Changes in mangrove surface area and morphodynamic implications in Mayotte Island, Indian Ocean.

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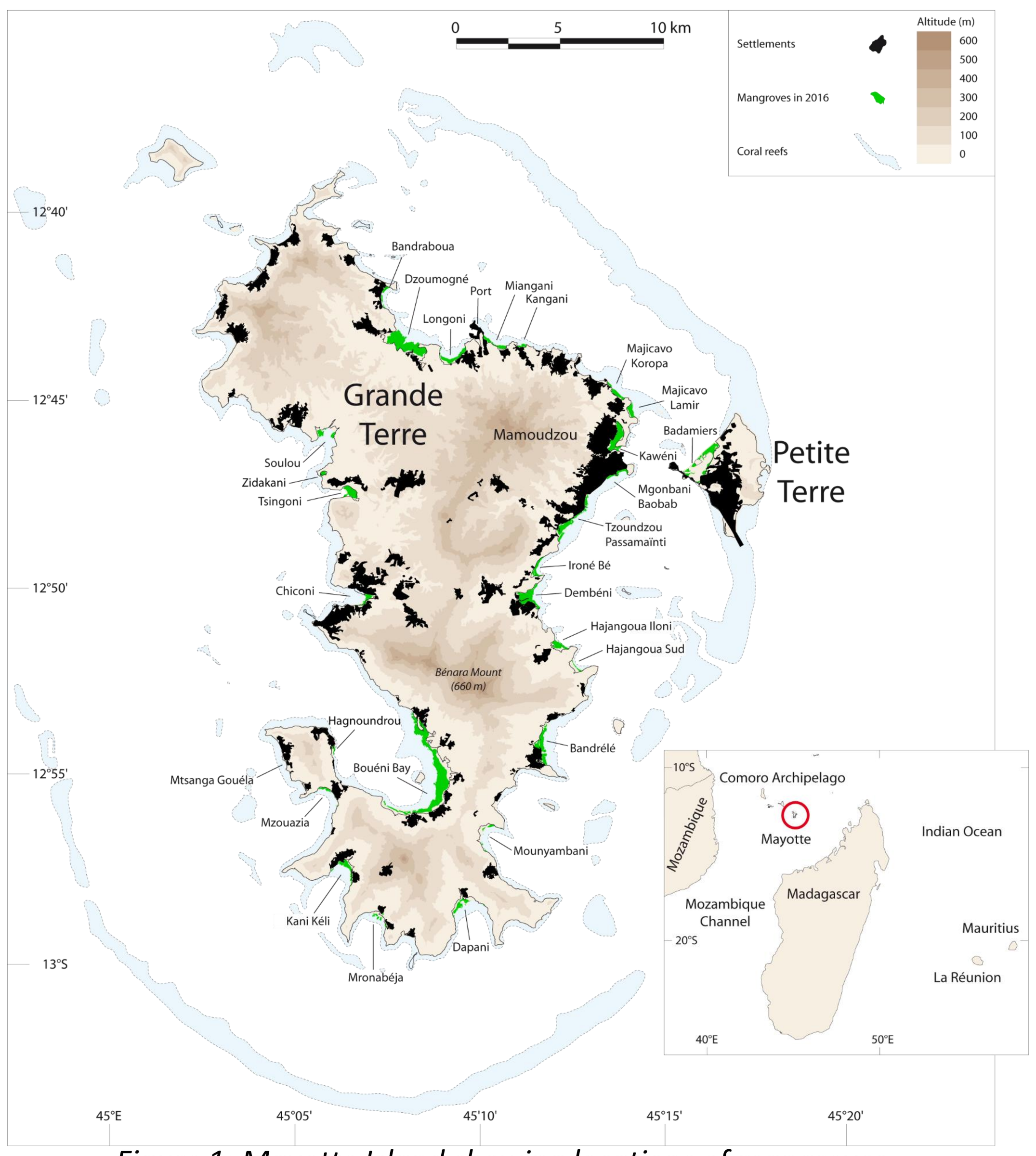

Figure 1: Mayotte Island showing locations of mangroves

Mayotte and its mangroves

The Island of Mayotte, in the south western Indian Ocean (Fig. 1), is characterized by a remarkable coastal geomorphological diversity. The total length of Mayotte's shoreline is 265 km and is an intricate alternation of volcanic cliffs separating variably indented pocket beaches of sand and sandy mud (total beach length 58 km), of which the sheltered low-energy backshores are often colonized by mangroves (76 km) (Fig. 2). Eight true mangrove plant species are found in Mayotte with a dominance of *Rhizophora mucronata*, *Sonneratia alba* and *Avicennia marina*.

