Project Update: March 2018

This is the first comprehensive study on the status of the Nile crocodiles (*Crocodylus niloticus*) and their habitats conducted along the Kerio River and Lake Kamnarok, the major habitats for Nile crocodiles in Kerio Valley-Kenya. The study aims to help conserve Nile crocodile habitats, understand Human Crocodile Conflicts (HCC), assess Knowledge, Attitudes & Perceptions (KAP) towards crocodiles and educate local people how to adopt measures to sustainably use resources & conserve the remaining habitats and ecosystems in Kerio Valley.

Desk-top review of available data on Lake Kamnarok to describe anthropogenic activities and impacts on wildlife.

Information was obtained from grey literature including newsletters, reports, technical notes, internet forums, blogs, video sharing sites (YouTube) and social networking platforms (Facebook).

The following information was gathered;

1. The Lake Kamnarok is an ox-bow Lake lying between (0° - 38°N) and (35° - 37° E) at the base of Kerio Valley in Kenya.
2. The Kerio Valley lies in the Great Rift Valley between the Tugen Hills and the Elgeyo escarpment at an elevation of 1,000 m and is some 80 km long by 10 km wide (at its widest), through which the Kerio River flows.
3. The name ''Kam-narok'' originated from the word *narok*, which is a species of water plant that was widely found in the Lake in the early stages of the lake's formation.
4. Initially, the lake was 1 km² in size and was in existence before 1961. The flood rains of that year (1961) led to its enlargement to approximately 13.5 km².
5. The lake was gazetted in 1984 and it saw the creation of the Lake Kamnarok Game Reserve, which is the home of over 500 elephants.
6. In the early 1990s, Lake Kamnarok was a vibrant water body; flourishing with abundant biodiversity and the Nile crocodile population was at pristine levels of abundance (over 25,000); -the highest concentration of Nile crocodiles in Africa after Lake Chad hence the name "*The Lake with one thousand and one crocodiles".*
7. However, within a span of less than 10 years, human encroachment and farming activities in the area threatened the lake's existence.
8. Particularly, illicit destruction of indigenous forests in major catchment area in Elgeyo-Marakwet County (Embobut forest) and Baringo County (Tugen hills) led to land modifications causing seasonal changes of the Kerio River riparian ecosystem and the desiccation of the lake.

