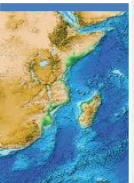
Oceanographic Research in the North Kenya Banks - KMFRI, Kenya

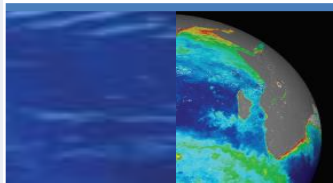
Dr. Joseph Kamau

Empowered lives.
Resilient nations.

SAPPHIRE – North Kenya Bank

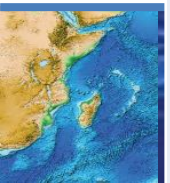
No	Activity	Status
1	Generate biotic and abiotic dataset of climate change variables that are likely to impact on the NKB fisheries and their ecosystems	• A 15 days cruise conducted in March, 2020 on board RV. Mtafiti data collected and samples analyzed.
2	Map and characterize the North Kenya Bank benthic habitat and determine the NKB larval dispersal and connectivity	• Fish samples collected to determine connectivity using molecular technics. A report has been submitted. • We lost the Remote Operated Vessel (ROV) while conducting research in the sea thus will not be able to characterize the benthic habitat. • We however managed to characterize the geomorphological formation of the North Kenya Bank using acoustics. • We have a technical report on connectivity

