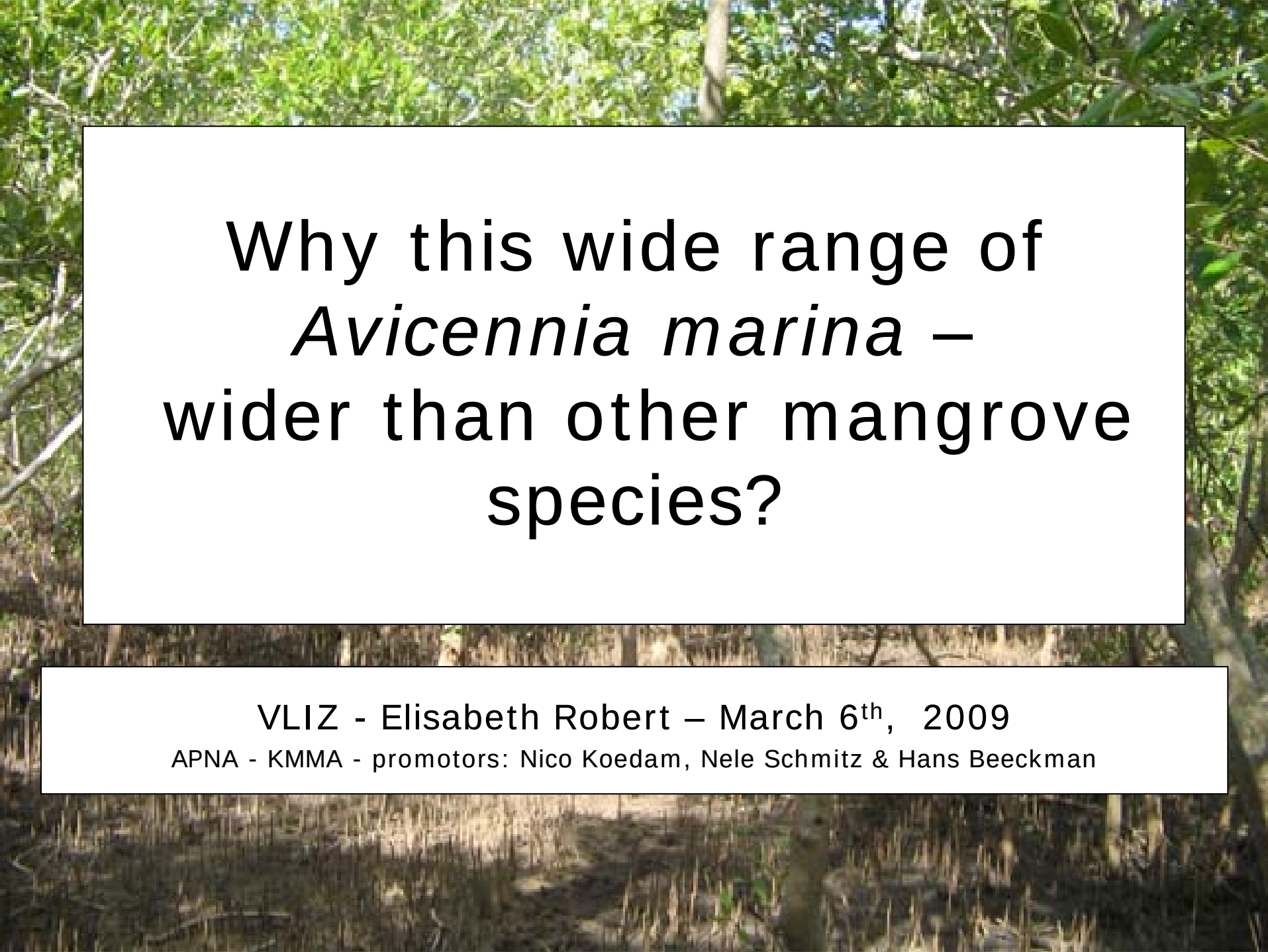


Why this wide range of *Avicennia marina* – wider than other mangrove species?

