the province include: *Conocarpus erectus*. *Chrysobalanus ellipticus*, *Annona palustris*, *Pandanus* sp., *Erythroxylon emarginatum*, *Dalbergia ecastophylum*, *Raphia* sp. and *Phoenix reclinata* (FAO and UNEP, 1981; Spalding *et al*., 1997; UNEP, 2011). The natural vegetation of the mangrove zone includes mangrove forests in the upper tidal zone; mangrove swamps in the lower tidal zone and along distributaries and estuaries; saltmarsh and tidal mudflats along shorelines; and coastal forests and barrier sand ridges (NDES, 1997). *Nypa fruticans*, although a true mangrove species, is present in the province as an invasive species (see section 3. Ecosystem Threats and vulnerabilities).

There is no province-wide assessment of animal species associated with mangrove vegetation, but national estimates are available. There are 66 plant and animal species within the class Actinopterygii, Bivalvia, Chondrichthyes, Gastropoda, Liliopsida, Magnoliopsida, Mammalia, Polypodiopsida and Reptilia that are associated with mangrove habitats in the IUCN Red List of Threatened Species within the province

(Appendix 2). Among the species, two evergreen trees: *Bikinia congensis* and *Prioria mannii*, and the mammal *Hydrictis maculicollis* (Spotted-necked Otter), are Near Threatened; four are Vulnerable: *Negaprion brevirostris* (Lemon Shark), *Carcharhinus amboinensis* (Pigeye Shark), *Trichechus senegalensis* (African Manatee) and *Trionyx triunguis* (African softshell Turtle); two tree species are Endangered: *Cassipourea plumosa* and *Dactyladenia* jongkindii; and four species are Critically Endangered: the orchid *Dinklageella villiersii*, *Pristis pectinata* (Smalltooth Sawfish), *P. pristis* (Largetooth Sawfish), and *Eretmochelys imbricata* (Hawksbill Turtle).

Many endemic species are found in the forests and mangrove swamps of the Niger Delta region. Bird species endemic exclusively to Nigeria include the Ibadan Malimbe, the Jos Plateau Indigobird, the Rock Firefinch and the Anambra Waxbill (Pariona, 2017). The Dwarf olive Ibis, São Tomé Fiscal and São Tomé Grosbeak are critically endangered (Patrice, 2000). There are seven amphibian species native to São Tomé and Príncipe, and all are endemic (Warne, 2003; Gascoigne, 2023).

Over 60% of fish caught between the Gulf of Guinea and Angola breed in the mangrove belt of the Niger Delta (World Rainforest Movement, 2002). Wildlife species in the province such as manatees, turtles, and crocodiles are listed as threatened (World Bank, 1995). Many species remain unstudied in large areas of the province due to limited accessibility to the mangrove swamp forests.

Abiotic Components of the Ecosystem

Mangrove distributions in the province are influenced mainly by the prevailing ocean currents, landscape position, rainfall, sea-level, sediment dynamics, subsidence, storm-driven processes, and disturbance by pests and predators. The province lies mainly in the humid equatorial climatic region with two distinct wet and dry seasons. In some areas, rainfall is prevalent all through the year, with a short dry spell between January and March (NDES, 1997). The ocean currents within the region include the surface eastward and northward flowing Guinea Current; subsurface westward and northward flowing Benguela Current; north-north-westward and eastwards surface longshore drift; and the easterly flowing surface Equatorial Counter Current. These current influences the movement of floating debris reaching the mangrove swamp forests in the province (NDES, 1997). The tides are semi-diurnal and a significant portion of the mangrove vegetation is subject to tidal incursion. The Atlantic Ocean, which bounds the southern shores of the province, provides marine waters of high salinity and conductivity, particularly in the dry season. In response to the semi-diurnal tidal cycle, high tides carry saline marine water into the river mouths and coastal flood areas (NDES, 1997). High rainfall reduces salinity stress and increases nutrient loading from adjacent catchments, while tidal flushing also regulates salinity.

The province has two major rivers, the Niger and Congo rivers, and a myriad of smaller and shallower distributaries. These distributaries end up in the creeks and estuaries characteristic of the tidal flood plain and coastal front of the deltas. Many of the creek outlets are silted up and marked by sandbars, which greatly limit navigation (NDES, 1997). Rainfall and sediment supply from rivers and currents promote mangrove establishment and persistence, while waves and large tidal currents destabilise and erode mangrove substrata, mediating local-scale dynamics in ecosystem distributions. Sediments are brought down by the rivers draining into the Atlantic, principally the Niger and Congo River systems. The sediments become progressively finer in texture from the hinterland to the tidal zone, but the barrier ridges are also made up of coarse sands. The soils of the tidal mudflats are finer in texture, but more poorly drained and acidic, due to a high content of organic matter (NDES, 1997).

The Niger Delta region has extensive areas of peat and peaty soils that are mainly in the mangrove zone. The poor ground drainage encourages raw organic matter from the mangrove trees to accumulate on the soil surface where it decays slowly to form peat. The province has both renewable and non-renewable natural resources including finfish and shellfish, crude oil, natural gas, granite, sand, clay, precious stones, wildlife, timber, fuelwood, vegetables, fruits, nuts, seeds and medicinal plants (NDES, 1997).

Key processes and interactions

Mangroves act as structural engineers for ecological processes within the ecosystem. The dense matrices of mangrove roots, especially the pneumatophores, create traps for sand and mud, thus stabilizing the transport of sediments. The repeated inundations of the mudflats and interactions with brown algae and nutrients, oxygen and the water cycle create diverse habitats for barnacles, oysters, mussels, crabs and fishes (NDES, 1997; Huntley, 2023). Salinity, tidal flow, organic detritus and sulphate are some of the factors controlling the food web in mangrove waters (NDES, 1997). The organic matter in mangrove sediments creates anoxic conditions in which sulphate is converted to sulphide, contributing to the mangrove habitat’s distinctive odour and which is visible as black iron sulphide in mangrove sediments. Aside the reduction in light penetration, fine particles, detritus and associated bacteria may replace phytoplankton as a food source for many invertebrates. Primary production in the system may come more from the intertidal mud-dwelling algae (diatoms) which emerge at the mud surface at low tide (NDES, 1997; Huntley, 2023). Soft organic mud in shallow depressions and near the creek edge is home to microscopic mobile algae easily visible at low tide when they form a golden-brown film on the mud surface. Firmer ground consists of peat and may have filamentous mats of brown algae, which also cover the lower parts of breathing roots. Algae, decomposing mangrove leaves and associated microfauna are fed on by the macrofauna characteristic of the mangrove forest. Many species such as polychaete worms, crabs and certain shrimps, clams and fishes live in burrows. In some areas, mangroves roots may be covered with sessile invertebrates like oysters, mussels and barnacles, which filter-feed when covered by water at high tide (Huntley, 2023). Mangrove ecosystems also serve as major blue carbon sinks, incorporating organic matter into sediments and living biomass (Sam *et al*., 2023).