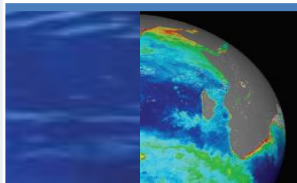


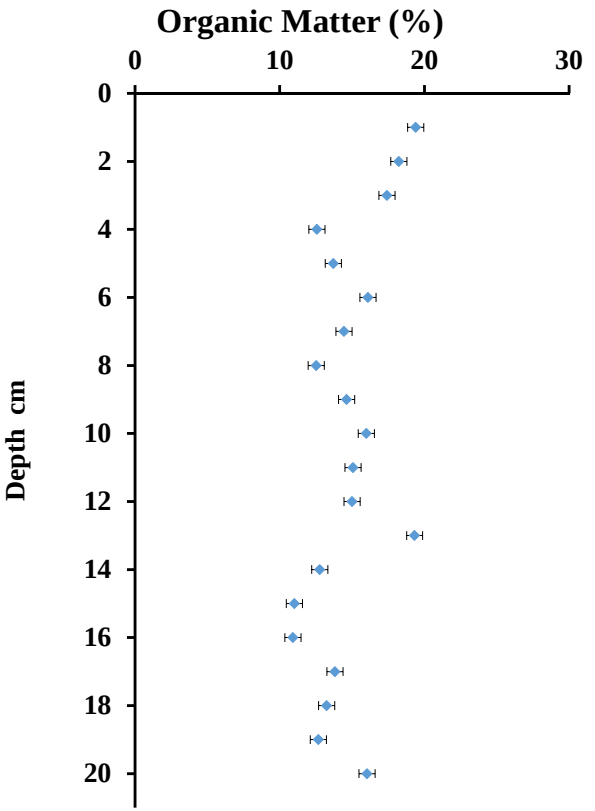


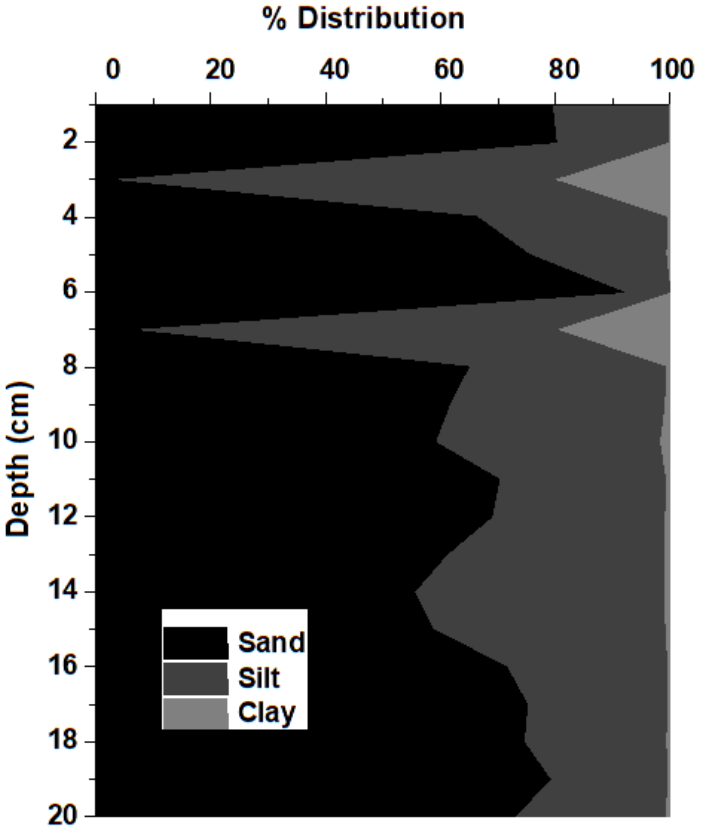
SAPPHIRE – North Kenya Bank

No	Activity	Status
3	Sediment cores sampling and analysis to determine the geo-chronological accretion of the North Kenya Bank sediments	Core samples collected, we have a report
3a	Determine the geo-chronological accretion of the North Kenya Bank sediments	We have a technical report
3b	Determine Tana River plume dynamics	We have a publication. **Influence of Tana river discharge on productivity along the Kenyan coast**
4	Underscore socio-economic and governance issues related to the changes in the upwelling regimes of the NKB	We have a publication. Title of the manuscript ***Managing environmental change within the emerging fisheries of the North Kenya Banks.*** ***We have a policy brief and dissemination materials***



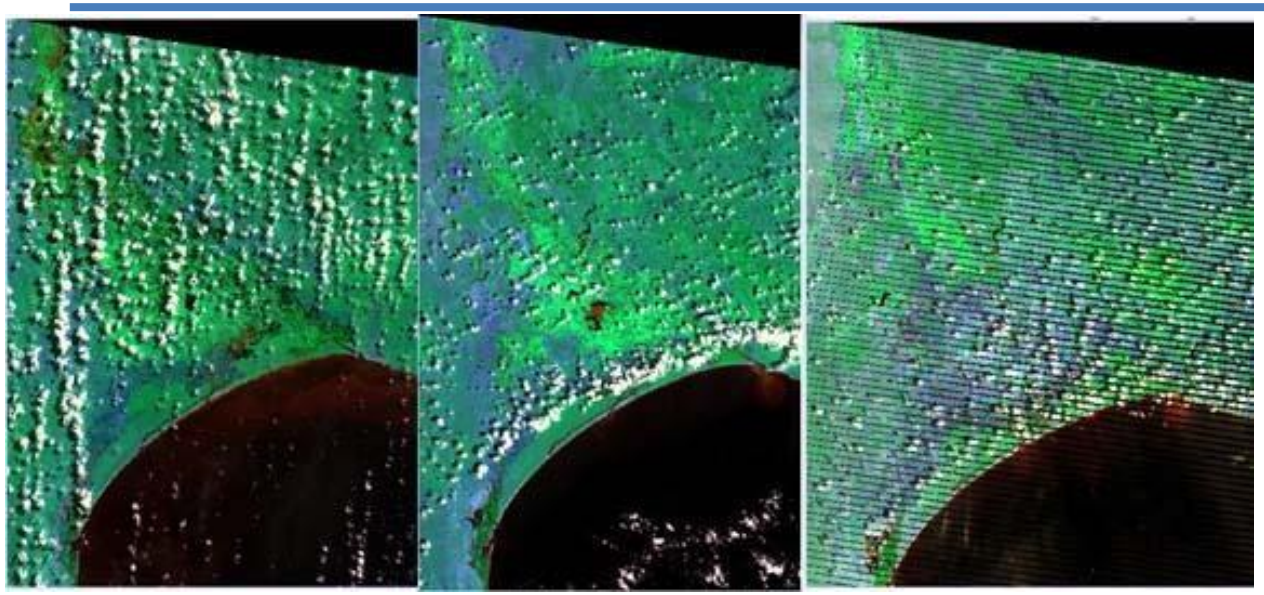



Organic Matter (%)
0
10
20
30
Depth cm
0
2
4
6
8
10
12
14
16
18
20


% Distribution
0
20
40
60
80
100
Depth (cm)
2
4
6
8
10
12
14
16
18
20
Sand
Silt
Clay


