



**LAKE TURKANA & THE LOWER OMO:
HYDROLOGICAL IMPACTS OF MAJOR DAM
& IRRIGATION DEVELOPMENTS**

VOLUME II - ANNEXES



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VOLUME II - ANNEXES

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Annex 1: Field Assistants' Log – January 2012 Field Expedition on Lake Turkana – Kieran Avery

Lake Turkana Trip Log – 4th to 13th January 2012

Day 1

We flew from Jomo Kenyatta International Airport, Nairobi, to Lodwar via Kitale. Peter Ekale, our guide for the next few days, met us in Lodwar, with Jade Sea Safari's vintage Mercedes 4WD truck.

Our first stop was Lodwar District Hospital close to the airport, where we met with health officials (see separate report included in Annex 3).

After a stewed goat lunch in town, we headed off in the truck to Kalokol; a growing centre located near Ferguson's Gulf on the western shore of Lake Turkana.

On arrival in Kalokol we visited the Kenyan Marine and Fisheries Research Institute where we had an interesting talk with John Malala – an expert on Lake Turkana's fish species and stocks. It was clear that there is extreme pressure on the lake with over-fishing depleting fish stocks. Fish breeding in the lake depends on flooding of the Omo River and recent droughts are said to have affected stocks significantly. The construction of Gibe III dam will inevitably affect the natural flooding of the Omo River so there are concerns emerging as how to how this may affect fish breeding.

We stayed one night at Joyce Scheuerman's house – Joyce is the wife of the late Halewijn, a Dutchman who set-up Jade Sea Safaris in 1993. Halewijn died tragically in a motorcycle accident in 2009 in Nairobi. Throughout our journey it was clear that Halewijn was well known. Joyce continues to operate Jade Sea Safaris, which offers off-the-beaten-track safaris around Lake Turkana and up the Omo River into Ethiopia.

Day 2

The morning was spent visiting the Africa Inland Church Health Clinic in Kalokol. A separate document details this visit (see Annex 3).

In the afternoon we loaded the two boats and headed off to North Island.

Our camp crew for the next 10 days were Peter (guide), Fred (cook), Kamate (boat driver/camp crew), Alila (boat driver/camp crew) and Simon (camp crew).

On arrival at North Island, we were greeted by the local fishermen camped on the beach with their boats – as a rule no women are allowed on the island as "it would only cause issues" according to the men. We set up camp just up the shoreline from their fishing camp. On exploring the beach we found a freshly dug crocodile nest which had been un-buried by the fishermen and the eggs taken. The island is desolate with no vegetation – just lava. North Island would be our base for 3 nights.

Day 3

We made an early start and took one boat north to Todenyang – a mission centre located on the northwest shore of the lake near the Kenya-Ethiopia border. The inhabitants of the Todenyang area live in a vulnerable situation, as attacks from the neighbouring Dasenech tribe in Ethiopia are reported to be frequent and malicious. We were advised not to land the boat here as a massacre had taken place only a few days before.

We headed south along the shoreline and landed near a small fishing camp south of Todenyang. Peter our guide has spent years travelling the lake with Halewijn and in doing so

has become very well known and has accumulated a wealth of local knowledge. Peter gets on very well with everyone. His knowledge and ability to translate the local languages made him an invaluable companion. We spent time talking with the fishermen – they had been involved in a gunfight with some Dasenech warriors the day before, but luckily no casualties. Nearly every individual in this area of the country carries a gun. It was obvious how tense the fishermen were. They told us how they were too nervous to stay in their shore camp at night, so every day they would walk two hours each way from their home village at the base of the nearby mountains to the fishing camp. They would leave their fish catch stored on timber racks in the camp, with the risk of losing all of their income from the previous week's fishing.

We spoke to the fishermen about the Gibe III dam and it was clear that they had concerns over its effects on the fishing but were unaware of the more specific effects - mainly the drop in lake levels and increase in salinity potentially making the water inhabitable for many fish species.

While in their camp, we spotted crocodile carcasses, pelican remains, and soft-shelled turtle shells. As fishing becomes tougher, with the depleting fish stocks, people are resorting to other sources of food. Soft-shelled turtles are endangered in the lake, and crocodile numbers are worryingly low. At this stage of the trip we had only seen two living crocodiles.

We headed back to North Island for the night.

Day 4

We headed north again, but this time towards the Omo River delta. The river was in full flow – lots of brown water flowing between huge beds of reeds. We hoped to see crocodiles in large numbers but only saw three. The birdlife was abundant. Unfortunately it seems that hippo have been wiped out from this area.

When lake levels are high, as it was when we visited, the reed beds appear afloat. During low river/lake levels the Dasenech tribe can evidently graze their cattle deep within the delta.

We headed upriver into the Omo, and turned around once at the Ethiopian border. On entering the main channel of the delta, we found fishing nets strung up across the width of the channel. Two very large Nile Perch were floating dead, stuck in the nets – Peter explained how the Turkana fishermen come at night to check their nets, as it is too unsafe during daylight hours. These nets must do real damage to fish populations – the delta is a breeding site and if large sexually mature fish are trapped heading in and out, then the impact on fish stocks must be huge.

After exploring the delta we headed back into the lake and to the east, and landed on the NE shore near a small fishing village called Selicho. Selicho is just south of the Kenya-Ethiopia border and has mixed inhabitants from both the Turkana and Dasenech tribes. We spoke with more fishermen who again expressed their concern about Gibe III. We also learned that the people in this area reportedly hunt wildlife, mainly zebra and giraffe, although wildlife is sparse. In fact the only mammals we saw throughout our safari were one ground squirrel in Kalokol and one vervet monkey in Lodwar. Peter told us that people are so desperate that they even hunt squirrels for food. We spotted an enormous Nile perch carcass while at Selicho and the fishermen explained how despite the fishing pressures, they still frequently catch these monsters in the shallow water amongst the reed-beds.

There was a big bunch of children at Selicho who were in great spirits and loved having their picture taken. A few of them spoke some English, as they are educated at a school in the village.

We arrived back at North Island in the dark.

Day 5

Up before sunrise, we walked to the peak of North Island. Dad was keen to calibrate his barometer against historic measurements of the altitude of North Island's peak from the original trig point shown on the map, and to use it to measure the current lake level relative to the Dept of Surveys trig point. Unfortunately the concrete and steel from the original trig point had long since disappeared, likely for use as fishing weights or to make spears. Instead, we had to use a GPS to record the highest point.

Feral goats were numerous around the island and their presence explains the lack of vegetation – the fishermen gather the goats together once a year, which in that terrain must be a real challenge!

The peak was covered in steam vents, and stained yellow with sulphur. The whole Turkana region is composed of numerous volcanoes and the countryside is covered with lava flows.

On our walk down from the peak, we found a lovely grove of desert roses in amongst a lava flow we were traversing. We walked back through the fishing village where our binoculars became very popular items as the fishermen wanted to “check on their wives” on the mainland! What characters! We found more remains of soft-shelled turtles. The fishermen were very welcoming and enjoyed a break from their fishing activities to chat and show us around. Plus there was one man sitting under shelter with eyes that looked badly sun burned. Patrick took a cautious look, and advised him to rest and keep out of the sun. An hour later we saw him out in the sun repairing nets, too busy to rest.

After a late breakfast we took down camp and loaded the boats. One boat headed directly to South Island, while we took a detour in the second boat via Allia Bay – a favourite safari destination of ours on the eastern shore, just south of Sibiloi National Park. Here we tried some fishing from the shore and landed our biggest fish from the lake to date – a 100+ pound Nile perch. This large fish was safely released after a period of assisted recovery. We caught quite a few more perch and lots of tilapia. Sibiloi is a protected area but there was evidence of commercial fishing activity where we stopped, with long line and net remains in evidence.

From Allia Bay we headed across to Central Island, our base for the next two nights. We arrived to be greeted by some very distressed camp crew – swarms of mosquitoes were out in force! Having laughed at the crew’s predicament, we soon appreciated the severity of the insects. The only way to escape being eaten alive was through total body immersion in the lake!

Day 6

Central Island is a Kenya Wildlife Service protected area (Central Island National Park). The island is a little bigger than North Island, and is beautiful, with lots of vegetation cover, as goats are not allowed. We spent the day exploring the island and doing measurements. We also tried fishing (sport fishing is allowed in the lake’s National Parks with licenses). We caught a number of perch and tilapia but nothing like one would expect from a protected area of the lake. Despite being renowned as a ‘crocodile breeding area’, we found endless signs of commercial fishing camps, and very few crocs; only three were seen in the lake around the island.

There are three isolated crater lakes on the island. We walked to each of them; the turquoise saline ‘Flamingo Lake’ which held several thousand Lesser Flamingos; ‘Crocodile Lake’ which contains fresher water than Flamingo Lake but saltier than the main lake and is known as a crocodile haunt, yet we only saw five crocs. The third lake, ‘Tilapia Lake’, had well worn fishermen footpaths leading to it, but contained only two visible crocs. Measurements of the lake levels showed that the crater lakes were at the same level as the main lake, and thus are hydraulically linked. The wild flowers were out everywhere over the island as it had recently rained and the variety was amazing.

In late afternoon, we took one of the boats to the small pinnacles south of Central Island where large colonies of cormorants, herons, ibis, and egrets breed. One croc was spotted.

It was clear that Central Island is not being protected as it should be, and that there is a great deal of illegal fishing activity. We noted at least one active encampment with people ashore whilst encircling the island.

Day 7

An early morning walk to one of the islands’ peaks gave us a good view west over the lake to Ferguson’s Gulf.

After breakfast, we dismantled camp and loaded the boats again. Our final destination for the day was South Island, but we had to go via Joyce’s permanent camp at Lobolo on the western shore (a few kilometres north of Eliye springs), to re-stock with camp provisions.

After re-stocking at Lobolo we headed south for the Turkwel River delta. The Turkwel is a river with its source on Mt Elgon on the Uganda border with Kenya. We explored the sandy delta, which was alive with birds. A small volume of water was flowing down the river. The margins of the delta have been invaded by *Prosopis juliflora* – a plant introduced from South America, which grows into a tree. We spotted one crocodile here and the tracks of a single mongoose.

From the Turkwel we had a very rough journey to South Island – two metre high waves generated by strong south-easterly winds pounded the boat, but we made it there safely arriving in the dark, landing on a beach on the north west of the island.

Day 8

South Island is the largest of the three islands. It too is a National Park and World Heritage site, but once again it was clear how much illegal fishing activity is taking place on the island; we found old camps everywhere, full of fish bones and in places we found dismembered crocodile remains. We encountered one fisherman braving the rough water on a doum log raft. We found doum rafts hidden in reed beds with fishing nets.

We climbed a nearby peak and had stunning 360-degree views. To the north the lake disappeared over the horizon, and on the eastern shoreline the distant Porr Volcano could be seen with Loiyangalani to the south. Nabuyatom Volcano could be seen south of Central Island at the southernmost point of the lake, with the 'Barrier' and Teleki's Volcano in the background. To the west, huge cliffs dropped down to the lakeshore. The wind was blowing a gale making it hard to stand on the peak.

After breakfast we did some fishing – only one perch but lots of tilapia and tiger fish. Dad found a really interesting eroded gully high up the peak we had climbed earlier which showed evidence of ancient lake levels with fossilized molluscs and mud; we planned to explore this the following day.

In the afternoon we took a boat around the whole island – we found a beach that held around 15-20 freshly dug crocodile nests. While on the beach we saw two crocs just offshore watching us. These nests are so vulnerable. Fishermen were spotted on the southern most point. We caught some perch down there while trolling but the water was very rough so we didn't hang around for too long. The island is dramatic with numerous small volcanoes. We fished around the famous pinnacles to the north of the island where Peter told us stories of monsters including Halewijn's record – a 220 pounder. He told us how they used to catch fish there every time they went there but that these days it is a real struggle – we didn't catch any.

Day 9

We explored the gully Dad had spotted the previous day – the different lake levels were clear to see and a number of different mollusc species seen in fossil beds. Dad's barometer was used to measure the elevation of these ancient levels. They were about 80 metres above the present-day lake.

We had a visit from the KWS patrol boat from Loiyangalani, comprising a single armed ranger and a boat driver. The ranger was excited at the prospect of collecting park fees from us, but in fact we had already paid our national park entry fees. He told us they use 100 litres of petrol to get to and from the island. We alerted him to the illegal fishermen at the southern point but he said they didn't have enough fuel to investigate. We also warned him about the crocodile nests. So, they had burnt 100 litres of fuel and departed having been unable to fully patrol the island despite a tip-off from us. We asked the ranger about their patrols. He said KWS try and get to the island once per month at least, but he said the patrols were dangerous, as the fishermen are armed, and a single armed ranger is insufficient. Plus, it is impractical to arrest anyone, as the rangers have limited capacity to transport offenders back to shore, and then on to court in far distant Marsabit. So, all in all the patrols seemed pointless. We suggested KWS establish a continuous presence on the island. It seems that only with permanent presence could KWS effectively manage the national park. The ranger agreed with everything we talked about, but he told us "this is for senior management to decide".

After breakfast we packed camp for the last time, and loaded the boats. We headed to the western shore where we expected to find a deserted shoreline, but despite the ruggedness,

there are beaches, and there were fishermen ashore with their boats. We tried some trolling but had no luck. We followed the shoreline north back to the Turkwel delta where Dad got stuck in some quick sand whilst water sampling! The sunset was dramatic. We headed off at dusk with Lobolo camp our destination. Arriving in the dark we were welcomed by Joyce and her crew.

We spent our final night at Lobolo Camp.

Day 10

Our final day took us overland in the Mercedes truck from Lobolo Camp back to Lodwar, where we caught the Fly540 flight back to Nairobi.

Concluding comment

A bird list is included in Annex 2.

The above journey summary was prepared by: Kieran Avery BVSc MRCVS
With contributions from: Sean and Patrick Avery.

**Annex 2: Field Assistants' Nature Kenya article & bird sighting record –
L.Turkana January 2012 Field Expedition – Kieran Avery**

The following article was published in the East African Natural History Society's *Nature Kenya* Journal "KENYA BIRDING". The bird sightings and observations were based on the team's field expedition on Lake Turkana in January 2012 (journey log reported in Annex 1).

KENYA BIRDING



How to avoid being bird food

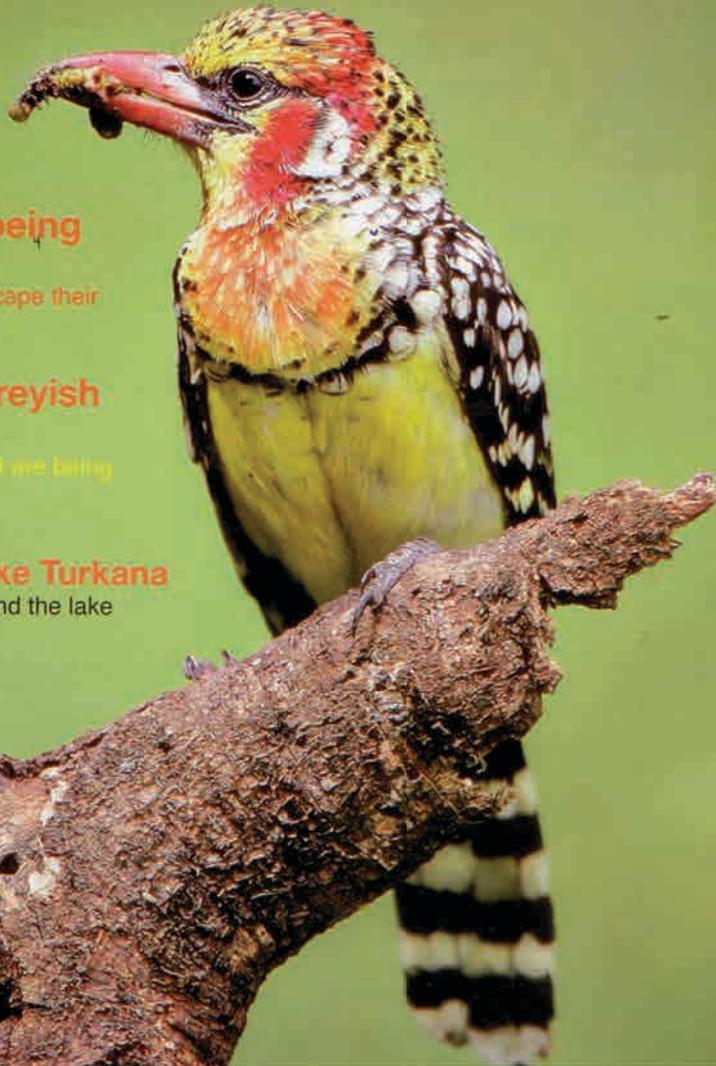
Find out how insects escape their
avian predators

Spotted and Greyish Eagle Owls

Possible intergrades that are being
missed

Go birding at Lake Turkana

A rare look at birds around the lake





Abyssinian Roller. Photo by Wenfel Tong

Lake Turkana - a twitcher's paradise

Kieran Avery

In January this year I had an opportunity to assist on a two-week scientific study at Lake Turkana, in northern Kenya. Travelling by boat I discovered amazing birding at North Island, the Omo Delta, Sibilo National Park, Central Island, the Turkwel Delta and South Island.

We were off to a great start when on arriving at the lakeshore at Kalakol we were surprised by numerous House Sparrows and sighted two Caspian Terns diving sporadically.

Our first stop was North Island, a desolate place with little vegetative cover due to feral goats. Speckled Pigeons from the mainland roost on the lava fields, which is perhaps safer because of fewer nocturnal predators. However, they don't escape the keen watch of raptors, including two peregrines that were hunting as we climbed to the island's peak. Other raptors observed were Pallid Harriers, Common and Fox Kestrels and the occasional Osprey.

After three days on North Island we went to explore the Omo Delta and northern shorelines. In the

deltas' extensive reed beds were many breeding Northern Masked Weavers. We also caught sight of Yellow-crowned Bishops and Blue-cheeked Bee-eaters neither of which is reported as being found there. There were thousands of egrets (Great White, Yellow-billed, Cattle and Little) and numerous Black-headed, Squacco, Grey and Goliath Herons, but only a single Purple Heron and a single Black-crowned Night Heron. White-faced and Fulvous Whistling Ducks, African Fish Eagles, Pink-backed and Great White Pelicans were also in large numbers.

Security and food are real issues in this region. Talking with Turkana fishermen near Todenyang on the northwest shore, we found they had had a gunfight the previous day with Dassenach warriors from southern Ethiopia. Also while at their camp we spotted crocodile skulls and pelican carcasses, which they had shot to eat. Soft-shelled turtle remains were also apparent in all the fishing camps we visited and these are now rare in the lake.

On our fourth day we travelled to Sibilo National Park on the eastern

shore and then to Central Island for two nights. Central Island, a protected area, is beautiful with lots of vegetative cover, as goats are not allowed. But despite being renowned as a 'protected crocodile breeding area', we found endless signs of fishing camps and very few crocs. There are three isolated lakes on the island. The saline 'Flamingo Lake' held several thousand Lesser Flamingos, Cape Teal and a single Black-winged Stilt. 'Crocodile Lake' had large breeding colonies of Black-headed Herons, Great Cormorants, Sacred Ibis, African Spoonbills and only five crocs. The third lake, 'Tilapia Lake', had well worn fishermen footpaths leading to it and held few birds. A memorable moment was when a Eurasian Marsh Harrier, engrossed in searching the shoreline for a meal, almost crashed into my brother! On our walk to the island's peak we spotted two Fox and one Common Kestrel diving to catch dragonflies and a number of Variable Sunbirds of the white-bellied morph. We also found a Willow Warbler, but only after our attention was drawn to a very noisy, excited juvenile White-browed Coucal with an enormous locust!

where to watch birds >

We headed to South Island for two nights via the Turkwel River Delta, a lovely silt-bar fringed by reed beds and being invaded by *Prosopis juliflora*. Here Kentish, Caspian, Three-banded and Blacksmith Plovers, Ruffs, Common Greenshanks, Marsh and Green Sandpipers, and Little Stints were all numerous. There were five Greater Flamingo, a single Eurasian Curlew and large flocks of Collared Pratincoles circling overhead.

