KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

FRESH WATER SYSTEMS

A technical report on the update of biological data on two small pelagic fish species Dwarf robber (*Brycinus minutus)* and Large toothed robber (*Brycinus ferox)*) to determine their commercial status and contribution to the trophic structure of Lake Turkana, and the dissemination of the findings to inform management

TECHNICAL REPORT

KMF/RS/2020/21/C827(6)

JUNE 2021

DOCUMENT CERTIFICATION

Certification by Director (Fresh Water Systems)

I hereby certify that this report has been done under my supervision and submitted to the Director General.

Name: Dr. Christopher Mulanda Aura (PhD)

Signature:  **Date: 16th June 2021**

Certification by Director General - KMFRI

I hereby acknowledge receipt of this Report

Name: Prof. James M. Njiru (PhD)

Signature:  **Date: 18th June 2021**

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EXECUTIVE SUMMARY

Lake Turkana is endowed with over 60 species of fish, 8-15 are exploited at commercial level and 5 of the exploited species contribute over 70% of the total fish landed. Annual production stands at 7,000 metric tonnes valued at over 600 million Kenya shillings. Both commercial landing and experimental data suggest overexploitation of stocks hence the need to expand the fishery. Several species of small pelagic fishes exist in the lake and are not exploited due to lack of information on their biology, ecological roles and commercial viability. Towards this, we undertook a study of two endemic small pelagic fish species with a view to update their biological data so as to determine their commercial status and assess their contribution to the trophic structure. The two species namely the Dwarf robber (*Brycinus minutus)* and Large toothed robber (*Brycinus* ferox) were sampled using set multi-meshed monofilament and trawl nets made from 3 mm seine nets. Trawl nets were towed at a constant speed behind a boat at predetermined depth and time. Fish collected were sorted, weighed, gutted, sexed, maturity stages determined and stomach contents analysed. Results indicate that the two species were more abundant in the pelagic area off Longech spit and Namadak compared to the rest of the stations sampled. The maximum recorded size of the smaller *Brycinus minutus* was 32 mm TL (range 15 mm – 32 mm; mean = 25 ± 6 mm; n=173). while that of the larger *Brycinus ferox* was 113 mm TL (range 50 mm – 113 mm; mean = 78 ± 12 mm; n = 89). The sex ratio (M:F) was calculated at 1:1.3 for the *B. minutus* and 1:1.1 for *B. ferox*. For the latter, females were bigger than males. The smallest *B. minutus* weighed 0.3 g while the largest weighed 2.1 g. Similarly, the smallest *B. ferox* weighed 3.0 g while the largest weighed 12.5 g. Size at 50% maturity (Lm_{50}) for *B. minutus*, was calculated at 28 mm TL. All fish caught above 31 mm TL were sexually mature. During the survey only 40% of the fish sampled were mature. For *B. ferox*, length at 50% maturity (Lm_{50}) was estimated at 94 mm TL. Stomach contents analysis an indicator of trophic structure, showed that both species fed on zooplankton and prawns but the bigger and more predatory *B. ferox* also fed on insects and fish. The main source of food for the two species was the detritus feeding calanoid copepod - *Tropdiaptomus turkanae*, which dominates the zooplankton biomass in the lake. The juveniles of the larger carnivorous fish species such as *Lates niloticus*, *L. longispinis*, *Hydrocynus forskahlii* fed on the two small pelagic fishes. Other commercially important fish species such as *Alestes baremose*, *Clarias gariepinus* and *Synodontis schall* fed on both zooplankton and the small pelagics showing the importance of these fishes in the food chain of the lake as they appear to be the principal consumers of the zooplanktons

and link to primary production. Given their position in the food chain and small sizes, it would be important that more studies are conducted in the lake on their spatial and temporal distribution, standing stock biomass and possible maximum sustainable yield after which an acceptable technique will be worked out that will not over exploit these species and lead to ecological damage. Lake-wide sampling, use of hydroacoustics and development of appropriate gear are recommended prior to conclusions on commercial viability

Key words: small pelagic fishes, Lake Turkana, Trophic structure and viability

ABREVIATIONS AND ACRONYMS

BMU	Beach Management Units B
BOM	Board of Management
GOK	Government of Kenya
KMFRI	Kenya Marine and Fisheries Research Institute
Lm_{50}	Total length at which 50% of fish sampled were sexually mature

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1. INTRODUCTION

Lake Turkana (Figure 1) is located between 2° 27´ - 2° 40´N and 35° 50´ - 36° 60´E. It is the largest desert lake in the world. The catchment area is 130,860 km^2 (Hopson, 1982) out of which 60% is located in Ethiopia. The surface area is approximately 7,560 km^2, making it the largest lake in Kenya. It is 260 km long with an average width of 30 km, a mean depth of 31 m, and a maximum depth of 114 m. The ecosystem is unique, distinguished as the world's largest permanent desert lake and the largest alkaline water body. The water conductivity levels average 3,500 μScm^{-1}, making it a "high ion" or "Class II" lake (Talling and Talling, 1965). Due to its closed-basin nature, the conductivity of the lake has been increasing by approximately 0.45 μScm^{-1} $year^{-1}$ (Hopson 1982). Lake Turkana is also the world's largest alkaline lake, with a pH range of 8.6–9.5 (Cohen 1986). The annual surface temperature ranges between 27.2°C and 29.4 °C and bottom temperatures vary only 1.0 °C from 25.4 °C to 26.4 °C. Turbidity levels are high in Lake Turkana and the euphotic zone extends to only 6 m in the open lake (Källqvist et al. 1988). The lake is known for its strong southeasterly winds, which create surface water currents to the northwest and deep reverse bottom water currents (Hopson 1982).

Despite the high salinity, the lake is endowed with more than 60 described fresh water fish species (Worthington, 1932; Worthington and Ricardo, 1936a; Hopson, 1982; Kolding, 1989, Seegers, et al, 2003, FishBase, 2020). The fish communities have been loosely grouped into littoral, inshore demersal, offshore demersal and pelagic dwellers. About 22 species are currently exploited and 17 regarded as of commercial importance thus forming the mainstay of the fledging artisanal fishery. Five of the exploited species contribute over 70% of the total fish landed annually which stands at 7,000 metric tonnes and valued at over 600 million Kenya shillings.

There is currently an inshore based thriving gillnet fishery occasionally augmented with offshore longline fishing. The status of the inshore fishery is regarded as fully exploited and may be tending towards over exploitation. The offshore pelagic fishery is moderately exploited targeting mainly *Alestes* spp, *Labeo horie* and *Hydrocynus* spp. The fishery is a major source of livelihood to local communities who for a long time, were mostly known for their nomadic lifestyle. Lake Turkana has increasingly gained popularity as a source of supply of fish to national fish markets in Kenya,

border markets of Uganda and Congo. Recent data for both commercial landings and experimental surveys suggest that the stocks of these species may currently be overexploited.

Figure 1. Map of Kenya showing the geographical position of Lake Turkana

The fishery of small pelagic species does not exist in Lake Turkana, yet small pelagic fishes play significant ecological roles in the ecosystem by converting energy from lower trophic levels into food for larger fish. In addition, they are nutrient-rich food but is mainly processed and lost to livestock feed, fish feed, fish oil, pet food and omega-rich vitamins. The nutritional importance of small pelagics lies in their easily digestible protein source, rich in essential lipids with fatty acids (EPA/DHA), essential amino acids, minerals and vitamins. They also contain all the elements of a healthy and nutritionally optimal food source for humans and are an important contributor to the

food and nutritional security of many poor, low-income households in developing countries (Isaacs, 2016; Peck, et al, 2021, Saraux, et al, 2014).

As the current exploitation level and fish production from Lake Turkana is flattening off, there is need to expand the fishery to new areas to enhance fish production. Earlier studies (Hopson, 1982) identified the presence of several species of small pelagic fish whose initial estimates of biomass was significant. Notable amongst these were two small indigenous pelagic fish species; the Dwarf robber (*Brycinus minutus)* and the Large toothed robber (*Brycinus ferox)*. Their status, ecological roles and fishery potential are currently unknown. This study was therefore initiated to update biological information on the above two species, with a view to determining their stocks and potential commercial importance also taking into consideration their roles in the food chains of Lake Turkana.

1.1. Study Objectives

The overall objective of the study was to update biological data on two small pelagic fish species Dwarf robber (*Brycinus minutus)* and Large toothed robber (*Brycinus ferox)*) to determine their commercial status and contribution to the trophic structure of Lake Turkana, prepare a technical report and disseminate the findings to inform management.

The specific objectives were to:

1. Study their biology and ecology so as to generate morphometric, trophic and reproductive information.
2. Determine the trophic roles of the two species especially in supporting the larger commercial fish species
3. Use the above information to recommend management guidelines for the fishery and share findings.