VLIZ - Elisabeth Robert – March 6th, 2009

APNA - KMMA - promotors: Nico Koedam, Nele Schmitz & Hans Beeckman

Mangrove = intertidal forest in the (sub)tropics

⇨ mangrove trees subjected to :

- frequent inundation
- high and changing salinities
- high temperatures
- low atmospheric relative humidity
- hypoxia in the substrate (= lack of O_2)

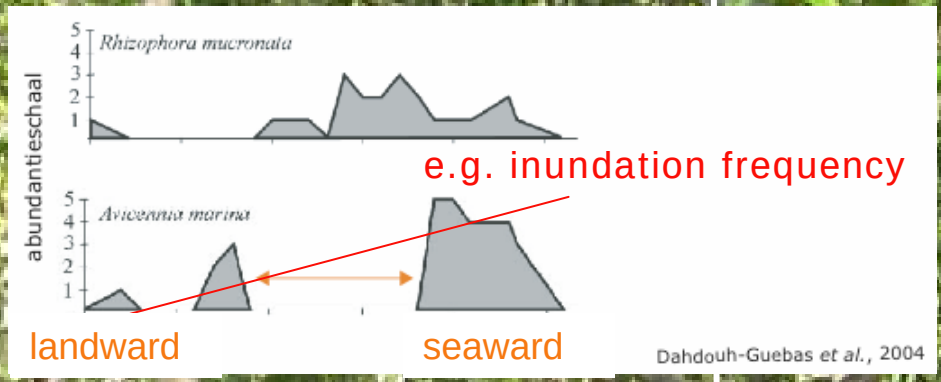
adaptations

vivipary → propagules

aerial roots → pneumatophores

salt exclusion + salt excretion → salt glands

Avicennia marina



biogeographically: 'wide' range (latitude)

- a mangrove species from Japan to Australia

- >< other mangrove species with more restricted latitudinal range

ecologically: 'wide' local distribution

- disjunct zonation pattern: landward as well as seaward side of the forest

- eurytopic with respect to salinity, inundation, ...

Why?

How does a tree survive ?

?

?

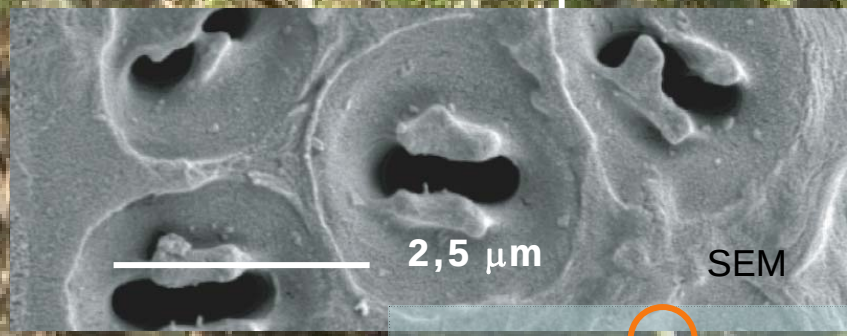
?

successive cambia

> sequence of phloem & xylem

mouthlike pits with heavy ‘lips’ and heavy pit membranes

Robert, 2007



Schmitz *et al.*, 2007

vascular features

vessel density

vessel grouping

vessel diameter

1.

variation within the species and one site

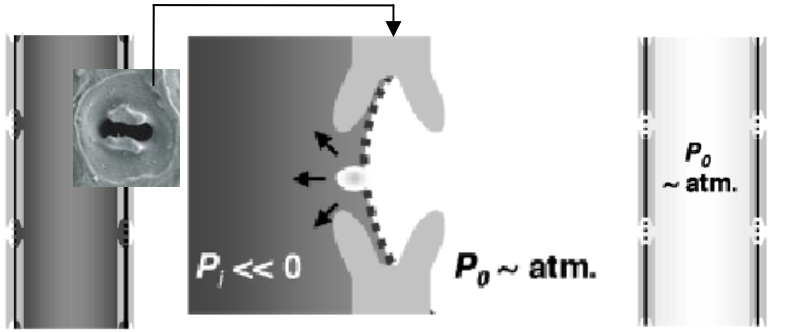
A. marina

2.

difference between the species *A. marina* and *Rhizophora mucronata*

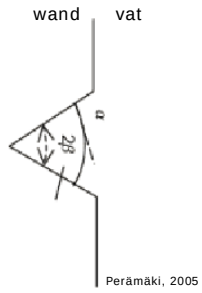
Safer water transport under stressful conditions?