On South Island we had a very interesting sighting of a White-fronted Plover collecting water in its breast feathers, which suggests that it may be breeding there. Other birds of interest were both black-morph and white-morph Little Egrets. Again there were crocodile remains in abandoned fishing camps.

Our last night was spent at Lobolo Camp where we found a pair of Spotted Eagle Owls – a great end to a fascinating trip. Throughout the trip Brown-tailed Rock Chats, Crested Larks and flocks of Yellow Wagtails were common. Nighttime silence was always broken by the calls of

Senegal Thick-knees and the very frequent gusts of wind! Having travelled to Turkana numerous times over many years, I have observed that while birds thankfully still abound, wildlife has decreased. Today, crocodiles and their breeding sites are vulnerable and the numbers of large Nile Perch has declined.

Threats include oil exploration, human population increase and food security. Developments in the Omo Basin are reducing water flows and the consequent effect on lake levels may adversely affect the world's largest desert lake, potentially affecting valuable fisheries and bird habitats. f



Lichtenstein's Sandgrouse. Photo by Wenfei Tong

ACKNOWLEDGEMENTS

We thank the University of Oxford for making our visit possible, and to Jade Sea Safaris for ably handling all the logistics.

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Lake and people photos by Kieran Avery



BIRD LIST – Lake Turkana and its islands - January 2012

Field observations and bird list prepared by Kieran, Patrick and Sean Avery.

Area visited included Lodwar, Kalokol, North Island, Todenyang, Omo Delta, Selicho, Central Island, Camp Turkana (Sibilo National Park), Lobolo Camp, Turkwel Delta, South Island, and south-western shores near Mugurr.

New species for us *

Abyssinian Roller *
Caspian Tern *
Blue-cheeked Bee-Eater *
Northern Masked Weaver *
Heuglin's Wheatear *
Lesser Black-backed Gull *
White-fronted Plover *
Kentish Plover *
Caspian Plover *
Eurasian Marsh Harrier *
Jackson's hornbill *
Black-morph Little Egret *
White-bellied Morph Variable Sunbird *
Sand Martin *
Curlew
Speckled Pigeon
Feral Pigeon
Yellow-vented Bulbul
Pied Crow
Brown-necked Raven
Fan-tailed Raven
White-billed Buffalo Weaver
White-bellied Go-away Bird
Common Swift
Eurasian Swift
Palm Swift
Ring-necked Dove
Namaqua Dove
Laughing Dove
Mourning Dove
Crested Lark
Rufous Chatterer
Somali Sparrow
House Sparrow
Hoopoe
Taita Fiscal
Somali Fiscal
Chestnut-backed Sparrow Lark
White-headed Buffalo Weaver
Northern Wheatear
Pied Wheatear
Pied Wagtail
Yellow Wagtail
White Wagtail
Yellow-bellied Eremomela
Blue-naped Mouse-bird
Red-fronted Warbler
Eastern Violet-backed Sunbird

Black Kite
White-winged Tern
Grey-headed Gull
Gull-billed Tern
Glossy Ibis
Sacred Ibis
Hadada Ibis
White-faced Whistling Duck
Purple Heron
Black-headed Heron
Squacco Heron
Black-crowned Night Heron
Goliath Heron
Grey Heron
Great Egret
Intermediate Egret
Little Egret
Cattle Egret
Green-backed Heron
Long-tailed Cormorant
Great cormorant
Egyptian Goose
Spur-winged Plover
Blacksmith Plover
Three-banded Plover
Collared Pratincole
Little Stint
Ruff
Marsh Sandpiper
Green Sandpiper
Common Greenshank
Pied Kingfisher
Senegal Thick-knee
Brown-tailed Rock Chat
Pallid Harrier
Osprey
Fish Eagle
Fox Kestrel
Common Kestrel
Peregrine Falcon
Black-shouldered Kite
Knob-billed Goose
White Stork
Marabou Stork
Yellow-billed Stork
Cape Teal
Carmine Bee-eater
Eurasian Bee-eater
Pink-backed Pelican
Great-white Pelican
African Jacana
Red and Yellow Barbet
Black-throated Barbet
Willow Warbler
Red-tailed Shrike
Cinnamon-breasted Rock Bunting
White-browed Coucal
Wattled Starling
Slender-tailed Nightjar
Plain Nightjar

Black-winged Stilt
Lesser Flamingo
Greater Flamingo
African Spoonbill
Northern Brownbul
Harlequin Quail
Spotted Eagle-owl

Kieran, Patrick & Sean Avery
January 2012

Annex 3: Field Assistant's Report – Healthcare observations – Patrick Avery

Healthcare in Turkana

Introduction

In January 2012, I accompanied my father and brother on a field expedition to Lake Turkana, an area we have been visiting since I was very young. We were travelling to remote parts of the lake with security challenges, and my father required two Field Assistants. I am trained in 'Expedition Medicine' and I volunteered to fulfil a 'medical' role in the team, in addition to assisting with my father's field measurements and observations. In particular, together with my brother, I undertook a survey of the lake's ornithology and wildlife population, as these topics are of close personal interest.

Field Trip in January 2012

On our trip we visited two local health facilities in Turkana County. Turkana County is geographically the largest county in Kenya. It has a population of 855,000¹ and is ranked amongst Kenya's poorest with a poverty rate of 94.3%². 70%³ of the population live as nomadic pastoralists and traditionally survive on a basic subsistence economy based around livestock. Due to a number of factors including recurrent drought and famine, livestock raiding, and animal diseases, a number of Turkana tribesmen now engage in fishing, agriculture and various forms of wage-employment. Agriculture is practiced in only a few places along the Turkwel River where irrigation is possible. A lack of government investment, illiteracy, poor health care infrastructure, and lack of employment opportunities compound the issues outlined above to make life in Turkana very difficult for most of the population.

Figures from a 2012 USAID² assessment of Turkana County state that only 30.9% of the population aged one year and under are fully immunised compared to a national average of 64%. Only 6.9% of births occur in a recognised health care facility under the supervision of a qualified medical assistant, compared to a national average of 37.5%. Only 18.1% of the population can read and write, compared to the national average of 66.4%. Figures from the Kenya Ministry of Medical Services show that in the County there is only one nurse for every 14,748 persons of population compared to national average of one per 2,054, and only one doctor for every 285,000 persons of population, compared to national average one per 25,000. There is some discrepancy in these figures because Kenya Vision 2030⁴ states that there is one doctor for every 52,434 of population. Regardless, these figures are fairly astounding and make it clear that the area is deprived as far as education and health care are concerned. The 2008/09 Government expenditure figures² also indicate that the area is significantly deprived with an average per capita expenditure of K.Shs 385, compared to an average national per capita expenditure of K.Shs 725. (Note that K.Shs 385 equates to GBP£ 3).

¹ Kenya National Bureau of Standards

²<http://kenya.usaid.gov/sites/default/files/profiles/Turkana%20County%202023%20Jan%202012.pdf>

³ http://www.combonikenya.or.ke/charter_turkana.html

⁴ <http://kenyadecides.co.ke/county/turkana/>

Lodwar District Hospital

Lodwar District Hospital is the only functional government regional referral hospital for all of Turkana region. It is located in the Turkana Central District within the Turkana County. There are two smaller government-run district hospitals within the County, at Lokitaung in Turkana North, and Katilu in Turkana South. In addition to these hospitals there are a number of government health centres, clinics and dispensaries. Non-government run hospitals, dispensaries, health centres and clinics meet up to 50% of the County's health care needs. Mostly these are church, missionary or NGO run establishments, and there is also much NGO related input in terms of food aid and water supply development. The IRC have a 60-bed hospital in Kakuma (the location for a refugee camp) although they refer many of their more difficult cases to Lodwar District Hospital.

We visited the Lodwar District Hospital and met with Mr Innocent Munyefo Sifuma, the Public Health Officer for Turkana Central. Lodwar District Hospital is where the vast majority of the Turkana people go when they need more elaborate care that cannot be treated at dispensaries, health centres, or private health clinics. Lodwar District Hospital has been struggling for years with wards in need of major repair and supplies and drugs which come in with great irregularity from the government health supplies department in Nairobi. The situation has become so dire that patients are often requested to purchase disposables and medicines themselves in Lodwar town because the hospital cannot provide them⁵.

Mr Sifuma explained that the hospital had approximately 240 beds. The hospital has three general physicians, one specialist in obstetrics and gynaecology and one surgeon. In addition to the hospital, in Turkana Central District there are 2 health centres, 34 dispensaries, and 7 clinics. It is 400 kilometres by poor roads to Eldoret where cases in need of more specialised care are transferred when needed. The observations in the following paragraphs come from our discussions with Mr Sifuma.

The highest morbidity in the County is due to malaria, which accounts for up to 35% of all outpatient presentations. The hospital's water supply comes from the Lodwar public supply. The hospital does have its own borehole but this was not working because they have no functioning pumps to extract the water. They estimate that up to 65% of the public supply is lost due to leaks within the aging Lodwar pipe system.

HIV prevalence is approximately 7% in the district. In 2009 there were 19 cases of polio, which is a reflection of the large numbers of children who are not receiving their full programme of immunisation. Mr Sifuma explained that the immunisation programme was somewhat 'hit and miss', with intermittent supplies of vaccines, and difficulties in maintaining the cold chain needed to store the vaccines. Most of the population live an average of 50 kilometres from the nearest health facility, so these rural populations are targeted by vehicle based immunisation programmes. Unfortunately many children miss out on vaccinations because of the nomadic nature of their family existence, and the sporadic nature of the immunisation visits, poor organisation, and logistical problems such as car breakdowns.

In 2009 there were also 34 deaths in the district due to cholera.

One of the big areas being targeted from a public health perspective is hygiene and sanitation. This is an area that is not recognised by the general population as being a health care need. Only 18% of the population have access to latrines and 96% of the population practice open defecation, even when they are living in built-up villages and towns. This has obvious health implications and there is a real drive to try to educate the population about the dangers of open defecation and its role in the spread of disease. Trachoma is another disease that is linked to poor hygiene and sanitation and the prevalence of trachoma in Turkana is 42.3%, the highest in Kenya.

⁵ <http://www.realmedicinefoundation.org/initiative/kenya-lodwar-district-hospital-support>

The prompt payment of monthly salaries to staff working within the healthcare system is problematic and has made it difficult to retain trained staff in these posts. Many clinics and health centres have only one trained member of staff working in them and some centres were unmanned at the time of our visit.

Following the severe drought in 2008, an assessment was carried out which led to the recommendation that 60% of the under-5 year old population should be targeted for food aid to try to reduce the rates of malnutrition. Oxfam estimates that up to 50% of the population are reliant on food aid for survival.

AIC Kalokol Health Centre

From Lodwar we moved on to Kalokol, the largest town on the western shore of Lake Turkana. The AIC Kalokol Health Centre tries to meet the healthcare needs of the population. This small poorly equipped 30-bed health facility is situated in the sand dunes on the southern side of the town. The Centre is not government funded. A large part of the funding for the institution has now been taken over by the Elizabeth Glaser Paediatric AIDS Foundation (EGPAF) and as such there is a heavy bias towards HIV treatment, education and prevention. The Centre offers many services outside of those covered by the EGPAF funding, and to cover these additional costs the Centre seeks additional donations, and charges patients a small user fee to try to generate some extra funds.

We visited the Health Centre where we met Daniel Eripon, who is the Administrator. He very kindly spent several hours showing us around and has subsequently provided me with extra information regarding the history of the Health Centre, its budget, and its challenges.

Kalokol Health Centre is situated within Kalokol Division of Turkana Central District. It is the sixth largest division in the jurisdiction of Turkana County. It is the only Health Centre in the newly formed District. Kalokol Division covers an area of 3,470 km² and has a population of 28,735 (1999 census).

Fishing is an important activity for the community of Kalokol. Lake Turkana has fishing potential and capacity to provide sustainable income earning opportunities for the local people. Fish is also an important food item especially for a district that lives with drought and food shortage. Sustainable fishing is dependent on a healthy inflow of water into the lake. Over-abstraction of water on the key river draining into the lake from Ethiopia will impact negatively on water levels in the lake. Coupled with drought, fish yields from the lake have been declining.

In 1963, the Africa Inland Mission (AIM) established the Kalokol Health Centre (by a missionary named Mrs. G. Stauffacher). It became a Cottage Hospital in 1974, and remained so until the 1980s when it suddenly dropped its status to the Health Centre following withdrawal by donors. AIC Kalokol Health Centre is a faith-based Level three facility and a member of the Christian Health Association of Kenya, which has a network of 468 member health units countrywide. It is under the umbrella of the AIC Health Ministries – Kenya, with its headquarters in Nairobi. GoK/MOH recognizes AIC Kalokol Health Centre under Master Facility List (MFL) 14663. Although the Centre is nominally under the umbrella of the AIC, it receives no direct funding from AIC.

The Health Centre is managed by a board of trustees and employs a range of personnel that includes: clinical officers, nurses, a laboratory technician, HIV counsellors, patient attendants, and field assistants. Since its establishment, it has continued to collaborate with a number of partners to implement various health projects. With support from the Elizabeth Glaser Paediatrics AIDS Foundation (EGPAF), AIC Kalokol Health Centre is implementing the TUNAWEZA programme the aim of which is to reduce new HIV infection and to increase access for HIV patients to care and support. TUNAWEZA is 5-year U.S. Centres for Disease Control and Prevention (CDC) funded program providing support and assistance to indigenous Kenyan organizations working in HIV / AIDS prevention, care and treatment.

The EGPAF funding from Oct 2011 to Sept 2012 amounts to \$53,367 and this provides for nine members of staff: the administrator; a clinical officer; three nurses; a lab technician; an accountant; HIV counselling and testing counsellor; and a data entry clerk. There is no doctor in the Centre and any severely unwell patients; patients with surgical problems, or difficult obstetric problems must be transferred to Lodwar District Hospital. The most senior medically trained person is the Clinical Officer, who has done a three-year training diploma and one-year internship prior to taking up the post. In addition to this, the Health Centre employs 13 other members of staff: a nurse; cleaners; patient attendants; lab technician; and security staff. These staff are funded through what the Centre makes through charging patients for care and from other goodwill donations. This income is very variable and as such the staff sometimes go for several months without receiving a salary. Morale is low as a result. In addition, this income also has to be used to buy necessary drugs and pay for the maintenance of the Centre.

The EGPAF funds are used only for HIV related anti-retroviral drugs, and antibiotics for TB, so all additional drugs such as antibiotics and antimalarials must be bought from what extra funds the Centre can raise. As a result restocking of medications is unpredictable and intermittent. The Centre occasionally receives donations of medications from well-wishers and occasionally also from the Government. The Government provides vaccines as part of the national immunisation programme, and World Food Programme, UNICEF and World Vision provide the Centre with food aid for malnourished children under five years of age, and their mothers.

The Centre sees up to 900 patients in a month and charges 20 Kenya shillings for a consultation, and 500 Kenya shillings for intravenous medications. A 3-4 day inpatient stay usually costs in the region of 1,000 Kenya shillings (£1 = Kenya Shillings 135).

The infrastructure at the Centre is generally quite run down and in need of attention. Most of the windows are broken and most of the wards lack doors. There is a very basic laboratory in which they are able to do HIV rapid diagnostic testing, malaria rapid diagnostic tests and blood films, Widal test for typhoid, and microscopy for acid fast bacilli (TB). They are unable to do a full blood count and blood has to be sent to Lodwar for HIV CD4 counts.

The Centre has a gas-powered fridge in which vaccines are stored. This consumes four gas cylinders per month. One gas cylinder is donated free, while the Ministry of Health pays for two cylinders. The Centre pays for the fourth cylinder at a cost of 4,000 Kenya shillings. The Centre borrows a small generator for powering the office. The Centre has no permanent electricity and this is a big problem at night when there is no way of lighting the wards. The Centre has recently invested in a single solar battery and solar panel, which gives enough power to light a single bulb on each of the wards, from dusk until 0200 hrs when the battery runs flat.

The Centre has no formal catering facilities, and depends on relatives providing inpatients with food. Water is a big issue. The facility is dependent on piped water once weekly. This fills a 5,000 litre tank, but the supply is unreliable. It is not unusual for the Centre to run out of water, at which point the Centre buys 20 litre water jerry cans from nearby Longech, at the cost of 30 Kenya shillings per jerry can. The Centre gets through 20 jerry cans in a day. When we visited the Centre had not been supplied water for more than a month, because the pump in town had been broken.

The other issue with the local water supply is the very high fluoride content of many of the water sources. Many of the local community also use the lake as a water source and this has an extremely unsafe level of fluoride. In the nearby village of Longech there are a number of people suffering from crippling joint and bone deformities due to skeletal fluorosis from drinking the lake water all their lives. We saw one such man when we were at Lobolo at the end of our field trip. He could barely walk due to the extreme deformity of both of his knees. When we questioned him about the problem he said it was because he was 'cursed'. Despite much knowledge about this problem and input from the NGO / donor community it would appear that people along the lakeshore are still not being adequately educated about the problem. There have been a number of programmes to try to provide safe drinking water with acceptable levels of fluoride but it would appear from talking to Daniel and Peter Ekale, our

guide, that many of these good intentioned projects, have not been successful. A good example of this was the springs at Lobolo where a Unicef donated windmill was sited to pump water up to a holding tank inland but was reported not capable of generating enough pressure to pump water to the level of the tank.

Another big problem that the Centre has is the lack of a functioning vehicle. The Centre owns a Toyota Landcruiser but this has been in a state of disrepair for the last year due to an engine problem. We saw the vehicle gathering dust on the site. Daniel said that they had been quoted 170,000 Kenya shillings to repair the vehicle but looking at the car we thought it might well ultimately cost more than that. With the lack of a vehicle, the outreach clinic programme that was previously carried out by the Centre has collapsed. This had previously been carried out every two weeks and so the vaccination coverage of the local area was suffering as a result. The vehicle has also been used for transferring sick patients to Lodwar District Hospital. Unfortunately the Centre now has to rely on local transport to get sick patients to hospital - a service for which the patient must pay. As a result, the Centre had a recent case where a child had died from malaria whilst waiting for the minibus to depart for Lodwar. The drivers delay departure until a vehicle is totally full, regardless of critically ill patients. Occasionally the Catholic Mission will donate their car, or Lodwar District Hospital will send its only ambulance to collect the patient.

We were given a tour of the wards, and we witnessed a typical case of a young Turkana child with malaria who was accompanied by his grandparents. They had walked 56 kilometres to get him treatment, carrying him all the way. By the time he arrived he was very nearly dead but thankfully had recovered well with quinine and intravenous rehydration. It really puts things into perspective when you see fellow human beings living in such deprived conditions, even in this day and age.

Due to the lack of funds, the Centre focuses on treating infectious diseases such as malaria, respiratory and diarrhoeal illness, worms, Vitamin A deficiency, and malnutrition. The Centre keeps stocks of ciprofloxacin, augmentin, septrin, chloramphenicol, benzylpenicillin, metronidazole, and amoxicillin antibiotics. Albendazole and nystatin are used for fungal infections. The Centre uses metoclopramide as an antiemetic agent, and phenobarbital is used for seizures. The only analgesia kept in the Centre is paracetamol and ibuprofen. Quinine is used for malaria. The Centre has no budget for treating chronic diseases such as diabetes or hypertension.