2.0 MATERIALS AND METHODS

2.1 Study Area

The study area covered the pelagic part of the Midwestern and Central parts of the lake off Central Island. The Stations were chosen due to accessibility, differing environmental variables and earlier studies that had alluded to the presence of the species in these areas. They were locayed innthe pelagic areas off the following beaches; Station 1: (Namadak), Station 2: (Napsinyang river Mouth), Station 3 (Mouth of Ferguson's gulf), Station 4 Longech Spit and Stationnn 5 Off Central Island National Park (Figure 2)

Lake Turkana (Figure 1) represented with stations located off central Island and pelagic areas along the Midwestern shores. Selected depths ranged from shallow inshore gradually increasing to the deeper parts of the open lake to around the 20-30 meters contour depth. This area was selected as earlier studies had showed the midwater scattering layer was more pronounced and was associated with both zooplankton and small pelagic fish species.

2.2 Data Collection

Fish biology and ecology data was collected through the use of duplicate sets of monofilament sets of gill nets set from the motorized KMFRI research boat RV Kokine. One set of monofilament gill nets of various meshes with geometric increment in their mesh sizes (10, 15, 20, 30, 30, 40, 50,….110 mm). These were set at various depths. In addition, a trawl made from fine "mosquitoe-net" sized nets (Figure 4) was used to sample fish at predetermined depths. Qualitative samples were also collected using beach seine net (Figure 3) to collect inshore samples for comparison. Fish identification was done using available taxonomic guides (Hopson (1982). For each fish caught total length (TL, cm) and total weight (W, g) were recorded. For the smaller *B. minutus* (Figure 5) the weighing was done in the laboratory using a satorious balance to the nearest 0.01 g from preserved samples (5% formalin). The fish were then dissected, where possible the gut examined and the contents recorded. The proportion of the *B. nurse* and *B, ferox* (Figure 6) in the catches were carefully recorded. Length-Weight relationship and Relative condition factor (RCF)

determined through method of Le Cren (1951) and estimates of size at 50% maturity (Lm_{50}), food and feeding habits and reproductive status also analyzed.

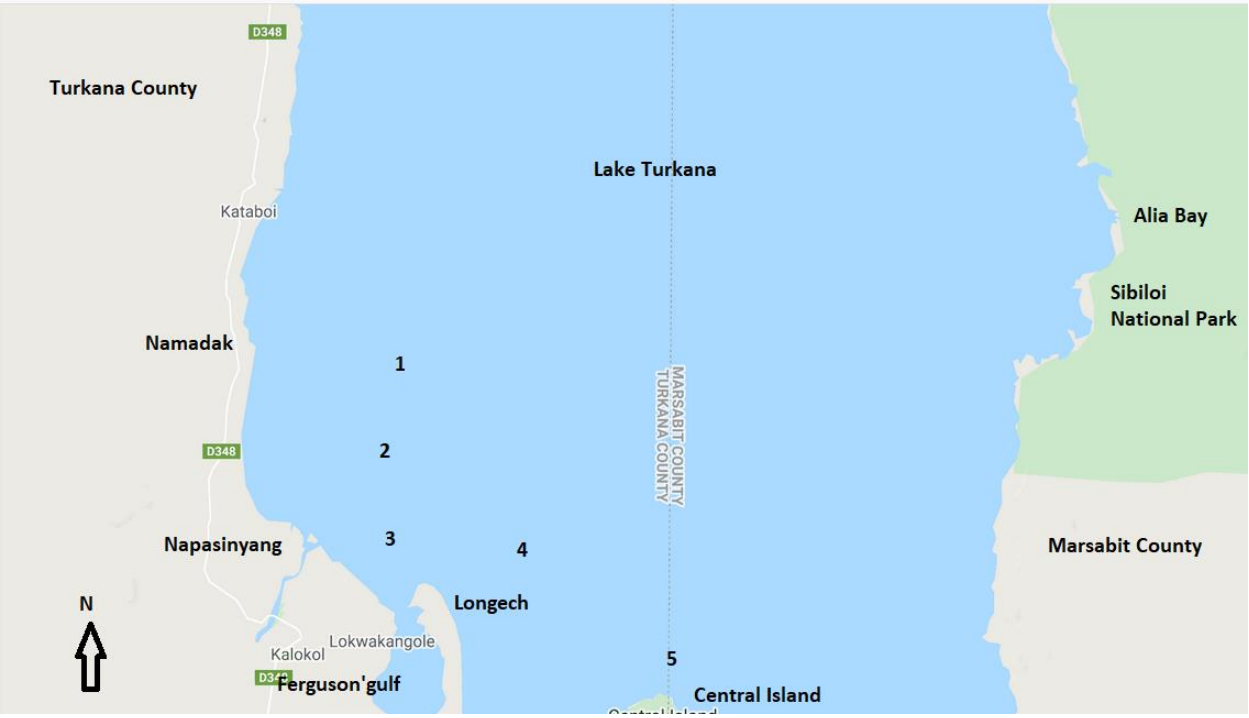

Figure 2. The Map of central part of Lake Turkana showing the main sampling stations.

At each station water quality measurements were made in situ and measurements taken using standard water quality meters and instruments for temperature, conductivity, pH, transparency and dissolved oxygen. The sampling stations selected were also adopted for the phytoplankton, zooplankton and fish biology studies. Sampling for all these variables were done concurrently.

Estimates of fish biomass and stock status using hydroacoustics was planned but not undertaken due to logistical challenges associated with travelling during the COVID-19 pandemic.

2.3 Data Analysis

Data collected were entered in MS Excel, pooled and has been subjected to various statistical methods to help understand the interactions of both abiotic and biotic factors and their influence on the spatial distribution of the two pelagics. At the end of comprehensive data collection, R-statistical package and standard methods in fisheries will be used for more conclusive results.

Figure 3 Mosquitoe seine nets being prepared for sampling in the lake next to KMFRI research Boat RV Kokine

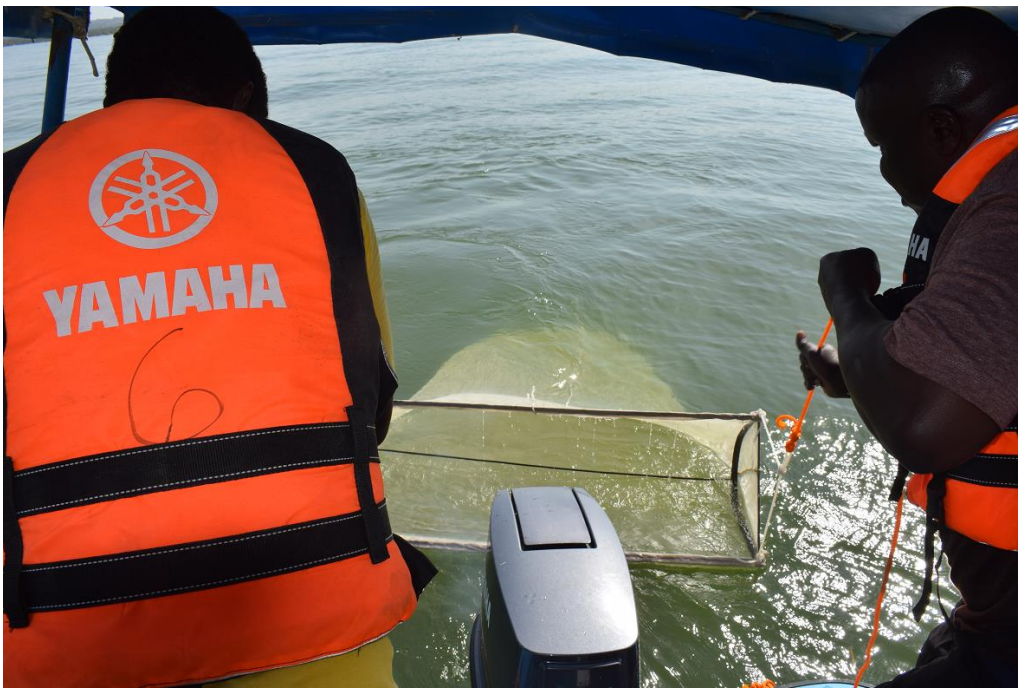

Figure 4 Sampling pelagic waters using small mesh sized trawl net

3.0 RESULTS AND DISCUSSIONS

3.1 Water quality (Physicochemical variables)

Table 1. shows the results of the main physicochemical variables analysed during the study period. The mouth of the Ferguson's gulf had lower transparency with values increasing with stations off the Longech Spit indicating more mixing offshore compared to the turbid area near the shore, Dissolved oxygen was also higher near the shore slightly decreasing toward the open waters compared to the rest of the stations. Conductivity also showed similar trends with higher values near the shores compared to the open pelagic areas.

Table 1. Physicochemical characteristics of the main sampling stations in December 2020.

