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An interdisciplinary approach to understanding the changing distribution of mangrove crabs affected by erosion in Mayotte

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Introduction

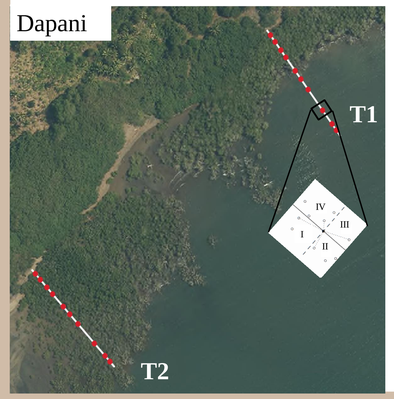
The loss of natural habitats is generally associated with a loss of biodiversity that will cause a change in the functioning of ecosystems and consequently in their capacity to provide ecosystem services. As ecosystem engineers, mangrove crabs fulfil key ecological roles in the structure of the mangrove ecosystem through burrowing and in the functioning through nutrient cycling and bioturbation. They are also of societal and economic interest for the populations.

Between 1950 and 2016, the mangroves of Mayotte have been affected by a moderate regression of 6%. This decrease is not very high, but it hides disparities with some mangroves relatively stable, other mangroves that have strongly decreased. This loss is likely to impact the distribution of crabs and consequently the structure and functioning of the ecosystem.

The objective of this study is to understand the impact of mangrove erosion on the distribution of crabs through an interdisciplinary approach combining methodologies in ecology, human geography and geomorphology.

Methodology

Aerial photography of one study site (IGN, 2016)



Second site: Mzouazia

T1: eroded transect, topographic surveys and ecology survey

T2: non-eroded transect, ecology surveys

Red dot: sampling station with PCQM method

4 quadrats per station

Medium scale

Geomorphology method
→ Analysis of vertical aerial photographs
→ Topographic surveys

Human geography
→ Semi-structured interviews: 19 in Mzouazia ; 18 in Dapani

Finer scale

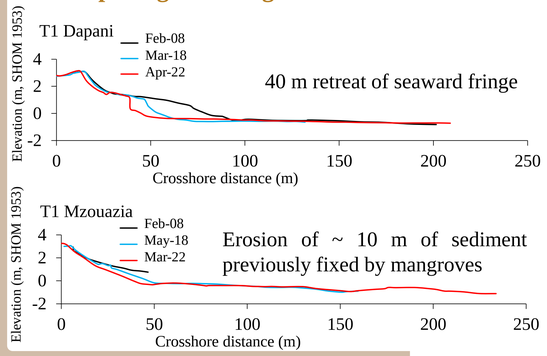
Ecology survey
→ Measurement of abundance of crab species, identity of dominant mangrove trees, tree circumference, and grain size by using the Point-Centered Quarter Method (PCQM) in 10 sample stations ; height on the foreshore is provided by a digital elevation model.

Results

① Evolution of mangrove surface and the coastal profile

The analysis of aerial photographs shows that these two mangroves have experienced a regression of -64% for Dapani and -49% for Mzouazia between 1950 and 2020.

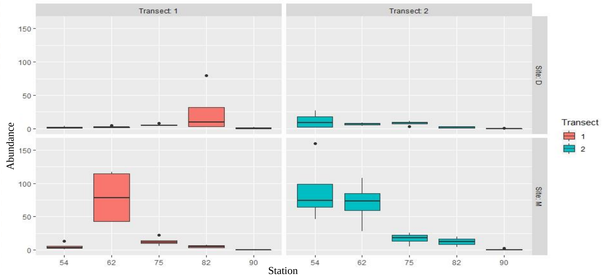
Morphological changes in eroded sections



② Distribution of mangrove crabs

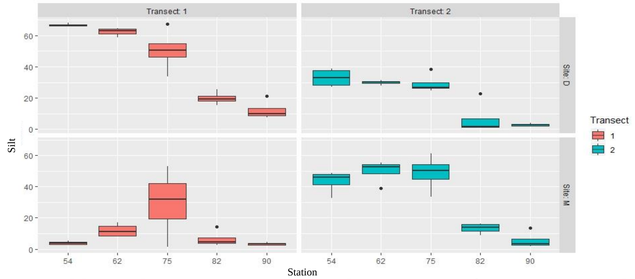
The data are tested by nested ANOVAs with the factors transect and station nested within the factor site. The transect and station interaction is always significant.

Abundance of crabs in mangroves



Abundances of crabs are lower in more eroded transects. At the Mzouazia site, the transect and stations interact, with a higher abundance of individuals at station 54 of transect 2. At the Dapani site, there is no effect of the transect on the stations.

Distribution of sediments



Muddy sediments prevail at the center of transects and decreases towards the top of the foreshore. At the Mzouazia site, the percentage of silt is higher on transect 2 than on transect 1, while at Dapani, the values are higher on transect 1 than on transect 2.

③ Local ecological knowledge of the inhabitants on state of stocks

Crab species	Mzouazia	Dapani
C. carnifex	[1]Constant	[2]Constant
S. serrata	[3]Constant	[4]Decreases
N. africanum	-	[5]Decreases
S. elongatum	-	[6]Decreases

Interview extract

"This crab (S. serrata) lives hidden in the mud [...] The mangrove leaves, the mud stays there. As long as there is mud, there will always be crabs (EM3).

C. carnifex

Raesons given by responds to justify the stocks of crabs:

[1, 2] Not affected by the presence or abscence of trees
[3] Mangrove is decreasing but has not disappeared. The mud where the crabs live is still present
[4, 5, 6] Where mangrove has disappeared

Conclusion

Aerial photographs have shown that the mangroves studied have decreased since 1950, with a retreat concentrated at the bottom of the foreshore. *S. serrata*, which lives seaward of the mangrove, does not seem to be disappearing according to interviewees, whereas species living within the forested portion seem to be more affected by habitat modification (data for Dapani only, not shown).

The top of the foreshore is not impacted by the retreat of the mangrove. Erosion does not seem to have an effect on *C. carnifex*, which lives at the landward end. At Mzouazia site, geomorphological measurements and sediment analysis show a higher concentration of sand on the beach ridge in the eroded area.

Some interviewees believe the arrival of sand is a cause of crab mortality. They perceive the crab population decrease and link it with the mangrove erosion. Indeed, lower crab abundances and species richness were measured in the most eroded part of the mangrove.