→ 700 ha of mangroves
→ 29 % of the coastline
→ 28 mangroves with area > 2ha


Figure 2: Example of a coastal village fringed by mangrove stands, Bandrélé (east coast).

Changes in mangrove surface area

An analysis of aerial photographs covering the period from 1950 to 2016 shows marked variability in the evolution of these mangroves (Fig. 3).

→ The northern part of the island shows stability or a slight increase in mangrove area.

→ The southern and western mangroves of the island have been characterized by a clear regression.

→ The total surface area of mangroves on Mayotte (694 ha in 2016) has diminished overall by about 6%.

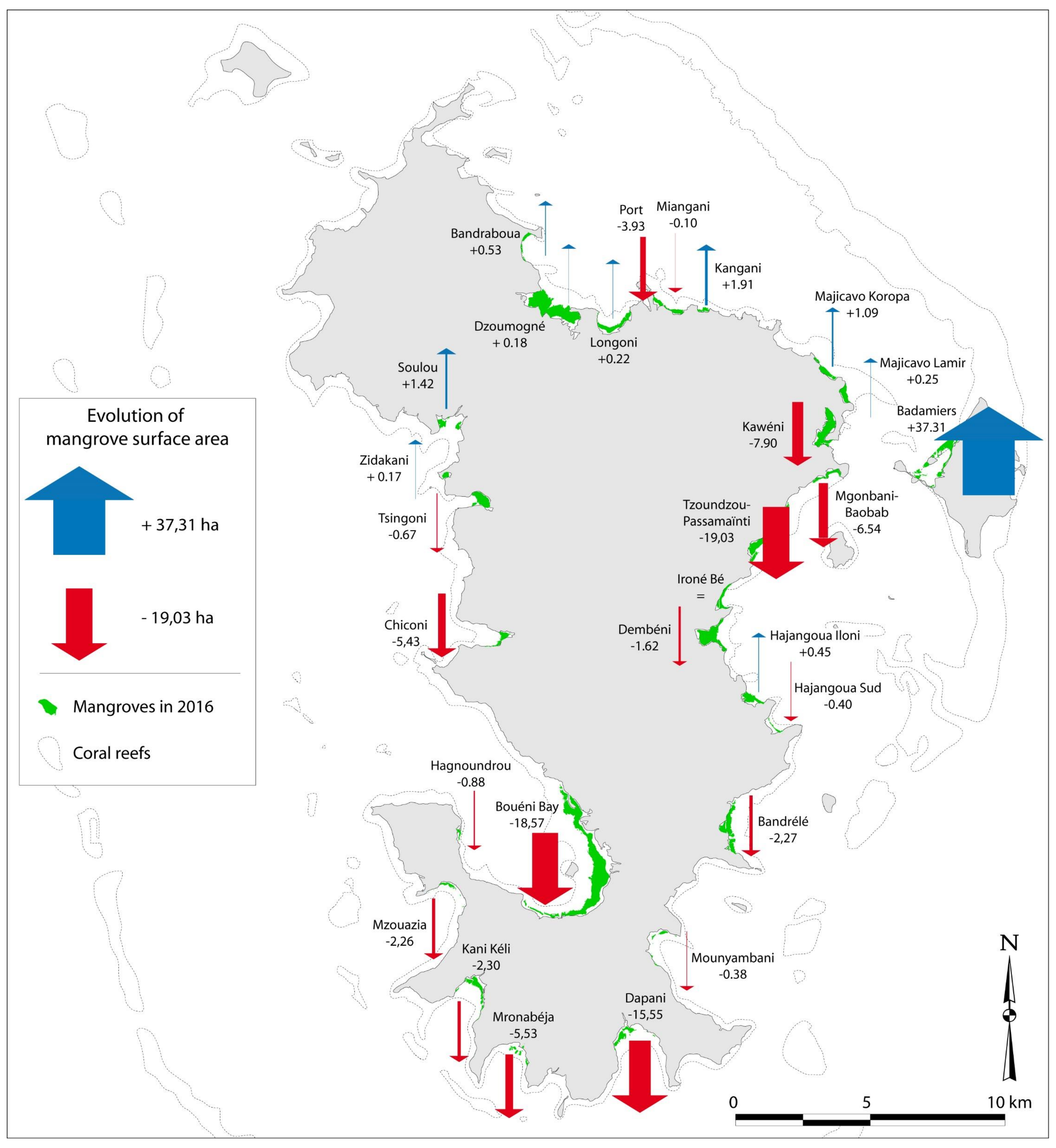

Figure 3. Overall evolution of mangroves in Mayotte between 1950 and 2016


Figure 4. Construction of roads led to a strong reduction of the mangrove around Mamoudzou.


Figure 5. Aerial view of the mangrove of Dapani showing uprooted mangrove trees and erosional peat outcrops.


Figure 6. Young expanding mangrove colony of Badamiers.

The pattern of evolution of mangroves in Mayotte is explained jointly by development pressures (Fig. 4) on the coast and spatial variability in mangrove recovery determined by hydrological conditions and exposure to waves on this reef-fringed island. The north coast is exposed to a moderate Monsoon-dominated wave-energy regime, whereas the south and west coasts are more exposed to the higher-energy trade-wind waves.

Mangrove recovery potential is weak on the more exposed south and west coasts of the island, where all the mangrove stands fronting the lagoon have retreated (Fig. 5), compared to those on the north coast which show increase or stability in area (Fig. 6).

Morphodynamic implications of mangrove regression

Topographic profile data were acquired since February 2005 on several mangroves using high-resolution total stations and D-GPS.

Observations of cross-shore profiles show that progressive mangrove retreat exposes the muddy substrate to waves (Fig. 7a-b and 8a). Substrate reworking by waves leads to the concentration of sand into well-defined bars (Fig. 8b) whereas the mud is dispersed towards the lagoon. These sand bars progressively migrate shoreward and they are built up into beach ridges behind the subsisting mangrove fringe.