Station	Station depth (m)	Water temp (°C)	pH	Conductivity (μScm^{-1})	Secchi depth (m)	DO (mgl^{-1})
F. gulf mouth	7.5	28.0±0.4	9.9±0.1	3680±0.1	1.3±0.2	8.6±0.8
Longech	15.4	27.8±0.2	9.6±0.2	3630±0.2	2.1±0.1	6.8±0.2
Napasinyang	15.0	28.9±0.3	9.3±0.1	3660±0.0	1.1±0.2	8.2±0.3
Namadak	10.0	28.0±0.3	9.5±0.1	3660±0.0	1.7±0.2	7.9±0.3
Central Island	48.9	27.3±0.2	9.2±0.1	3620±0.05	2.9±0.3	7.49±0.2

3.2 Fish Species Distribution and Abundance

A total of 262 fish were collected from the four stations located Midwestern part of the lake. Figure 7 shows the distribution of the two species in the 5 stations sampled. More fish were caught in the northern part of the lake off Longech Spit compared to the nearby Ferguson's gulf mouth a situation we may be attribute to difference in depth and the large number of predatory species also recorded aggregating near the gulf mouth.

Similarly, more fish were caught in Namadak area compared to the nearby water off Napasinyang river mouth a situation that may be attributed to the clearer waters off Namadak area compared to the turbid waters off Napasinyang river mouth. No samples were collected from the Central Island

ares owing to strong currents and deep waters. Results of the final trials currently going on in the same area will be will be included in the final report to be submitted early June 2021.

Figure 5 Pictures of *Brycinus minutus* endemic to Lake

(a)

(b)

Figure 6 Pictures of *Brycinus ferox* caught during earlier sampling (a) and caught during the present study (b)

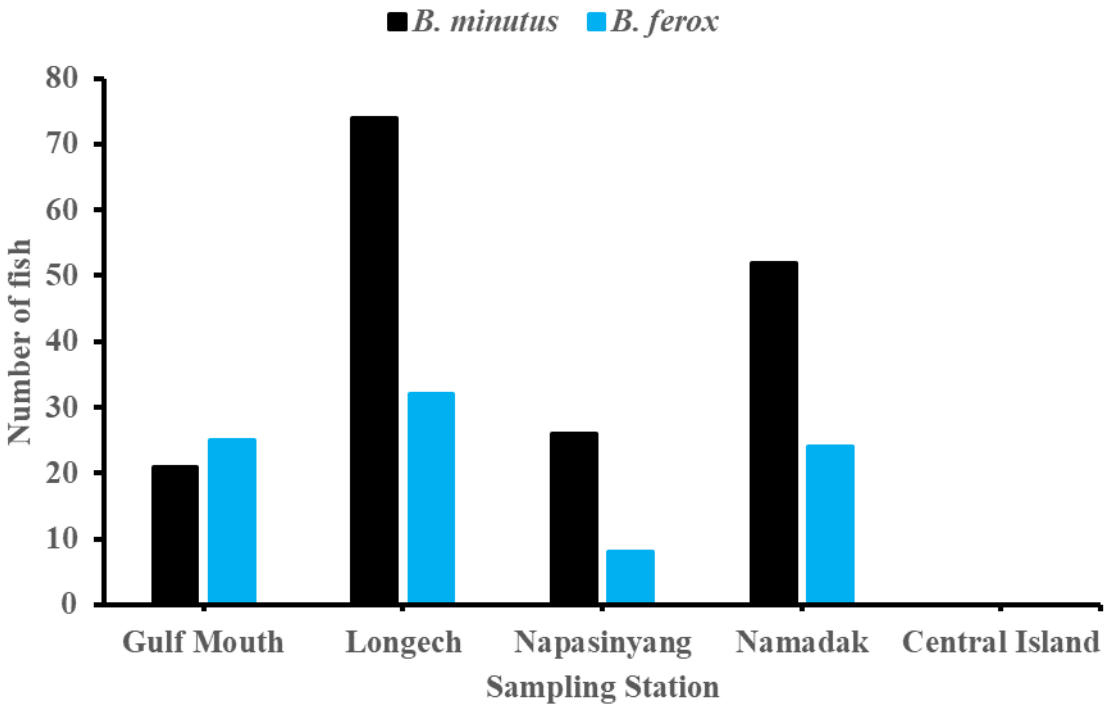

Figure 7 The distribution of *Brycinus minutus* and *Brycinus ferox* in the stations sampled during the study period

3.3 Size at Maturity

Size structures for *B. minutus* and *B. ferox* are shown in Figures 8 and 9. The maximum recorded size of the smaller *Brycinus minutus* was 32 mm TL (range 15 mm – 32 mm; mean = 25 ± 6 mm; n=173). while that of the larger *Brycinus ferox* was 113 mm TL (range 50 mm – 113 mm; mean = 78 ± 12 mm; n = 89). The sex ratio (M:F) was calculated at 1:1.3 for the *B. minutus* and 1:1.1 for *B. ferox*. For the latter, females were bigger than males. For all the fish caught within the vicinity of the Ferguson's Gulf, the majority of *B. ferox* were sexually mature. The smallest *B. minutus* fish caught weighed 0.3 g while the largest weighed 2.1 g and for *B. ferox* the smallest fish weighed 3.0 g while the largest weighed 12.5 g

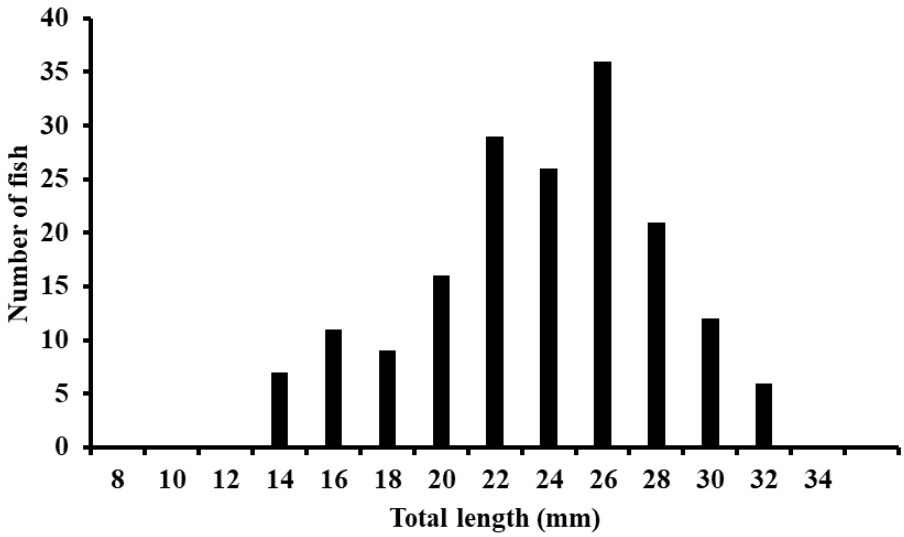

Figure 8. Length frequency distribution of *Brycinus minutus* in 4 stations.

The size at 50% maturity (Lm $_{50}$) for *B. minutus*, was calculated at 28 mm TL. All fish caught above 31 mm TL were sexually mature. During the survey only 40% of the fish sampled were mature. For *B. ferox*. length at 50% maturity (Lm $_{50}$) was estimated at 94 mm TL Both male and female gonads could easily be distinguished in all fishes with a total length of 83 mm onwards.

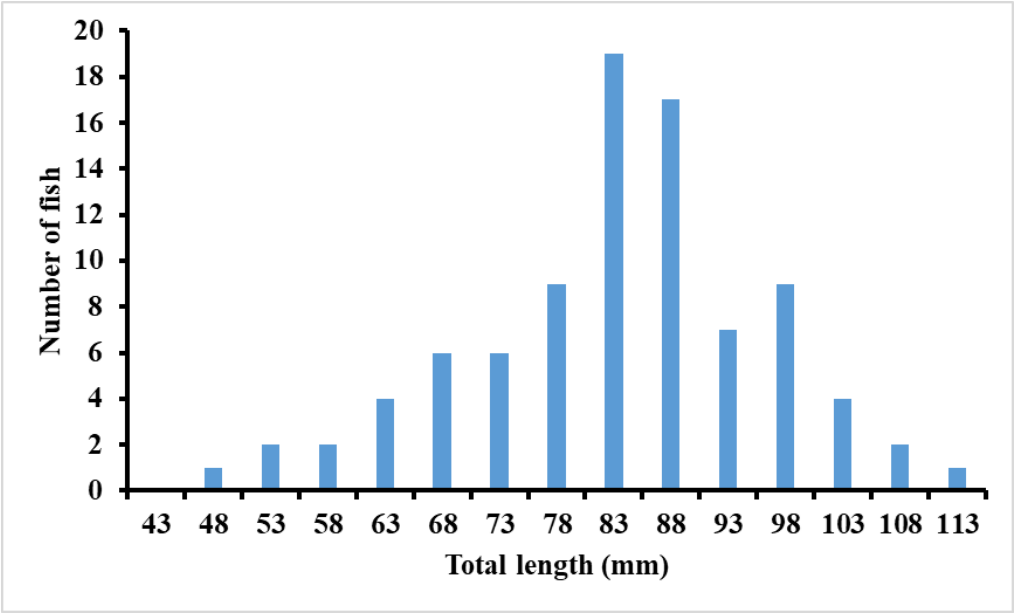

Figure 9. Length frequency distribution of. *Brycinus ferox* in 4 stations.