3. Ecosystem Threats and vulnerabilities

Main threatening process and pathways to degradation

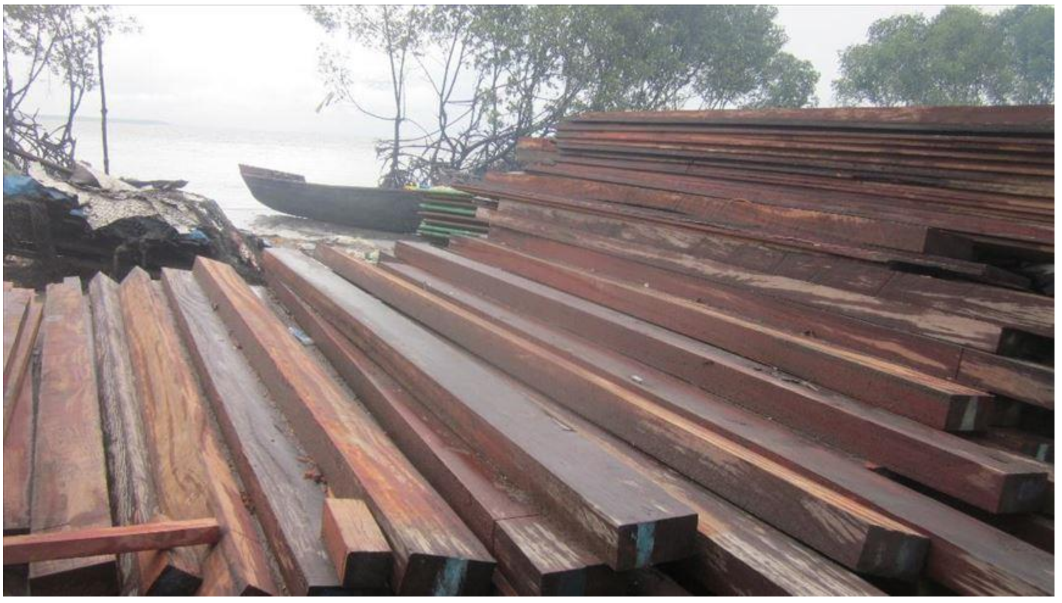
The main drivers of mangrove degradation are pollution from oil and gas exploration and production, overexploitation, urbanisation, coastal development, agriculture, land conversion, coastal flooding, sea-level rise and the spread of invasive alien species (NDES, 1997; Numbere, 2018; Sam *et al*., 2023). In Nigeria, the operations of oil and gas companies have destroyed substantial areas of mangrove swamp forest (World Bank, 1995). Oil activities include seismic lines, canalization, drilling operations, oil installation, pipeline right of way, oil terminals operations and oil spills (World Bank, 1995; UNEP, 2011). It was estimated that about 25% of the oil spill events occurred in freshwater wetlands, 69% in the coastal and offshore environment and 6% on land (UNDP, 2006).

Oil spills in coastal areas usually impact significantly on mangrove swamp forest (IUCN, 2018). An independent analysis of data between 1958 and 2018 put the scale of oil spills in the Niger Delta as equivalent to that of the Exxon Valdez disaster in every year in the region for the last 50 years (BSOEC, 2023). The study indicated that about 40% of the mangrove forests have been lost due to oil production (BSOEC, 2023). Another study using satellite tools reported a 12% loss in mangrove forest cover between 2007 and 2017 in the Niger Delta region due to oil production, urbanisation and development activities (Nwobi *et al*., 2020). The lighter oils produced in this region are more toxic to biota compared to heavy oils. The physical impact of oil on mangroves, especially young mangroves, usually results in yellowing of leaves, defoliation, and subsequent death of mangrove trees. More subtle responses include branching of pneumatophores, germination failure, decreased canopy cover, an increased rate of mutation, and increased sensitivity to other stressors (Naskar and Palit, 2015; IUCN, 2018).

Oil spills have also been reported to cause mortality of fishes, shellfish, flora and mangrove destruction (World Bank, 1995). However, the actual extent of the ecological damage, including the full toxicological impact of oil spills on mangroves and their associated biota, is not yet known in the Niger Delta region (Obot *et al*, 2003; IUCN, 2018). Oil pollution, if unattended to, could also result in the depletion of oxygen in water because bacteria multiply to consume spilled hydrocarbons and other organic material. During degradation most of the dissolved oxygen in the water is utilized, thereby creating dead zones where no higher aquatic or marine life can be sustained (Naskar and Palit, 2015; IUCN, 2018). In the Niger Delta region, there have been episodes of massive fish deaths attributed to petrochemical exploration and production activities (Ekperusi and Gbuvboro, 2022). Third party activities in the oil industry have also compounded mangrove degradation. Illegal oil bunkering and artisanal crude oil refining activities being undertaken in mangrove ecosystems are reported to have contributed to significant ecosystem degradation (UNEP 2011; Yabrade *et al*., 2023). For example, in Bodo West, Gokana LGA, an increase in artisanal refining between 2007 and 2011 resulted in a 10% loss of healthy mangrove cover. If left unchecked, oil refining may lead to irreversible loss of mangrove habitat in the Niger Delta region (UNEP, 2011).

Among invasive alien species in the province, nipa palm (*Nypa fruticans*) has been reported to pose a significant threat to the mangrove ecosystem. First introduced into Nigeria in 1906 for erosion control, nipa palm has taken over substantial areas previously occupied by mangrove vegetation (FMEnv, 2015; Nwobi *et al*., 2020). As the mangrove ecosystem became increasingly degraded, the nipa palm successfully invaded, colonized and outcompeted mangrove species in large areas of the Niger delta, resulting in a 694% increase in nipa between 2007 and 2017 (Nwobi *et al*., 2020). The invasion by nipa palm has altered the hydrology and soil properties of the area, as well as increasing sedimentation rates, which have been detrimental to biodiversity in downstream regions (Numbere, 2019).

Coastal population growth, and urbanisation for residential, commercial and industrial activities, has resulted in over-harvesting of mangroves for timber and non-timber resources, sand extraction and the clearing of mangroves for development purposes. As tropical forest hardwood sources decline, the hardwood from mangroves acts as suitable alternative for timber and lumber for construction purposes (Ajonina, 2022). In Cameroon, overexploitation of mangroves for wood, particularly timber for housing construction, gardening, etc., are some of the factors responsible for degradation of more than 75% of the mangrove ecosystem (Bonny, 2020). Similar factors, like the use of mangroves for smoked fish processing, are also responsible for mangrove decline in Angola, Congo, Equatorial Guinea, Gabon and Nigeria (Ajonina, 2022). There is also conversion of hardwood, including mangroves, into charcoal production, and on-site conversion of logs into lumber using chainsaws to supply local timber markets with cheap wood (FMEnv, 2015).



Mangrove trees converted to timber for housing construction in Cameroon
(Photo credit: Aurore Bonny, 2020)

Emulsified oil in surface water along mangrove swamp forest in the Niger Delta region of Nigeria
(Photo credit: Abraham O. Ekperusi, 2023)

The invasive nipa palm (Nypa fruticans) in mangrove forest in the Niger Delta region of Nigeria (Photo credit: Abraham O. Ekperusi, 2023)

Definition of the collapsed state of the ecosystem

Mangroves, acting as structural engineers, possess specialized traits that facilitate high nitrogen use efficiency and nutrient resorption, influencing critical processes and functions within their ecosystem. Ecosystem collapse is recognized when the tree cover of diagnostic true mangrove species dwindles to zero, indicating complete loss (100%).

Mangrove ecosystems exhibit remarkable dynamism, with species distributions adapting to local shifts in sediment distribution, tidal patterns, and variations in local inundation and salinity gradients. Disruptive processes can trigger shifts in this dynamism, potentially leading to ecosystem collapse. Ecosystem collapse may manifest through the following mechanisms: a) restricted recruitment and survival of diagnostic true mangroves due to adverse climatic conditions (e.g., extreme temperatures); b) alterations in rainfall, river inputs, waves, and tidal currents that destabilize and erode soft sediments, thereby hindering recruitment and growth; c) shifts in rainfall patterns and tidal flushing leading to salinity stress or altered nutrient loading that impact on overall survival.

Mangroves of the Gulf of Guinea - South province are amongst the most degraded globally. Given the rate of loss of mangrove vegetation, increased petrochemical activities without an improved regulatory framework for oil spill management could lead to severe degradation and complete collapse of mangrove forests. Moreover, because of the alarming rate of invasion by nipa palm in Nigeria, there is a potential threat that this invasive plant could replace mangroves in the Niger Delta within a century or less (NDES, 1997; Numbere, 2019).

The location of mangrove forests within intertidal areas also renders them vulnerable to sea-level rise because of climate change. A projected sea-level rise of around 1 m within the next 100 years would destroy much of the mangrove vegetation and force more than 50% of the population in this province to migrate to higher ground (World Bank, 1995). Moreover, the mangrove swamp ecological region in the province is a global biodiversity hotspot. An estimated 60% of the fish in the Gulf of Guinea breed in the mangroves within the province (World Rainforest Movement, 2002), while about 80% of the fish species caught at sea in Cameroon depends on mangroves (Bonny, 2020). Thus, mangrove collapse would significantly affect fishery resources and other important seafood production sectors in the province.