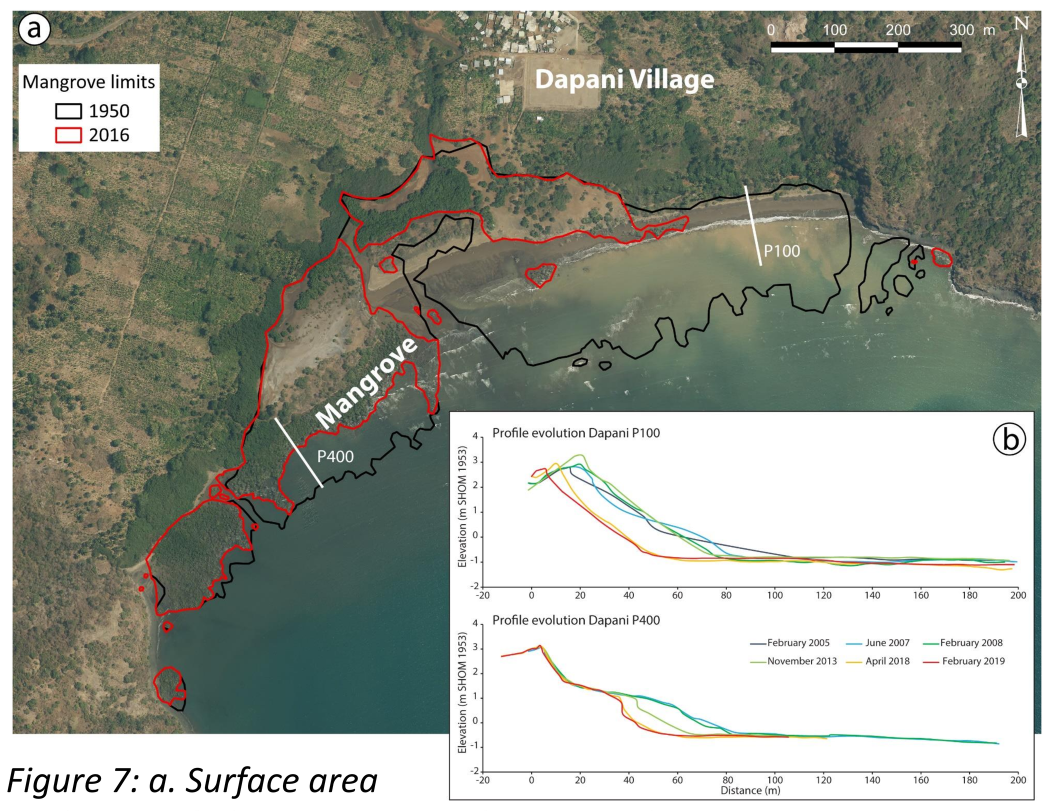

Figure 7: a. Surface area evolution of the mangrove of Dapani showing a very important regression: 1950: 27,61 ha → 2016: 12,06 ha. b. Profile changes of Dapani mangrove.

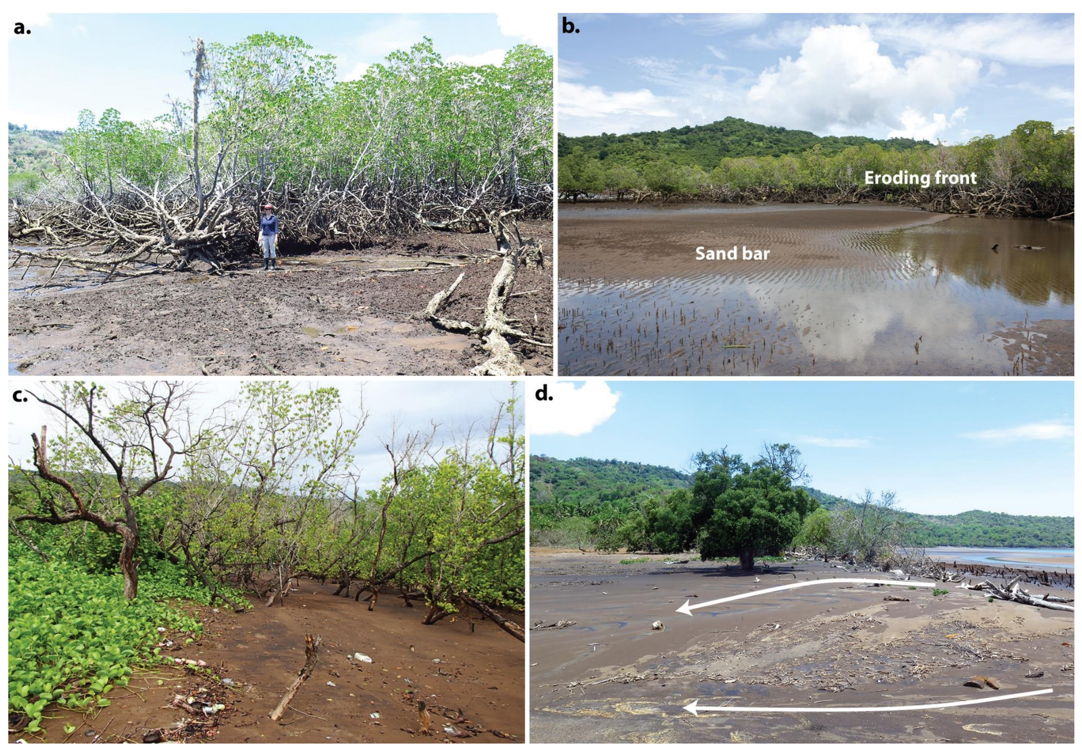

Figure 8: a. Eroding front of mature mangrove with fallen Rhizophora mucronata; b. Sand bar near eroding front; c. Sediment burial of mangrove root systems; d. Overwash on the top of the beach ridge.

Continuous beach ridge accretion leads to burial and asphyxia of mangrove root systems, generating mangrove mortality (Fig. 8c). At the same time, the decrease in the width of the mangrove fringe enhances wave energy transmission across this fringe.