ern Indian Ocean

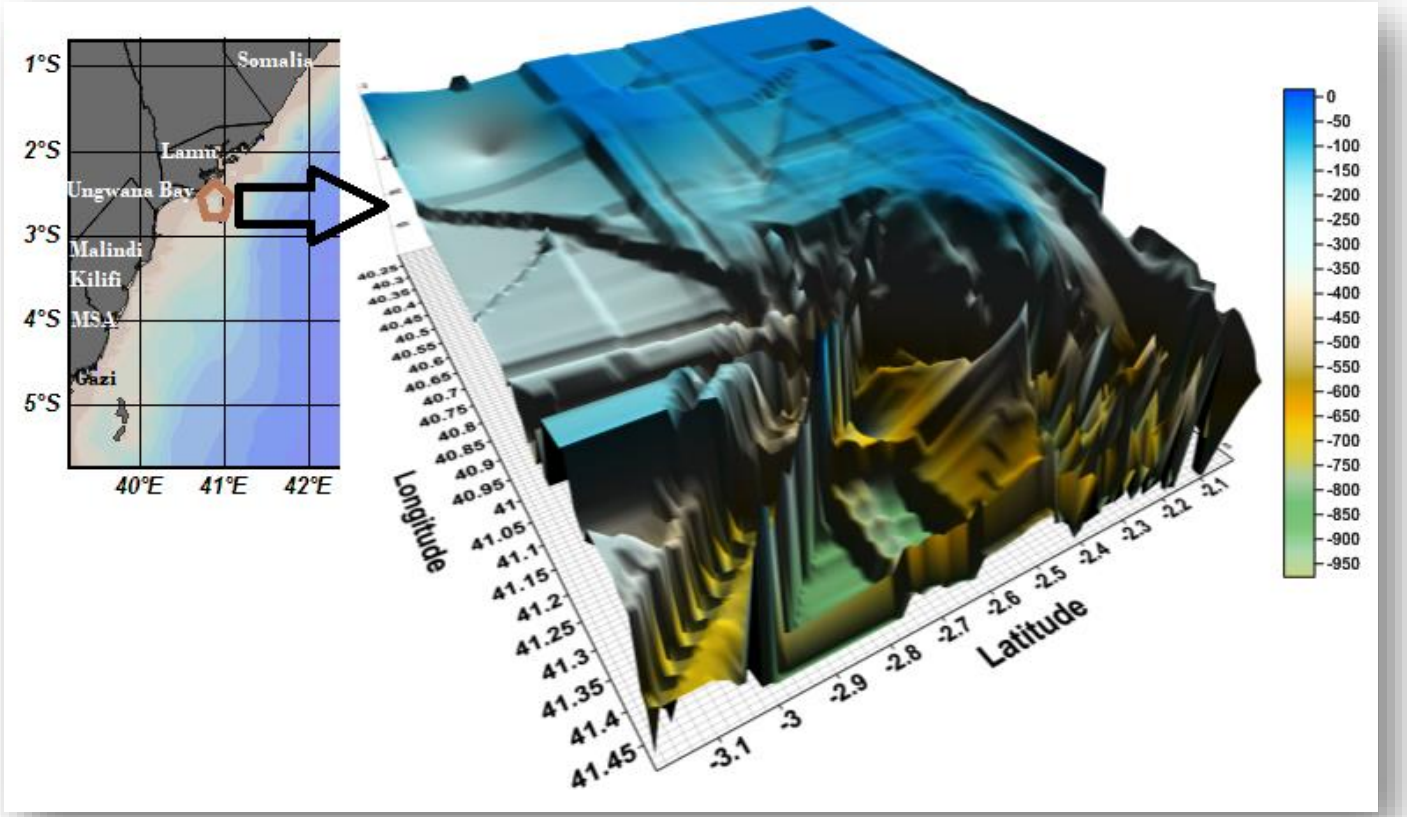
Land Use Change

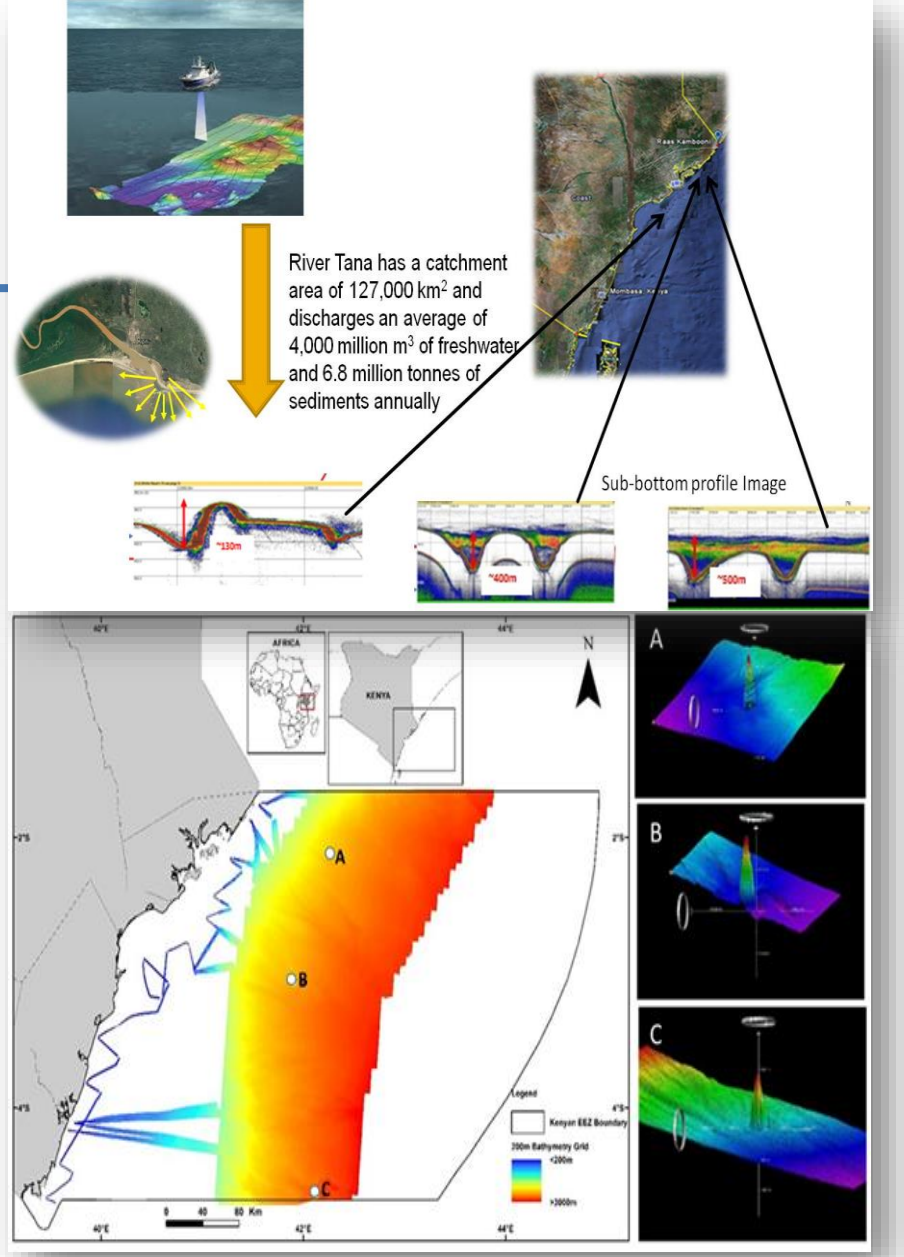


Key Habitats	Ha (2010)	Ha (2050)	% remaining
Forest	27,100	5,000	18
Riverine forest	32,300	12,300	38
Mangrove	8,400	7,400	88
Floodplain grassland	50,800	25,300	50

Increased human activities, mostly farming and pastoralism.
The mages from left to right, 1990, 2000 and 2011 (Source: Njuguna. et al., 1992)

Geophysical structures of ecological importance





Sediment traps deployment at North Kenya Banks

-Mtafiti-Monthly¶
ISSUE·#02¶
MARCH,·2020¤

Contents¶

BY·JANE·KIGUTA¶

Research·in·Brief¶

What· lies· in· the· North· Kenyan· Banks· new· fishery· frontier?·¶

A·submerged·Bank,·located·off·the·shores·of·northern· Kenya·is·acquiring·significance·-·the·North·Kenyan·Bank· (NKB).· This· feature· has· been· identified· to· host· an· important· emerging· fishery· that· is· expected· to· spur· economic· growth· for· the· local· fishing· communities.· Artisanal·fishers·are·now·advancing·towards·the·North· Kenyan· Bank,· which· remains· largely· unexploited,· in· search·of·new·fishing·grounds.·This·new·fishing·frontier· is· of· considerable· importance· as· it· holds· a· huge· potential·likely·to·boost·local·livelihoods.·¶

¶

Why·embark·on·the·research·cruise?·¶

Little· is· known· about· this· new· fishery· frontier.· It· was· under· this· backdrop· that· KMFRI· through· Dr· Joseph· Nyingi· Kamau· proposed· to· Nairobi· convention· under· the·SAPHIRE·project·to·consider·funding·a·study·on·this· new·fisheries·frontier.·This·led·to·the·funding·of·a·North·

Top,·KMFRI·researchers·and·Kenya·Coast·Guard·Services·team Below,· cruise· leader· Dr· Mbaru· (2nd· left)· with· researchers· and· technologists·prepare·CTD·rosette·for·deployment¶