3.4 The Contribution of the small pelagic fishes (*Brycinus minutus* and *Brycinus ferox*) to the trophic structure of Lake Turkana

Stomach contents analysis of the two species showed them to consume various food items (Table 2). The smaller *B. minutus* fed chiefly on zooplankton dominated by the detritus feeding calanoid copedpody *Tropdiaptomus turkanae* (Maas), *Mesocyclops ogunnus* (Onamabiro). Daphnia sp), small prawns. Unidentified food remains also appeared in the stomach. The stomach contents of the larger and more predatory *B. ferox* showed it fed mainly on zooplanktons, prawns, insects and fish. *Tropodiaptomus turkanae* was the dominant source of zooplankton source of food while smaller *Brycinus minutus* was the main fish consumed.

Table 2. The major food items identified in the stomachs of the two pelagic fish species

	Fish Species	
	Brycinus minutus	*Brycinus feros*
Prey Items	Copepods (*Tropdiaptomus turkanae*	Copepods (*Tropdiaptomus turkanae*
	Mesocyclops ogunnus,	Prawns
	Nauplii	Fish *B. minutus*
	Cladocera Daphnia spp	Insects
	Prawns	Prawns
	Others	Others

An anysis of the stomach contents of the juveniles of the larger carnivorous fish species such as *Lates niloticus*, *L. longispinis*, *Hydrocynus forskahlii* showed their dominant food items were the small pelagic fishes and juveniles of other fishes. Other commercially important fish species such as *Alestes baremose*, *Clarias gariepinus* and *Synodontis schall* fed on zooplankton and the small pelagic fishes showing the importance of the small pelagics in the food chain of the lake. These findings also mirror the earlier works of Hopson and Ferguson (1982) which indicated that all predatory fishes in the lake fees on the small pelagic species during their juvenile stages. Therefore, the small pelagics appear to be the principal consumers of the zooplanktons in the lake and the latter main link with the primary production.

3.5 Commercial utilization of the small pelagic species in Lake Turkana

Earlier studies (Hopson,1982) noted that pelagic species form a high proportion of the standing stock in Lake Turkana. He observed that *Brycinus minutus* was the dominant species in terms of biomass and it attains maturity at a maximum size of only 3 cm. He cautioned that it was too small to be considered a possible commercial species unless an industrial fishery is contemplated. During this study the maximum recorded size of the *B. minutus was* 28 mm while that of the larger *B. ferox* was 113 mm. Given their small size and position in the food chain, it would be important that an acceptable technique is worked out that will not over exploit these species. An analysis of the stomach contents of the juvenile forms of the larger predatory species with commercial importance also show that they prey on the small pelagic species, occupy the same zone and are difficult to separate from the small pelagic during fishing. Efforts need to be made to minimize the impact on the food chain should trials to commercialize their exploitation be made as they apparently form the backbone of the food chain linking the larger predatory species with the zooplankton, the main utilizer of the primary production in the lake. However, for trials, the use of pelagic gears in other lakes such as Lake Victoria where encircling nets and light attraction techniques are may be tried while the development of appropriate gear is considered before a definite decision is reached on the commercialisation. Data analysis is ongoing on the samples collected using other methods of fishing and will be presented at in the final write up.

4.0 CONCLUSION AND RECOMMENDATIONS

This study is a first attempt at updating information on the two small pelagic fishes endemic to Lake Turkana. It was more essential given that available experimental and commercial data suggests that the capture fisheries currently supported by big 5 commercial species may be peaking hence the need to expand the fishery to open up new fisheries so as to exploit species hitherto not exploited. These smaller offshore pelagic fish species may offer the solution.

The study further showed the two pelagics to be abundant in the open waters along the western side of the lake off Longech spit and occupy a distinctive band in the water column known as the midwater scattering layer at a depth ranging between 5-25 metres contour. Their diets were chiefly composed of zooplankton in varying proportions, small fish and prawns. Earlier studies supported by preliminary data collected during this study suggested that these two species form an important link between the bigger carnivorous fishes and the zooplankton and prawns hence are a critical link in the Lake Turkana food web. The data collected with the use of gill and trawl nets was limited hence inadequate for use in drawing conclusions on the distribution and abundance of the two species in the whole lake hence their commercial status.

From the above the following are hereby recommended: -

1. Continuation of the study through extensive sampling to cover greater parts of the lake for time series and depth gradient results on the biology and ecology of the two species.
2. The use of hydroacoustics to estimate biomass and stock levels at various depths
3. The development and testing of appropriate gear at various depths that will be selective for the small pelagics and not impact on the juvenile forms of the larger commercial species before conclusions can be reached on their commercial status.

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6.0 Appendix

6.1 Appendix 1. Technical report forwarding letter to the Director General KMFRI through the Director (Fresh Water Systems).

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KENYA

KMF/TUR/CON/AD/44/

14th June 2021

The Director-General,
KMFRI,
P.O. Box 81651,
MOMBASA.

THROUGH

The Director (Fresh Water Systems),
KMFRI,
P.O. Box 1881-40100,
KISUMU.

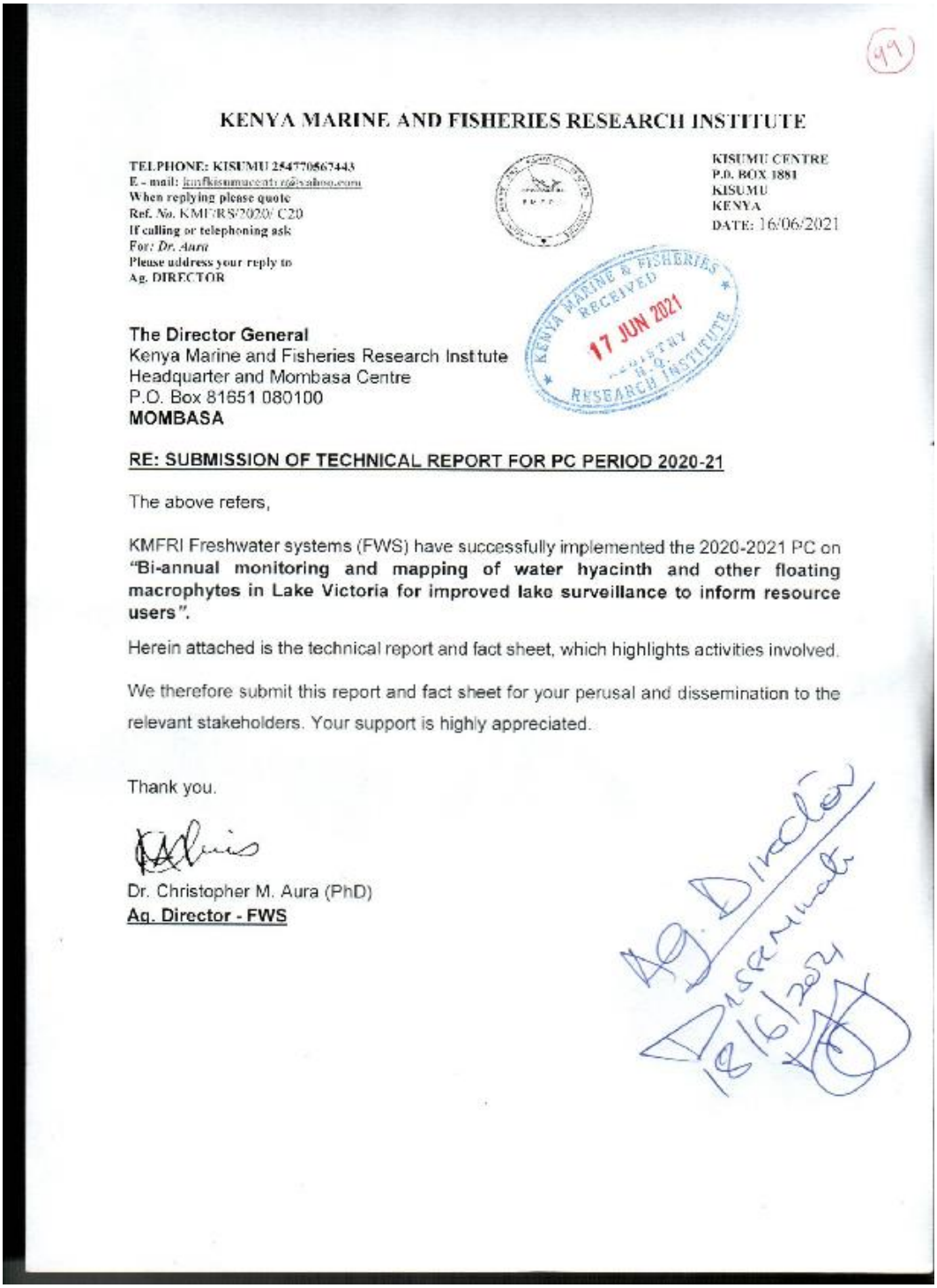
RE: SUBMISSSION OF 2020/2021 TECHNICAL REPORT ON PERFORMANCE CONTRACT TARGET NO. C7 (VI) FOR LAKE TURKANA

Sir, please find attached a technical report on the implementation of above referred target category on Stock Assessment and Ecology of Key Commercial Fisheries of Freshwaters titled: **"Update biological data on two small pelagic fish species (Dwarf robber (*Brycinus minutus)* and Large toothed robber (*Brycinus ferox)*) to determine their commercial status and contribution to the trophic structure of Lake Turkana, prepare a technical report and disseminate the findings to inform management"** for your information and further attention. Kindly consider sharing it with various stakeholders

Thank you

John Malala
Station Co-ordinator
KMFRI – TURKANA.