Threat Classification

IUCN Threat Classification (version 3.3, IUCN-CMP, 2022) relevant to mangroves of the Gulf of Guinea - South province:

1. Residential & commercial development

- 1.1 Housing & urban areas
- 1.2 Commercial & industrial areas
- 1.3 Tourism & recreation areas

2. Agriculture & aquaculture

- 2.1 Annual & perennial non-timber crops
  - 2.1.2 Small-holder farming

3. Energy production & mining

- 3.1 Oil & gas drilling
- 3.2 Mining & quarrying

4. Transportation & service corridors

- 4.1 Roads & railroads
- 4.2 Utility & service lines

5. Biological resource use

- 5.1 Hunting & collecting terrestrial animals
  - 5.1.1 Intentional use (species being assessed is the target)
- 5.3 Logging & wood harvesting
  - 5.3.1 Intentional use: subsistence/small scale (species being assessed is the target) [harvest]
  - 5.3.2 Intentional use: large scale (species being assessed is the target) [harvest]
- 5.4 Fishing & harvesting aquatic resources

6. Human intrusions & disturbance

- 6.2 War, civil unrest & military exercises

7. Natural system modifications

- 7.2 Dams & water management/use

8. Invasive & other problematic species, genes & diseases

- 8.1 Invasive non-native/alien species/diseases

9. Pollution

- 9.1 Domestic & urban waste water
  - 9.1.1 Sewage
  - 9.1.2 Run-off
- 9.2 Industrial & military effluents
  - 9.2.1 Oil spills
  - 9.2.2 Seepage from mining
- 9.3 Agricultural & forestry effluents
  - 9.3.1 Nutrient loads & eutrophication
  - 9.3.2 Soil erosion, sedimentation
  - 9.3.3 Herbicides & pesticides
- 9.4 Garbage & solid waste
- 9.5 Air-borne pollutants
  - 9.5.1 Acid rain
- 9.6 Excess energy

- 9.6.1 Light pollution
- 9.6.2 Thermal pollution

11. Climate change & severe weather

- 11.4 Storms & flooding
- 11.5 Other impacts (sea-level rise)

4. Ecosystem Assessment

Criterion A: Reduction in Geographic Distribution

Subcriterion A1 measures the trend in mangrove ecosystem extent during the last 50-year time window. No current regional dataset exist that provides information for the entire target area in 1970. However, country-level estimates of mangrove extent can be used to extrapolate the trend between 1970 and 2020. Accordingly, we compiled reliable published sources (see appendix 3) that contain information on mangrove area estimates close to 1970 (both before and after) for each country within the province. These estimates were then used to interpolate the mangrove area in 1970 in each country. By summing up these estimates, we calculated the total mangrove area in the province. We only considered the percentage of each country's total mangrove area located within the province and the estimated values for 1970 should be considered only indicative (see appendix 3 for further details of the methods and limitations).

In contrast, to estimate the Gulf of Guinea - South mangrove area from 1996 to 2020, we used the most recent version of the Global Mangrove Watch (GMW v3.0) spatial dataset. The mangrove area in the province (and in the corresponding countries) was corrected for both omission and commission errors, utilizing the equations in Bunting *et al.* (2022).

Results from the analysis of subcriterion A1 (Annex 3) show that the Gulf of Guinea - South mangrove province has lost approximately 32.70% of its mangrove area over the last 50 years (1970-2020). This significant decline in mangrove swamp forest is mainly due to pollution from oil and gas exploration and production, overexploitation, urbanisation, coastal development and the spread of invasive alien species. Given that the change in geographic distribution is above the 30% risk threshold, but below 50%, the ecosystem is assessed as **Vulnerable (VU)** under subcriterion A1.

Gulf of Guinea – South	Area 2020* (Km^2)	Area 1970* (Km^2)	Net area Change (Km^2)	% Net Area Change	Rate of change (%/year)
	12871.77	19371.53	6499.80	-33.50	-0.67

** Details on the methods and references used to estimate the mangrove area in 1970 are listed in appendix 3. Total mangrove area in 2020 is based on the Global Mangrove Watch Version 3 (GMW v3.0) dataset.*

Subcriterion A2 measures the change in ecosystem extent in any 50-year period, including from the present to the future. The Gulf of Guinea - South province mangroves show a net area change of -1.34% (1996-2020) based on the Global Mangrove Watch time series (Bunting *et al.*, 2022). This value reflects the offset between areas gained (+ 0.04%/year) and lost (- 0.10%/year). The largest decrease in mangrove area in this time series occurred between 2015 and 2020. Applying a linear regression to the area estimations between 1996 and 2020 we obtained a rate of change of -0.06%/year (Figure 2). Assuming this trend continues in the future, it is predicted that the extent of mangroves in the Gulf of Guinea - South province will change by -2.8% from 1996 to 2046; by -4.2% from 1996 to 2070; but by -2.9% from 2020 to 2070. Given that these predicted changes in mangrove extent are below the 30% risk threshold, the Gulf of Guinea - South mangrove ecosystem is assessed as **Least Concern (LC)** under subcriterion A2.

Subcriterion A3 measures changes in mangrove area since 1750. Unfortunately, there are no reliable data on the mangrove extent for the entire province during this period, and therefore the Gulf of Guinea - South mangrove ecosystem is classified as **Data Deficient (DD)** for subcriterion A3.

Overall, the ecosystem is assessed as **Vulnerable (VU)** under criterion A.

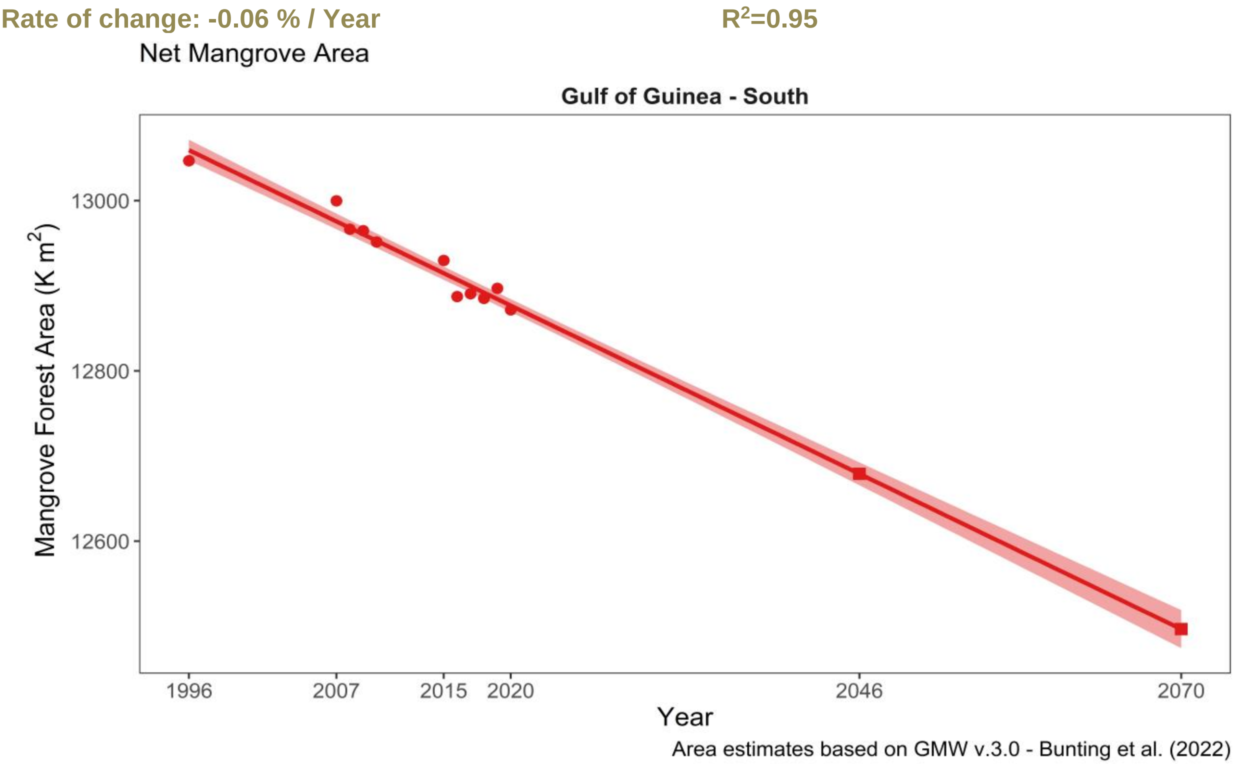


Figure 2. Projected extent of the Gulf of Guinea - South mangrove ecosystem to 2070. Circles represent the province mangrove area between 1996 and 2020 based on the GMW v3.0 dataset and equations in Bunting *et al*., (2022). The solid line and shaded area are the linear regression and 95% confidence intervals. Squares show the Gulf of Guinea - South province predicted mangrove area for 2046 and 2070. It is important to note that an exponential model (proportional rate of decline) did not give a better fit to the data (R^2 = 0.95).