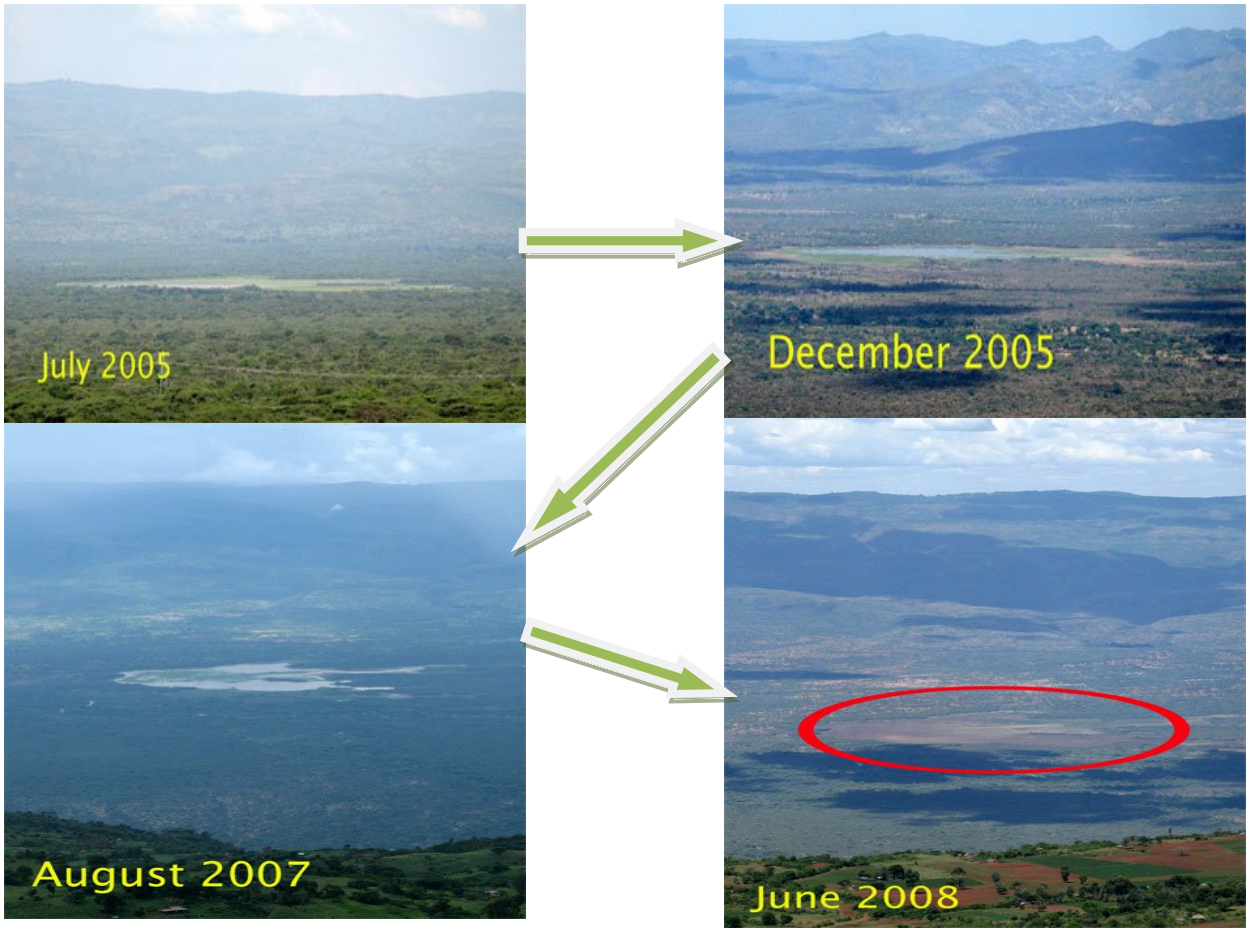
The destruction of the lake's catchment has resulted in the following effects to the Game Reserve despite its gazzetment;

1. Massive soil erosion in the area i.e. deep gullies formed spilling the lake's waters.
2. Massive levels of soil erosion/siltation in the Kerio River, its tributaries and the lake.
3. Movement of Nile crocodiles in search for suitable habitats

The reasons for the death of the lake included;

1. The uncontrolled burning of charcoal and tree felling in the 21,933.9 ha Embobut forest and the Tugen hills which resulted to the degradation of the lake's catchment.
2. Human encroachment e.g. farming activities, water diversion for agriculture and overgrazing inside the Game Reserve.
3. The rapid dehydration of Kerio River, which is the main inlet for the lake, as a result of the drought, was a second contributing factor.
4. The drought of 2007-2008; the lake dried up and despite subsequent rains, it never recovered.
5. The inadequate participation of the surrounding community in conservation efforts such as the building of gabions also contributed to the demise of the Lake.
6. Finally, hyacinth slowly choked life out of Lake Kamnarok as reported by Daily Nation Media-Kenya.(*http://www.nation.co.ke/video/news/4146788-4187228-gxr2ayz/index.html)*

The following photos describe the rapid reduction and drying of once famous Lake Kamnarok in Kerio Valley.



Above photos: Environmental degradation, habitat/catchment destruction, soil erosion and siltation ate up the fragile ecosystem and killed the lake, which provided water for 500 elephants and home to more than 20,000 Nile crocodiles.