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-Mtafiti-Monthly¶
ISSUE·#02¶
MARCH,·2020¤

Tracking·echo·sounder·data·on·the·screen¶

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Water·samples·were·taken·to·measure,·dissolved·oxygen· levels,· nutrients,· particulate· organic· carbon,· pH,· temperature·and·salinity.·Zooplankton·tows·using·a·bong· net· were· conducted· at· every· station· and· samples· preserved· under· formalin· for· further· analysis· in· the· laboratory.·While·phytoplankton·samples·were·collected· by·sieving·seawater·through·a·plankton·mesh.·¶

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Western Indian Ocean

NORTH KENYA BANKS: OPPORTUNITIES AND THREATS

Prepared by the Kenya Marine and Fisheries Research Institute

REWARD

focus on the Kenya's emerging fishery ground - North Kenya Banks (NKBs) - is a step in ight direction and complements the government's efforts in the achievement of the all- mpassing Big Four Agenda, and in particular in guaranteeing a food secure nation. His llency President Uhuru Kenyatta has in the past called on all fisheries authorities to step fforts for the country to benefit from her immense marine resources.

President's goodwill saw him sign into law the expanded Fisheries Management and lopment Act, 2016 (No. 35 of 2016) which incorporated the Blue Economy concept. inating in Kenya co-hosting the first global Sustainable Blue Economy Conference in at Nairobi, together with her co-hosts Canada and Japan, the conference was attended ver 16,000 participants from 184 countries.

reas the Act provides for the conservation, management and development of fisheries other aquatic resources, the conference was a golden opportunity for the country to build e economy, and come up with strategies on how to harness the potential of our oceans, lakes and rivers to improve the lives of all, particularly indigenous people.
her, the commissioning of Liwattoni Fisheries Complex supports the fisheries sector gh the establishment of a modern fishing port

therefore imperative that we leverage the structures put in place to tap the fisheries urces found in the North Kenya Banks for the economic well-being of our country. This will long way in achieving the Vision 2030 which aims to transform Kenya into a newly strializing "middle-income country".

her, the institutionalization of the Big Four Agenda in the five-year Medium Term Plans III gh which Vision 2030 is being implemented gives us an impetus to continuously seek s of unlocking the huge potential of the Blue Economy. This will be accelerated through ementation of research recommendations and the incorporation of the NKB in marine ial planning to capitalize on the gains achieved so far.

The construction of the ultra- modern tuna fish factory is another reform in the fisheries sector aimed at allowing the fishing vessels operating in the NKB and other Kenyan waters to land their catch. This huge investment demonstrates the government's preparedness in boosting the economy through fish processing. This is key in alleviating poverty and ending hunger, the two critical goals of the 17 Sustainable Development Goals (SDGs) aimed at transforming the world.

PREFACE

The North Kenya Banks (NKBs) in Lamu is an emerging fishery ground with unique geophysical features. It is of considerable interest as it holds huge potential likely to boost local fishery resources, and is critical in the achievement of Food Security and Nutrition, a major pillar under the Kenya's Big Four Agenda.

The high productivity of this emerging fishery frontier sparks interest due to its contribution to the Blue Economy initiative, Gross Domestic Product and ultimately the overall economic well-being of the country. Despite the area having high fish abundance, and lies within the tuna migratory route, and is home to high commercial fish such as Tuna, red snappers, among others, until now very little was known about its ecological and productivity dynamics.

It is against this background that Kenya Marine and Fisheries Research Institute (KMFRI) embarked on research expeditions within the NKBs ecosystem, employing state-of-the art equipment onboard RV Mtafiti, to investigate the oceanographic processes that occur within this important ecosystem.

This policy brief documents key findings that provide insight into the oceanic current regimes, their interaction with geophysical features, and their role in productivity. The productivity of this system largely depends on upwelling formations due to oceanic current interaction with the bank's topography, which is highly reliant on wind-driven currents associated with the prevailing monsoon season.

This is critical in the face of climate change, whose negative effects, if allowed unabated, might have serious repercussions on the ecosystem's productivity. And with the United Nations proclaiming 2021-2030 as Ocean Decade, there is need to provide managers with research findings to facilitate sustainable management of the fishery resources.

This policy brief therefore presents information on the mechanisms that support the high productivity of this key emerging fishery ground as well as associated threats. Fisheries managers will be well advised on the environmental controls that need to be taken into account when developing plans for the sustainable exploitation of the fisheries resources.