Criterion B: Restricted Geographic Distribution

Criterion B measures the risk of ecosystem collapse associated with restricted geographical distribution, based on standard metrics (Extent of Occurrence EOO, Area of Occupancy AOO, and Threat-defined locations). These parameters were calculated based on the 2020 Gulf of Guinea - South province mangrove extent (GMW v.3).

Province	Extent of Occurrence EOO (Km^2)	Area of Occupancy (AOO) ≥ 1%	Criterion B
The Gulf of Guinea - South	653,204	415	**LC**

For 2020, AOO and EOO were measured as 589 grid cells 10 x 10 km and 653,204 km^2, respectively (Figure 3). Excluding from the AOO those grid cells that contain patches of mangrove forest that account for less than 1% of the grid cell area, (< 1 km^2), the AOO is measured as **415, 10 x 10 km grid cells** (Figure 3, red grids). There is no evidence of plausible catastrophic threats leading to potential disappearance of mangroves across their extent that could lead to define reduced number of threats defined locations. As a result, the Gulf of Guinea - South mangrove ecosystem is assessed as **Least Concern (LC)** under criterion B.

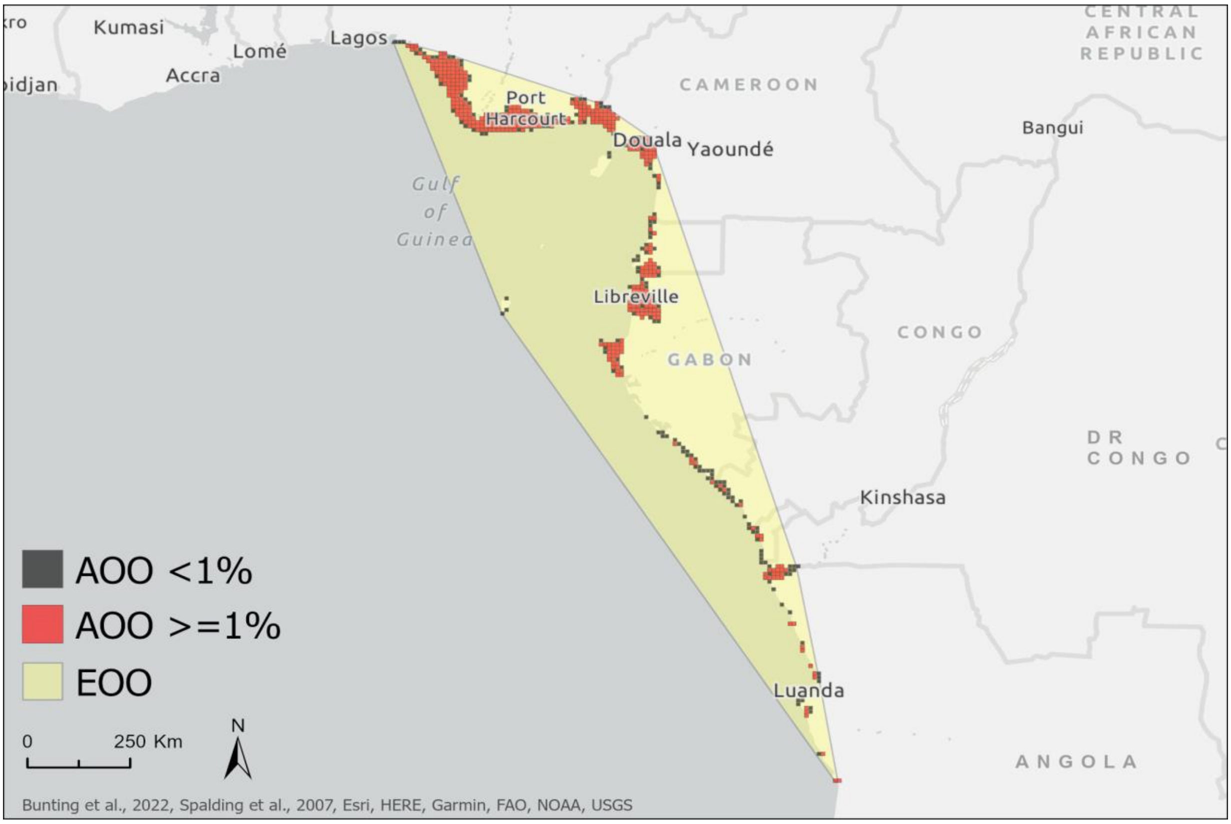


Figure 3. The Gulf of Guinea - South mangrove Extent of Occurrence (EOO) and Area of Occupancy (AOO) in 2020. Estimates based on 2020 GMW v3.0 spatial layer (Bunting *et al.*, 2022). The red 10 x 10 km grids (n=415.) are more than 1% covered by the ecosystem, and the black grids <1% (n= 174).

Criterion C: Environmental Degradation

Criterion C measures the environmental degradation of abiotic variables necessary to support the ecosystem.

Subcriterion C1 measures environmental degradation over the past 50 years: There are no reliable data to evaluate this subcriterion for the entire province, and therefore the Gulf of Guinea - South mangrove ecosystem is classified as **Data Deficient (DD)** for subcriterion C1.

Subcriterion C2 measures environmental degradation in the future, or over any 50-year period, including from the present. In this context, the impact of future sea level rise (SLR) on mangrove ecosystems was assessed by adopting the methodology presented by Schuerch *et al.* (2018). The published model was designed to calculate both absolute and relative change in the extent of wetland ecosystems under various regional SLR scenarios (i.e medium: RCP 4.5 and high: RCP 8.5), with consideration for sediment accretion.

Therefore, Schuerch *et al*. (2018) model was applied to the Gulf of Guinea - South mangrove ecosystem boundary, with spatial extent based on Giri *et al*. (2011) and assuming mangrove landward migration was not possible.

According to the results, under an extreme sea-level rise scenario of a 1.1 metre rise by 2100, the projected submerged area is ~ -26.3% by 2060 (Figure 4), which remains below the 30% risk threshold. Therefore, considering that no mangrove recruitment can occur in a submerged system (100% relative severity), but that -26.3% of the ecosystem extent will be affected by SLR, the Gulf of Guinea - South mangrove ecosystem is assessed as **Near Threatened (NT)** for subcriterion C2.