Herd of livestock grazing inside Lake Kamnarok Game Reserve

Farming taking place & encroachment inside Lake Kamnarok Game Reserve

Massive levels of soil erosion & siltation that takes place in the Lake Kamnarok

The Wrath of Nature: Drying of Lake Kamnarok in Kerio Valley and Impacts on Wildlife

Pushed by human activities to the extent of its resilient threshold, the Lake Kamnarok dried in 2015. Those who witnessed the lake's final stages of desiccation recall the scenery as devastating. The once famous lake turned into an open field where goats, sheep, donkeys and cows grazed and Nile crocodile carcasses were scattered everywhere and at various stages of decomposition.

The following photos describe the impacts of the drying of Lake Kamnarok on the Nile crocodiles.

Carcasses of Nile crocodiles at various stages of decomposition

The Nile crocodiles were not the only wildlife affected by the drying of Lake Kamnarok. Even the Africa's elephants faced the wrath of nature. In February, 2017, a herd of elephants from Rimoi Game Reserve in Elgeyo Marakwet County flocked into the drying Lake Kamnarok in Baringo County looking for water. Three elephant calves got stuck in the mud at the drying Lake.

In the photos above (Courtesy of Joseph Kangogo), elephants try to pull a calf from the muddy Lake (Left) & Kenya Wildlife Service officers rescues a stuck elephant calf (Right).

Greatly impacted; Suffering in Silence: Amphibian, Avian & Invertebrate diversity

As a wetland ecosystem, the lake supported numerous amphibians, avian and invertebrate diversity which suffered greatly with this unfolding of ecological disaster. Since its gazzetment in the year 1984, biodiversity documentation in Lake Kamnarok Game Reserve has not been done. There is no information about what biological species exist and what we could be missing with increasing threats. To make conditions worse, water management in the Kerio Valley has been, and continues to be focused on maximizing agricultural productivity with much less regard for how it affects biodiversity.

There is need for conservation status of biodiversity in and around Lake Kamnarok Game Reserve to document biodiversity that exist in the reserve.

The biodiversity documentation will help;

1) Ensure that a better understanding about Lake Kamnarok, its biodiversity, the threats they face and recognitions as a significant wetland ecosystem in Kerio Valley.
2) Help upgrade the quality of public information available to residents living along the Kerio River Basin and the general public on important aspects of conserving Lake Kamnarok.
3) Impart awareness of the importance of Lake Kamnarok as an economic resource and the benefits of its conservation through sustainable utilization.
4) Raise community awareness on conservation of biodiversity and educate the local community regarding the significance of conservation

Assessment and Identification of Nile crocodile habitats/status in Kerio Valley

The Nile crocodile habitats were assessed along the Kerio River riparian ecosystem from Cheploch gorge to Lake Kamnarok. Other evidence such as the presence of Nile crocodile tracts, nest mounds etc. were also monitored. To identify dispersal events, we conducted visits to community dams and along small tributaries of Kerio River and along river beds between localities where Nile crocodiles are known to occur.

The following was achieved;

1. Identification of Nile crocodile habitats and regional research priorities.
2. Sections of Kerio River with concentrations of Nile crocodiles were identified and recorded using GPS.
3. The Nile crocodile nesting places, distribution, abundance and survival was noted.
4. Measures to adopt to conserve the Nile crocodile habitats were formulated.
5. The identified habitats/ecosystems are the focus of the project activities where we aim to devote time and effort in the restoration and conservation.

The activities undertaken provided clear information of the Nile crocodiles in Kerio Valley and the status of their habitats. Nile crocodiles currently favour some habitats in Kerio Valley i.e. along some sections of Kerio River and remaining habitats in Lake Kamnarok and community dams. Presently, most of these habitats are cleared, altered and under pressure by human activities. This study provided a clear perspective on where Nile crocodile concentrations occur (especially outside the Lake Kamnarok Game Reserve) and identification of sites where crocodiles are likely to continue to survive given some assistance with awareness and protection to the community in these areas.