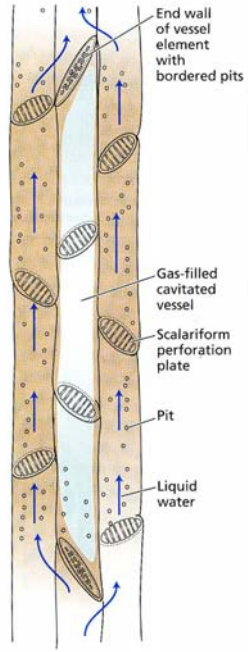
- safe = low probability of cavitation (air bubble in water cylinder) + potential to bypass embolism (air in vessels)
- stress = low tidal flushing + high salinity



Hacke & Sperry, 2001

Air-seeding





Taiz & Zeiger, 2002

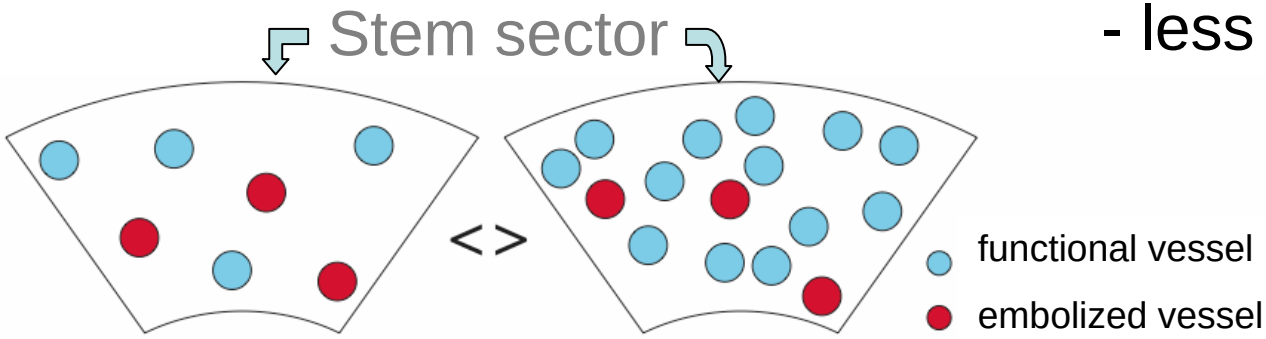
SAFER WATER TRANSPORT AGAINST STRESS

1

vessel density

Results: higher vessel density with

- higher salinity
- less tidal flushing



Why safer? - more functional vessels with same number of embolisms

- more bypasses

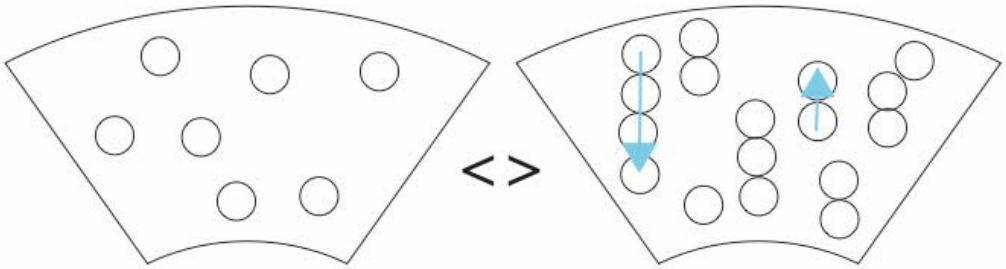
SAFER WATER TRANSPORT AGAINST STRESS

2

vessel grouping

Results: higher vessel grouping with

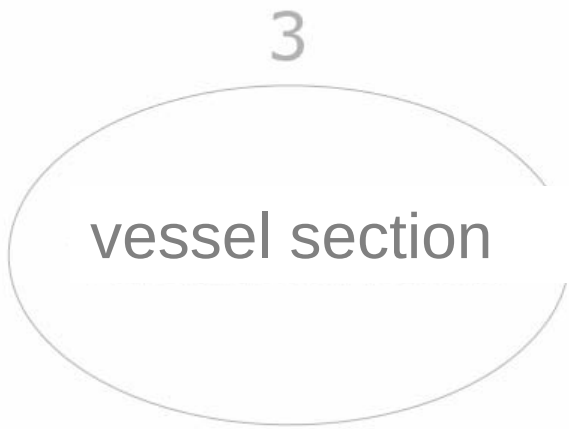
- higher salinity
- less tidal flushing



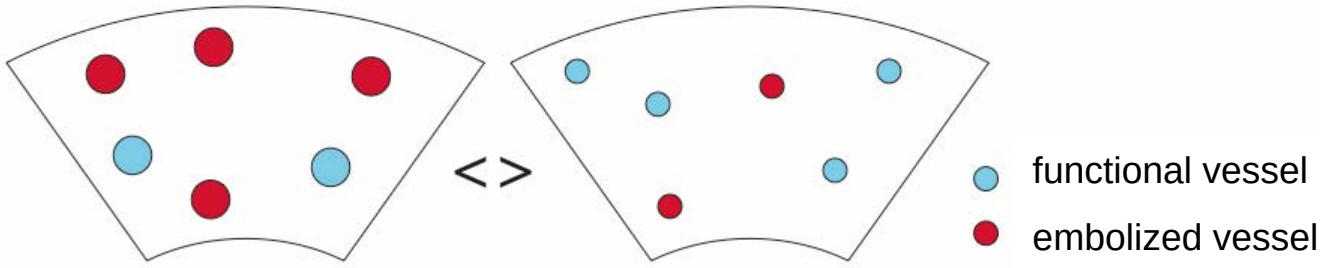
Why safer?

- more bypasses

SAFER WATER TRANSPORT AGAINST STRESS



Results: narrower vessels with - higher salinity



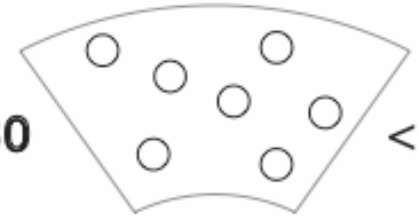
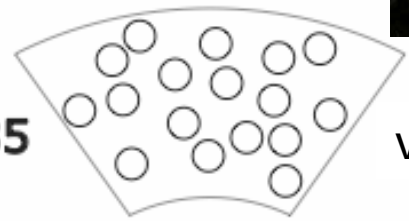
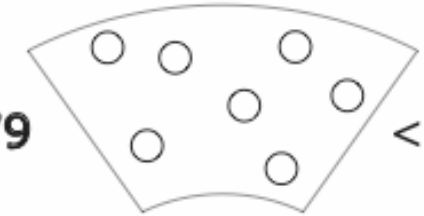
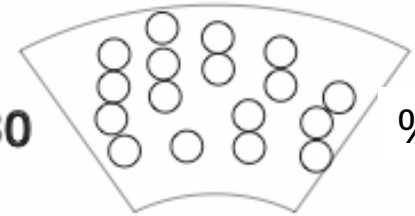