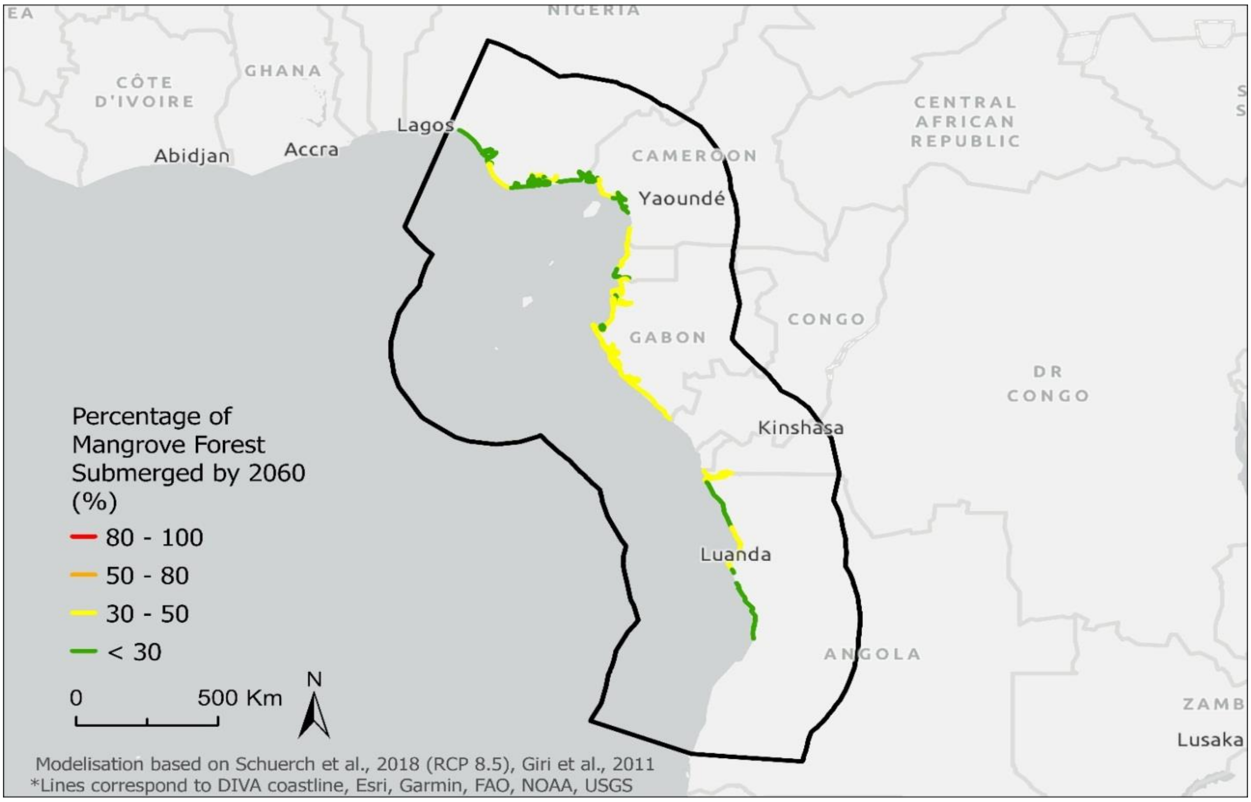


Figure 4. Predicted percentage of the Gulf of Guinea – South mangrove forest submerged by 2060 under the IPCC RCP 8.5 scenario (1.1 m SLR by 2100). Predictions are based on the model of Schuerch *et al.*, 2018 with adjusted parameters: assuming no accommodation space available, constant sediment supply over time and no delta subsidence. The baseline corresponds to the spatial extent of mangroves in 2010 (Giri *et al.*, 2011). Colour lines represent the Dynamic Interactive Assessment Model (DIVA coastline), and do not reflect spatial distribution of mangroves

Subcriterion C3 measures change in abiotic variables since 1750. There is a lack of reliable historic data on environmental degradation covering the entire province, and therefore the Gulf of Guinea - South province is classified as **Data Deficient (DD)** for this subcriterion.

Overall, the ecosystem is assessed as **Near Threatened (NT)** under criterion C.

Criterion D: Disruption of biotic processes or interactions

The global mangrove degradation map developed by Worthington and Spalding (2018) was used to assess the level of biotic degradation in the Gulf of Guinea - South province. This map is based on degradation metrics calculated from vegetation indices (NDVI, EVI, SAVI, NDMI) using Landsat time series (≈2000 and 2017). These indices represent vegetation greenness and moisture condition.

Mangrove degradation was calculated at a pixel scale (30m resolution), on areas intersecting with the 2017 mangrove extent map (GMW v2). Mangrove pixels were classified as degraded if two conditions were met: 1) at least 10 out of 12 degradation indices showed a decrease of more than 40% compared to the previous period; and 2) all twelve indices did not recover to within 20% of their pre-2000 value (detailed methods and data are available at: maps.oceanwealth.org/mangrove-restoration/). The decay in vegetation indices has been used to identify mangrove degradation and abrupt changes, including mangrove die-back events, clear-cutting, fire damage, and logging; as well as to track mangrove regeneration (Lovelock *et al.*, 2017; Santana, 2018; Murray *et al.*, 2020; Aljahdali *et al.*, 2021; Lee *et al.*, 2021). However, it is important to consider that changes observed in the vegetation indices can also be influenced by data artifacts (Akbar *et al.*, 2020). Therefore, a relative severity level of more than 50%, but less than 80%, was assumed.

The results from this analysis show that over a period of 17 years (~2000 to 2017), 1.04% of the Gulf of Guinea - South mangrove area is classified as degraded, resulting in an average annual rate of degradation of 0.06%. Assuming this trend remains constant, +3.1% of the Gulf of Guinea - South mangrove area will be classified as degraded over a 50-year period. Since less than 30% of the ecosystem will meet the category thresholds for criterion D, the Gulf of Guinea - South mangrove province is assessed as **Least Concern** (**LC)** under subcriterion D2b.

No data were found to assess the disruption of biotic processes and degradation over the past 50 years (subcriterion D1) or since 1750 (subcriterion D3). Thus, both subcriteria are classified as **Data Deficient (DD).**

Overall, the Gulf of Guinea - South ecosystem remains **Least Concern (LC)** under criterion D.

Criterion E: Quantitative Risk

No model was used to quantitatively assess the risk of ecosystem collapse for this ecosystem; hence criterion E was **Not Evaluated (NE)**.

5. Summary of the Assessment

CRITERION			
A. Reduction in Geographic Distribution	**A1** Past 50 years	**A2** Future or any 50y period	**A3** Historical (1750)
	VU	**LC**	**DD**
B. Restricted Geo. Distribution	**B1** Extent of Occurrence	**B2** Area of Occupancy	**B3** # Threat-defined Locations < 5?
	LC	**LC**	**LC**
C. Environmental Degradation	**C1** Past 50 years (1970)	**C2** Future or any 50y period	**C3** Historical (1750)
	DD	**NT**	**DD**
D. Disruption of biotic processes	**D1** Past 50 years (1970)	**D2** Future or Any 50y period	**D3** Historical (1750)
	DD	**LC**	**DD**
E. Quantitative Risk analysis	**NE**		
OVERALL RISK CATEGORY	**VU**		

DD = Data Deficient; LC = Least Concern; NE = Not Evaluated, NT = Near Threatened, VU = Vulnerable

Overall, the status of the Gulf of Guinea - South mangrove ecosystem is assessed as **Vulnerable (VU).**

6. References

Ajonina, G.N. (2022). Cameroon Mangroves: Current Status, Uses, Challenges, and Management Perspectives. In: Das, S.C., Pullaiah, Ashton, E.C. (eds) Mangroves: Biodiversity, Livelihoods and Conservation. Springer, Singapore. https://doi.org/10.1007/978-981-19-0519-3_21

Akbar, M.R., Arisanto, P.A.A., Sukirno, B.A., Merdeka, P.H., Priadhi, M.M. & Zallesa, S. (2020) 'Mangrove vegetation health index analysis by implementing NDVI (normalized difference vegetation index) classification method on sentinel-2 image data case study: Segara Anakan, Kabupaten Cilacap', *IOP Conference Series: Earth and Environmental Science*, 584(1), 012069. https://doi.org/10.1088/1755-1315/584/1/012069.

Aljahdali, M.O., Munawar, S. & Khan, W.R. (2021). Monitoring Mangrove Forest Degradation and Regeneration: Landsat Time Series Analysis of Moisture and Vegetation Indices at Rabigh Lagoon, Red Sea. *Forests*, *12*(1), 52. https://doi.org/10.3390/f12010052

Bonny, A. (2020). Cameroon's mangroves could vanish without action, 14/01/2020 https://www.aa.com.tr/en/africa/cameroons-mangroves-could-vanish-without-action/1701912#

BSOEC (2023). An Environmental Genocide: Counting the Human and Environmental Cost of Oil in Bayelsa, Nigeria, Bayelsa State Oil & Environment Commission, May 2023, Bayelsa State Government

Bunting, P., Rosenqvist, A., Hilarides, L., Lucas, R. M., Thomas, N., Tadono, T., Worthington, T. A., Spalding, M.D., Murray, N. J. & Rebelo, L.-M. (2022). Global Mangrove Extent Change 1996–2020: Global Mangrove Watch Version 3.0. *Remote Sensing*, *14*(15), 3657. https://doi.org/10.3390/rs14153657