It was humbling and sad to see the conditions in which the Centre's personnel were working. Despite what Daniel said about problems with low morale, they all seemed to be very committed and we were very impressed by Daniel's drive and enthusiasm for trying to improve things. It really made us all realise just how privileged some of us are to be able to access high quality medical care when we need it.

Eastern Lakeshore - Loiyangalani

Unfortunately we did not get to visit any health care facilities on the eastern shore of the lake on this trip, but from discussions on the phone with the Sisters at the Catholic Mission in Loiyangalani, it was clear that they were facing similar challenges. My father made a visit to the Catholic Mission Clinic in Loiyangalani, on a separate later safari, and he met with the Consolata Missionary Sisters running a health clinic. They also need assistance, and some of their needs are for very basic and inexpensive equipment, such as simple weighing scales. They also run medical outreach programmes to the poor lakeshore communities, but are hampered by a lack of available transport. In many ways the situation on the eastern shore is worse because the population density is much lower, and there are no paved roads, with the nearest hospitals many kilometres away, either in Marsabit, Wamba or Maralal, through roads that are impassable in wet conditions.

Summary

In summary we were fortunate enough to be given first hand exposure to two of the different tiers of health care provision in Turkana County. These were 'eye opening' to say the least, and it is clear that the region needs significant investment to improve the health of the population through education, improved nutrition, access to clean / safe drinking water, access to skilled maternity services, access to good primary and secondary care health services, and through delivery of an effective immunisation programme with population-wide coverage.

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Annex 4: East African Wildlife Society article – SWARA June July 2012 – Patrick Avery

The attached article published in SWARA was motivated by the observations of the field expedition on Lake Turkana in January 2012. The article aimed to draw attention to challenges facing Lake Turkana.



Flamingos on soda crater lake, Central Island

Kenya's jade jewel in peril from Ethiopian plans

BY PATRICK AVERY
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Patrick is a doctor currently living in Bristol, England where he is training to be a General Practitioner. He was born and raised in Nairobi where his

parents still live, and hopes to return there to work once he is fully qualified. He has a strong interest in tropical and expedition medicine and has been a passionate life long enthusiast of Africa's wild places, its people and its wildlife.

Lake Turkana and the Kenyans who live around and off its fabled jade green waters, are under threat from the demands of development in neighbouring Ethiopia.

Anyone who has been lucky enough to visit Lake Turkana will know what a unique and special place it is. But for how much longer?

Ethiopia's plan to use water from the Omo river to generate electricity, food and development may siphon off precious water that has fed Turkana for centuries.

Known as the Jade Sea because of the colour of its waters, it is the world's largest permanent desert lake, running 260km from north to south. It was the last of the great African lakes to be 'discovered' when the Austrian explorer

Count Teleki visited the lake in 1888. He found the alkaline waters of the lake to be teeming with fish and encountered animals such as elephant along its shore. Multiple discoveries of early hominid fossils in the area have led to it being dubbed the 'Cradle of Mankind', and in the 1960s the lake was reported to hold the greatest concentration of Nile Crocodiles on earth.

As a casual visitor it is easy to get caught up in the rugged romance of the landscape, and its history, thereby missing the bigger picture. Although the landscape is not much changed, the environmental and social aspects of modern Turkana are spectacularly different from that of Teleki's time and the lake is facing some very serious ecological challenges.



Cattle egrets on the lake shore



Cormorants on the beach, South Island



Dead Soft Shell Turtle in fishing camp

An estimated 300,000 Kenyans, mainly from six tribal groups, rely on the lake for their livelihoods, mostly through fishing and agro-pastoral means. The Turkana region has suffered from a severe lack of government investment and the people here are amongst Kenya's poorest with 94% living below the poverty line and in some areas up to 50% of the population reliant on food aid for survival¹. The very dry harsh climate makes for tough living conditions and this, coupled with severe recent droughts, has left many people destitute following the loss of all their livestock. So even more people are looking to the lake and fishing as a means for survival.

The story of the complex modern issues affecting this mighty lake is a fascinating and intriguing one that pulls together a range of important current topics that are pertinent to Africa as a whole.

300,000

Number of estimated Kenyans, mainly from six tribal groups, who rely on the lake for their livelihoods, mostly through fishing and agro-pastoral means.

I have been privileged to visit Lake Turkana on at least 10 occasions. Getting to the lake takes two long days of driving on rough dirt roads through very wild countryside. The area is frequently subject to tribal tension through banditry and livestock rustling, a situation exacerbated by the widespread availability of modern weapons from neighbouring war zones. These trips have generated in me a great

passion for this wild piece of Africa as well as its culturally diverse people. I have recently returned from a 10-day scientific expedition to the lake with my brother and my father, who is an engineering hydrologist, and who has become one of the modern experts on the lake's hydrology. Through our experiences of the lake over the last 30 years we have noticed a lot of changes, and our most recent trip was thought-provoking.

The lake has no outflow apart from natural evaporation and 80-90% of its inflow comes from a single source, the Omo river, which flows south out of the Ethiopian highlands, ending in a delta at the Lake's northern end². There are three areas on the lake that are conserved as national parks under the jurisdiction of the Kenya Wildlife Service (KWS). These include two large volcanic islands (Central Island and South Island) and a large piece

¹Oxfam Kenya

CONSERVATION



INSERT
TOP: Crocodile egg stolen from a nest and eaten by the fishermen on North Island.

BELOW: Crocodile tracks and nests South Island

Crocodile lake Central Island

SINCE 2006 THE ETHIOPIAN GOVERNMENT HAS BEEN BUILDING AN ENORMOUS 1800MW HYDROELECTRIC POWER SCHEME IN THE MIDDLE OMO RIVER BASIN. THE GIBE III DAM IS ALREADY 40% COMPLETED BUT WAS INITIATED WITHOUT ANY PROPER ENVIRONMENTAL IMPACT ASSESSMENT OF THE POTENTIAL DOWNSTREAM EFFECTS ON THE LAKE.

of land adjacent to the lake on its eastern shore, known as Sibiloi. These parks are listed by UNESCO as World Heritage Sites for a number of reasons including their importance as crocodile breeding areas and as a stop over for migrating palearctic bird species. The

area also supports hundreds of native bird species. Sibiloi protects a decent number of plains game as well as smaller numbers of predators including lions, cheetah, leopards and hyenas. Sadly the wildlife occupying the non-protected shores of the lake has been

decimated for bushmeat consumption and the elephants of Teleki's time are long gone. Even within Sibiloi there is much encroachment from people and their livestock and two years ago we heard several poachers with guns shooting at a herd of zebra within five kms of the park headquarters at Alia Bay.

Since 2006 the Ethiopian Government has been building an enormous 1800MW hydroelectric power scheme in the middle Omo River Basin. The Gibe III dam is already 40% completed but was initiated without any proper environmental impact assessment of the potential downstream effects on the Lake². Chinese banks have reportedly agreed to provide funding to complete the

²Avery ST. Hydrological impacts of Ethiopia's Omo basin on Kenya's Lake Turkana water levels and fisheries. Final Report prepared for the African Development Bank, Nov 2010.

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Turkana fisherman with AK-47



Fishing nets on North Island



Nile Perch caught by fishermen

scheme. Two further hydro schemes are planned downstream at Gibe IV and V. The Kenyan Government signed a memorandum of understanding to buy 500MW of electricity from Gibe III once it is complete although the impacts to Lake Turkana had not been published at that time. Ethiopia predicts that power exports from Gibe III could bring in \$440 million annually and will surpass coffee as the country's most valuable export³. This sort of development utilises a clean renewable energy source and is seen as vital for the growth of the Ethiopian economy and for the future energy security of the whole region, although it makes Ethiopia ever more reliant on hydropower, leaving its electricity supply vulnerable in drought years.

My father calculates that to fill the dam over the proposed course of three years will cause the lake to drop by two metres. A figure of 7-10 metres has been widely quoted but this is based on unsubstantiated calculations that a large proportion of Gibe III's water will be lost to the Omo due to underground cracks in the underlying rock formations⁴. The lake level should eventually restore but the flood cycles that the lake's plankton and fish species thrive on will potentially be lost because the dam will regulate any floods originating from the upper Omo basin. It is proposed that there will be a release of a simulated flood from Gibe III for 10 days every September but this will be very different from the natural state when the river would rise



Dead tilapia, Turkwell delta



Catfish skeleton in fishing camp, South Island

³Ethiopia's Gibe III dam sowing hunger and conflict. International Rivers, October 2009.

⁴ARWG (Africa Resources Working Group), January 2009. A Commentary on the Environmental, Socioeconomic and Human Rights Impacts of the Proposed Gibe III Dam in the Lower Omo River Basin of Southwest Ethiopia, ARWG-GIBE.org

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The Author's father collecting information from fishermen

IT GOES WITHOUT SAYING THAT AFRICA NEEDS TO DEVELOP IN ORDER TO IMPROVE FOOD SECURITY AND AN UNFORTUNATE COST OF THIS IS THE IMPACT TO THE ENVIRONMENT.

and fall over several months. The exact impact of the loss of these large floods and the nutrients they bring is not yet fully certain but one would suspect that it will have a negative impact on fish populations that rely on the seasonal inundation of the lake shore to trigger their breeding cycles. The loss of seasonal flooding of the lower Omo valley will also affect the people there who depend upon flood-recession agriculture to grow their crops.

The dam itself is not the immediate challenge however, because the Ethiopian Government is now

developing a huge 150,000 plus hectare irrigation scheme in the Lower Omo near the Lake; the Kuraz Sugar Cane Development Project. The scheme will need 19% of the total annual Omo flow and up to 135,000 hectares of the plantation has been taken from the Tama Wildlife Reserve and the Omo and Mago National Parks⁵. The Lower Omo is also a UNESCO listed World Heritage site so the national park excisions are extraordinary.

The Ethiopian Government says that the project will address the domestic sugar demand as well as generating

150,000 much-needed jobs. The local infrastructure will benefit from new roads and a new bridge over the lower Omo. Once again there has not been any publicly disclosed environmental and social impact assessment of these developments and the knock-on effects on Lake Turkana are a growing concern.

The Ethiopian government insists that the indigenous peoples of the lower Omo valley have been consulted as stakeholders in the new scheme on their tribal lands but there is much criticism growing from the likes of the NGO Survival International, with reports that these people are being forcibly removed from their lands by the Ethiopian authorities and re-housed in new villages to make way for the development. There is much concern about further marginalisation of the rightful owners of the land. The loss of 19% of water from the Omo will be

⁵Enawgaw C, Deksis D, Timer G. Plantation development versus wildlife conservation in the Omo-Tama-Mago complex. Ethiopian Wildlife Conservation Authority, September 2011.

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dramatic and my father's model predicts that the lake will drop permanently by 10 metres.

It goes without saying that Africa needs to develop in order to improve food security and an unfortunate cost of this is the impact to the environment. The question is what is the limit point at which we say the benefit in terms of development no longer justifies the social and environmental costs?

The lake is under plenty of pressure locally too. It is heavily utilised mainly by the Turkana tribe as a fishing resource. The people doing the fishing get paid very little for their efforts and most of the fish is dried and shipped to western Kenya or the DRC. When I first visited the lake as a child you would see huge crocodiles at numerous places along the shoreline. Sadly on our most recent trip we only counted 22 crocodiles in eight days on the lake. During this time we travelled the entire length of the lake by boat and visited the Omo delta, as well as the three protected areas including Central Island, which was famous for its huge numbers of crocodiles. Unfortunately we did not visit Alia Bay or Koobi Fora, two traditional crocodile strongholds. We found numerous remains of crocodiles, pelicans and soft-shell turtles in the many fishing camps that we visited around the lake. These are killed, sometimes unintentionally, for food with the added bonus that with fewer crocodiles there is less competition on fish and less danger to the fishermen. We also saw the fishermen digging up crocodile nests and eating the

eggs. From our own observations and from speaking to the local people it would appear that the predatory fish population is being depleted too and the fishing is more widespread than we realised. The lake once held a substantial hippo population but they too have mostly been eaten and we did not see a single hippo on the lake.

The sad thing is that much of the evidence of over-fishing and crocodile killing came from areas that are supposedly protected. All three protected areas are meant to be a haven for wildlife with no commercial fishing allowed within 2km of shore. Sadly all three are heavily utilised by fishermen. On South Island, which is more than 10 km long, we saw semi-permanent fishing camps but there are only two KWS rangers tasked with protecting the island. They are stationed on the mainland 40 minutes boat journey away, have limited resources, and only visit the island periodically. Local fishermen complained of corrupt practices. It is very hard to see how the crocodiles and turtles will survive when the few protected areas where they can breed are being exploited by commercial fishing. On a positive note, we did see over 100 hundred species of birds on the lake during our trip including a large number of migratory plovers, raptors, gulls and terns.

It is very sad to see the lake changing so much but at the same time when one spends time with the local fishermen and gets to understand how impoverished and poorly educated they are one realises that the daily

struggle for survival does not allow time for forward thinking. They live hand to mouth. As such they augment their diet in any way that they can, to the detriment of the wildlife, the lake and future generations of Kenyans. The reality is that crocodiles are very dangerous and damage their nets, and if we were in the same position we would want to get rid of them too. I think the key is to provide the animals with enough genuinely protected space whilst educating the fishermen and encouraging government investment in the region to improve the opportunities for those who live there, and ensure regulated fishing on the Lake. The reality is that this seems very unlikely to happen any time soon and if we are not careful irretrievable losses may result unless a serious and concerted effort is made to address this wealth of problems.

Turkana is no stranger to change. Within the four million years of its existence the lake has at times been 80m deeper than at present, when it spilled into the Nile system and in so doing inherited many Nilotic aquatic species including crocodiles and soft shell turtles. There is evidence that it has been much lower too. The only difference today is that the changes are man-made and potentially within our control. Wider publication of the issues facing the lake can only be a good thing because the last thing we want is another Aral Sea. ●



Fishing boats at sunset, North Island

Annex 5: Kenya Population Census 2009

POPULATION CENSUS 2009 - Western Shore							
Division Name	Location Name	Sub-Location Name	Sub-Loc Pop. No.	Sub-Loc Area km ²	Sub-Loc Density per km ²	Population On Lake No.	
Lapur	Karebur	Karebur	1,982	278.4	7.1		
		Nabulukok	1,171	232.9	5.0		
	Meyan	Lewan	2,798	414.6	6.7		
		Napeikar	2,788	270.1	10.3		
	Kokuro	Kokuro	3,843	573.5	6.7		
		Sasame	2,111	139.5	15.1		
		Todenyang	2,786	527	5.3	2786	
	Lokitaung	Lokitaung	Nakalale	3,527	194.9	18.1	
			Kachoda	2,387	34.8	68.6	
			Natoo	1,325	86.5	15.3	
Kataboi		Kataboi	4,203	287.8	14.6	4203	
		Katiko	2,031	186.3	10.9	2031	
		Lomekwi	2,527	434.4	5.8	2527	
Riakomori		Riakomori	5,710	115	49.7		
		Kokiselei	3,232	120.5	26.8		
Ngissiger		Lowerangak	5,481	172.7	31.7	5481	
		Kanamukuny (Nariokotome?)	2,231	36.3	61.5	2231	
		Nachukui	6,088	188.5	32.3	6088	
Kalokol		Kalokol	Kalokol	11,480	384.2	29.9	11480
			Kapua	3,972	516.4	7.7	
	Namadak		4,025	234.3	17.2	4025	
	Namukuse	Namukuse	6,282	35	179.5	6282	
		Locher Ekeny	4,580	104.7	43.7	4580	
	Kangatoha	Eliye	4,792	493.7	9.7	4792	
		Naworos	4,562	97.3	46.9		
		Lomopus	2,479	274.3	9.0		
Kerio							

POPULATION CENSUS 2009 - Western Shore						
Division Name	Location Name	Sub-Location Name	Sub-Loc Pop. No.	Sub-Loc Area km ²	Sub-Loc Density per km ²	Population On Lake No.
	Kerio					
		Kerio	4,254	266	16.0	
		Nakurio	7,754	769.3	10.1	
		Nadoto	8,425	156.3	53.9	
	Kangirisae					
		Kangirisaye	3,643	455	8.0	
		Nakoret	4,198	225.8	18.6	
	Lorengelup					
		Lorengelup	2,173	112.1	19.4	
		Kangagetei	1,886	286.4	6.6	
		Kakimat	1,879	433.4	4.3	
Katilia						
	Katilia					
		Katilia	7,747	814.4	9.5	
		Elelea	3,907	748.6	5.2	
		Parkati	9,329	1774.9	5.3	
Totals			153,588	12,476		56,506
				240		
			Band width	51.98		

POPULATION CENSUS 2009 - Western Shore						
Division	Location	Sub-Location	Sub-Loc	Sub-Loc	Sub-Loc	Pop. on Lake
Name	Name	Name	Pop No.	Area km ²	Density per km ²	People
Lapur						
	Karebur					
		Karebur	1,982	278.4	7.1	
		Nabulukok	1,171	232.9	5.0	
	Meyan					
		Lewan	2,798	414.6	6.7	
		Napeikar	2,788	270.1	10.3	
	Kokuro					
		Kokuro	3,843	573.5	6.7	
		Sasame	2,111	139.5	15.1	
		Todonyang	2,786	527	5.3	2786
Lokitaung						
	Lokitaung					
		Nakalale	3,527	194.9	18.1	
		Kachoda	2,387	34.8	68.6	
		Natoo	1,325	86.5	15.3	
	Kataboi					
		Kataboi	4,203	287.8	14.6	4203
		Katiko	2,031	186.3	10.9	2031
		Lomekwi	2,527	434.4	5.8	2527
	Riakomori					
		Riakomori	5,710	115	49.7	
		Kokiselei	3,232	120.5	26.8	
	Ngissiger					
		Lowerangak	5,481	172.7	31.7	5481
		Kanamukuny (Nariokotome?)	2,231	36.3	61.5	2231
		Nachukui	6,088	188.5	32.3	6088
Kalokol						
	Kalokol					
		Kalokol	11,480	384.2	29.9	11480
		Kapua	3,972	516.4	7.7	
		Namadak	4,025	234.3	17.2	4025
	Namukuse					
		Namukuse	6,282	35	179.5	6282
		Locher Ekeny	4,580	104.7	43.7	4580
	Kangattha					
		Eliye	4,792	493.7	9.7	4792
		Naworos	4,562	97.3	46.9	
		Lomopus	2,479	274.3	9.0	
Kerio						
	Kerio					
		Kerio	4,254	266	16.0	
		Nakurio	7,754	769.3	10.1	

POPULATION CENSUS 2009 - Western Shore						
Division Name	Location Name	Sub-Location Name	Sub-Loc Pop No.	Sub-Loc Area km ²	Sub-Loc Density per km ²	Pop. on Lake People
		Nadoto	8,425	156.3	53.9	
	Kangirisae					
		Kangirisaye	3,643	455	8.0	
		Nakoret	4,198	225.8	18.6	
	Lorengelup					
		Lorengelup	2,173	112.1	19.4	
		Kangagetei	1,886	286.4	6.6	
		Kakimat	1,879	433.4	4.3	
Katilia						
	Katilia					
		Katilia	7,747	814.4	9.5	
		Elelea	3,907	748.6	5.2	
		Parkati	9,329	1774.9	5.3	
Totals			153,588	12,476		56,506
				240		
				51.98		