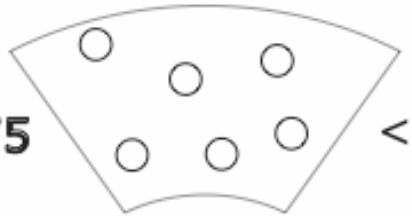
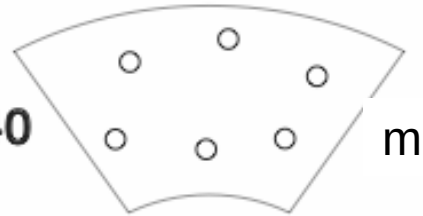
Why safer? - less risk for cavitation

- lower probability of large pores - no *air seeding*

- no air propagation

SAFER WATER TRANSPORT AGAINST STRESS

<> *Rhizophora mucronata*

	Rhizophora		*Avicennia*	
vessel density →	30		<> 85	 vessels mm^{-2}
vessel grouping →	79		<> 30	 % solitary vessels
vessel dimensions →	75		<> 40	 micrometer μm

Verheyden A, De Ridder F, Schmitz N, Beeckman H, Koedam N (2005) High-resolution time series of vessel density in Kenyan mangrove trees reveal a link with climate. New Phytologist 167: 425-435.

Schmitz N, Verheyden A, Beeckman H, Kairo JG, Koedam N (2006) Influence of a salinity gradient on the vessel characters of the mangrove species Rhizophora mucronata Lam. Annals of Botany 98: 1321-1330.

Schmitz N, Jansen S, Verheyden A, Kairo JG, Beeckman H, Koedam N (2007) Comparative Anatomy of Intervessel Pits in Two Mangrove Species Growing Along a Natural Salinity Gradient in Gazi Bay, Kenya. Annals of Botany 100: 271-281.