Ekperusi, O.A. & Gbuvboro, A.E. (2022). Developing a chemical database for resolving environmental issues in the petrochemical industry in Nigeria, *Proceedings of the 51st Nigeria Annual International Conference and Exhibition, Society of Petroleum Engineers*, doi:10.2118/211948-MS

FAO & UNEP. (1981). *Tropical forest resources assessment project. Forest resources of tropical Africa. Part II: Country Briefs.* FAO, UNEP. 586 pp

FAO. (2003). *Status and trends in mangrove area extent worldwide.* By Wilkie, M.L. and Fortuna, S. Forest Resources Assessment Working Paper No. 63. Forest Resources Division. FAO, Rome. (Unpublished) https://www.fao.org/3/j1533e/J1533E00.htm

FMEnv (2015). National Biodiversity Strategy and Action Plan 2016-2020. Federal Ministry of Environment, Abuja, Nigeria. https://www.cbd.int/doc/world/ng/ng-nbsap-v2-en.pdf

Gascoigne, A. (2005). Sao Tome, Principe and Annobon moist lowland forest. Terrestrial Ecoregions. World Wildlife Fund. https://www.worldwildlife.org/ecoregions/at0127

Giri, C., Zhu, Z., Tieszen, L.L., Singh, A., Gillette, S. & Kelmelis, J.A. (2011). Status and distribution of mangrove forests of the world using earth observation satellite data. *Glob. Ecol. Biogeogr*. 20, 154-159

Huntley, B.J. (2023). The Mangrove Biome. In: Ecology of Angola. Springer, Cham. https://doi.org/10.1007/978-3-031-18923-4_17

IUCN (2012). *IUCN Habitats classification scheme* (3.1). [Data set]. https://www.iucnredlist.org/resources/habitat-classification-scheme.

IUCN (2018). IUCN Niger Delta Panel. Developing a biodiversity conservation strategy for the Niger Delta: Integrating biodiversity considerations into SPDC's operation. IUCN, Gland, Switzerland, 2018. viii+36pp. https://doi.org/10.2305/IUCN.CH.2018.07.en

IUCN (2022). *The IUCN Red List of Threatened Species.* (Version 2022-2) [Data set]. https://www.iucnredlist.org

IUCN-CMP (2022). *Unified Classification of Direct Threats* (3.3) [Data set]. https://www.iucnredlist.org/resources/threat-classification-scheme.

Keith, D.A., Ferrer-Paris, J.R., Nicholson, E. & Kingsford, R.T. (Eds.) (2020). *IUCN Global Ecosystem Typology 2.0: Descriptive profiles for biomes and ecosystem functional groups*. IUCN, International Union for Conservation of Nature. https://doi.org/10.2305/IUCN.CH.2020.13.en

Lee, C.K.F., Duncan, C., Nicholson, E., Fatoyinbo, T.E., Lagomasino, D., Thomas, N., Worthington, T.A. & Murray, N.J. (2021). Mapping the Extent of Mangrove Ecosystem Degradation by Integrating an Ecological Conceptual Model with Satellite Data. *Remote Sensing*, *13*(11), 2047. https://doi.org/10.3390/rs13112047

Lovelock, C.E., Feller, I.C., Reef, R., Hickey, S. & Ball, M.C. (2017). Mangrove dieback during fluctuating sea levels. *Scientific Reports*, *7*(1), 1680. https://doi.org/10.1038/s41598-017-01927-6

Murray, N.J., Keith, D.A., Tizard, R., Duncan, A., Htut, W.T., Oo, A.H., Ya, K.Z. & Grantham, M. (2020). *Threatened ecosystems of Myanmar: An IUCN Red List of Ecosystems Assessment. Version 1*. Wildlife Conservation Society. https://doi.org/10.19121/2019.Report.37457

Naskar, S. & Palit, P.K. (2015). Anatomical and physiological adaptations of mangroves. *Wetlands Ecol Manage*. 23, 357. doi:10.1007/s//273-014-9385-z

NDES (1997). Niger Delta Environmental Survey. Final Report Phase 1, Vol IV: Abridged Version of Findings and Recommendations of Phase 1 Report. Technical Report. September 1997, 128 pp

Numbere, A.O. (2018). Mangrove Species Distribution and Composition, Adaptive Strategies and Ecosystem Services in the Niger River Delta, Nigeria, in Mangrove Ecosystem Ecology and Function. InTech Open. https://doi.org/10.5772/intechopen.79028

Numbere, A.O. (2019) Impact of invasive nypa palm (*Nypa fruticans*) on mangroves in coastal areas of the Niger delta region, Nigeria, in Coastal Research Library. Springer, 425-454 pp. https://doi.org/10.1007/978-3-319-91382-7_13

Nwobi, C., Williams, M. & Mitchard, E.T. (2020) Rapid mangrove forest loss and nipa palm (*Nypa fruticans*) expansion in the Niger Delta, 2007-2017. *Remote Sensing* 12(14), 2344. https://doi.org/10.3390/rs12142344

Obot, E.A., Augustine, U., Ezealor, R.K., Anthony, B. & Edem, A.E. (2003). A new Barn Swallow (*Hirundo rustica*) Roost at Itu Wetlands Akwa Ibom State, Nigeria. *Roan.* 1(1&2), 103-118

Pariona, A. (2017). The Native Birds of Nigeria. WorldAtlas. 25 April, 2017. https://www.worldatlas.com/articles/the-native-birds-of-nigeria.html

Patrice, C. (2000). Important Bird Areas in Africa and associated islands - São Tomé and Príncipe BirdLife International, 2000.

Sam, K., Zabbey, N., Gbaa, N.D., Ezurike, J.C. & Okoro, C.M. (2023). Towards a framework for mangrove restoration and conservation in Nigeria. *Reg. Stud. Mar. Sci.* 66, 103154

Santana, N. (2018). Fire Recurrence and Normalized Difference Vegetation Index (NDVI) Dynamics in Brazilian Savanna. *Fire*, *2*(1), 1. https://doi.org/10.3390/fire2010001

Schuerch, M., Spencer, T., Temmerman, S., Kirwan, M.L., Wolff, C., Lincke, D., McOwen, C.J., Pickering, M.D., Reef, R., Vafeidis, A.T., Hinkel, J., Nicholls, R.J. & Brown, S. (2018). Future response of global coastal wetlands to sea-level rise. *Nature*, *561*(7722), 231-234. https://doi.org/10.1038/s41586-018-0476-5

Spalding, M.D., Blasco, F. & Field, C.D. Eds. (1997). *World Mangrove Atlas*. The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.

Spalding, M.D., Fox, H.E., Allen, G.R., Davidson, N., Ferdaña, Z.A., Finlayson, M., Halpern, B.S., Jorge, M. A., Lombana, A., Lourie, S.A., Martin, K.D., McManus, E., Molnar, J., Recchia, C.A. & Robertson, J. (2007). Marine Ecoregions of the World: A Bioregionalization of Coastal and Shelf Areas. *BioScience*, *57*(7), 573-583. https://doi.org/10.1641/B570707

UNDP (2011). Niger Delta Biodiversity Project. The Global Environment Facility’s Strategic Programme for West Africa (SPWA) - Sub-component Biodiversity. United Nations Development Programme (UNDP), Abuja, Nigeria. https://info.undp.org/docs/pdc/Documents/NGA/Niger%20Delta%20Biodiversity_Prodoc.pdf

UNEP (2011). Environmental Assessment of Ogoniland. United Nations Environment Programme, Nairobi, Kenya. ISBN: 978-92-807-3130-9

Warne, S. (2003) *Gabon, São Tomé and Príncipe: the Bradt Travel Guide*, Bradt. ISBN 1-84162-073-4

World Bank (1995) Defining an Environmental Development Strategy for the Niger Delta. Vol. I & II, Report prepared by Smigh J, Moffat D, and Linden, O. Industry and Energy Operation Division, West Central Africa. World Bank, 14266, May 25, 1995

World Rainforest Movement. (2002). Nigeria: threatened mangroves-oil and violence. Monthly Bulletin of the World Rainforest Movement, December, 2002.