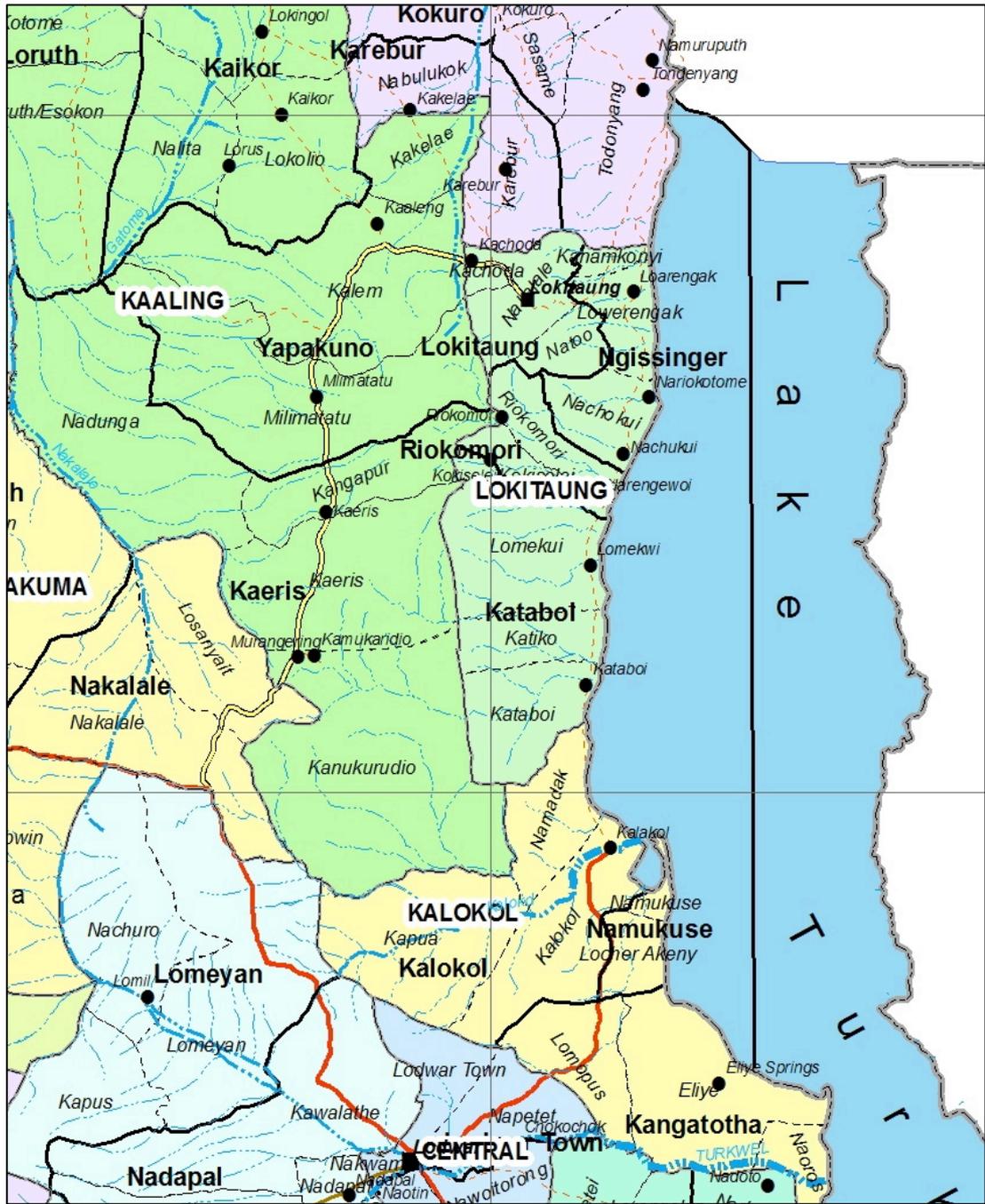


Figure 1: 2009 Census administrative boundaries – West and northwest shore (Turkana District)
 Source: UNICEF / Rural Focus

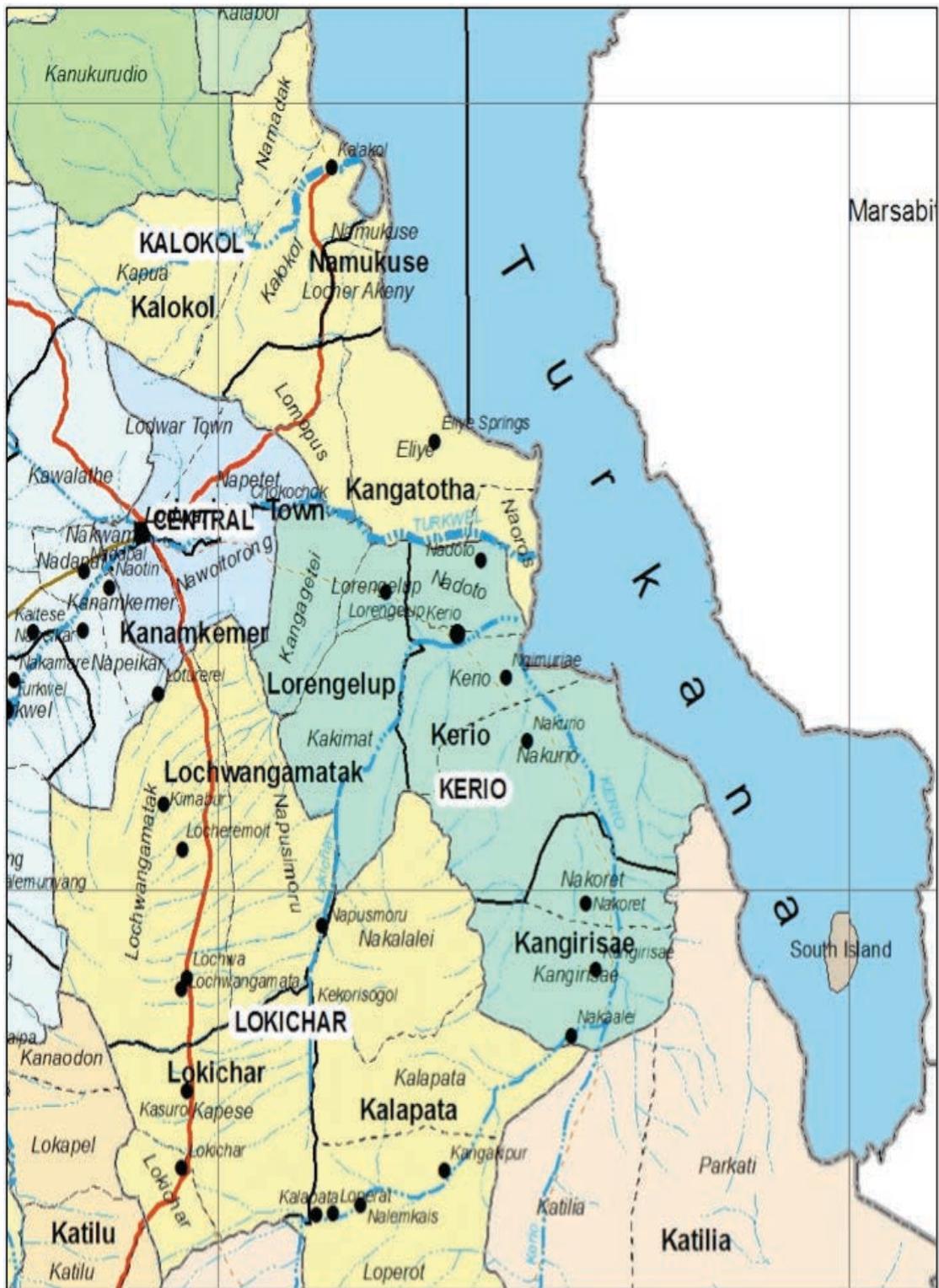


Figure 2: 2009 Census administrative boundaries – West and southwest lakeshore (Turkana District)

Source: UNICEF / Rural Focus (2006)

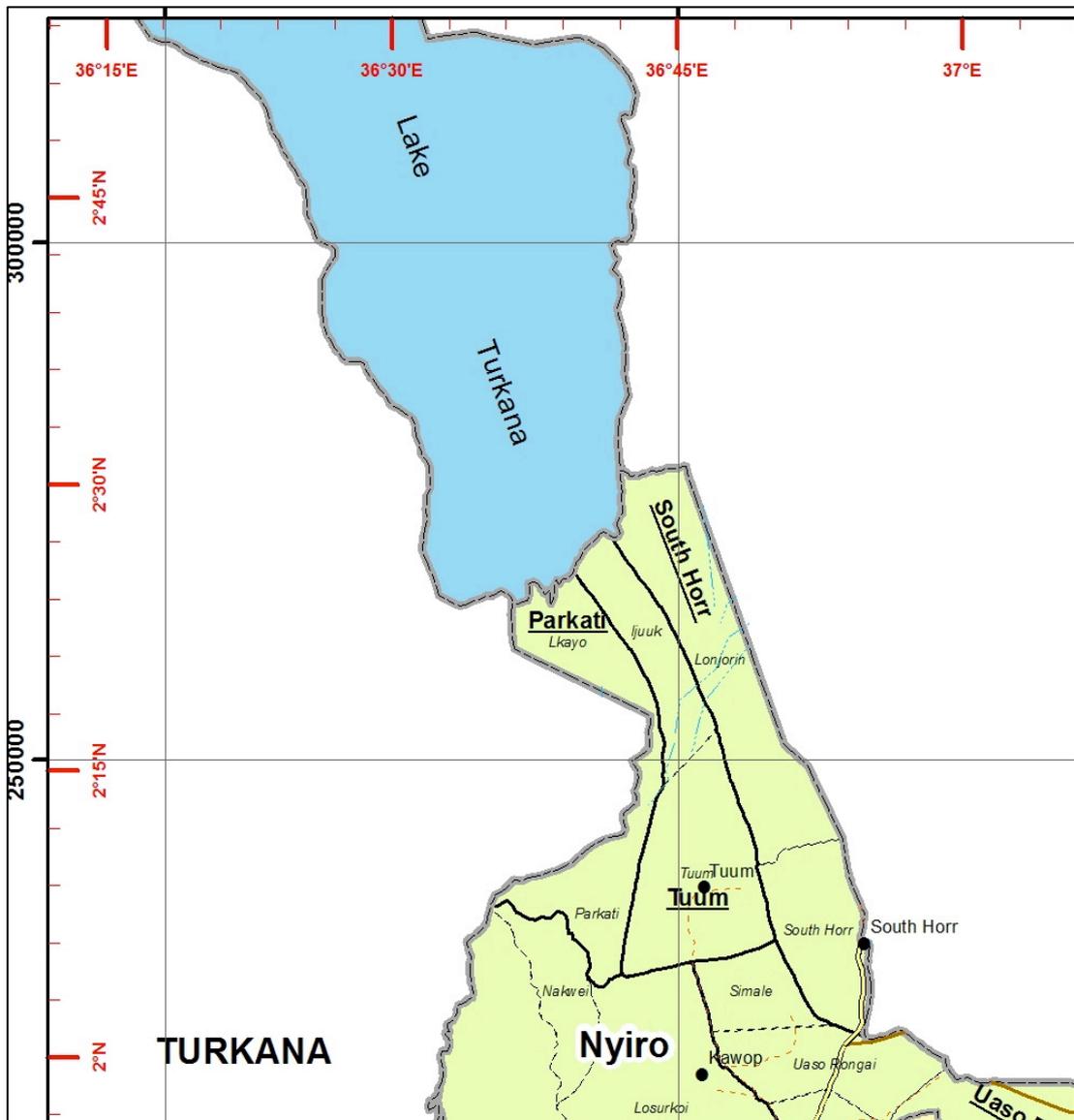


Figure 3: 2009 Census administrative boundaries – Southern lakeshore (Samburu District)

Source: COOPI / Rural Focus

Annex 6: “Facts” On Gibe III (EEPCo, May 2009)

EEPCo’s reaction to the issues raised by BBC’s documentary and environmental activists)

(Extracted from Avery, 2010)

1. Design considerations during reservoir impounding:

- a. Dec 31st 2011: Reservoir impounding will start; the ecological flows of 25-50 m³/sec will be released.
- b. April 1st 2011, Middle Level Outlets will be opened - a flood will be released in the July – Sept period, 7-10 day duration, 1,250 – 1,600 m³/sec.
- c. Dec 2012, max operating level will be reached.
- d. June 2013, all units will be commissioned, discharge will be 950 m³/sec.

2. Design considerations - Minimum environmental flow:

An ecological flow of 25-50 m³/sec will be discharged to guarantee the sustainability of the d/s environment. This corresponds to the lowest monthly average dry season flow.

3. Design considerations - Recession agriculture:

An artificial flood will be released during July – Sept. The flood will be of 7-10 days duration, and the flow quantity will be 1,250 – 1,600 m³/sec.

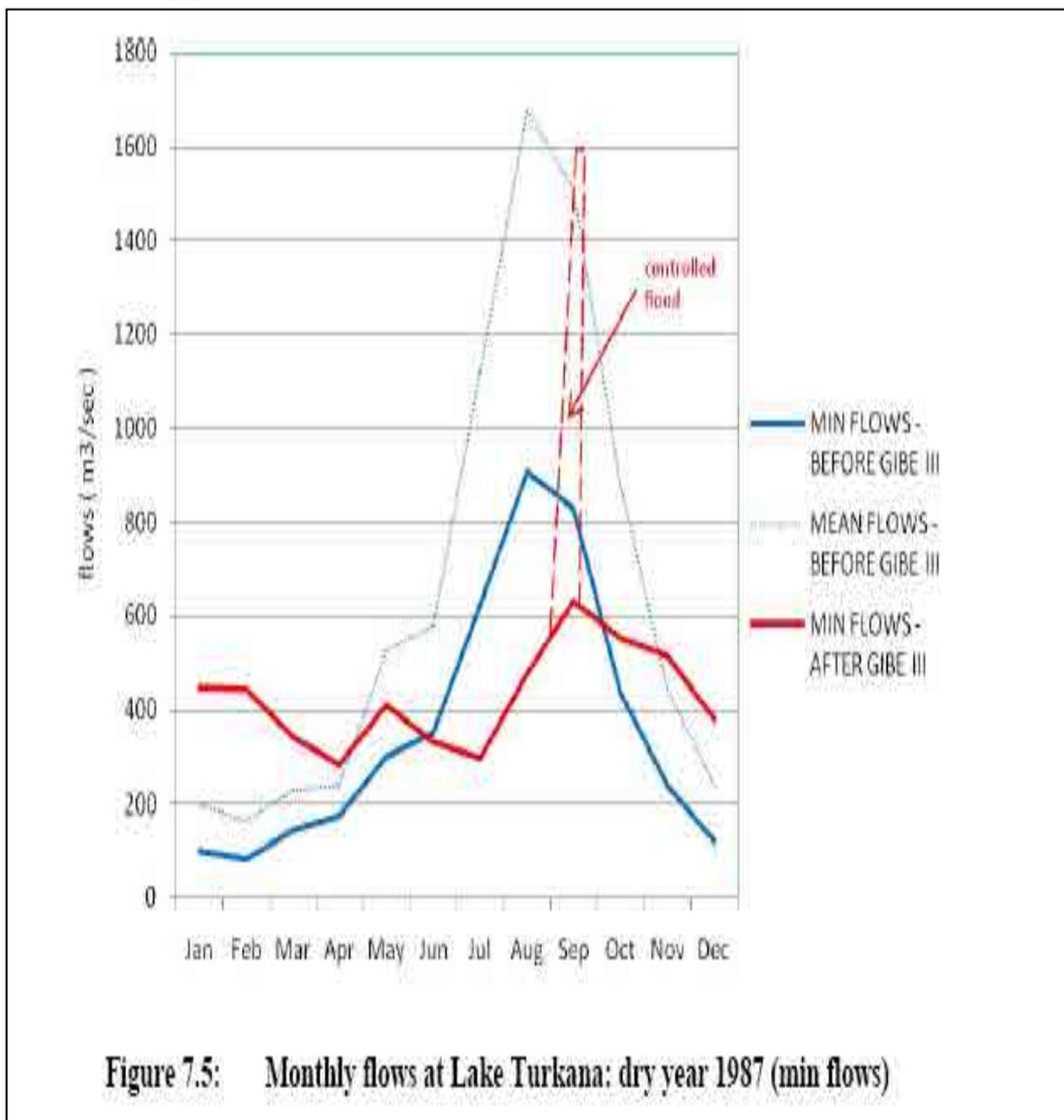
4. Design considerations - Flood regulation and sustainable flow to Lake Turkana.

- a. The lake is characterized by high rate of fluctuations which is currently reducing at an alarming rate due to climate changes
- b. The lake gets its water from different sources, the largest contribution being from the Omo River.
- c. During the dry season these rivers contribute an average monthly flow of 120 to 162 m³/sec while at the dam site the flow is only 61 to 76 m³/sec in the same period.
- d. In addition to the proposed 25 - 50 m³/sec ecological flow, the contribution of the small rivers shall maintain the inflow to the Lake during the dry season.
- e. Thus the presence of the dam allows continuous and regulated flow into the Lake that help maintain its level.

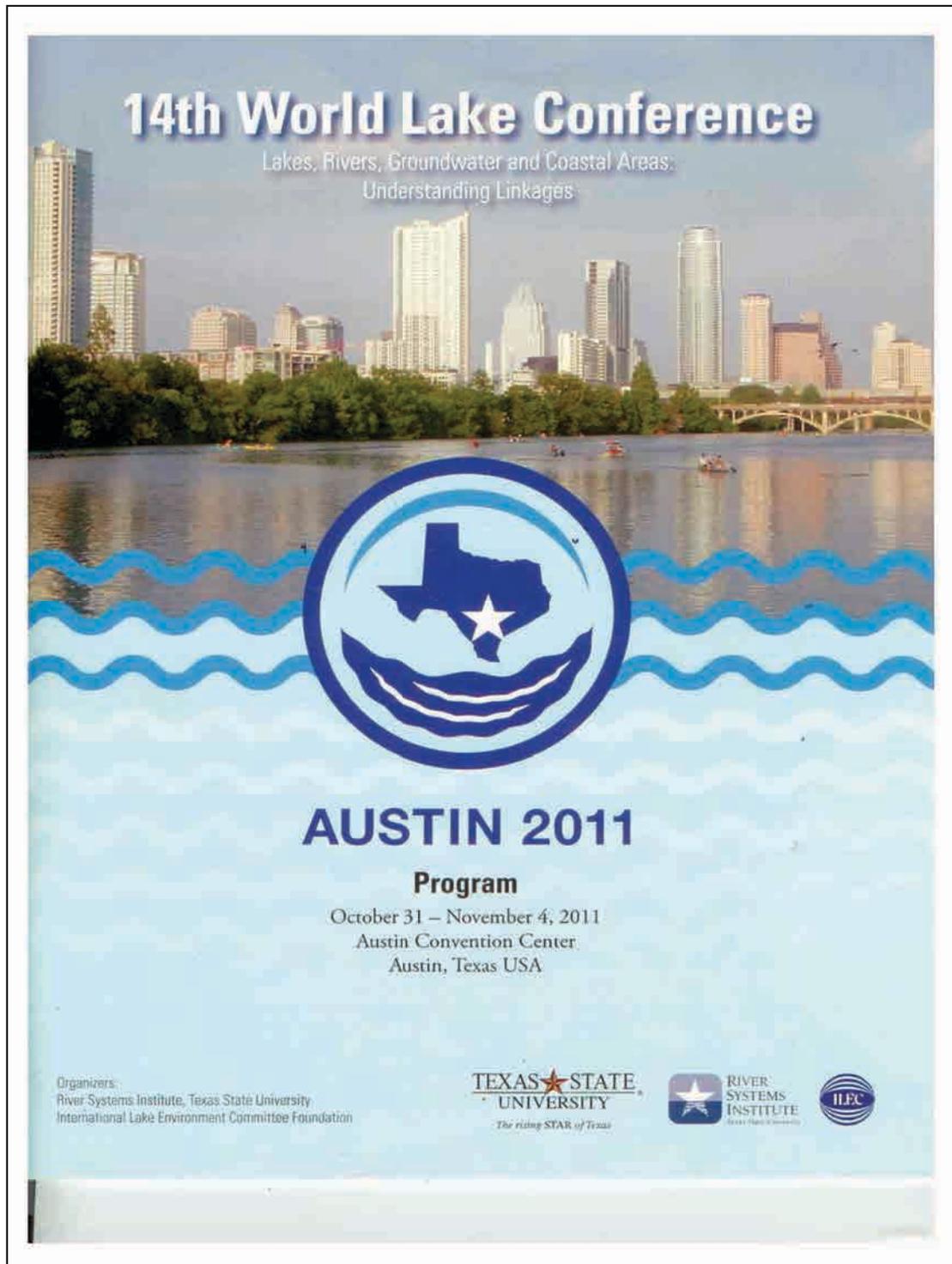
5. Benefits of the dam to the d/s ecosystem:

- a. Regulated flow to the flood prone areas
- b. Reliable and timely water supply for the recession agriculture
- c. Reduction of evaporation losses in the flood plains
- d. Sustainable flow and positive hydrological balance to Lake Turkana

- e. Reduction of extended drought periods
- f. Long term sustainable development schemes that can positively change the lives of the d/s population
- g. Beyond maintaining the existing natural environment (ecosystem), several developmental interventions that guarantee improvements in the livelihood of the indigenous population are recommended in the Environmental Management & Monitoring Plan.
- h. These include irrigation schemes, infrastructures, Social services, Improved Fishing, Tourism and other benefits.
- i. A total budget of more than 400 M Birr is estimated for the implementation of the mitigation measures. Out of this \approx 250 M Birr is earmarked for the downstream interventions.