The ridges are built up by swash processes but are also subject to active overwash processes (Fig. 8d) that lead to landward ridge migration (Fig. 9).

In some cases, the extermination of mangrove stands can lead to an active erosional cliff and the retreat of the adjacent coastal plain. Mangrove degradation and the ensuing coastal reworking will ultimately render vulnerable adjacent coastal socio-ecosystems.

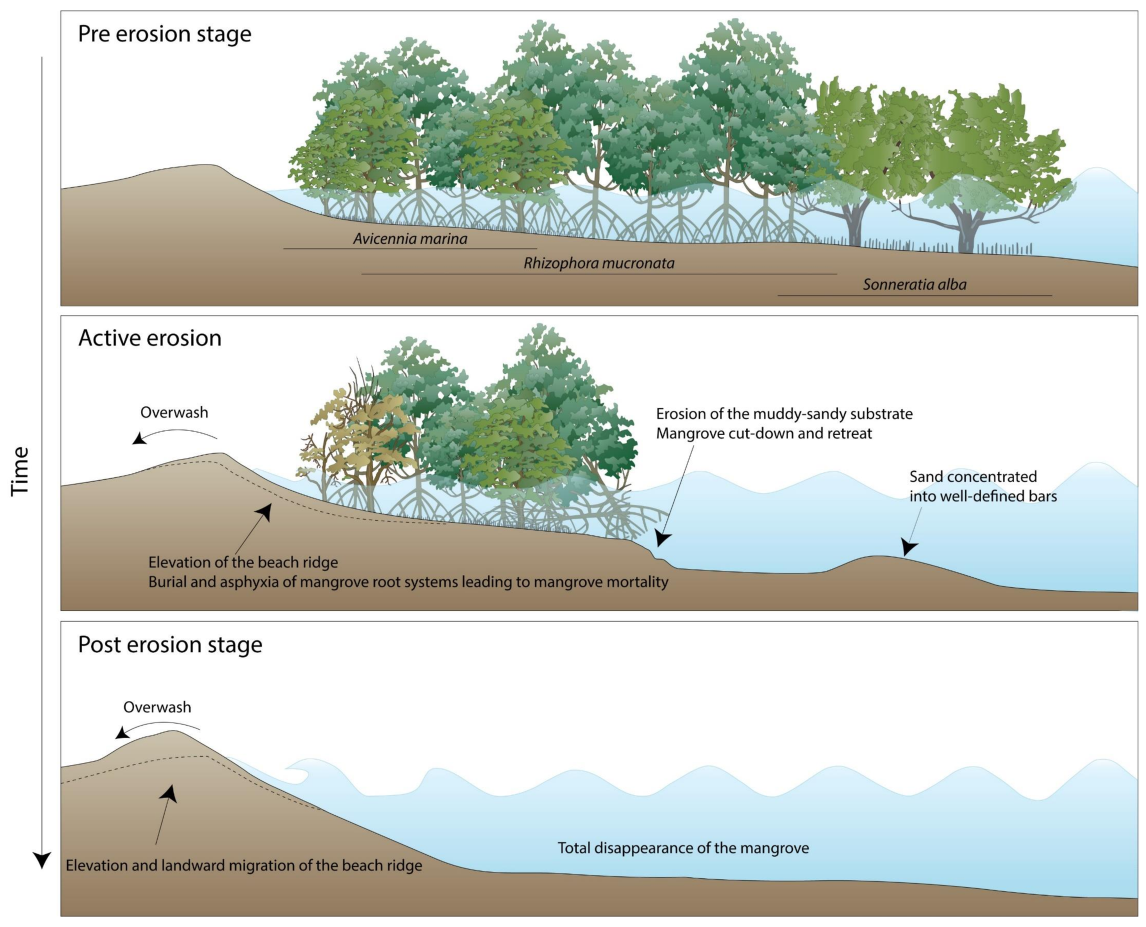

Figure 9. Model of the hydro-sedimentary reorganisation of an eroded mangrove in Mayotte

REFERENCES

Jeanson M., Anthony E.J., Dolique F., Cremades C., 2014, Mangrove Evolution in Mayotte Island, Indian Ocean: A 60-year synopsis based on aerial photographs. *Wetlands*, 34, 459-468.

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