Conclusion: wood anatomical features (vessel properties) make *Avicennia marina* biogeographically and ecologically successful

landward

seaward

SAFE WATER TRANSPORT

HIGH VESSEL DENSITY

HIGH VESSEL GROUPING

NARROW VESSELS

an adaptation to ecologically stressful conditions

Rhizophora mucronata

Avicennia marina as a species

X

biogeographically wide range

X

ecologically wide range

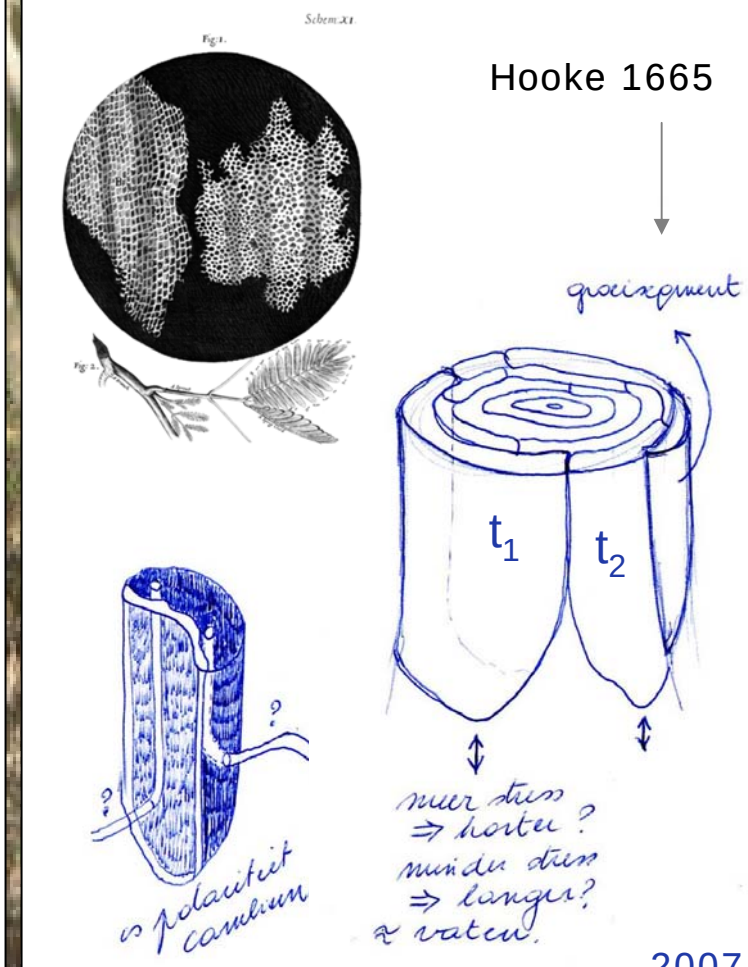
Future 1

Successive cambia: an ecological and biogeographical asset?

- a network of successive cambia giving a different, beneficial growth pattern?
- the ‘segment’ organisation adapted to a less predictable environment?

Spatial organisation of vessels in *Avicennia marina*?

- where do vessels start and end near the limits of a growth ‘segment’?



Future 2

Is this a genus feature?

- *Avicennia* spp. constitute mangrove limits worldwide
- do *Avicennia* spp. worldwide share these anatomical features ?

Tidal mudflat, Mauritania

Avicennia germinans

Thanking Nele Schmitz, Nico Koedam, Hans Beeckman, James Gitundu Kairo, Hamisi Ali Kirauni, Joseph Kipkorir Sigi Langat, Jared Bosire, Herman Van Hemelrijck, Anouk Verheyden, Peter Kitin, Samuel Teissier, Ilse Boeren, Henri Eisendrath, Sandrine Godefroid, Nicky Roggen, Mia Van Mellaert, Jos Robert, Karel Robert, Hilde Robert, Frans Robert, René Kokkelmans, Angèle Baggen, Elisha Mrabu Jenoh, Leen Haagdorens, Ronny Merken, Ann Vanden Wyngaert, Liza Lauwers, Franky Valckenborg, Sunita Janssenswillen, Laila Higazi, Sofie Corluy, Céline Gillain, Clara Noé, Judith Okello, Roger Van Mellaert, Cornelia Vanderloock, Maria Huygens, Lieve Van Mellaert and all Boezeroenen.

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Foto's: E. Robert en N. Schmitz

Mangroves in Gazi Bay, Kenya