Annex 7: 14th Lake Conference Program, Austin, Texas, USA, 2011



THURSDAY Nov. 3rd 2011

Protection of Lake Malawi through Water, Sanitation and Food Security

Saburo Matsui, *Kyoto University, Kyoto, Japan*
m36@3kankyo.co.jp

Improving Efficiency in Irrigation Water Use

Ranjith Thomas Scimon, *Director, Ministry of Irrigation, Sri Lanka*
ranjith.scimon@gmail.com

Nitrate Loads in Agricultural Drainage in Ujjain Wetland and its Basin in Western Part of India

Nagesh Tekale, *Emire Vigil, Thane District, Mumbai, Maharashtra, India*
nstekale@rediffmail.com

Achieving TMDLs in Agricultural Watersheds Using EPA-Compliant Watershed Planning Strategies

Robert Wilson, *Kansas State University Research and Extension, Manhattan, Kansas*
rmwilson@k-state.edu

Complex Systems in Hydrology

Room 5B

Co-Chairs: **Ken Mix**, *Texas State University, San Marcos, Texas*
Vincente Lopes, *Texas State University, San Marcos, Texas*

Understanding Linkages in Boundary Spheres Through Multi-Level Evaluation of Hydrologic Cycle

Tadanobu Nakayama, *National Institute for Environmental Studies, Tsukuba, Ibaraki, India*
nakate@nies.go.jp

Present State of Human Impacts on Lake Baikal

Eugene Silow, *Institute of Biology, Irkutsk State University, Siberia, Russia*
eugenesilow@gmail.com

Sustainability Science: Reconciling Human and Natural systems

Vincente Lopes, *Texas State University, San Marcos, Texas*
vlope@txstate.edu

A Systems Approach Framework for Management of Lake Baringo, Kenya

Christine Omuombo, *University of Nairobi, Nairobi, Kenya*
omuumbo@gmail.com

Socio-Ecological Benefits of Lake Conservation:

A Developing Country Perspective

E.T. Puttaiah, *Gulbarga University, Gulbarga, Karnataka, India*
E-mail address not provided

Exergy Analysis of Lake Baikal and Lake Geneva Pelagic Community Dynamics

Eugene Silow, *UNESCO Chair of Water Resources, Institute of Biology, Irkutsk State University*
eugenesilow@gmail.com

Global Climate Change and Hydrologic Linkages

Room 4C

Chair: **Charles Goldman**, *University of California, Davis, California, USA*

Spatial and Seasonal Variations of Sea Level Rise in the Nigerian Coastline

Okuku Ediang, *Nigerian Meteorological Agency, Lagos, Nigeria*
ediang2000@yahoo.com

Leima Wetlands, Mexico:

Eutrophication and Greenhouse Gas Emissions

Gratia Dei Salgado Flores, *Universidad Autónoma del Estado de México, México*
gdfst@hotmail.com

Lake Tahoe:

Five Decades of Change and the World Water Crisis

Charles Goldman, *University of California, Davis, California, USA*
crgoldman@ucdavis.edu

Management of a Tropical Freshwater Lake Under a Changing Environment

Shadananan Nair, *Nansen Environmental Research Centre, Kochi, Kerala, India*
nair59@yahoo.com

Climate Change Effects on Water Resources Management in Rio Grande of Mexico Basin, Michoacan, Mexico

Sonia-Tatiana Sánchez Quispe, *Universidad Michoacana de San Nicolás de Hidalgo, Morelia, México*
soniastq@hotmail.com

Global Programs and Strategies on Assessment and Management of Lakes and Their Basins: UNEP-ILEC Collaboration

Room 6A

In addition to the presentations below, this session will discuss possible avenues and targets for enhancing UNEP-ILEC collaboration in research and management activities of interest to both organizations.

Co-Chairs: **Peter Gilruth**, *Division of Early Warning and Assessment, UNEP, Nairobi, Kenya*
Masabisa Nakamura, *ILEC, Japan*

Global Water Quality Data and Statistics for Inland Waters - Providing Water Quality Data to the World

Kelly Hudson, *UNEP-GEMS/Water Programme, Canada*
E-mail address not provided

Managing Critical Surface and Groundwater Resources

Within River Basins in Africa: The Case of the Mau Forest Complex in Kenya

Salif Diop, *Division of Early Warning and Assessment, UNEP, Nairobi, Kenya*
salif.diop@unep.org

Hydrological Impacts of Ethiopia's Dmo Basin on Kenya's Lake Turkana

Sean Avery, *UNEP, Nairobi, Kenya*
E-mail address not provided



Annex 8: Mission Report to UNEP following 14th Lake Conference

14th ILEC LAKE CONFERENCE, TEXAS – UNEP SESSION 3rd November 2011.

Presentation by Dr SEAN AVERY:

“HYDROLOGICAL IMPACTS OF ETHIOPIA’S OMO BASIN ON KENYA’S LAKE TURKANA”

WITH MENTION OF SIMILAR EMERGING TRANS-BOUNDARY CHALLENGES ON “LAKE NATRON – THE BREEDING LAKE FOR EAST AFRICA’S FLAMINGO POPULATION”

1. Lake Turkana, Kenya’s largest lake, Africa’s fourth largest lake, and the world’s largest desert lake, is located within Kenya’s northern arid and semi-arid lands.
2. 90% of the lake fresh water inflow to the lake is provided by Ethiopia’s second largest river, the Omo River.
3. Lake Turkana is a closed lake without outlet; its waters are almost saline, are unfit for consumption, and are unsuitable for agriculture. However, local agro-pastoralists farm the Omo river delta. Local people also harvest the lake fish, which provides a valuable protein source and alternative livelihood in a food security challenged area.
4. Southern parts of the lake fall within the Mount Kulal Biosphere Reserve, listed in the UNESCO Biosphere Directory. The Lake Turkana National Parks within Kenya include Sibiloi, Central Island and South Island National Parks, and together these comprise a UNESCO listed World Heritage Site. To the north of the lake in Ethiopia lie the Omo and Mago National Parks, and the Tama Wildlife Reserve, all of whose borders have been redefined to accommodate commercial irrigated sugar development along the Omo River. Another UNESCO listed World Heritage Site, called the Lower Omo Valley, formerly located within the Omo National Park, now appears to fall within the sugar development zone.
5. The key environmental factors governing fisheries in Lake Turkana are:
 - a) Salinity of the water: This lake is the most saline lake in the Rift Valley that supports a diverse fisheries resource. It is uncertain what increases in salinity can be tolerated by the fisheries.
 - b) The lake’s prevailing SE winds: These control the lake currents, oxygenation, and nutrient distribution.
 - c) The lake’s water temperature: This is stable, with stratification at depth.
 - d) Most important, the annual flooding influx of the Omo River: This influx stimulates fish spawning. The ecology of the wetlands and lake has evolved in response to naturally variable hydrology. The lake’s principal nutrient conduit is the Omo River.
6. Runoff patterns in the Omo River have been changing over recent years. Vegetation is being cleared in the Omo Basin through human activity, runoff is becoming more variable, and changes to the Omo delta reflect accelerated erosion. A fresh baseline assessment is needed.
7. The Omo River is the lake’s “umbilical cord”. The Omo River inflow will be reduced, and the lake level and associated biomass will fall. Nutrient inflow patterns will be altered. The Omo River flow patterns will be modified through hydropower scheme regulation, and the lake and delta wetland ecology will be impacted. The lake is almost entirely within

Kenya, whereas the Omo River is entirely within Ethiopia. Hence management of the Omo Basin and lake water resources presents trans-boundary challenges.

8. Major developments are under way in the Basin. These include:
9. Gibe III Hydropower Project (1870 MW), under construction since 2006. The scheme will regulate downstream flows to the lake.
10. Gibe IV and V Hydropower schemes, under study. These schemes are under study, and the potential sites are located downstream of Gibe III. Their impacts are not known yet, but further regulation of flows is inevitable. Gibe IV will store a volume of water similar to Gibe III.
11. Kuraz Irrigation Project. Construction of associated infrastructure commenced in 2011. The scheme area is 150,000 ha and 3 million cubic metres of water will be required annually (19% of the annual inflow to the lake). (Postscript: 3 billion cubic metres has been established in Volume I of this report to be a NET water requirement, hence gross water requirements will be much higher).
12. Other agricultural developments are in progress within the Lower Omo.
13. The potential consequences of Omo River hydropower and irrigation developments on Lake Turkana's levels were presented at the 14th World Lake Conference. The exact impacts will depend on the prevailing lake level at the time of scheme implementation, and will also depend on the operational rules finally adopted and enforced for the schemes.
14. Filling Gibe III will drop the lake by about two metres, and the lake level will take more than 10 years to recover its level.
15. The irrigation abstractions will reduce the lake level below the lake's historic lowest level. The lake level drop will increase in proportion to the volumes of water abstracted from the Omo. Based on the Kuraz scheme's stated irrigation requirement of 3 million cubic metres, a permanent lake level drop of the order of 5 metres was predicted. This volume reduction effect is independent of the effect of Gibe III filling, and of other schemes such as Gibe IV. Hence cumulative effects can be expected, the full extent of which are unknown but significant.
16. Of particular concern are the rights of the indigenous people of the Lower Omo. The farmers traditionally depend on flood recession agriculture, which will cease to occur naturally with regulated river flows resulting from the hydropower schemes. People are being displaced from areas allocated for sugar plantation. The sugar developments and factories will require an influx of skilled workers, with social consequences that will impact existing social fabric. Comprehensive studies and resettlement plans are needed. The UN Committee on the Elimination of Racial Discrimination (CERD) has written to Ethiopia appealing for constructive dialogue on indigenous peoples.
17. The Consultant's presentation to the 14th World Lake Conference stressed the importance of trans-boundary co-operation in determining the value of the lake as a resource, and in the application of a management plan with scientifically derived ecological flows, acceptable to both Kenya and Ethiopia.
18. The presentation referred to two previous studies referring to the lake fisheries, which concluded the following in connection with hydrology / fisheries inter-dependance:
 - a. "...Substantial effect on fisheries can be expected..." (NIVA referring to hydrological change)
 - b. The lake ecology is "...unstable and highly geared to flood cycles...closely linked to hydrology..." (Kolding referring to the importance of hydrology)

The impact of the Omo river developments on the lake's flood plain fisheries is a major concern. Baseline scientific studies are essential to evaluate the current baseline of the Lower Omo and the lake, and the factors governing the fisheries and the nutrient sources, and how these will change with the hydropower and irrigation developments.

19. Lake Natron – Another Emerging Trans-boundary Challenge:

Lake Natron is the most chemically extreme of the Rift Valley lakes. This lake is located within Tanzania, with its northern boundary encroaching into Kenya. The lake is fed by many cool and some hot springs, but 40% of the fresh water input to the lake is provided by Kenya's Ewaso Ngiro South River, which rises in Kenya's threatened Mau Forest. The lake is the sole breeding ground for the entire East African flamingo population. The flamingo population numbers an estimated two million birds, and are categorised by IUCN as "near threatened".

The birds move constantly along the many Rift Valley lakes from Ethiopia to Tanzania in response to food availability. However only Lake Natron provides a suitable breeding habitat.

The lake ecology is pivotal to the survival of the birds.

The lake ecology and bird breeding is threatened by hydrological change that will arise from the following proposed developments:

- Mau Forest changes affecting the catchment runoff to Natron;
- Commercial soda ash extraction from Lake Natron in Tanzania;
- Ewaso Ngiro South Hydro & Irrigation dam. The project design process was launched under Kenya's Vision 2030. The development proposals will alter the hydrological flow patterns, and water abstraction for irrigation will reduce river flow reaching the lake and its wetlands. Some of these wetlands provide crucial dry-season forage for the livestock and wildlife.

This trans-boundary lake offers similar hydrological change issues to Turkana, albeit on a different scale.

Dr Sean Avery BSc PhD

Updated March 2012

Consultant in African Water Resources, Hydrology, and the Environment

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Chartered Water & Environmental Manager (UK)

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Licensed by Kenya's Ministry of Water & Irrigation

Licensed by Kenya's Ministry of Environment

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PO Box 24135-00502, Nairobi, Kenya

Selected References

1. Avery, S.T., *Hydrological Impacts of Ethiopia's Omo Basin on Kenya's Lake Turkana Water Levels & Fisheries*, Final Report prepared for the African Development Bank, November 2010.
2. Hopson A.J. (editor) (1982). *Lake Turkana, A Report on the Findings of the Lake Turkana Project, 1972-75*, Volumes 1-6.
3. ILEC, 14th World Lake Conference, Austin, Texas, 2011.
4. Kolding, Jeppe (1989). *The fish resources of Lake Turkana and their environment*, Thesis for the Cand.Scient.degree in Fisheries Biology and Final Report of KEN043 Trial Fishery 1986-87, University of Bergen, Norway. Report to NORAD, Oslo, December 1989, 262 pp.
5. NIVA (Norwegian Institute for Water Research), Kallqvist, T., Lien, L., Liti, D., (1988), *Lake Turkana Limnological Study 1985-1988*, ISBN-82-577-1510-7.
6. Tebbs, E.J., Avery, S., Harper, D.M., *Remote Sensing of Alkaline-Saline Lakes: Applications to Flamingo Conservation* <http://www.earthzine.org/2012/01/11/remote-sensing-of-alkaline-saline-lakes-applications-to-flamingo-conservation/>.
7. Ojwang, W., Gichuki, J., Getabu, A., Wakwabi, E., Abila, R., KMFRI / LTRP / Technical Report/1 (2007.) *Lake Turkana: Fisheries, People and the Future, "Intervention for Economic Benefit"*, Kenya Marine Fisheries Research Institute (KMFRI).

Annex 9: Presentation to 14th World Lake Conference, USA

Some sample slides are attached for illustration purposes.

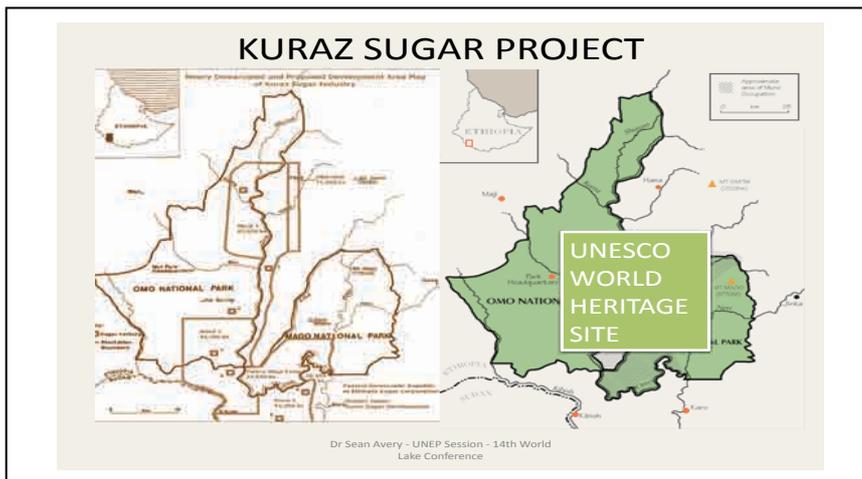


The Jade Sea *3-D Sat image*

Lake Turkana Hydrology

Researched by: Dr Sean Avery
Study commissioned by: African Development Bank, Tunis
Conference Funding: UNEP & University of Oxford

Dr Sean Avery - UNEP Session - 14th World Lake Conference

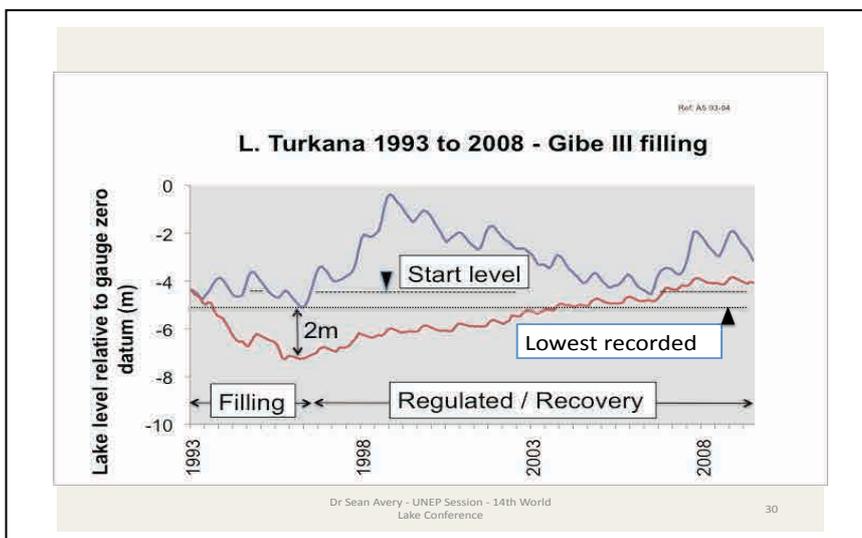


KURAZ SUGAR PROJECT

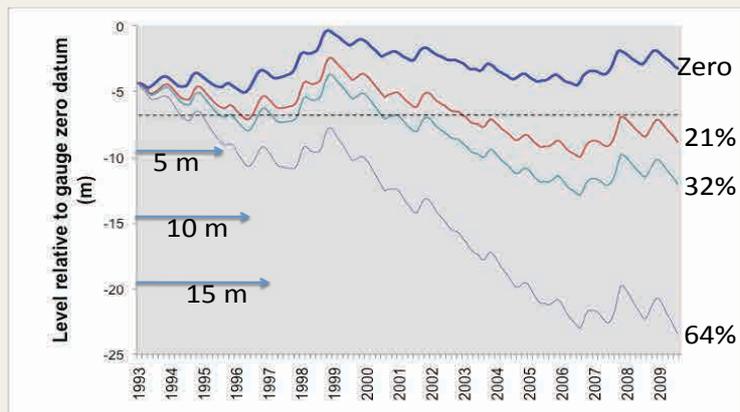
Heavy Development and Irrigation Government Area Map of Kuraz Sugar Industry

UNESCO WORLD HERITAGE SITE

Dr Sean Avery - UNEP Session - 14th World Lake Conference



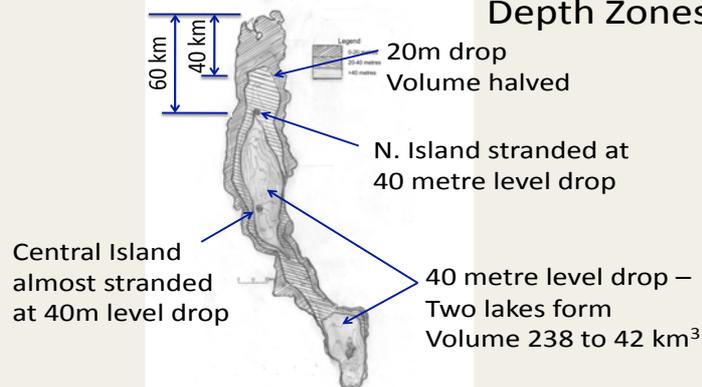
Increasing abstraction



Dr Sean Avery - UNEP Session - 14th World Lake Conference

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Depth Zones



Dr Sean Avery - UNEP Session - 14th World Lake Conference

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Conclusions – the Lake

FINDINGS

- Range +15m to -3m. Once 100m higher.
- Lowest -5m (1945-46, 1954-55, 1988)
- General rising trend 1990-2008 = 1m rise
- Salinity increasing gradually
- Poor quality water
- Evaporation constant, temp constant
- Rainfall trend shows no increase
- Hence increasing %runoff in Omo causing lake rise
- Runoff more variable, increasing floods, more erosion and sediment, expansion of delta

QUESTIONS

- How has lake already been affected?
- How has population / livestock pressure affected lake?