To this end, I wish to extend my sincere gratitude to the Government of Kenya for funding the oceanographic research through RV Mtafiti which it commissioned for marine research in 2014. I also wish to acknowledge SOLSTICE (Sustainable Oceans, Livelihoods and Food Security Through Increased Capacity in Ecosystem Research in The Indian Ocean) and WIO LME SAPPHIRE (The Western Indian Ocean Large Marine Ecosystems Strategic Action Programme Policy Harmonisation and Institutional Reforms) projects for their support and research collaboration.

Last but not least, I recognize KMFRI researchers' and technical staff's tireless efforts in conducting the research expeditions, and the Kenya Navy & Kenya Coast Guard Services (KCGS) commitment in ensuring safety of the officers throughout the research cruises. I wish also to commend the editorial team headed by Dr. Joseph Kamau and comprising Dr. James Mwaluma, Dr. Melckzedeck Osore, Dr. Thomas Kalama, Mr. Harrison Ong'anda, and Ms. Jane Kiguta.

Professor James Njiru

DIRECTOR GENERAL,
KENYA MARINE FISHERIES RESEARCH INSTITUTE (KMFRI)

KEY MESSAGE:

- **The North Kenya Banks (NBKs) has high abundance of fish larvae and are more diverse than other coastal ecosystems along the Kenyan coast.**
- **The higher abundance of larvae, taxon richness and diversity makes the NKBs a distinct region that plays a key role of providing a favourable reproductive and nursery habitat for a wide range of commercially important fish species.**
- **The nearby estuaries, mangrove habitats and seagrass beds are important nursery and feeding grounds for larval fish and crustaceans that grow to recruit to join offshore harvestable adult stocks.**
- **These habitats should therefore be protected from the negative effects of human pressure and climate change to ensure sustainability of the NKBs fisheries.**

Potential nursery grounds for fish and crustaceans

The specific areas prevalent with larval fish follow patterns of high chlorophyll-a and zooplankton abundance, these being located within the 200m depth contour (Figure 6). During the SEM, the prevalent tuna species at the NKBs are mainly comprised of yellowfin, albacore and skipjack tuna listed in order of abundance. Spawning of these stocks is reported to take place throughout the year. The high larval densities of anchovies, snappers, barracudas and jacks are indicative of the area being a spawning and nursery ground (Figure 6). Besides, the Malindi-Ungwana Bay being part of the NKBs, it harbours an economically important penaeid prawn resource that is targeted by both small-scale and semi-industrial trawl fishers. The area has a total of seven prawn species, with the Indian white prawn and speckled prawn, dominating yearly catches of both small-scale and trawl fisheries. The life history of these species largely depends on both estuarine mangrove ecosystems for feeding and offshore mud banks for breeding.

Recruitment area

The life cycles of the fishery depend on both marine and estuarine mangrove habitats. Breeding usually occurs in relatively nearshore areas dominated either by corals or mud-banks where females release their eggs. The eggs hatch into planktonic larvae which after several weeks (depending on the species) enter coastal and estuarine nursery areas, where they feed and grow into juveniles. The juveniles and sub-adults then migrate out of the estuaries to join adult offshore pop-ulations. Nevertheless, the majority of marine species in the NKBs have dispersive larvae often comprising an admixture of juveniles and adults from different sources, both local and regional, suggesting that recruits may originate from local nurseries, and/or from multiple sources. The recruitment pattern within the NKBs is influenced by many factors, including life history characteristics of the species, ocean currents and physical or hydrographical barriers or environmental cues.

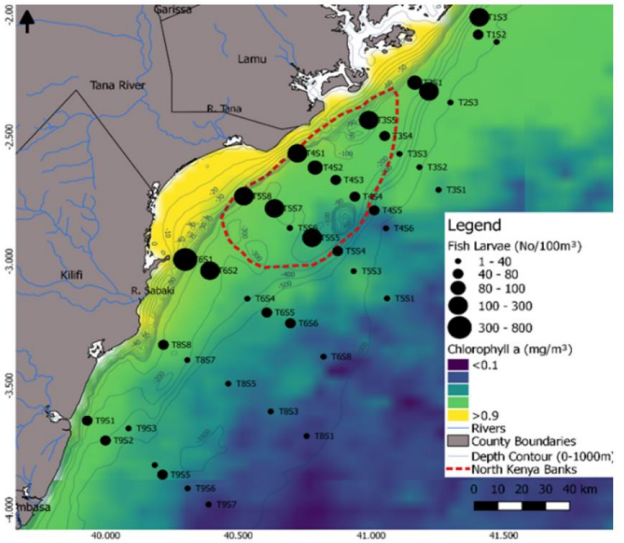

Fig. 6. Recruitment areas of NKBs prevalent with fish larvae (Tunas, Snappers and Jacks 4.0-5.0 mm)