6.2 Appendix 2. Technical Report submission letter by the Director (Fresh Water Systems) to the Director General – KMFRI and subsequent approval by the Director General KMFRI.



KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

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E - mail: kmfkisumucentre@yahoo.com
When replying please quote
Ref. No. KMFRS/2020/ C20
If calling or telephoning ask
For: Dr. Aura
Please address your reply to
Ag. DIRECTOR

KISUMU CENTRE
P.O. BOX 1881
KISUMU
KENYA
DATE: 16/06/2021

KENYA MARINE & FISHERIES RESEARCH INSTITUTE RECEIVED 17 JUN 2021 HQ REGISTRY

The Director General
Kenya Marine and Fisheries Research Institute
Headquarter and Mombasa Centre
P.O. Box 81651 080100
MOMBASA

RE: SUBMISSION OF TECHNICAL REPORT FOR PC PERIOD 2020-21

The above refers,

KMFRI Freshwater systems (FWS) have successfully implemented the 2020-2021 PC on **"Bi-annual monitoring and mapping of water hyacinth and other floating macrophytes in Lake Victoria for improved lake surveillance to inform resource users".**

Herein attached is the technical report and fact sheet, which highlights activities involved.

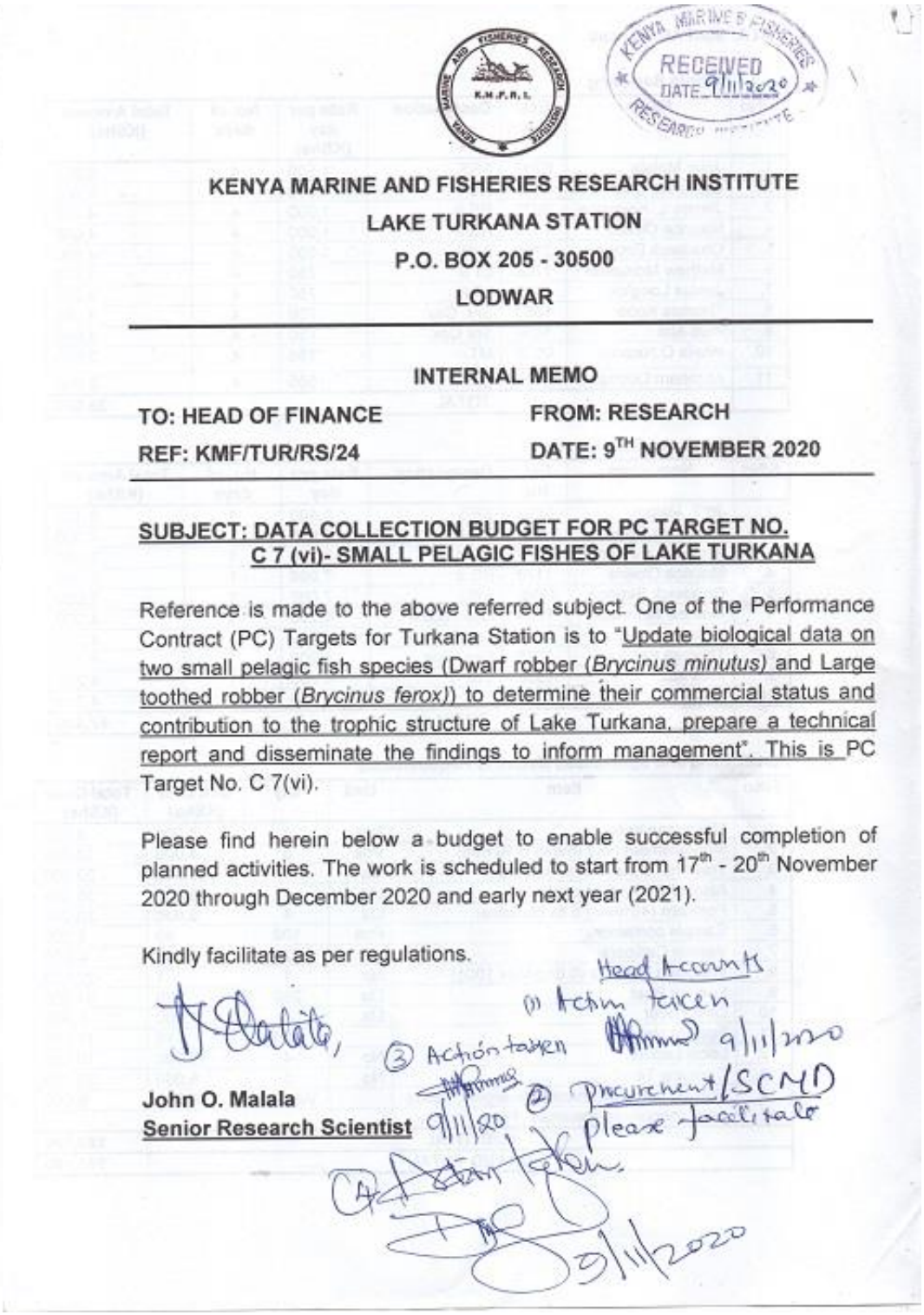
We therefore submit this report and fact sheet for your perusal and dissemination to the relevant stakeholders. Your support is highly appreciated.

Thank you.

Dr. Christopher M. Aura (PhD)
Ag. Director - FWS

Ag. Director
Disseminate
18/6/2021

6.3 Appendix 3. Authority to access funds to implement the Performance Contract Target.



KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

LAKE TURKANA STATION

P.O. BOX 205 - 30500

LODWAR

INTERNAL MEMO

TO: HEAD OF FINANCE — FROM: RESEARCH

REF: KMF/TUR/RS/24 — DATE: 9TH NOVEMBER 2020

SUBJECT: DATA COLLECTION BUDGET FOR PC TARGET NO. C 7 (vi)- SMALL PELAGIC FISHES OF LAKE TURKANA

Reference is made to the above referred subject. One of the Performance Contract (PC) Targets for Turkana Station is to "Update biological data on two small pelagic fish species (Dwarf robber (*Brycinus minutus*) and Large toothed robber (*Brycinus ferox*)) to determine their commercial status and contribution to the trophic structure of Lake Turkana, prepare a technical report and disseminate the findings to inform management". This is PC Target No. C 7(vi).

Please find herein below a budget to enable successful completion of planned activities. The work is scheduled to start from 17th - 20th November 2020 through December 2020 and early next year (2021).

Kindly facilitate as per regulations.