Cheploch gorge, Nile crocodile habitats in Kerio Valley-Kenya. The gorge is a recreational site where the daring Kerio divers plunge into the gorge.

Habitats such as Cheploch gorge exhibited an increase in Nile crocodile population abundance. In contrast, localities such as Lake Kamnarok reported a significant reduction in abundance values. In total, 4 critical habitats with the most optimal conditions for long-term conservation and maintenance of *C. niloticus* populations were identified for conservation priority (two in Baringo County and two covering both Baringo County and Elgeyo Marakwet County) where there is need to conserve/research/monitor and/or generate management actions. Habitat conservation of this species is critical, which implies the necessity to increase efforts to conserve Nile crocodile habitats, restore remaining habitats of the species, especially in Lake Kamnarok and Cheploch gorge to guarantee its survival as a structural and functional component of the ecosystems it inhabits.

<u>Adopting measures to sustainably use resources and restore/conserve the remaining habitat and ecosystems in Kerio Valley</u>

Project investigations revealed that the direct causes of environment degradation in Kerio Valley are well known. However, the underlying root causes of soil erosion, deforestation and land degradation are embedded in the socio-economic conditions of the local communities. This objective revealed that environmental degradation in the Kerio Valley has contributed to the following;

1. Constant shrinkage of Lake Kamnarok.
2. Rapid dehydration of Kerio River.
3. Altered hydrological conditions.
4. Bare land cover and soil erosion.

The locals living along the Kerio River riparian ecosystem were engaged on issues pertaining to soil/water conservation, deforestation and land degradation. It was found out that most locals are not fully aware of conservation measures and how adopting measures to sustainably use resources (soil and water in particular) can improve both agricultural productivity and habitat conditions for the harboring of Nile crocodiles.

In this activity, the local constraints in the adoption of conservation measures were investigated to set foundation for the formulation of appropriate conservation interventions. A total of one hundred and fifty households within the catchment area of Kerio Valley were randomly selected and interviewed using a structured questionnaire. A scheme for measuring local-level conservation effort was developed and barriers to adoption derived from an analysis of a range of independent social, economic, cultural, land ownership and household economics.

The data collected will be analysed using both descriptive and inferential statistics in a Statistical Package for the Social Sciences (SPSS version 22). The findings will have relevance for the design of public policies and programs, notably the importance of supplying information on local community-level implications of conservation methods and the need for a stable environment and allow long-term planning for conservation of Nile crocodiles/habitats in Kerio Valley.

Table 1: Localities identified with the most optimal conditions for long-term conservation and maintenance of *C. niloticus* populations

	Locality	**Habitat Threats**	**Mitigation Measures**
1.	Cheploch gorge	a) Soil erosion & Siltation b) Recreational activities c) Pollution d) Deforestation	a) Construction of soil erosion preventive mechanisms (building of gabions). b) Visitor management programs i.e. education & awareness creation on proper waste disposal. c) Reforestation around Cheploch gorge.
2.	Kerio River Riparian ecosystem	a) Soil erosion b) Poor farming methods c) Deforestation	a) Construction of soil erosion preventive mechanisms (building of gabions). b) Farmer education & capacity building on sustainable farming methods. c) Reforestation along Kerio River.
3.	Lake Kamnarok	a) Deep gully erosion b) Catchment destruction (Deforestation & Charcoal burning) c) Encroachment (Farming & grazing) d) Water diversion for agriculture. e) Growth of hyacinth on the Lake	a) Construction of soil erosion preventive mechanisms (building of gabions). b) Education, Capacity & awareness Creation among the surrounding community to participate in conservation efforts. c) Reforestation programs d) Catchment restoration & conservation e) Removal of hyacinth from the Lake
4.	Kipsoit Community Dam (Silanga)	a) Siltation b) Agricultural activities c) Pollution	a) Construction of soil erosion preventive mechanisms (construction of gabions & Construction of terraces). b) Local Education & Capacity building on adoption of conservation measures c) Education on sound practices of waste management