Dr Sean Avery - UNEP Session - 14th World Lake Conference

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Annex 10: National Museums of Kenya invitation to attend UNESCO's Stakeholder Meeting – Fact finding mission to Lake Turkana

**UNESCO WORLD HERITAGE FACT FINDING MISSION
STAKEHOLDERS MEETING
16TH MARCH 2012**

TIME	PERSON
11.15 a.m.	Opening Remarks (Director KWS)
11.15 – 11.30 a.m	Director General (National Museums of Kenya)
11.30p.m. – 11.45 p.m.	Overview of L. Turkana Drs. Wario + Njogu
11.45 a.m – 12.15 p.m	Guy Debonnet-Chief Special Projects- UNESCO Goran Gucic –IUCN
12.15 p.m. 12.45.pm	Discussion questions & answer
12.45 p.m. – 2.30 p.m.	Lunch
2.30pm- 3.00pm	Dr. Sean Avery GIBE III presentation
3.00pm	Tullow presentation -Discussion
4.00 p.m	Tea break/closing

Annex 11: UNESCO Fact Finding Mission to Lake Turkana March 2012 - Mission Report Executive Summary



United Nations
Educational, Scientific and
Cultural Organization
Organisation
des Nations Unies
pour l'éducation,
la science et la culture

World Heritage
Patrimoine mondial

36 COM

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Original: English

UNITED NATIONS EDUCATIONAL,
SCIENTIFIC AND CULTURAL ORGANIZATION
ORGANISATION DES NATIONS UNIES
POUR L'EDUCATION, LA SCIENCE ET LA CULTURE

CONVENTION CONCERNING THE PROTECTION OF THE WORLD
CULTURAL AND NATURAL HERITAGE
CONVENTION CONCERNANT LA PROTECTION DU PATRIMOINE
MONDIAL, CULTUREL ET NATUREL

WORLD HERITAGE COMMITTEE / COMITE DU PATRIMOINE MONDIAL

Thirty-sixth session / Trente-sixième session

Saint Petersburg, Russian Federation / Saint Pétersbourg, Fédération de Russie
24 June – 6 July 2012 / 24 juin – 6 juillet 2012

Item 7 of the Provisional Agenda: State of conservation of properties inscribed on the
World Heritage List and/or on the List of World Heritage in Danger.
Point 7 de l'Ordre du jour provisoire: Etat de conservation de biens inscrits sur la Liste
du patrimoine mondial et/ou sur la Liste du patrimoine mondial en péril

MISSION REPORT / RAPPORT DE MISSION

Lake Turkana National Parks (Kenya) (N801bis)/ Parcs nationaux du Lac Turkana
(Kenya) (N 801bis)
14-22 March 2012/14-22 mars 2012

This mission report should be read in conjunction with Document:
Ce rapport de mission doit être lu conjointement avec le document suivant:

WHC 12/36. COM/7B.Add

1

Extract from Mission Report: Acknowledgements – P4:

ACKNOWLEDGEMENTS

The mission team would like to thank the Government of Kenya for its kind invitation, hospitality and assistance throughout the duration of the mission. The team is grateful to the Permanent Secretary, Ministry of Natural Resources and Tourism, and the General Director of National Museums of Kenya and the Director of Kenya Wildlife Service and their staff, for their support throughout the mission. The team would like to thank in particular Dr. Hassan Wario of National Museums of Kenya and Dr. James Njogu of Kenya Wildlife Service, who organized the mission and accompanied the mission team throughout. Special thanks also to field staff of the Kobi Fora field station and of Sibiloi National Park, who worked tirelessly to make the field mission a success. The mission would also like to thank Dr Sean Avery, who took the time to present and discuss with the mission team the findings of the assessment of the hydrological impacts of the Omo Basin on Lake Turkana water levels and fisheries he conducted for the African Development Bank and shared his knowledge of the issues with the mission team.

EXECUTIVE SUMMARY AND RECOMMENDATIONS

The Lake Turkana National Parks World Heritage site is constituted of Sibiloi National Park, the South Island and the Central Island National Parks, covering a total area of 161,485 hectares located within the Lake Turkana basin whose total surface area is 7 million ha. The property was inscribed on the World Heritage List in 1997 as Sibiloi / Central Island National Parks on the basis of natural criteria (viii) and (x).

At its 35th session, the World Heritage Committee requested the States Parties of Ethiopia and Kenya to invite a joint World Heritage Centre / IUCN reactive monitoring mission to review the impacts of the Gibe III dam on the Outstanding Universal Value (OUV) of the property. At the invitation of the Kenyan authorities a joint World Heritage Centre/IUCN monitoring mission was undertaken from 14 to 22 March 2012, which visited the property had discussions with various stakeholders and the Kenyan authorities, including a meeting with Prime Minister. The mission only visited Kenya and at the time of preparation of this report, no invitation has been received from the State Party of Ethiopia.

The mission looked at the following key conservation issues:

Impact of the GIBE III dam and related issues

The mission noted that the EIA submitted by Ethiopia does not assess any impacts beyond the Ethiopian territory and did not consider possible impacts on Lake Turkana. The documented public consultation process also did not include affected populations in Kenya. The mission further notes that the EIA only considers the impacts of the dam as a standalone project, and does not include any reference to other related planned or on-going projects, such as downstream agricultural development projects which will use the water for irrigation. These irrigation projects are made possible because the dam will ensure a steady and constant flow of water in the Omo River, compared to the natural seasonal variation pattern currently in place. The mission notes that while a report of the State Party of Ethiopia asserts that irrigation development is not part of the Gibe III project, a sugar cane development is already being implemented, with infrastructure including irrigation canals currently under construction. Two additional dams are also already planned downstream of the Gibe III dam. At the time of preparation of this report, the official website of the Ethiopian electricity cooperation reports that construction of Gibe III is more than 50% completed.

In preparation of the mission, IUCN commissioned an independent review of the potential hydrological impacts of the proposed Gibe III dam on the Outstanding Universal Value of Lake Turkana National Parks, prepared by Hydro-ecology Consulting Ltd, which looked at the different documents and studies currently available. Based on this review and its own review of the Environmental Impact Assessments submitted by the State Party of Ethiopia as well as other assessments which have been done, the mission believes that the potential cumulative impacts on Lake Turkana of the Gibe III dam and the other related developments would be significant:

- Modeling shows that over the expected three years period of filling of the GIBE III reservoir lake water levels will be reduced significantly from 1.65 to 4 m above natural fluctuation levels. After filling is complete and if no water would be extracted from the Omo river downstream of the dam, normal river flow volumes would return to the lake, but it could take 12 years for the lake to return to its equilibrium level. Thus the impact of filling may last 15 years in total. The drop in water levels will move the shoreline of the lake significantly, particularly in the northern part of the lake where 2 components of the property are located

Extract from Mission Report: Acknowledgements – P6:

(estimated at 2-3 km minimum at a drop of 1.65 m). This significant drop in lake levels could result in increased salinity and in likely impacts on wildlife which depends on the riparian flood plains and wetland habitats along the lake's shore for food and breeding as well as on fish stocks as a result of the drying out of major fish spawning areas, such as Ferguson's Gulf and the delta of the Omo River).

- The current seasonal nature of inflows from the Omo River means that Lake Turkana water level naturally rises and falls. The dam will result in a loss of this seasonality in water inflow into the lake and is predicted to dampen the magnitude of this variation significantly (from 1.20 m down to 0.80 m) following dam construction. This constitutes a major change to both the riparian and lake ecosystems and the Omo River delta and is predicted to have important impact on fish stocks and wildlife species which depend on the floodplains of the Omo River and the wetlands along the lake's shore.
- The drop in lake water levels will likely be long term due to the expected fall of seasonal oscillations mentioned above and the cumulative impact of irrigation projects on the Omo River downstream of the dam. As mentioned above, a sugarcane development is already under construction and there are plans to convert 278,000 ha of land along the river to sugar plantations and other agricultural developments using irrigation. The African Development Bank study cites the Omo-Gibe basin master plan in which irrigation developments by 2024 would use 16% of the basin's water and calculates this would lead to a reduction in lake level of 8.4 m. This is a significant hydrological change to the lake.
- Gibe III is part of a system of dams which will impact the water inflow into Lake Turkana: Gibe I and Gibe II dams are already in operation upstream of Gibe III, although Gibe II is under repair due to a tunnel collapse. A dam also exists on the Turkwel River, which also flows into Lake Turkana. On the Omo River, Gibe IV and V are also planned, but few details of their design and operation are available. Simulations show that the cumulative impact of increasing the surface area of all the reservoirs will reduce the volume because of increased evaporation. Each reservoir will need to be filled, so reduced flow inputs to Lake Turkana and further reduction in seasonal variations in flow might continue for a much longer period than 15 years.

The mission therefore concluded based on the information available through the mission in Kenya that the potential and ascertained cumulative impacts of the GIBE III dam and related developments are highly likely to impact the Outstanding Universal Value of the property.

During the meeting with the Prime Minister, the mission was informed that the Government of Ethiopia had assured the Government of Kenya that the Gibe III dam would not have a long term impact on the water level of Lake Turkana, but that they had not been informed about the related irrigation projects and other developments. The Kenya National Environment Management Authority (NEMA) also informed the mission that they had never received a copy of the Gibe III EIA and that they were not aware of any environmental impact assessment which was done to assess the downstream impacts of the dam in Kenya, including on Lake Turkana. The mission also notes the very serious negative impacts that the dam and related projects are likely to have on the livelihoods of local communities living around Lake Turkana.

Oil exploration

The mission was informed that several oil exploration blocks have been attributed which cover Lake Turkana, including some parts of the property. The mission was further informed that the company to whom these blocks have been attributed, Tullow Oil, received the authorisation for oil exploration activities in all these blocks based on an EIA, which has not been submitted to the World Heritage Centre. The mission was

Extract from Mission Report: Acknowledgements – P7:

provided with a copy of the exploration licence for one of the blocks which overlaps with SNP and noted that the licence includes a provision that the company must collaborate with the management authority of SNP, Kenya Wildlife Service (KWS), to ensure the protection of the World Heritage property. The mission was further informed that neither KWS nor National Museums of Kenya (NMK), which is in charge of managing the fossils sites in the property, had been informed before the licence was attributed.

Representatives of Tullow Oil clarified to the mission team that for the moment only aerial seismic surveys have been undertaken and that seismic operations on the ground are currently planned and starting on the western shore only and the lake itself and therefore avoid the property. They also stated that further ground surveys on the eastern shore, where SNP is located, may not be necessary.

Impacts of the larger development vision for Northern Kenya

The mission notes that as part of its 2030 development vision, the government of Kenya in cooperation with the governments of Ethiopia, and South Sudan is planning a larger development which includes the Lamu Port Initiative, the planned Lamu Port Sudan Ethiopia Transport Corridor (LAPSET) and related developments (roads, railway, pipeline, power lines, wind farms, resorts, etc.). The mission considers that these projects will cause major changes in northern Kenya, and that the cumulative impacts could affect the property. The mission recommends that a Strategic Environmental Assessment (SEA) is undertaken which takes into account Lake Turkana and other potentially affected World Heritage properties.

Wildlife populations and pressure from poaching and livestock grazing

While the mission had no access to data on wildlife populations, it noted from observations during the field visit that wildlife populations seem to be impoverished and concentrated in the most secure areas of the property. This indicates also that poaching pressure is an important threat to the property. Certain flagship species such as reticulated giraffe and Grevy's zebra are reported to have disappeared from the property. The mission further noted fishing activities within the borders of the World Heritage property.

The mission was informed that at the time of creating the park, local pastoralists were guaranteed grazing and watering rights in the case of drought. The mission notes that grazing is currently permanently affecting the entire northern part of the park, resulting in overgrazing, trampling and an increase in shrub vegetation.

The mission concluded that livestock grazing, poaching and fishing activities are important management issues that need to be urgently addressed and need to be reflected in the new management plan. Consideration should also be given to the reintroduction of species which have disappeared, such as the reticulated giraffe and the Grevy's zebra.

Management issues

The mission acknowledges the challenges of managing the property due to its remoteness. The mission emphasizes the importance of involving local stakeholders, particularly pastoralists and fishermen and notes that NMK's knowledge regarding the cultural heritage of pastoralist communities. It considers that an increase in institutional cooperation between NMK and KWS would be important not only to address the many practical challenges, but also to ensure better protection of both fossil sites and wildlife and to address conservation issues and improve cooperation with local communities. The mission encourages KWS to ensure a permanent presence both in SINP, as well as in the northern part of SNP.

Extract from Mission Report: Acknowledgements – P8:

The mission was informed that a new management plan is under preparation and considers this an excellent opportunity to develop strategies to address main threats and management issues of the property. They note that it is important that the management plan is developed by the two management agencies KWS and NMK and addresses all three components of the property.

The mission concludes that the potential and ascertained cumulative impacts of the GIBE III dam and related developments are highly likely to impact the Outstanding Universal Value of the property and therefore considers that the property should be inscribed on the List of World Heritage in Danger, in accordance with paragraph 180 (b) of the Operational Guidelines.

The mission considers that the State Parties of Kenya and Ethiopia should urgently address together the question of the impacts on the Property of the Gibe III dam and related developments, and that a Strategic Environmental Assessment (SEA) should be conducted urgently to assess cumulative impacts of all developments impacting on the Omo river basin, Lake Turkana and the World Heritage site in order to identify appropriate corrective measures to ensure that the water level in Lake Turkana as well as a level of seasonal variation will be maintained which is sufficient to maintain the Outstanding Universal Value of the Property.

The mission further recalls the position of the World Heritage Committee that oil exploration is not in accordance with the World Heritage status and considers that the State Party of Kenya should urgently clarify the provision of the EIA licence on the protection of the World Heritage property, to ensure that no exploration can take place within the property, including the lake, when it would come to oil exploitation. They recommend that Tullow Oil subscribes to the no-go commitment already supported by ICMM and Shell.

The mission notes the significant impacts of poaching, fishing and livestock grazing on the property and considers that these issues that need to be addressed urgently and need to be reflected in the new management plan. They recommend that the following measures are taken to address these issues:

- a) Conduct a detailed census of key wildlife species to establish their status and develop a baseline to monitor their recovery;
- b) Strengthen the efficiency of law enforcement and surveillance based on the results of the MIST monitoring system which is being introduced in the property;
- c) Establish permanent presence of Kenya Wildlife Service staff in the northern part of Sibiloi National Park as well as on Central and South Island National Parks;
- d) Increase the rotation period for the Biodiversity Officer and the Community Warden to at least three years, given the vital importance of these posts in building long-term sustainable relations with local communities and in ensuring systematic monitoring within the property;
- e) Develop in close consultation with representatives of the local pastoralist communities a strategy to diminish grazing pressure in the property, including by identifying grazing areas outside the property and provide them with access to water; and
- f) Consider with the reintroduction of the Reticulated Giraffe and the use of Giraffe and Nile Crocodile as flagship species in the communication process with local communities.

Extract from Mission Report: Acknowledgements – P9:

The mission also requests Kenya Wildlife Service and National Museums of Kenya to ensure that the new management plan addresses all 3 components of the property and covers both the biodiversity and paleontological values in accordance to the Convention, and to submit the draft management plan to the World Heritage Centre for review.

The mission further recommends that a reflection is begun on re-designing the property, to include a larger portion of the lake as well as important fossil sites currently outside the property and to consider re-nominating the property under cultural criteria, as an important site for human evolution.

Extract from Mission Report: Acknowledgements – P11:

progress accomplished in the implementation of the corrective measures and recommendations of the mission, for examination by the World Heritage Committee at its 37th session in 2013;

Option proposed by IUCN;

11. ***Decides to inscribe the Dja Faunal Reserve (Cameroon) on the List of World Heritage in Danger;***
12. *Takes note of the proposals made by the mission concerning a draft Desired state of conservation, and requests the State Party to develop, in cooperation with the World Heritage Centre and IUCN, a proposal for the Desired state of conservation for the removal from the List of World Heritage in Danger based on the results of the ecological monitoring.*

3. Lake Turkana National Parks (Kenya) (N 801bis)

Year of inscription on the World Heritage List
1997

Criteria
(viii) (x)

Year(s) of inscription on the List of World Heritage in Danger
N/A

Previous Committee Decisions
See page + <http://whc.unesco.org/en/list/801/documents/>

International Assistance
Global amount granted to the property: USD 35,300
For details, see page <http://whc.unesco.org/en/list/801/assistance/>

UNESCO Extra-budgetary Funds
N/A

Previous monitoring missions
N/A

Factors affecting the property identified in previous reports
N/A

Illustrative material
See page <http://whc.unesco.org/en/list/801>

Current conservation problems

On 31 January 2012, a report was submitted by the State Party of Kenya in response to Decision **35 COM 7B.3**. In the report, the State Party expresses its concern about the potential impacts of the Gibe III dam on the property and notes that it is of the opinion that no adequate scientific proof has been provided by the State Party of Ethiopia that adequate mitigation measures have been taken and that this has to be addressed urgently to avoid irreversible damage to the property. The report further notes that this issue is of transboundary nature and that a solution has to be found together with the State Party of Ethiopia. On the same date, a report was also received from the State Party of Ethiopia, in

State of State of conservation of World Heritage properties
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WHC-12/36.COM/7B.Add, p. 10

Extract from Mission Report: Acknowledgements – P11:

which it notes that the Gibe III dam will not result in consumptive use of water, and hence water levels in Lake Turkana will return to normal once the reservoir is filled. It notes that irrigation development is not part of the Gibe III project. It concludes that all Environmental Impact Assessments (EIA) carried out indicate that the Gibe III dam will not have significant impacts on the environment and therefore it will not suspend the construction of the dam, as was requested by the World Heritage Committee. The State Party also transmitted electronic copies of EIA, including the additional study on downstream impacts.

From 14 to 22 March 2012, a joint World Heritage Centre/IUCN monitoring mission visited Sibiloi National Park (SNP) and South Island National Park (SINP) which are part of the property, and had discussions with various stakeholders and the Kenyan authorities, including a meeting with Prime Minister.

The mission report is available at <http://whc.unesco.org/en/sessions/36COM/documents>. The mission had only visited Kenya and at the time of preparation of this report, and the mission to Ethiopia has not yet been scheduled. The mission to Ethiopia will be important to update the information that the mission was able to collect in Kenya and to confirm its conclusions.