John O. Malala
Senior Research Scientist

Part A: Staff Allowances

1. Inshore Sampling

S/No	Name	Est. No.	Designation	Rate per day (KShs)	No. of days	Total Amount (KShs)
1.	John Malala	0707	SRS	1,500	4	6,000
2.	Casianes Olilo	1169	RS I	1,000	4	4,000
3.	James L. Keyombe	2077	RS II	1,000	4	4,000
4.	Maurice Obiero	1178	RS II	1,000	4	4,000
5.	Chadwick Bironga	2150	ARS	1,000	4	4,000
6.	Mathew Moruesse	1739	LT II	750	4	3,000
7.	Justus Long'ok	1740	LT III	750	4	3,000
8.	Thomas Kebo	1363	Snr. Cox.	750	4	3,000
9.	Pius Alal	1030	Snr Cox	750	4	3,000
10.	Vitalis O.Nicanor	0616	MT	750	4	3,000
11.	Abraham Onchari	2100	Driver II	500	4	2,000
			TOTAL			**39,000**

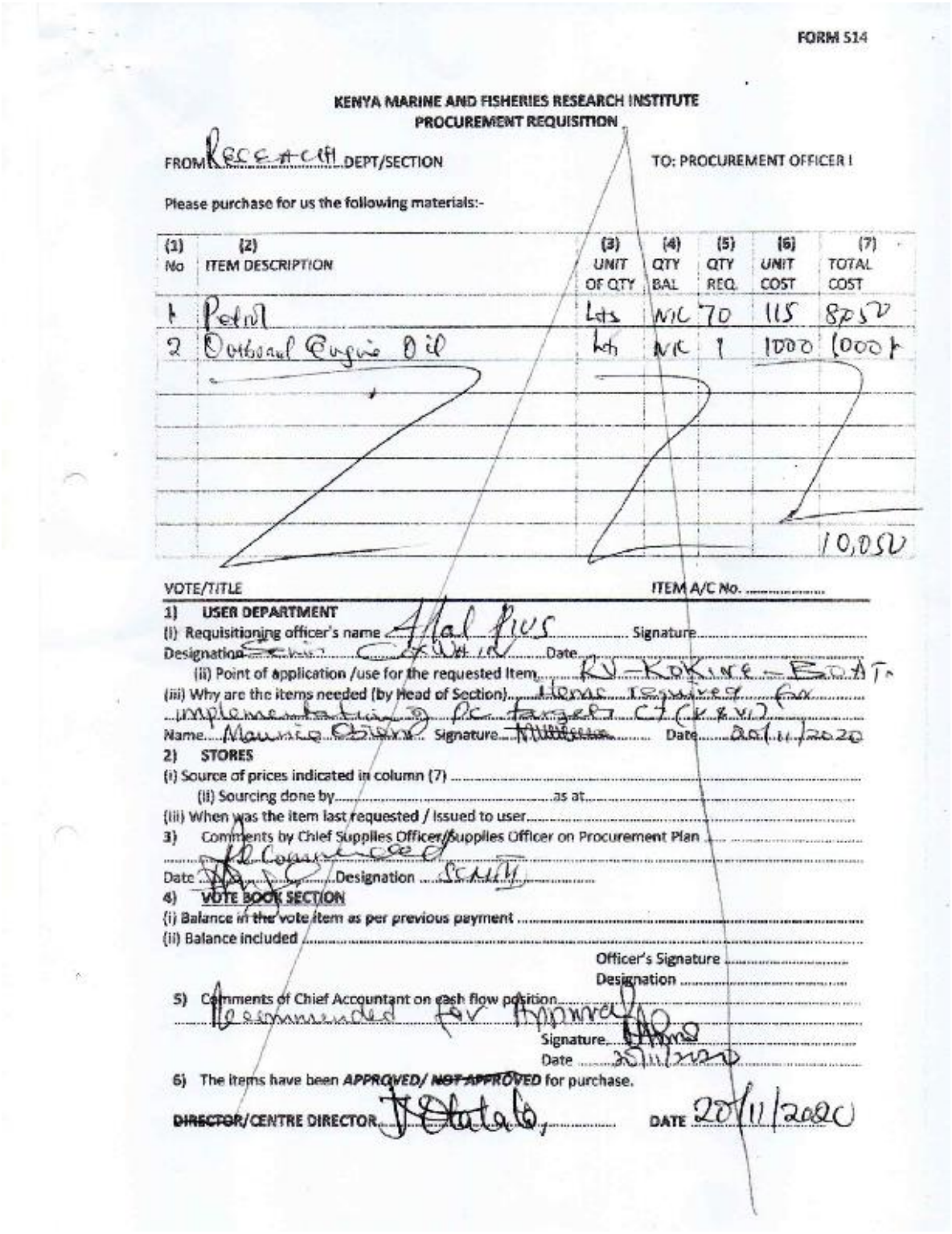
2. Main Lake Offshore Areas

S/No	Name/Item	Est. No.	Designation	Rate per day	No. of days	Total Amount (KShs)
1.	John Malala	0707	SRS	8,400	1	8,400
2.	Casianes Olilo	1169	RS I	7,000	1	7,000
3.	James L. Keyombe	2077	RS II	7,000	1	7,000
4.	Maurice Obiero	1178	RS II	7,000	1	7,000
5.	Chadwick Bironga	2150	ARS	7,000	1	7,000
6.	Mathew Moruesse	1739	Lab Tech II	4,200	1	4,200
7.	Justus Long'ok	1740	Lab Tech III	4,200	1	4,200
8.	Thomas Kebo	1363	Sen. Cox.	4,200	1	4,200
9.	Pius Alal	1030	Cox. 1	4,200	1	4,200
10.	Driver			4,200	1	4,200
			TOTAL			**57,400**

Part B: Field and Specialised Materials Requirements

S/No.	Item	Unit	Qty	Unit cost (KShs)	Total Cost (KShs)
1.	Mosquitoe nets	Pcs	1	8,000	8,000
2.	Monofilament nets (mesh 5-10 mm)	Pcs	3	4,000	12,000
3.	Trawl net construction materials	No	1	20,000	20,000
4.	Alcohol (70%) 5 lts container	Lts	2	8,000	16,000
5.	Formalin (40%ww) 5 lts container	Lts	4	5,000	20,000
6.	Sample containers	Pcs	100	50	5,000
7.	Veneer Callipers	No	2	2,000	4,000
8.	Weighing Balance (0.01g Max 100g)	No	1	1	22,000
9.	Fuel for Boat	Lts	260	120	31,200
10.	Oil for boat	Lts	8	1,000	8,000
11.	Fuel for Vehicle		100	115	11,500
12.	Local Labour	No	4	10,000	10,000
13.	Camping Tents	No	5	5,000	25,000
14.	Gloves, sanitizer, masks, detergent, tissue		Various	6,000	6,000
15.	Add. specialised materials (From Kisumu)				
	SUBTOTAL				**198,700**
	GRAND TOTAL				**295,100**

6.4 Appendix 4. Processed requisition to enable procurement of goods (boat fuel and boat engine oil) to be used in the field during for data collection.



FORM 514

KENYA MARINE AND FISHERIES RESEARCH INSTITUTE
PROCUREMENT REQUISITION

FROM Research DEPT/SECTION TO: PROCUREMENT OFFICER I

Please purchase for us the following materials:-

(1) No	(2) ITEM DESCRIPTION	(3) UNIT OF QTY	(4) QTY BAL	(5) QTY REQ.	(6) UNIT COST	(7) TOTAL COST
1	Petrol	Lts	NIL	70	115	8050
2	Outboard Engine Oil	Ltr	NIL	1	1000	1000
						10,050

VOTE/TITLE ITEM A/C No. .....

1) **USER DEPARTMENT**
(i) Requisitioning officer's name Mal Pius Signature .....
Designation Ex. No. CEO Date .....
(ii) Point of application /use for the requested Item KV-KDKing-Boat
(iii) Why are the items needed (by Head of Section) Items required for implementation of 2 No. targeted CT (CK & KD)
Name Maurice Odour Signature ..... Date 20/11/2020

2) **STORES**
(i) Source of prices indicated in column (7) .....
(ii) Sourcing done by ..... as at .....
(iii) When was the item last requested / issued to user .....

3) Comments by Chief Supplies Officer/Supplies Officer on Procurement Plan .....
Recommended
Date ..... Designation SCMO