Worthington, T.A. & Spalding, M.D. (2018). *Mangrove Restoration Potential: A global map highlighting a critical opportunity*. Apollo - University of Cambridge Repository. https://doi.org/10.17863/CAM.39153

Yabrade, M., Idomeh, E.J. & Ekperusi, O.A. (2023). Assessment of the impact of local crude oil refineries on soil quality in selected island communities in Niger Delta, Nigeria. *Ethiop. J. Environ. Stud. Manage.* 16(5), 644-655. https://ejesm.org/doi/v16i5.10

Authors:

Ekperusi, O.A. & Suárez, E.L.,

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Peer revision:

Donald J. Macintosh
Marcos Valderrábano

Web portal:

http://iucnrle.org/

7. Appendices

1. List of Key Mangrove Species

List of plant species considered true mangroves according to Red List of Threatened Species (RLTS) spatial data (IUCN, 2022). We included species whose range maps intersected with the boundary of the marine provinces/ecoregions described in the distribution section. *True mangrove species in this province, but not yet assessed in the RLTS. *Nypa fruticans*, although a true mangrove species, is present in the province as an invasive species and therefore not included in this list (see section 3. Ecosystem Threats and vulnerabilities).

Class	Order	Family	Scientific name	RLTS category
Magnoliopsida	Lamiales	Acanthaceae	*Avicennia germinans*	LC
Magnoliopsida	Malpighiales	Rhizophoraceae	*Rhizophora harrisonii**	-
Magnoliopsida	Malpighiales	Rhizophoraceae	*Rhizophora mangle*	LC
Magnoliopsida	Malpighiales	Rhizophoraceae	*Rhizophora racemosa*	LC
Magnoliopsida	Myrtales	Combretaceae	*Laguncularia racemosa*	LC
Polypodiopsida	Polypodiales	Pteridaceae	*Acrostichum aureum*	LC

2. List of Associated Species

List of taxa that are associated with mangrove habitats in the Red List of Threatened Species (RLTS) database (IUCN, 2022). We included only species with entries for Habitat 1.7: “Forest - Subtropical/Tropical Mangrove Vegetation Above High Tide Level” or Habitat 12.7 for “Marine Intertidal - Mangrove Submerged Roots”, with Presence recorded as “Extant”, “Possibly Extant” or “Possibly Extinct”, Origin recorded as "Native" or "Reintroduced" and with any value of Seasonality except “Passage”. The common names are those shown in the RLTS, except common names in brackets, which are from other sources.

Class	Order	Family	Scientific name	RLTS category	Common name
Actinopterygii	Anguilliformes	Ophichthidae	*Myrophis plumbeus*	LC	Leaden Worm Eel
Actinopterygii	Anguilliformes	Ophichthidae	*Dalophis cephalopeltis*	LC	
Actinopterygii	Cyprinodontiformes	Poeciliidae	*Aplocheilichthys spilauchen*	LC	Banded Lamprey
Actinopterygii	Elopiformes	Elopidae	*Elops lacerta*	LC	West African Lady Fish
Actinopterygii	Gobiiformes	Gobiidae	*Awaous lateristriga*	LC	West African Freshwater Goby
Actinopterygii	Gobiiformes	Eleotridae	*Bostrychus africanus*	LC	
Actinopterygii	Gobiiformes	Eleotridae	*Dormitator lebretonis*	LC	Sleeper Goby
Actinopterygii	Gobiiformes	Gobiidae	*Periophthalmus barbarus*	LC	Atlantic Mudskipper
Actinopterygii	Gobiiformes	Gobiidae	*Porogobius schlegelii*	LC	
Actinopterygii	Gobiiformes	Gobiidae	*Yongeichthys thomasi*	LC	
Actinopterygii	Gobiiformes	Gobiidae	*Bathygobius soporator*	LC	Frillfin Goby
Actinopterygii	Mugiliformes	Mugilidae	*Liza grandisquamis*	DD	Largescaled Mullet
Actinopterygii	Perciformes	Mullidae	*Mulloidichthys martinicus*	LC	Yellow Goatfish
Actinopterygii	Perciformes	Lutjanidae	*Lutjanus dentatus*	DD	African Brown Snapper
Actinopterygii	Perciformes	Carangidae	*Caranx bartholomaei*	LC	Yellow Jack

Class	Order	Family	Scientific name	RLTS category	Common name
Actinopterygii	Perciformes	Cichlidae	*Sarotherodon melanotheron*	LC	Blackchin Tilapia
Actinopterygii	Perciformes	Carangidae	*Caranx hippos*	LC	Crevalle Jack
Actinopterygii	Perciformes	Carangidae	*Chloroscombrus chrysurus*	LC	Atlantic Bumper
Actinopterygii	Perciformes	Sciaenidae	*Pseudotolithus elongatus*	LC	Giant Captainfish
Actinopterygii	Perciformes	Epinephelidae	*Epinephelus itajara*	VU	Atlantic Goliath Grouper
Actinopterygii	Pleuronectiformes	Bothidae	*Bothus lunatus*	LC	Plate Fish
Actinopterygii	Syngnathiformes	Syngnathidae	*Enneacampus kaupi*	LC	VipÃ¨re de mer
Actinopterygii	Tetraodontiformes	Tetraodontidae	*Lagocephalus laevigatus*	LC	Smooth Puffer
Bivalvia	Ostreida	Ostreidae	*Crassostrea tulipa*	LC	
Bivalvia	Venerida	Donacidae	*Galatea nux*	LC	
Bivalvia	Venerida	Donacidae	*Galatea bengoensis*	LC	
Chondrichthyes	Carcharhiniformes	Carcharhinidae	*Negaprion brevirostris*	VU	Lemon Shark
Chondrichthyes	Carcharhiniformes	Carcharhinidae	*Carcharhinus amboinensis*	VU	Pigeye Shark
Chondrichthyes	Rhinopristiformes	Pristidae	*Pristis pectinata*	CR	Smalltooth Sawfish
Chondrichthyes	Rhinopristiformes	Pristidae	*Pristis pristis*	CR	Largetooth Sawfish
Gastropoda	Cycloneritida	Neritidae	*Vitta adansoniana*	LC	
Gastropoda	Cycloneritida	Neritidae	*Vitta rubricata*	NT	
Gastropoda	Ellobiida	Ellobiidae	*Melampus liberianus*	LC	
Gastropoda	Littorinimorpha	Littorinidae	*Littoraria angulifera*	LC	Mangrove Periwinkle
Gastropoda	Littorinimorpha	Assimineidae	*Assiminea hessei*	DD	
Gastropoda	Littorinimorpha	Tateidae	*Potamopyrgus ciliatus*	LC	
Gastropoda	Neogastropoda	Muricidae	*Thais nodosa*	LC	
Gastropoda	Sorbeoconcha	Hemisinidae	*Pachymelania byronensis*	LC	
Gastropoda	Sorbeoconcha	Potamididae	*Tympanotonos fuscatus*	LC	Mud-flat Periwinkle
Gastropoda	Sorbeoconcha	Hemisinidae	*Pachymelania aurita*	LC	
Liliopsida	Alismatales	Araceae	*Lasimorpha senegalensis*	LC	Swamp Arum
Liliopsida	Alismatales	Cymodoceaceae	*Halodule wrightii*	LC	Species code: Hw
Liliopsida	Arecales	Arecaceae	*Raphia vinifera*	LC	Raphia Palm
Liliopsida	Asparagales	Orchidaceae	*Dinklageella villiersii*	CR	
Liliopsida	Commelinales	Pontederiaceae	*Scholleropsis lutea*	LC	
Magnoliopsida	Fabales	Fabaceae	*Dalbergia ecastaphyllum*	LC	
Magnoliopsida	Fabales	Fabaceae	*Berlinia bracteosa*	LC	
Magnoliopsida	Fabales	Fabaceae	*Bikinia congensis*	NT	
Magnoliopsida	Fabales	Fabaceae	*Prioria mannii*	NT	
Magnoliopsida	Gentianales	Rubiaceae	*Tarenna thomasii*	LC	
Magnoliopsida	Malpighiales	Clusiaceae	*Symphonia globulifera*	LC	Boarwood
Magnoliopsida	Malpighiales	Malpighiaceae	*Heteropterys leona*	LC	
Magnoliopsida	Malpighiales	Rhizophoraceae	*Cassipourea plumosa*	EN	
Magnoliopsida	Malpighiales	Chrysobalanaceae	*Dactyladenia jongkindii*	EN	
Magnoliopsida	Malpighiales	Violaceae	*Rinorea aylmeri*	LC	
Magnoliopsida	Malpighiales	Chrysobalanaceae	*Maranthes robusta*	LC	Mahogany nut
Magnoliopsida	Malvales	Malvaceae	*Hibiscus tiliaceus*	LC	Coast Cottonwood