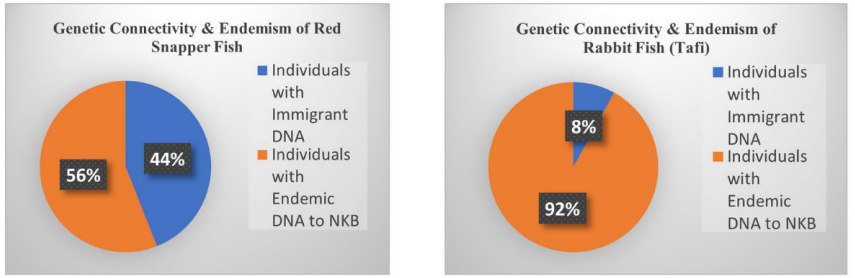

Fig. 7. Genetic connectivity and endemism of NKBs fish populations

The information presented in this brief is based on the following publications:

1. Mwaluma J.M., Ngisiange N., Osore M., Kamau J., Onganda H., Kilonzi, J., Roberts M., Popova E., Painter S. (In Press). Assemblage structure and distribution of larval fish on the North Kenyan Banks during the South East Monsoon season.
2. Mzingirwa, F. A., Mkare, T. K., Nyingi, D. W., & Njiru, J. (2019). Genetic diversity and spatial population structure of a deep-water snapper, Pristipomoides filamentosus in the south-west Indian Ocean. Molecular Biology Reports. doi:10.1007/s11033-019-04962-w
3. Mkare, T., Groeneveld, J., Teske, P., & Matthee, C. (2017). Comparative genetic structure in two high-dispersal prawn species from the south-west Indian Ocean. African Journal of Marine Science, 39(4), 467–474. doi:10.2989/1814232x.2017.1402089
4. Mkare, T. K., von der Heyden, S., Groeneveld, J. C., & Matthee, C. A. (2014). Genetic population structure and recruitment patterns of three sympatric shallow-water penaeid prawns in Ungwana Bay, Kenya, with implication for fisheries management. Marine and Freshwater Research, 65(3), 255. doi:10.1071/mf13047
5. Mkare, T. K., Mwaluma J., & Wambiji, N. (unpublished). Genetic population structure of Shoemaker spinefoot, Siganus sutor along the Kenyan coast

KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

OCEAN·AND·COASTAL·SYSTEMS·DIRECTORATE¶

Genetic·population·structure·and·recruitment·pattern·of·the·Shoemaker·spinefoot,·*Siganus·sutor,*·within·the·North·Kenya·Bank·¶