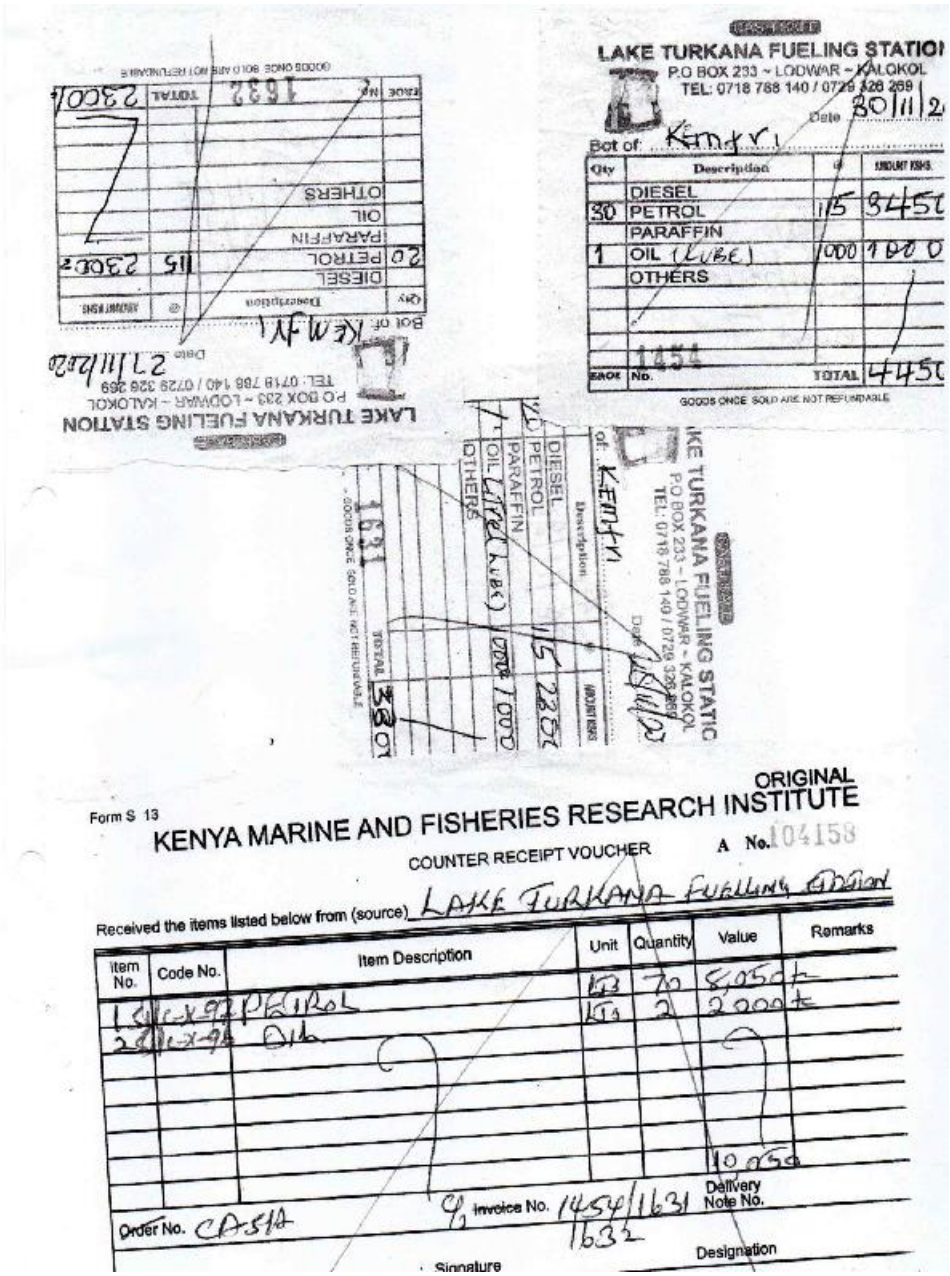
4) **VOTE BOOK SECTION**
(i) Balance in the vote item as per previous payment .....
(ii) Balance included .....
Officer's Signature .....
Designation .....

5) Comments of Chief Accountant on cash flow position .....
Recommended for approval
Signature .....
Date 20/11/2020

6) The items have been ***APPROVED/*** ~~***NOT APPROVED***~~ for purchase.

~~DIRECTOR~~/CENTRE DIRECTOR ..... DATE 20/11/2020

6.5 Appendix5. Sample of purchase receipts and official Stores Counter Receipt Voucher for goods such as petrol fuel for the research boat "RV Kokine".



LAKE TURKANA FUELING STATION
P.O BOX 233 ~ LODWAR ~ KALOKOL
TEL: 0718 788 140 / 0729 326 269

Bot of: Kemfyl

Qty	Description	@	AMOUNT KSHS.
	DIESEL		
30	PETROL	115	3450
	PARAFFIN		
1	OIL (LUBE)	1000	1000
	OTHERS		
	1454	TOTAL	4450

GOODS ONCE SOLD ARE NOT REFUNDABLE

Form S 13

ORIGINAL

KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

COUNTER RECEIPT VOUCHER A No. 104158

Received the items listed below from (source) LAKE TURKANA FUELLING STATION

Item No.	Code No.	Item Description	Unit	Quantity	Value	Remarks
1	5[illegible]-x-92	PETROL	LTS	70	8,050/=	
2	5[illegible]-x-95	Oil	LTS	2	2000/=	
					10,050	

Order No. CA512 Invoice No. 1454/1631/1632 Delivery Note No.

Signature Designation

6.6 Appendix 6. Motor vehicle work ticket as used during the implementation period

These headings to be completed by Issuing Officer

KENYA MARINE & FISHERIES RESEARCH INSTITUTE 10537

TRANSPORT - DAILY WORK TICKET DEPT.: KMFRI TICKET NO KM

PREVIOUS W.T. NO.: 10526 REG. NO.: KCH 935Q MAKE: TOYOTA L/CRUISER UNIT: KMFRI-MIE LABORATORY: KMFRI-KANA

Driver's Name and Number: ABRAHAM ONCHARI (2100) 4

Number, Name and Designation of Authorizing Officer: 1 0707 - JOHN MALALA - SIN/COORDINATOR; 2 1078 - MAURICE OBIERO - RSIT; 3 1408 - RICHARD BIKONDO - AAO 2077 - ATALIBA JAMES LAST - RSIT

Specimen Signature of Authorizing Officer

Date	Driver's No.	Details of Journey and Route in full	No. and Signature of person authorizing Journey	Oil drawn (Litres)	Fuel drawn (Litres)	Voucher No. or L.P.O. No.	Time Out	Time In	Speedo Reading end of Journey	Kilometres of Journey
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
02/12/20	1	OFFICE KAORIE - JAPLEGA - OFFICE KALOLA	3				10:20 AM	11:30 AM	47070		
03/12/20	1	Kalokol - Lodwar - Back	3				11:45	7:00 PM	47262		132 Km
8/12/20	1	Kalobeyei - Nakalola	1				10:30 AM	5:15 PM	47253		49 Km
9/12/20	1	Office - Arc Hospital - Back	3				6:30 AM	7:18 PM	47260		7 Km
14/12/20	1	Kalokol - Lodwar - Back	4		83 Ltrs	10967	7:32 AM	10:23 PM	47394		134 Km
16/12/20	1	Kalokol - Nakalokol - Kalokol	1				9:25 AM	6:35 PM	47470		76 Km
17/12/20	1	Kalokol - Kapoe - Nachuunar - Kalokol	1				6:25 AM	9:43 AM	47552		82 Km
17/12/20	1	KMFRI OFFICE - KAKUMOL - BACK	2				11:04 AM	12:05 PM	47558		7 Km
17/12/20	1	KMFRI OFFICE - NARIOKOTOME	2				2:05 PM	7:20 PM	47645		87 Km
18/12/20	1	NARIOKOTOME - MOKUPURAT	2				8:25 AM	7:20 PM	47717		72 Km
19/12/20	1	NARIOKOTOME - BEACH - BACK	2				8:00 AM	11:30 AM	47720		3Km
19/12/20	1	NARIOKOTOME - NACHUKUI -	2				12:00 PM	2:40 PM	47734		14Km
19/12/20	1	NACHUKUI - NAELOKENYI - NARIOKOTOME	2				3:00 PM	6:15 PM	47769		35Km
20/12/20	1	NARIOKOTOME - LOMEKWI - KATABOI	2				1:00 PM	1:40 PM	47870		51Km
21/12/20	1	KATABOI - KALOKOL - KMFRI	2				2:00 PM	6:15 PM	47918		68 Km
21/12/20	1	KMFRI - KALOKOL	2				10:15 AM	12:25 PM	47925		37Km
22/12/20	1	OFFICE KAORIE - MATERDAE	2				EST 3:00 PM	6:35 PM	47938		13Km
22/12/20	1	NAKUR RD - NAIROBI - NAIROBI	2				9:40 AM	5:01 PM	47950		12Km

Date	Driver's No.	Details of Journey and Route in full	No. and Signature of person authorizing Journey		Oil drawn (Litres)	Fuel drawn (Litres)	Voucher No. or L.P.O. No. or Cash Voucher No.	Time		Speedo Reading end of Journey	Kilometres of Journey
			No.	Signature				Out	In		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
23/12/20	1	OFFICE NATIRAGE – OFFICE	2			40 Ltr		6:05pm	5:40	47961	11Km
24/12/20	1	office Natirae – back	21					8:30 am	4:28 pm	47974	13 Km

DRIVER'S REPORT OF DEFECTS

Date	Defects

Action taken by Officer i/c

SUMMARY OF WORK TICKETS

	Ltr. (fuel)	Ltr. (Oil)
Totals - Fuel and Oil drawn		
Fuel in Tank to be carried forward	Ltr.	
Total Distance (km)		
Miles per litre (fuel)		
Miles per litre (Oil)		

Certified all entries checked. Details entered in Vehicle Log Book.