Class	Order	Family	Scientific name	RLTS category	Common name
Magnoliopsida	Myrtales	Myrtaceae	*Syzygium guineense*	LC	
Magnoliopsida	Rosales	Moraceae	*Ficus louisii*	LC	
Mammalia	Carnivora	Mustelidae	*Hydrictis maculicollis*	NT	Spotted-necked Otter
Mammalia	Sirenia	Trichechidae	*Trichechus senegalensis*	VU	African Manatee
Polypodiopsida	Polypodiales	Pteridaceae	*Acrostichum danaeifolium*	LC	
Reptilia	Crocodylia	Crocodylidae	*Crocodylus niloticus*	LC	Nile Crocodile
Reptilia	Testudines	Cheloniidae	*Eretmochelys imbricata*	CR	Hawksbill Turtle
Reptilia	Testudines	Trionychidae	*Trionyx triunguis*	VU	African Softshell Turtle

3. National Estimates for subcriterion A1

To estimate the Gulf of Guinea - South mangrove ecosystem extent in 1970, we gathered reliable information on the mangrove area for each country within the province around this period (Table b). We then estimated the mangrove area in 1970 for each country, assuming a linear relationship between mangrove extent and time. Finally, we summed up the country estimates to determine the total mangrove area in the Gulf of Guinea - South province (Table a). We assumed that the percentage of mangrove extent by country within the province remained constant over time, as the percentages did not change between 1996 and 2020 (GMW v3.0 dataset). However, using mangrove area estimates from different sources can lead to uncertainty (Friess and Webb 2014)[2] and there were no regional statistics or global studies available for this time period. Thus, the estimates for 1970 should be considered only indicative.

Table a. Estimated mangrove area (km^2) by country in 1970 and 2020. Estimates for 2020* mangrove area are based on the Global Mangrove Watch Version 3 (GMW v3.0) dataset. The references used to calculate mangrove area for each country in 1970 are listed below in Table b.**

	Country total	Within province	Country total	Within province
Year	**2020***	**2020***	**1970****	**1970****
Angola	**283.16**		**1301.42**	
Cameroon	**1970.06**		**2008.86**	
DR Congo	**237.05**		**495.27**	
Equatorial Guinea	**254.71**		**204.42**	
Gabon	**1747.94**		**2320**	
Nigeria	**8357.52**		**11056.03**	
Republic of Congo	**20.83**		**1985.04**	
Sao Tome and Principe	**0.48**		**0.48**	
Gulf of Guinea - South	**12,956.87**		**19,371.53**	

[2] Friess, D. A. and Webb, E. L. (2014). Variability in mangrove change estimates and implications for the assessment of ecosystem service provision. *Global Ecology and Biogeography*, 23 (7). 715-725 doi:10.1111/geb.12140

Table b. List of selected studies considered to have reliable information on mangrove area for the period around 1970 in each country of the Gulf of Guinea - South province.

Country	Year	Area (Ha)	Reference
Angola	1980	125000	FAO, UNEP. 1981 *Tropical Forest Resources Assessment Project, Forest Resources of Tropical Africa. Part II: Country Briefs* FAO, UNEP 586pp.
Angola	1992	60700	Spalding, M.D., Blasco, F. and Field, C.D., eds. 1997. *World Mangrove Atlas*. The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.
Angola	2000	59700	FAO (2001). The State of the World's Forests. Food and Agriculture Organization of the United Nations, Rome, 2001. ISBN 92-5-104590-9.
Cameroon	1980	272000	FAO, UNEP, 1980. *Système mondial de surveillance continue de l'environnement - Projet pilote sur la surveillance continue de la couverture forestière tropicale - Cameroun - Cartographie du couvert végétal et étude de ses modifications.* UN 32/6(1102-75-005) -Rapport technique 3 - Rome.
Cameroon	1993	350000	Apollinaire, Z. 1993. Mangroves of Cameroun. *In:* Diop, E.S., 1993. *Conservation and sustainable utilization of mangrove forests in Latin America and Africa regions, Part II – Africa,* p. 193-211. Mangrove Ecosystems Technical Reports vol.3 ITTO/ISME Project PD114/90. Okinawa, Japan, ISME. 262 pp.
Cameroon	2000	229000	FAO (2001). The State of the World's Forests. Food and Agriculture Organization of the United Nations, Rome, 2001. ISBN 92-5-104590-9.
Congo	1980	250000	FAO, UNEP. 1981. *Tropical Forest Resources Assessment Project, Forest Resources of Tropical Africa. Part II: Country Briefs* FAO, UNEP 586pp.
Congo	1995	12000	Saenger, P. and Bellan, M.F. 1995. *The Mangrove vegetation of the Atlantic coast of Africa.* Universitè de Toulouse Press, Toulouse 96 pp.
Congo	2000	11900	FAO (2001). The State of the World's Forests. Food and Agriculture Organization of the United Nations, Rome, 2001. ISBN 92-5-104590-9.
DRC	1980	53000	Library of Congress, Science and Technology Division. 1980. *Phase I Environmental Profile of the Republic of Zaire*. AID Contract No. SA/TOA 1-77 with U.S. MAB Secretariat, Washington, D.C.
DRC	1995	22600	Saenger, P. and Bellan, M.F. 1995. *The Mangrove vegetation of the Atlantic coast of Africa.* Universitè de Toulouse Press, Toulouse 96 pp.
DRC	2000	22100	FAO (2001). The State of the World's Forests. Food and Agriculture Organization of the United Nations, Rome, 2001. ISBN 92-5-104590-9.
Equatorial Guinea	1981	20000	FAO, UNEP. 1981 *Los Recursos Forestales de la America Tropical* Proyecto de Evaluación de los Recursos Forestales Tropicales (en el marco de SINUVIMA) FAO, UNEP, 349 pp.
Equatorial Guinea	1995	25700	Saenger, P. and Bellan, M.F. 1995. *The Mangrove vegetation of the Atlantic coast of Africa.* Universitè de Toulouse Press, Toulouse 96 pp
Equatorial Guinea	2001	25300	FAO (2001). The State of the World's Forests. Food and Agriculture Organization of the United Nations, Rome, 2001. ISBN 92-5-104590-9.
Gabon	1970	232000	FAO, UNEP. 1981. *Tropical Forest Resources Assessment Project, Forest Resources of Tropical Africa. Part II: Country Briefs* FAO, UNEP 586pp.
Gabon	1995	612 900	Saenger, P. and Bellan, M.F. 1995. *The Mangrove vegetation of the Atlantic coast of Africa.* Universitè de Toulouse Press, Toulouse 96 pp.
Gabon	2000	115 000	World Resources Institute. 2000. *World resources 2000-2001: people and ecosystem-the fraying web of life*. Washington, DC., UNDP. 400 pp.
Nigeria	1980	973000	FAO, UNEP. 1981. *Tropical Forest Resources Assessment Project, Forest Resources of Tropical Africa. Part II: Country Briefs.* FAO, UNEP 586 pp.
Nigeria	1997	1113400	Spalding, M.D., Blasco, F. and Field, C.D., eds. 1997. *World Mangrove Atlas*. The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.
Nigeria	2000	1050000	Aizpuru, M., Achard, F., and Blasco, F. 2000. Global Assessment of Cover Change of the Mangrove Forests using satellite imagery at medium to high resolution. *In EEC Research project n 15017-1999-05 FIED ISP FR* – Joint Research Center, Ispra.
Sao Tome & Principe	-	136	Machava-António, V.; Fernando, A.; Cravo, M.; Massingue, M.; Lima, H.; Macamo, C.; Bandeira, S.; Paula, J. A Comparison of Mangrove Forest Structure and Ecosystem Services in Maputo Bay (Eastern Africa) and Príncipe Island (Western Africa). Forests 2022, 13, 1466. https://doi.org/10.3390/f13091466