BID Africa 1 – National Grant Template
Mid Term narrative report

1. Table of Contents

2. Project Description

2.1. Project Coordinator: Institution/network/agency name:

Kenya Wildlife Service (KWS)

2.2. Main contact person and role:

Dr. Samuel Kasiki - Deputy Director, Biodiversity Research & Monitoring

2.3. BID proposal identifier:

BID-AF2015-0035-NAC

2.4. Project title:

Organizing and mobilizing biodiversity information from the Kenya Wildlife Service

2.5. Start date and end date of the reporting period:

01/07/16 to 31/08/2017

2.6. Country in which the activities take place:

Kenya

3. Overview of results

3.1. Executive summary

To date the following two activities have been implemented although not completely. The first activity comprised participation in the BID Capacity Enhancement Workshop that was held in Kigali, Rwanda from 22nd-25th August, 2016. The second activity comprised the organization of an inception workshop and which was held from 27th-30th September, 2016 in Nairobi, Kenya.

One of the outcomes from the BID Capacity Enhancement workshop was increased knowledge in biodiversity data digitizing, cleaning and publishing on the Internet using the Integrated Publishing Toolkit (IPT). For the inception workshop, one of the outcomes was the creation of awareness about GBIF and BID to KWS Scientists. A further outcome was a better understanding about the biodiversity related datasets that exist in Kenya Wildlife Service's (KWS) field stations and also at Nature Kenya. In addition, dissemination of knowledge on Darwin Core and the OpenRefine tool to KWS Scientists.

3.2. Progress against expected milestones:

Expected milestones/activities	Completed? Yes/No	Explanatory notes	Sources of verification
Completed capacity self-assessment questionnaire for national biodiversity information facilities (www.gbif.org/resource/82277).	Yes		Submitted self-assessment
At least three national data publishing institutions are registered with GBIF.org For registered data publishers see: http://www.gbif.org/publisher/search	No	There are 3 partners in this project viz: 1. Kenya Wildlife Service 2. National Museums of Kenya (NMK) 3. Nature Kenya (NK) Of the above 3: . NMK is a registered publisher . KWS has now registered and is waiting for endorsement. . For NK, KWS has made an appeal to them to register. KWS will continue to follow up closely with NK so that they can register.	Communication from GBIF on successful registration
At least one person from the project team has completed the certification process following the first BID Capacity Enhancement workshop	Yes	Have now completed and submitted the third and final assignment emanating from the first BID Capacity Enhancement Workshop.	Answer sheets
Knowledge dissemination activities have been scheduled following the first BID	Yes	At an inception workshop attended by Kenya Wildlife Service and Nature Kenya,	Power Point Presentation made during the inception

Capacity Enhancement workshop		disseminated knowledge on GBIF, BID and the knowledge gained during the Enhancement workshop in Kigali. Further dissemintation will be done as additional activities of the project are undertaken.	workshop. Initially National Museums of Kenya were supposed to have made the presentation on GBIF but since they did not attend the inception workshop, I had to do the presentation.

3.3. Datasets published on GBIF.org

It is useful to mention that in the first draft report I included the two datasets for which I had most certainty in obtaining. For the other datasets there is going to be some negotiation with the data custodians internally and externally. As KWS we shall be working on this in the next three months. This means that during the next reporting period the report will be more representative of all partners as we shall have had meetings with them and discussed on the data mobilization.

Now, to avoid the impression that we have dropped some of the datasets in the contract, I have put them back in the table below.

In terms of update of plans in view of the Biodiversity Capacity Enhancement Workshop, we shall initially stay with the datasets contained in the contract. It is on these that we shall bring to bear the skills learnt under the enhancement workshop.

According to the grant agreement one dataset was supposed to have been published by Mid-Term Review. This has not been published as KWS has not been given access rights to publish in GBIF depsite reuest.