Designation

Station

6.7 Appendix 7. Communication from the Director General sharing of research findings with the Chairman Turkana Central Water body BMU Networks

KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

Telephone: 020-8021560/1
020-2353904
Mobile: 0712003853
FAX: 020-2353226
E-mail: director@kmfri.co.ke
When replying please quote
Ref: no:
and date:
If calling or telephoning ask
For:
Please address your reply to:
The DIRECTOR GENERAL

HEADQUARTERS
P.O. Box 81651
MOMBASA
KENYA

KMF/RS/2021/ B2. (i)

Date: 21st June 2021

LAKE TURKANA WATER BODY B.M.U NETWORK
23 JUN 2021
P.O. BOX 11 30500, LODWAR

The Chairman
Turkana Central Water Body Beach Management Unit (BMU)
P.O. Box 36-30502
KALOKOL

Received 23/6/2021

Dear Sir/Madam,

RE: SHARING 2020-21 FY FACT SHEET/BRIEF

Kenya Marine and Fisheries Research Institute (KMFRI) is a state corporate body, established in 1979 under the Science and Technology Act (Cap 250), which has since been repealed by the Science, Technology and Innovation Act No. 28 of 2013. KMFRI is under the Ministry of Agriculture Livestock and Fisheries. The institute is mandated to carry out research in marine and freshwater fisheries, aquatic biology, aquaculture, environmental chemistry, ecological, geological and hydrological studies, socio-economics as well as chemical and physical oceanography.

In this regard, KMFRI conducted a number of research expeditions in 2020-2021 financial year on ***"Update biological data on two small pelagic fish species (Dwarf robber (Brycinus minutus) and Large toothed robber (Brycinus ferox)) to determine their commercial status and contribution to the trophic structure of Lake Turkana"***, and came up with technical report and Fact sheet/brief.

The purpose of this letter is to share the findings in a summarised fact sheet/brief as information for possible management and conservation measures of the aforementioned systems.

Attached herewith please find the technical reports and Fact sheet/brief for your perusal and further action.

Yours Sincerely,

Dr. Christopher M. Aura (PhD)
For: Director/CEO, KMFRI

6.8 Appendix 8. Attendance register during sharing /sensitization of the office of the Chairman Turkana Central Water body BMU Networks

KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

TURKANA STATION

P.O. BOX 205

LODWAR

KENYA MARINE & FISHERIES RESEARCH INSTITUTE TURKANA STATION P.O. Box 205 30500, LODWAR

23 JUN 2021

LAKE TURKANA WATER BODY BMU NETWORK P.O. BOX 21 30500, LODWAR

23 JUN 2021

Attendance Register

Meeting/Sharing of research finding at BMU Networks Office - Lake Turkana

Sharing 2020/2021 FY Fact Sheet /Brief on (Update biological data on two small pelagic fish species (Dwarf Robber (*Brycinus minutus*) and Large Toothed Robber (*Brycinus ferox*)) to determine their commercial status and contribution to the trophic structure of Lake Turkana)

S/N	NAME	INSTITUTION	PHONE NUMBER	EMAIL ADDRESS	SIGNATURE
1	Ekwom Stephen	BMU	0713561061	ekwomjnr@gmail.com	
2	Maurice O. Obiero	KMFRI	0719577205	mobiero@kmfri.co.ke	
3	Dennis Nicholas	KMFRI	0701162073	dnicholas@kmfri.co.ke	
4	Abraham P. Ongwae	KMFRI	0720015200	ongwae.abraham@kmfri.co.ke	
5	JOHN O. NAPALA	KMFRI	0710497520	napalajohn@gmail.com	
6	Benson Ekwom	Jntpresident BMU	0745306949	—	
7	[illegible]	Immediate BMU	0713556561	—	

6.9 Appendix 9. Communication from the Director General sharing of research findings with the Turkana Regional Coordinator – Kenya Fisheries Service

KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

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020-2353904
Mobile: 0712003853
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E-mail: director@kmfri.co.ke
When replying please quote
Ref: no:
and date:
If calling or telephoning ask
for:
Please address your reply to:
The DIRECTOR

HEADQUARTERS
P.O. Box 81651
MOMBASA
KENYA

KMF/RS/2021/ B2. (i)

Date: 21st June 2021

ASSISTANT DIRECTOR OF FISHERIES
TURKANA REGIONAL OFFICE
P.O. BOX 44 LODWAR
Received
25/6/21

The Regional Coordinator
Kenya Fisheries Service
Trkana Region
P.O. Box 44-30500
LODWAR

Dear Sir/Madam,

RE: SHARING 2020-21 FY FACT SHEET/BRIEF

Kenya Marine and Fisheries Research Institute (KMFRI) is a state corporate body, established in 1979 under the Science and Technology Act (Cap 250), which has since been repealed by the Science, Technology and Innovation Act No. 28 of 2013. KMFRI is under the Ministry of Agriculture Livestock and Fisheries. The institute is mandated to carry out research in marine and freshwater fisheries, aquatic biology, aquaculture, environmental chemistry, ecological, geological and hydrological studies, socio-economics as well as chemical and physical oceanography.

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Yours Sincerely,

Dr. Christopher M. Aura (PhD)
For: Director/CEO, KMFRI

6.10 Appendix 10. Attendance register during sharing /sensitization of the office of the Turkana Regional Coordinator – Kenya Fisheries Service

KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

TURKANA STATION

P.O. BOX 205

LODWAR

KENYA MARINE & FISHERIES RESEARCH INSTITUTE TURKANA STATION
23 JUN 2021
STATION COORDINATOR
P.O. Box 205 - 30500, LODWAR

ASSISTANT DIRECTOR OF FISH
TURKANA REGIONAL OFFICE
P.O. BOX 47 LODWAR

Attendance Register

Meeting/Sharing of research finding at Kenya Fisheries Service - Lake Turkana

Sharing 2020/2021 FY Fact Sheet /Brief on (Update biological data on two small pelagic fish species (Dwarf Robber (*Brycinus minutus)* and Large Toothed Robber (*Brycinus ferox)*) to determine their commercial status and contribution to the trophic structure of Lake Turkana)

S/N	NAME	INSTITUTION	PHONE NUMBER	EMAIL ADDRESS	SIGNATURE
1.	JOSEPH KASUTI	KEFS	0721356590	josephkasuti@gmail.com	
2.	MWAURICE O. OGEDO	KMFRI	0719517205	mebiemo@yahoo.com	
3	NTHARA OMUTO	KMFRI	0701496972		
4	ABRAHAM ONCHARI	KMFRI	0720015000		

6.11 Appendix 11. Communication from the Director General sharing of research findings with the office of the County Director of Fisheries Turkana

KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

Telephone 020-8021560/1
020-2353904
Mobile: 0712003853
FAX: 020-2353226
E-mail: director@kmfri.co.ke
When replying please quote
Ref: no:
and date:
If calling or telephoning ask
For:
Please address your reply to:
The DIRECTOR

HEADQUARTERS
P.O. Box 81651
MOMBASA
KENYA

DIRECTOR OF FISHERIES
TURKANA COUNTY GOVERNMENT
21 JUN 2021
P.O. Box 52-30500, LODWAR

KMF/RS/2021/ B2. (i) **Date: 21st June 2021**

To: County Director of Fisheries
Turkana County Government
P.O. Box 11-30500
LODWAR
Dear Sir/Madam,

RE: SHARING 2020-21 FY FACT SHEET/BRIEF

Kenya Marine and Fisheries Research Institute (KMFRI) is a state corporate body, established in 1979 under the Science and Technology Act (Cap 250), which has since been repealed by the Science, Technology and Innovation Act No. 28 of 2013. KMFRI is under the Ministry of Agriculture Livestock and Fisheries. The institute is mandated to carry out research in marine and freshwater fisheries, aquatic biology, aquaculture, environmental chemistry, ecological, geological and hydrological studies, socio-economics as well as chemical and physical oceanography.

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Yours Sincerely,

Dr. Christopher M. Aura (PhD)
For: Director/CEO, KMFRI

6.12 Appendix 10. Attendance register during sharing /sensitization of the office of the County Director of Fisheries Turkana

KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

TURKANA STATION

P.O. BOX 205

LODWAR

KENYA MARINE & FISHERIES RESEARCH INSTITUTE TURKANA STATION 23 JUN 2021 P.O. Box 205 - 30500, LODWAR

DIRECTOR OF FISHERIES TURKANA COUNTY GOVERNMENT 23 JUN 2021 P.O. Box 62-30500, LODWAR

Attendance Register

Meeting/Sharing of research finding at County Director of Fisheries - Lake Turkana

Sharing 2020/2021 FY Fact Sheet /Brief on (Update biological data on two small pelagic fish species (Dwarf Robber (*Brycinus minutus)* and Large Toothed Robber (*Brycinus ferox)*) to determine their commercial status and contribution to the trophic structure of Lake Turkana)

S/N	NAME	INSTITUTION	PHONE NUMBER	EMAIL ADDRESS	SIGNATURE
1.	ROBERT KIBUNJA	TLH-FISHERIES	0723316795	rkkenyaturkana@gmail.com	
2.	MAURICE O. OBIERO	KMFRI	0719577205	mobiero@yahoo.com	
3	Nikolas Ewoi	KMFRI	0701161272	nicholasewoi@gmail.com	
4	JOHN O. MACHIA	KMFRI	0710467520	Malakijohn@gmail.com	
5	ABRAHAM P. ONYARO	KMFRI	0720015000	eucharisbotanee@gmail.com	