The mission looked at the following key conservation issues:

a) *Impact of the GIBE III dam and related issues*

The mission noted that the EIA submitted by Ethiopia does not assess any impacts beyond the Ethiopian territory and did not consider possible impacts on Lake Turkana. The documented public consultation process also did not include affected populations in Kenya. The mission further notes that the EIA only considers the impacts of the dam as a stand alone project, and does not include any reference to other related planned or on-going projects, such as downstream agricultural development projects which will use the water for irrigation. These irrigation projects are made possible because the dam will ensure a steady and constant flow of water in the Omo River, compared to the natural seasonal variation pattern currently in place. The World Heritage Centre and IUCN note that while the report of the State Party of Ethiopia asserts that irrigation development is not part of the Gibe III project, a sugar cane development is already being implemented, with infrastructure including irrigation canals currently under construction. Two additional dams are also already planned downstream of the Gibe III dam. At the time of preparation of this report, the official website of the Ethiopian electricity cooperation reports that construction of Gibe III is more than 50% completed.

In preparation of the mission, IUCN commissioned a review of the potential hydrological impacts of the proposed Gibe III dam on the Outstanding Universal Value (OUV) of Lake Turkana National Parks, prepared by Hydro-ecology Consulting Ltd, which looked at the different documents and studies currently available. Based on this review, the mission believes that the potential cumulative impacts on Lake Turkana of the Gibe II dam and the other related developments would be significant:

- (i) Modelling shows that over the expected three years period of filling of the GIBE III reservoir lake water levels will be reduced significantly from 1.65 to 4 m above natural fluctuation levels. After filling is complete and if no water would be extracted from the Omo river downstream of the dam, normal river flow volumes would return to the lake, but it could take 12 years for the lake to return to its equilibrium level. Thus the impact of filling may last 15 years in total. The drop in water levels will move the shoreline of the lake significantly, particularly in the northern part of the lake where two components of the property are located (estimated at 2-3 km minimum at a drop of 1.65 m). This significant drop in lake levels could result in increased salinity and in likely impacts on wildlife which depends on the riparian flood plains and wetland habitats along the lake's shore for food and breeding as well as on fish stocks as a result of the drying out of major fish spawning areas, such as Ferguson's Gulf and the delta of the Omo River).

Extract from Mission Report: Acknowledgements – P12:

- (ii) The current seasonal nature of inflows from the Omo River means that Lake Turkana water level naturally rises and falls. The dam will result in a loss of this seasonality in water inflow into the lake and is predicted to dampen the magnitude of this variation significantly (from 1.20 m down to 0.80 m) following dam construction. This constitutes a major change to both the riparian and lake ecosystems and the Omo River delta and is predicted to have important impact on fish stocks and wildlife species which depend on the floodplains of the Omo River and the wetlands along the lake's shore.
- (iii) The drop in lake water levels will likely be long term due to the expected fall of seasonal oscillations mentioned above and the cumulative impact of irrigation projects on the Omo River downstream of the dam. As mentioned above, the Kuraz sugar development is already under construction and there are plans to convert 278,000 ha of land along the river to sugar plantations and other agricultural developments using irrigation. The African Development Bank study cites the Omo-Gibe basin master plan in which irrigation developments by 2024 would use 16% of the basin's water and calculates this would lead to a reduction in lake level of 8.4 m. This is a significant hydrological change to the lake.
- (iv) Gibe III is part of a system of dams which will impact the water inflow into Lake Turkana: Gibe I and Gibe II dams are already in operation upstream of Gibe III, although Gibe II is under repair due to a tunnel collapse. A dam also exists on the Turkwel River, which also flows into Lake Turkana. On the Omo River, Gibe IV and V are also planned, but few details of their design and operation are available. Simulations show that the cumulative impact of increasing the surface area of all the reservoirs will reduce the volume because of increased evaporation. Each reservoir will need to be filled, so reduced flow inputs to Lake Turkana and further reduction in seasonal variations in flow might continue for a much longer period than 15 years.

The mission therefore concluded based on the information available through the mission in Kenya that the potential and ascertained cumulative impacts of the GIBE III dam and related developments are highly likely to impact the OUV of the property and that the conditions for inscribing the property on the List of World Heritage in Danger are met.

During the meeting with the Prime Minister, the mission was informed that the Government of Ethiopia had assured the Government of Kenya that the Gibe III dam would not have a long term impact on the water level of Lake Turkana, but that they had not been informed about the related irrigation projects and other developments. The Kenya National Environment Management Authority (NEMA) also informed the mission that they had never received a copy of the Gibe III EIA and that they were not aware of any EIA which was done to assess the downstream impacts of the dam in Kenya, including on Lake Turkana. The mission also notes the huge negative impacts that the dam and related projects are likely to have on the livelihoods of local communities living around Lake Turkana.

b) *Oil exploration*

The mission was informed that several oil exploration blocks have been attributed which cover Lake Turkana, including some parts of the property. The mission was further informed that the company to whom these blocks have been attributed, Tullow Oil, received the authorisation for oil exploration activities in all these blocks based on an EIA, which has not been submitted to the World Heritage Centre. The mission was provided with a copy of the exploration licence for one of the blocks which overlaps with SNP and noted that the licence includes a provision that the company must collaborate with the management authority of SNP, Kenya Wildlife Service (KWS), to ensure the protection of the World Heritage property. The mission was further informed that neither KWS nor National Museums of Kenya (NMK), which is in charge of managing the fossils sites in the property, had been informed before the licence was attributed.

Representatives of Tullow Oil clarified to the mission team that for the moment only aerial seismic surveys have been undertaken and that seismic operations on the ground are currently planned and starting on the western shore only and the lake itself and therefore

Extract from Mission Report: Acknowledgements – P13:

avoid the property. They also stated that further ground surveys on the eastern shore, where SNP is located, may not be necessary.

c) *Wildlife populations and pressure from poaching and livestock grazing*

While the mission had no access to data on wildlife populations, it noted from observations during the field visit that wildlife populations seem to be impoverished and concentrated in the most secure areas of the property. This indicates also that poaching pressure is an important threat to the property. Certain flagship species such as reticulated giraffe and Grevy's zebra are reported to have disappeared from the property. The mission further noted fishing activities within the borders of the World Heritage property.

The mission was informed that at the time of creating the park local pastoralists were guaranteed grazing and watering rights in the case of drought. The mission notes that grazing is currently permanently affecting the entire northern part of the park, resulting in overgrazing, trampling and an increase in shrub vegetation.

The mission concluded that livestock grazing, poaching and fishing activities are important management issues that need to be urgently addressed and need to be reflected in the new management plan. Consideration should also be given to the reintroduction of species which have disappeared, such as the reticulated giraffe and the Grevy's zebra.

d) *Impacts of the larger development vision for Northern Kenya*

The mission notes that as part of its 2030 development vision, the government of Kenya in cooperation with of the governments of Ethiopia, and South Sudan is planning a larger development which includes the Lamu Port Initiative, the planned Lamu Port Sudan Ethiopia Transport Corridor (LAPSET) and related developments (roads, railway, pipeline, power lines, wind farms, resorts, etc.). The mission considers that these projects will cause major changes in northern Kenya, and that the cumulative impacts could affect the property. The mission recommends that a Strategic Environmental Assessment (SEA) is undertaken which takes into account Lake Turkana and other potentially affected World Heritage properties.

d) *Management capacity of KWS and NMK*

The mission acknowledges the challenges of managing the property due to its remoteness. The mission emphasizes the importance of involving local stakeholders, particularly pastoralists and fishermen and notes that NMK's knowledge regarding the cultural heritage of pastoralist communities. It considers that an increase in institutional cooperation between NMK and KWS would be important not only to address the many practical challenges, but also to ensure better protection of both fossil sites and wildlife and to address conservation issues and improve cooperation with local communities. The mission encourages KWS to ensure a permanent presence both in SINP, as well as in the northern part of SNP.

The mission was informed that a new management plan is under preparation and considers this an excellent opportunity to develop strategies to address main threats and management issues of the property. They note that it is important that the management plan is developed by the two management agencies KWS and NMK and addresses all three components of the property.

e) *Design of the World Heritage site*

The mission noted that most of the lake itself is outside the borders of the World Heritage property although it is named Lake Turkana National Parks. Many important fossil sites are also outside the boundaries. The mission recommends that a reflection is begun on re-designing the site, to include a larger portion of the lake as well as important fossil sites currently outside the property, and to consider re-nominating the property under cultural criteria, as an important site for human evolution.

Extract from Mission Report: Acknowledgements – P14:

Conclusion

The World Heritage Centre and IUCN wish to draw the attention of the Committee on the fact that, based on the information gathered by the reactive monitoring mission to Kenya, the potential and ascertained cumulative impacts of the GIBE III dam and related developments are highly likely to impact the OUV of the property, and therefore recommend that the Committee inscribe the property on the List of World Heritage in Danger, in accordance with paragraph 180 (b) of the *Operational Guidelines*.

The World Heritage Centre and IUCN stress that the State Party of Kenya needs to urgently address the issue of cumulative impacts of Gibe III and related developments on Lake Turkana on a bilateral basis with the State Party of Ethiopia. They further note that a SEA should be conducted urgently to assess the cumulative impacts of all developments impacting on Omo River basin in order to make strategic choices on the management of water in the basin and to identify appropriate corrective measures to ensure that the water level in Lake Turkana, as well as a level of seasonal variation, will be maintained which is sufficient to maintain the OUV of the property. They recommend that the World Heritage Committee reiterates its request to the State Party of Ethiopia to halt the construction of Gibe III as well as other developments which will use the water of the Omo River for irrigation until the SEA is completed and the above mentioned measures are identified.

The World Heritage Centre and IUCN reiterate that oil exploration is not in accordance with World Heritage status and take note of the fact that so far no oil exploration activities have taken place within the property itself. They further consider that the State Party should urgently clarify the provision of the EIA licence on the protection of the World Heritage property, to ensure that no exploration can take place within the property. They further recommend that the World Heritage Committee call on Tullow Oil to subscribe to the no-go commitment already supported by the International Council on Mining and Metals (ICMM) and Shell.

The World Heritage Centre and IUCN note the significant impacts of poaching, fishing and livestock grazing on the property and highlight to the Committee that these issues that need to be urgently addressed and need to be reflected in the new management plan.

Draft Decision: 36 COM 7B.3

The World Heritage Committee,

1. *Having examined Document WHC-12/36.COM/7B.Add,*
2. *Recalling Decision 35 COM 7B.3, adopted at its 35th session (UNESCO, 2011),*
3. *Takes note of the results of the joint World Heritage Centre/IUCN monitoring mission undertaken to Kenya to assess the state of conservation of the property and in particular the impact of the GIBE III dam project and related developments;*
4. *Reiterates its utmost concern about the potential and ascertained cumulative impacts on Lake Turkana of the GIBE III dam, the related on-going and planned irrigation projects as well as the planned Gibe IV and V dams, and considers that these developments represent a clear potential threat to the Outstanding Universal Value of the property, in accordance with Paragraph 180 (b) of the Operational Guidelines;*
5. *Urges the State Party of Ethiopia to invite the joint World Heritage Centre/IUCN mission to review the impacts of the GIBE III dam on the Outstanding Universal Value of Lake Turkana, as was done by the State Party of Kenya;*

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Extract from Mission Report: Acknowledgements – P15:

6. Also urges the State Parties of Kenya and Ethiopia to address this issue on a bilateral basis and conduct a Strategic Environmental Assessment (SEA) to assess the cumulative impacts of all developments impacting on the Lake Turkana basin in order to identify appropriate corrective measures to ensure that the water level in Lake Turkana, as well as a level of seasonal variation be maintained, which is sufficient to maintain the Outstanding Universal Value of the property;
7. Further reiterates its request to the State Party of Ethiopia to immediately halt all construction on the GIBE III dam and related irrigation projects until the SEA is completed and appropriate corrective measures have been identified and implemented;
8. Takes note that oil exploration licences have been granted for exploration blocks which cover part of the property, but that so far no oil exploration activities have been carried out or are planned within the property, and requests the State Party of Kenya to clarify the provision already included within the oil exploration licence on the protection of the World Heritage property, to ensure that no exploration can take place within the property;
9. Calls on Tullow Oil to subscribe to the no-go commitment, already supported by the International Council on Mining and Metals (ICMM) and Shell, not to explore or exploit oil or minerals inside World Heritage properties;
10. Notes the significant impacts of poaching, fishing and livestock grazing on the property reported by the World Heritage Centre / IUCN monitoring mission, and requests the State Party to implement the recommendations of the mission to address these and other management issues, in particular:
 - a) Conduct a detailed census of key wildlife species to establish their status and develop a baseline to monitor their recovery,
 - b) Strengthen the efficiency of law enforcement and surveillance based on the results of the MIST monitoring system which is being introduced in the property,
 - c) Establish permanent presence of Kenya Wildlife Service staff in the northern part of Sibiloi National Park as well as on Central and South Island National Parks,
 - d) Develop in close consultation with representatives of the local pastoralist communities a strategy to diminish grazing pressure in the property, including by identifying grazing areas outside the property and provide them with access to water,
 - e) Assess the feasibility of reintroducing flagship species which have disappeared from the property such as reticulated giraffe and Grevy's zebra;
11. Also requests Kenya Wildlife Service and National Museums of Kenya to ensure that the new management plan addresses all three components of the property and covers both the biodiversity and paleontological values;
12. Recommends that a reflection is begun on re-designing the property, to include a larger portion of the lake as well as important fossil sites currently outside the property, and to consider re-nominating the property under cultural criteria, as an important site for human evolution;
13. Further requests the State Party of Kenya in cooperation with the State Party of Ethiopia to develop based on the corrective measures identified through the SEA, a timeframe and costed action plan for their implementation as well as a draft Desired state of conservation for its removal from the List of World Heritage in Danger;

Extract from Mission Report: Acknowledgements – P16:

14. Requests furthermore the States Parties of Ethiopia and Kenya to submit to the World Heritage Centre, by **1 February 2013**, a report on the implementation of the above mentioned requested actions for consideration by the World Heritage Committee at its 37th session in 2013;
15. **Decides to inscribe Lake Turkana National Parks (Kenya) on the List of World Heritage in Danger.**

5. Selous Game Reserve (United Republic of Tanzania) (N 199)

Year of inscription on the World Heritage List
1982

Criteria
(ix) (x)

Year(s) of inscription on the List of World Heritage in Danger
N/A

Previous Committee Decisions
See page <http://whc.unesco.org/en/list/199/documents/>

International Assistance
Global amount granted to the property: USD 60,480
For details, see page <http://whc.unesco.org/en/list/199/assistance/>

UNESCO extra-budgetary Funds
N/A

Previous monitoring missions
November 2007 and November 2008: World Heritage Centre / IUCN monitoring missions

Factors affecting the property identified in previous reports

- a) Poaching;
- b) Reduction of elephant populations;
- c) Insufficient funding;
- d) Mineral and hydrocarbon prospecting and mining;
- e) Tourism management and development;
- f) Potential and proposed dam development.

Illustrative material
See page <http://whc.unesco.org/en/list/199>

Current conservation issues

On 2 February 2012, the State Party submitted a concise report on the state of conservation of the property. The report provides an overview of the progress achieved in the implementation of the Committee's decision adopted at its 35th session (UNESCO, 2011).

- a) *Finalize the creation of the autonomous Wildlife Authority and reinstate the Revenue Retention Scheme*

The State Party notes that a consulting firm was engaged to facilitate the establishment of the Tanzania Wildlife Authority (TAWA). This process is now in its final stages. The State Party notes that once TAWA becomes operational, the revenue retention scheme will automatically be reinstated. No timeline for the finalization of the establishment of TAWA is provided.

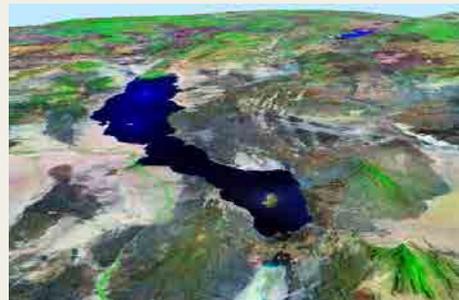
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Annex 12: Presentation by the Consultant to the UNESCO Stakeholder Mission Workshop in Nairobi, March 2012



The Jade Sea



3-D Sat image (USGS)

**UNESCO World Heritage Sites, National Parks,
and Lake Turkana Hydrology**

Dr Sean Avery

Water Resource Associates (www.watres.com)

Dr Sean Avery - UNESCO World Heritage
Mission, Nairobi, March 2012

1

Acknowledgements

- African Development Bank
- UNEP
- African Studies Centre, University of Oxford supporting further studies

Dr Sean Avery - UNESCO World Heritage
Mission, Nairobi, March 2012

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Annex 13: Imre Loeffler Lecture to EA Wildlife Society, June 2012 – Announcement

(Note that the year was 2012, not 2011).

Imre Loeffler Lecture

Lake Turkana

by
Dr. Sean Avery

**Wednesday, 20th June 2011
in the Ballroom**



Dr. Sean Avery, a gazette, Qualified Water Resource Professional (Engineer & Hydrologist) with over 30 years African water resources experience, will talk about Lake Turkana and its islands, its fascinating dramatic Climate change history, its contemporary hydrology and the potential changes to the lake. For many years Dr. Avery has been exploring northern Kenya with his family and friends, and since 2009 he has been engaged in detailed consultancy to an initiative of the African Development Bank

Charges

Lecture & Canapes

Members - 1000/-
Members' Guests - 1000/-

Lecture & Dinner

Members - 2200/-
Members' Guests - 2200/-

Programme

6:30 p.m - Bar available
7:00 p.m - Lecture starts

Annex 14: Imre Loeffler Lecture to EA Wildlife Society, June 2012 – Sample slides



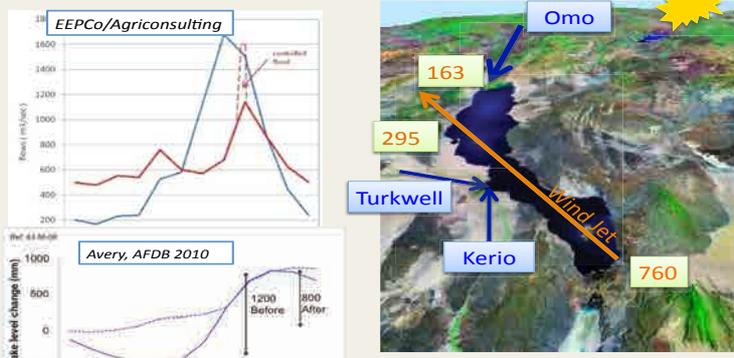
Lake Turkana
Dr Sean Avery
Water Resource Associates
(www.watres.com)



Dr Sean Avery – Imre Loeffler Lecture
 Nairobi, June 2012

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Key environmental factors



EEPCo/Agriconsulting

Avery, AFDB 2010

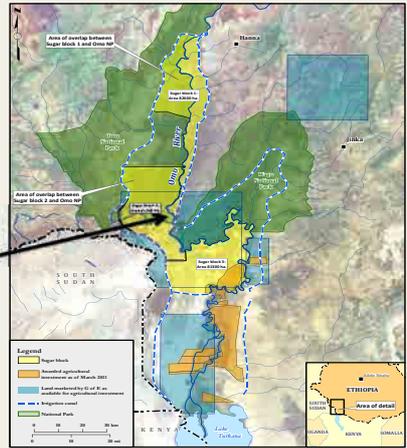
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Lower Omo Agricultural Development

Lower Omo WH Site Fossil Beds

Map Source: Human Rights Watch



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The Omo River – Feb 2012 Below irrigation offtake



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Things to ponder...