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TECHNICAL·REPORT·¶

KMFRI··2021¶

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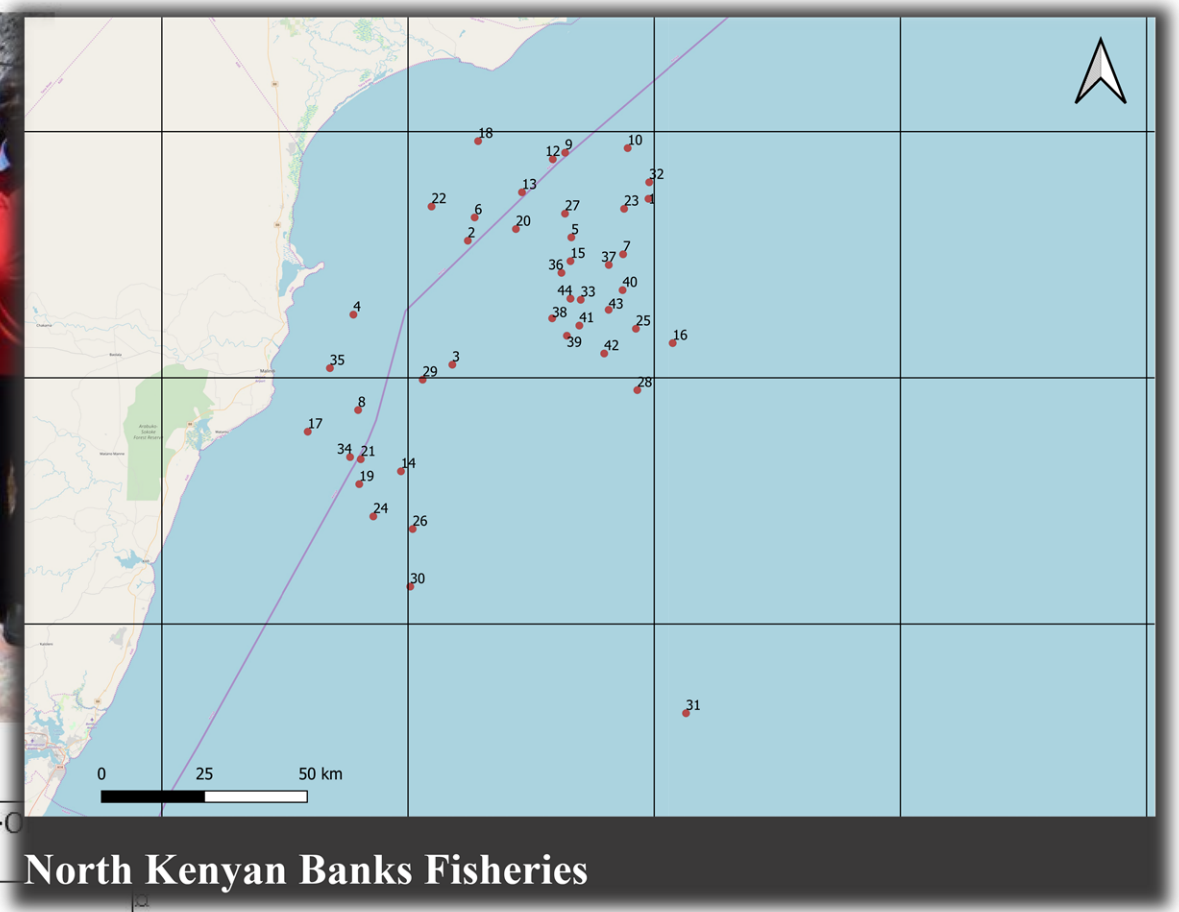
KENYA·MARINE·AND·FISHERIES·RESEARCH·INSTITUTE¶

FIELD·WORK·-·BACK·TO·OFFICE·REPORT¶

NORTH KENYA BANK FISHING GROUNDS



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Activity·Title¤	DISSEMINATION·OF·RV·MTAFITI·FINDINGS·ON·PRODUCTIVITY·O NORTH·KENYA·BANKS·¤
Thematic·area¤	Lamu,·Kenya¤
Reference·Memo¤	**KMF/RES/¤**
Project·Title¤	·Sapphire·Project¤

Key findings and areas of further studies

- The confluence has been project to shift down south into Tanzania as climate change continues unabated
  - It is projected to affect the NKBs productivity
- Modelled scenarios in the advent of unmitigated climate change project about 70% loss in fish biomass
- There are indications that the NKBs ecosystem is a tuna spooning ground
- Tana sediments have been observed to disperse into the NKBs habitat
- It is presumed that these sediments drive productivity
- Land use change along the Tana river lower catchment area accelerating sedimentation
- A study needs to be formulated to understand the ecological functioning of the deep-sea canyons located at the NKBs

Challenges

- COVID -19 affected much of our activities we were not able to effectively disseminate – we are however now focused on disseminating now that the infection rates are much lower.

- Much higher sampling intensity is required, however were not able due to the high cost involved in such expeditions.

Financial status

SSFA starting date: 01/05/2020

Reporting period: from 01/05/2020 to 02/10/2021

Activity	Original Budget (USD)	Expenditures in (YYYY) (USD) *past year* (if SSFA goes over two calendar years)	Expenditures incurred in (1st Quarter 2020) (USD) *this year*	Total Expenditures (USD)	Comments *(if the expenditures were different from what was originally planned, please provide a short explanation)*
Activity 1	**85,800**				
		3,902	72,912	76,814	
				0	
Sub-total	**85,800**	**3,902**	**72,912**	**76,814**	
Activity 2	**34,500**				
		15,967	14,450	30,417	
				0	
Sub-total	**34,500**	**15,967**	**14,450**	**30,417**	
Activity 3	**10,200**				
		0	6,034	6,034	
				0	
Sub-total	**10,200**	**0**	**6,034**	**6,034**	
Activity 4	**19,500**				
		2,660	10,311	12,971	
Sub-total	**19,500**	**2,660**	**10,311**	**12,971**	
Total Cost	**150,000**	**22,529**	**103,707**	**126,236**	

Signature of a duly Authorized officer:

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Name : Samuel Ogila

Position : Project Accountant

Date: 02 Oct 2021

Thank you