- Wildlife threats, extensive human encroachment into protected areas (see UNESCO 2012)
- UNESCO request to stop Gibe III
- FoLT objections to AFDB
- Human Rights Watch Report on Lower Omo
- Proper scientific understanding of the impacts of hydrological change on the lake
- Dialogue on trans-boundary change through competent feasibility studies and ESIs (prior to project commencement, not after)
- Sustainable population / reduced Food Aid dependence

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Acknowledgements

- Family & safari friends in Kenya
- African Development Bank, Tunis
- African Studies Centre, University of Oxford
- EAWLS



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Annex 15: Friends of Lake Turkana Press Release July 13th 2012

PRESS RELEASE

For immediate release

World Bank Damns Lake Turkana by Approving Gibe III Power Line

Nairobi - 13 July 2012 - On Thursday, 12 July 2012, the World Bank shafted its own Safeguard Policies and effectively doomed Lake Turkana by approving the Eastern Electricity Highway Project connecting Ethiopia's electrical grid with Kenya's. The Bank has committed to fund the 1,000 km transmission line from Ethiopia to Kenya via a credit line.

Considering that most of the electricity that Ethiopia will export to Kenya will come from Africa's most destructive hydropower dam, Gibe III Dam, which the World Bank itself withdrew funding for saying it was against their Safeguard Policies, this approval is equal to smearing mud in the face of these same policies.

Ms. Ikal Angelei, founder of the Friends of Lake Turkana, an activist group that has been fighting the Gibe III Dam since 2008, felt betrayed by the organization that she lobbied until they withdrew funding for building the dam. "The World Bank stood by its principles when it refused to fund the dam in the absence of concrete measures to uphold the rights of indigenous peoples and address serious environmental concerns," she said, "Now it has stamped on those same principles by funding Gibe III through the back door."

The Gibe III Dam is considered Africa's most destructive dam project, threatening the food security and local livelihoods of at least half a million people in the Lower Omo Valley and along the shores of Kenya's Lake Turkana. The project has been in violation of Ethiopia's laws on environmental protection and procurement practices. Although the dam will cut off the main water supply for Lake Turkana for years while the reservoir fills, Ethiopia continues to maintain that the dam will have no negative impacts on the Lake. Ethiopia has done no scientific analysis on the impacts of the dam on the Lake.

Gibe III has always been justified as producing electricity for domestic consumption and for export. Official East African Power Pool (EAPP) documents list only five projects being developed in Ethiopia for the power pool (all large hydropower dams); only Gibe III will be online by the time the transmission line is complete. This means that, at this time, the transmission line would not be viable without Gibe III, and hence, Gibe III is indeed an Associated Facility of the power pool. Exporting electricity to Kenya has always been presented as part of the Gibe III Dam's rationale.

By approving this project, the World Bank in effect deviously endorses the building of Gibe III, thus placing the lives of more 500,000 people on the line and damning perhaps the only significant natural life-support system in the dry Omo-Turkana ecosystem.

Lake Turkana is the largest permanent desert lake in the world, and a profoundly important oasis in a harsh and unforgiving land. Nearly 90% of the lake's inflow is from the Omo River which Gibe III is damming. Gibe III is projected to result in a drop of 7-10 meters in the lake's depth in the first five years alone (without considering the impacts of climate change). Resulting changes in the chemistry and sediment levels of the river threaten the region's tremendous biodiversity, including large populations of Nile crocodiles, hippopotamus, and over 40 different species of fish and snakes.

The EAPP is hugely dependent on hydropower. Presentations by EAPP officials list additional power projects for a total of 12,070 megawatts, of which all but 300 megawatts are supposed to be generated by hydropower plants. This one-sided focus will massively increase the climate vulnerability of the whole region.

Since droughts and floods are expected to become more frequent and intense under climate change (including in the Horn of Africa), the Director of the International Monetary Fund's Africa Department recommended in August 2011 that governments "work to minimize a very significant dependence on

hydropower in East Africa.” The World Bank’s own ESMAP suggested in January 2011 that for heavily hydro-dependent countries “an adaptation response [to climate change] may require a policy decision to diversify away from hydropower.” Oddly, the World Bank admits that it did not evaluate the transmission line for climate risks.

The Friends of Lake Turkana lobby is now calling on the World Bank to cancel its support for this transmission line that is a clear endorsement of one of the most dangerous development projects in the world.

Friends of Lake Turkana (FoLT) is a community trust interested in the survival and conservation of Lake Turkana, its ecosystem and its cultural diversity. *For More information go to www.friendsoflaketurkana.org*

For More Information, email info@friendsoflaketurkana.org

See the [International Monetary Fund’s Africa Department recommendations here](#)

See also an assessment of the [Impacts of Gibe III on Lake Turkana](#) (PDF)

Read the [World Bank's announcement here](#)

Read an update with more information about the decision at [International Rivers](#)

Go to <http://friendsoflaketurkana.org/what-we-do/gibe-iii-campaign> to learn about Gibe III

Friends of Lake Turkana Phones: +254 20 268 5120 and +254 712 142 901

Annex 16: Friends of Lake Turkana Lodwar Workshop, October 2012

The FoLT invitation is attached on two sheets below.



14th September, 2012

Sean Avery
Nairobi

Dear Dr Avery

RE: Workshop on “Integrating Environmental Governance, Land and Socio-Cultural Rights”

Friends of Lake Turkana (FoLT) has the pleasure of inviting you to the above referenced workshop that will be held between Monday 1st and Tuesday, 2nd October 2012 at Anne Nanjala Resource Center, Lodwar. The workshop is aimed at highlighting and enriching the knowledge, policy and community awareness gaps, opportunities and threats, and their impacts on environment, land and socio-cultural aspects especially with the recent interests in the region focussing on oil, gas, resort cities, regional transport network from Lamu to South Sudan as well as the pipeline from South Sudan.

We would like you to share with us and the other participants in a panel discussion on **“Current Status of Dam Development and Implications for People and the Environment”**

FoLT is a grassroots organization whose mission is to foster social, economic and environmental justice in the Lake Turkana Basin. With its focus on Environmental Justice, Resource Governance and Community Rights, FoLT is committed to promote and advocate for environmental governance, protection of land and cultural rights, by increasing communities' participation in governance within the Lake Turkana basin, which covers Turkana and Marsabit County within Kenya, and South Ethiopia.

FoLT's goal is:

- ⤴ Protect and conserve Lake Turkana, the Lake Turkana Basin and its environment.
- ⤴ Advocate for the rights of the Lake Turkana Basin communities,
- ⤴ Increase the participation of communities in environmental protection policy formulation, sustainable management and wise use of natural resources,
- ⤴ Lobby for increased participation of communities in the development and governance of their resources
- ⤴ Work in solidarity with indigenous communities and groups seeking to advance indigenous rights Work in solidarity with civil society groups seeking to advance social, economic and environmental rights.

We highly appreciate your presence, participation and insights at the workshop. We consider your participation to be of fundamental importance to the development of frameworks to enable stakeholders engagement at local, national, regional and international level.

P.O Box 565-30500 Lodwar, Kenya. Tel: +254 2(0) 2685120, +254 (712) 142901.
Website: www.friendsoflaketurkana.org Email: info@friendsoflaketurkana.org

Participants coming from outside Turkana will be booked at St Theresa Resource Center and Bethany Center. Check-in on Sunday, 30th September 2012 and departure on Tuesday 2nd October (Unless otherwise communicated)

While the mode of the workshops is panel discussions, we would like to request you to produce a paper on your presentation.

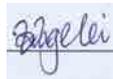
Attached kindly find the concept note and agenda for the workshop

Kindly confirm your participation by email to: ikal@friendsoflaketurkana.org/ friendsoflaketurkana@gmail.org; or by telephone to: 254-712-142901 or 254-20-2685120

Looking forward to hearing from you and to seeing you at the workshop.

We are at your disposal for any questions and we look forward to your response.

Kind regards,



IKAL ANG'ELEI
DIRECTOR

P.O Box 565-30500 Lodwar, Kenya. Tel: +254 2(0) 2685120, +254 (712) 142901.
Website: www.friendsoflaketurkana.org Email: info@friendsoflaketurkana.org

Annex 17: Satellite-based lake products

The Global Reservoir and Lake Monitoring program - Additional satellite-based lake level products (Birkett, Pers. Comm.)

(Extracted from Avery, 2010)

The US Dept. of Agriculture, Foreign Agricultural Service (USDA-FAS) together with the National Aeronautics and Space Administration (NASA) are funding a program that aims to monitor in near real time the changing water levels of the world's largest lakes. The database currently contains around 75 lakes with products based on the NASA/CNES Topex/Poseidon and Jason-1 satellite missions (1992 - 2008), and the Naval Research Lab's (NRL) GFO mission (2000 - 2008).

The Jason-2 (or OSTM The Ocean Surface Topography Mission) satellite was launched in June 2008 and is the follow on mission to Topex/Poseidon and Jason-1. It is a joint venture between NASA, CNES, NOAA and EUMETSAT with science objectives that focus on the ocean, coastal regions and inland waters.

Utilizing radar altimetry the Jason-2/OSTM mission will continue the lake and reservoir water level observations through the 2008 - 2014 timeframe. The first preliminary OSTM products for the largest of the lakes were uploaded on October 1st, 2009 and operational procedures will update these weekly. Product revisions and additional lakes will continue to be uploaded through 2009 and 2010, as research and additional satellite data sets are incorporated into the program.

The GRLM Reservoir/Lake web site can be found at:
http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/index.cfm

Additional information on the Jason-2/OSTM mission can be found at:
<http://sealevel.jpl.nasa.gov/mission/ostm.html>
<http://smc.cnes.fr/JASON2/index.htm>
<http://www.osd.noaa.gov/ostm/>
http://www.eumetsat.int/HOME/Main/What_We_Do/Satellites/Jason/index.htm

Funding Sources:
USDA/FAS Office of Global Analysis for implementation and operational tasks
NASA research grants NNS06AA15G, NNX08AM72G, NNX08AT88G and NASA/JPL sub-award 4-33637(UMD) for radar altimetry and product validation.

Data Sources:
NASA/PODAAC, CNES/AVISO, F-PAC, and LEGOS, and NOAA/NODC for provision of the TOPEX/Poseidon, Jason-1, Jason-2/OSTM and GFO satellite data sets.

Dr. Charon M. Birkett
Earth System Science Interdisciplinary Center (ESSIC)
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Annex 18: Notes on Soil Map for Turkana area

(Extracted from Avery, 2010)

Soil descriptions are given as follows, working in a clockwise direction around the lake (Sombroek *et al*, Kenya Soil Survey):

- **North-Eastern Lake Shore:** This area includes the Sibiloi National Park and its famous fossil beds and petrified forest. The area is accessible by road from North Horr, which is on the edge of the Chalbi Desert.
 - W2: Badlands developed on various older lacustrine and volcanic rocks, excessively drained soils.
 - L6: Plateaus and high-level structural plains away from the lake, flat to gently undulating, well drained soils developed on Tertiary igneous rocks
 - Hs1: Step-faulted scarps of the Rift Valley, slopes variable, well drained soils.

- **Eastern Lake Shore:** This shoreline is less accessible by road.
 - H9: Soils developed on undifferentiated Tertiary volcanic rocks.
 - L6: Described above.

- **South-Eastern Lake Shore (Loiyangalani):** This is the most accessible part of the eastern lake shore, and Loiyangalani is the most important centre on the eastern side of Lake Turkana, with a mission, tourist hotel, and an increasing settlement.
 - P11: Lacustrine Plains: Imperfectly drained soils developed on sediments from pyroclastic rocks and olivine basalts.
 - F8: Footslopes, well drained soils developed from colluvium from various volcanic rocks (mainly basalts)
 - R7: Volcanic footridges (dissected lower slopes of older volcanoes), with well drained soils.
 - M7: Well-drained soils developed on olivine basalts and ashes of major older volcanoes. The volcano in question is Mt Kulal, which looms over Loiyangalani and the lake.
 - Hs1: Step-faulted scarp, described above, running along the shore to the south end of the lake.

- **South End of the Lake: (The Barrier Volcanic Complex):** This area is very inaccessible.
 - Hs1: Scarp described above, running along both south-eastern and south-western shores.
 - M1: Mountains and major scarps with steep slopes and excessively drained soils. The Barrier Volcanic Complex is an E-W trending whale-back ridge, 20 km in length and 15 km wide, which forms a natural dam blocking Lake Turkana from the Suguta Valley to the south (ref British Geological Survey). Interestingly, the Suguta Valley is almost 100 metres below the water level in Lake Turkana. In spite of this hydraulic gradient, seepages from the lake into the Suguta Valley are low (British Geological Survey)
 - South western shore: This area is also inaccessible by road.
 - Hs1: The scarp described above, continues along the shoreline, rising to the Loru Plateau to the south-west.
 - H9: Hills and minor scarps, well-drained soils developed on volcanic rocks.
 - Ux7: Uplands, undifferentiated levels, undulating to rolling, soils developed on volcanic rocks.
 - P13: Lacustrine Plains, soils developed on sediments.
 - A8: Floodplains, soils developed on sediments. The flood plain is the Turkwel and

Kerio Rivers, which drain into the lake.

- *Western Shore:* There is good road access to Lodwar in this area, and the road continues north up to Todenyang. Lodwar is the most important centre on the western lake shore.
 - D1 + PI3: Dunes, Lacustrine Plain. This is the area between Eliye Springs and Ferguson's Gulf. Eliye Springs has sandy beaches as one would see on the Kenya Coast.
 - Y5: Piedmont Plains, nearly flat.
 - W2: badlands, as seen across the lake from here.
 - DI + PI3: More dunes and plains are found to the north near Todenyang. Further back from the lake, the topography rises to hills.

- *Northern End:* This comprises the Omo delta, much of which is within Ethiopia. The delta is being formed through the deposition of sediments carried by the Omo River from the Ethiopian highlands.

Annex 19: Satellite imagery interpretation by Nicholas Ngece

(Source: Ngece, 2010) (Extracted from Avery, 2010)

The specific zones studied by Ngece are shown “boxed” in Figure 5. Tabulations for 1973 and 2008 have been reproduced in Table 1 below, and a trend analysis has been added. Note the following:

1. All woodland areas have diminished.
2. The figures for the Omo delta cannot be directly compared with the other “boxes” as they reflect an increase in delta area as a result in falling lake level over the period studied.
3. The fall in lake level over the period studied is evident from the reduced water area apparent for the Box 3 and 4 data.
4. The alien plant *Prosopis juliflora* invaded the “Box 4” zone at some point between 2001 and 2008. This alien species is extensive in Baringo District and is found throughout northern Kenya. The species is said to have arrived in Kenya in the 1980s. The plant is native to Mexico.

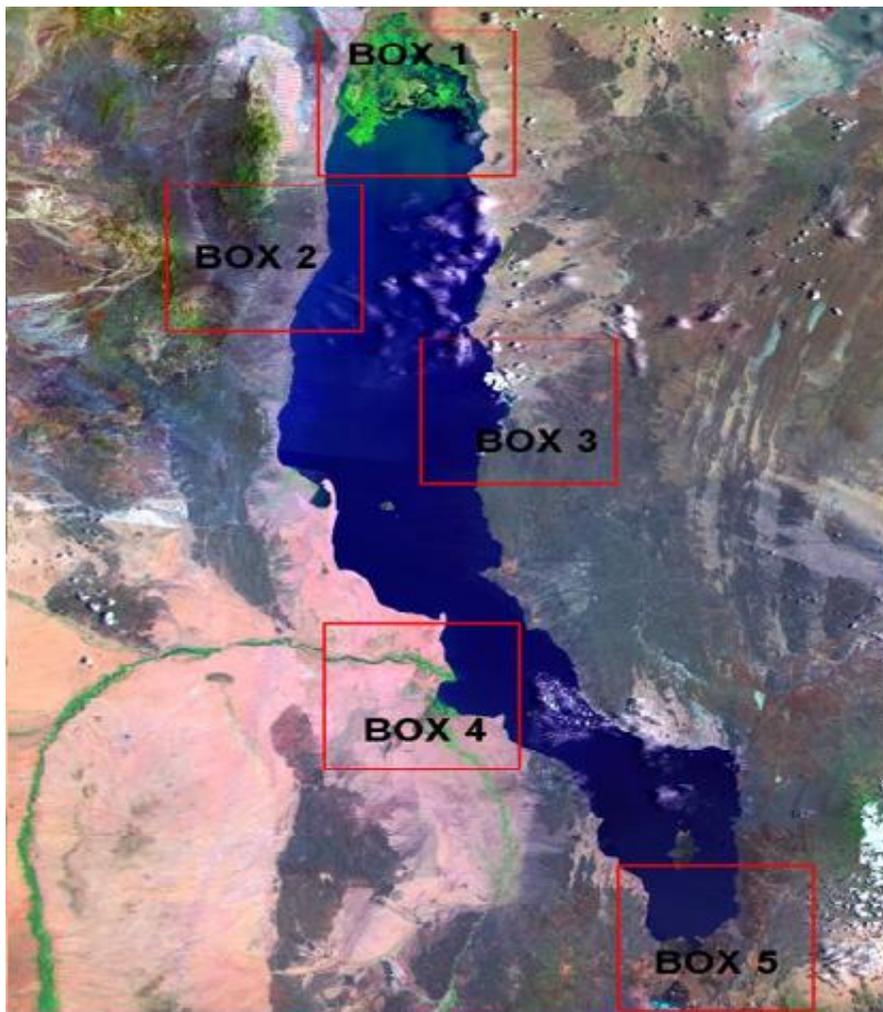


Figure 5: Zones studied by Ngece (Ngece, 2010)

Table 1: Vegetation coverage in selected area, and trends

(1973 and 2008 columns abstracted from Ngece, 2010)

	1973 hectares	2008 hectares	Trend Since 1973	Trend Since 1973
Box 1: Omo Delta (1)				
Water	99,837	53,767	54%	Fall
Woodland	14,906	17,682	119%	Rise
Closed shrub	30,723	26,148	85%	Fall
Sparse shrubs	9,841	15,706	160%	Rise
Grassland	7,516	18,497	246%	Rise
Swampy grassland	2,048	33,152	1619%	Rise
Bare ground	551	443	80%	Fall
Box 2: Lokitaung				
Water	37,720	38,056	101%	Rise
Woodland	40,848	38,274	94%	Fall
Closed shrub	68,978	1,295	2%	Fall
Sparse shrubs	15,557	14,062	90%	Fall
Grassland	812	2,757	340%	Rise
Swampy grassland	0	0	-	
Bare ground	1,484	1,295	87%	Fall
Box 3: Koobi Fora				
Water	61,382	60,340	98%	Fall
Woodland	695	0	-	Fall
Closed shrub	92,700	68,384	74%	Fall
Sparse shrubs	6,694	36,675	548%	Rise
Grassland	0	0	-	-
Swampy grassland	0	0	-	-
Bare ground	3,927	0	0%	Fall
Box 4: Turkwel/Kerio deltas				
Water	49,676	43,213	87%	Fall
Woodland	21,643	9,397	43%	Fall
Closed shrub	5,761	11,086	192%	Rise
Sparse shrubs	85,456	48,456	57%	Fall
Grassland	1	48,576	>1000%	Rise
Bare ground	2,860	2,063	72%	Fall
Prosopis	1	1,895	>1000%	Rise
Box 5: South end				
Water	37,947	37,884	100%	Fall
Woodland	0	1,542	>1000%	Rise
Closed shrub	62,127	50,729	82%	Fall
Sparse shrubs	62,392	73,366	118%	Rise
Grassland	397	322	81%	Fall
Bare ground	2,241	1,506	67%	Fall

Source: Ngece, 2010

Note(1): Lake level fell from 1973-2008, hence land area of Omo delta increased