Dataset title	**Publishing institution**	**DOI or URL/Planned hosting institution**	**Date/ expected date of publication**	**Explanatory notes**
Samburu-Laikipia Total Aerial Census	KWS	KWS	August 31 2017	Dataset is on large mammals that are counted during aerial censuses. The data are for the period 2012. They are in ArcGIS Shapefile format.
Ground Census	KWS	KWS	Oct, 2017	Dataset is on large mammals for ground censuses conducted in various conservation areas that include Nairobi and Lake Nakuru National Parks. The data are for the period 2000-2013. They are in Microsoft Excel format. They do not have GPS coordinates

Marsabit Forest Ecosystem Plants	KWS	KWS	Oct, 2017	The checklist is for the Marsabit Forest Ecosystem which is in Northern Kenya. It is in MS Word format. The checklist is for data collected in 2014-15.
Mt. Kenya Forest Ecosystem	KWS	KWS	Oct, 2017	The checklist is for Sirimon and Chogoria sectors of the Mt. Kenya Ecosystem. The checklist is for data collected in 2015 and is in MS Word.
Zoology collection data	NMK	NMK	Oct 2017	Birds, mammals, reptiles/amphibians, fishes, bones and invertebrates preserved as dry and wet collections
Botany collection data	NMK	NMK	Oct 2017	Reference collections preserved as herbarium materials, metadata, reports
Kenya Bird Map	NK	NK	Oct 2017	Data on birds at national level. Data is from 2014 to present. It is geo-referenced and is in MS Excel format
Important Bird Areas	NK	NK	Oct 2017	Data on birds at global level. Data is from 1999 to present. It is geo-referenced and is in MS Excel format

3.4. Examples of use of biodiversity data available through GBIF

Dataset	Data user	Data use	Date/ time frame	Sources of verification	Notes
Doi:10.15468/aomfnb	KWS	Examine data with a view to complementing KWS datasets	6 months		KWS mainly has data on large mammals. KWS plans to investigate GBIF's data on other major taxa (birds, plants, reptiles/amphibians, fish, insects and micro-organisms) with a view to enriching its data on these taxa. These data will be used to improve the

					data that KWS will be organizing and mobilizing during this project. Further, the data will be evaluated with a view to incorporating it into Wildlife Protected Area Management Plans.
Doi:10.15468/ib5ypt	KWS	Examine data with a view to complementing KWS datasets	6 months		Ditto
Doi:10.15468/2rlrvh	KWS	Examine data with a view to complementing KWS datasets	6 months		Ditto
Doi:10.15468/bvoyqy	KWS	Examine data with a view to complementing KWS datasets	6 months		Ditto
Doi:10.15468/dl.6tiroy	NK	Enhance its data on birds with data from other taxa.	6 months		In its proposal under BID, NK had expressed great interest in expanding its datasets to include other taxa outside birds. This dataset would move NK in that direction.
	NMK	Enhance its data on large mammals	12 months		Through this project KWS will mobilize data on large mammals. Since NMK has in general not dealt with large mammals, it is expected that they will have great interest in the large mammal dataset that KWS will provide. There is no DOI for this dataset as it hasn't been published yet.

3.5. Events organized as part of the project

Full title	Organizing institution	Dates	Number of participants	Sources of verification
Data Organization Workshop	Kenya Wildlife Service	27-30 September, 2016	30	. Draft workshop report . Photographs . Power Point Presentations

4. Implementation of BID project activities

4.1. Goal 1: Establish or strengthen national biodiversity information facility

Activity 1 name: Biodiversity Training

Description of any implementation during the reporting period

KENYA WILDLIFE SERVICE

European Union

Title of Workshop: Biodiversity Training, Naivasha KWSTI

"Organizing and mobilizing biodiversity information in Kenya Wildlife Service, Global Biodiversity Information Facility (GBIF)"

18-21st December, 2017

List of Tables

List of Plates

ACRONYMS

H-PEC - Acting Head Planning and Environmental Compliance

GBIF - Global Biodiversity Information Facility

KWS – Kenya Wildlife Service

CUCK – Cooperative University College, Kenya

NMK - National Museums of Kenya

DDBRM – Deputy Director Biodiversity Research and Monitoring

GIS – Geographic Information Systems

EU - European Union

RS - Remote Sensing

KWSTI - Kenya Wildlife Service Training Institute

ESRI – Environmental Systems Research Institute

QGIS - Quantum GIS

HWC - Human Wildlife Conflict

SRS – Senior Research Scientist

IUCN – International Union for Conservation of Nature

UNESCO – United Nations Educational, Scientific and Cultural Organization

MFE - Marsabit Forest Ecosystem

EIA – Environmental Impact Assessment

TWDG – Biodiversity information standards

EOL - Encyclopedia of Life

OBIS - Ocean Biogeographic Information System

TWNP – Tsavo West National Park

TENP – Tsavo East National Park

RS – Remote Sensing

SVO – Senior Veterinary Officer

SS – Senior Scientist

HGNP – Hell's Gate National Park

WCA – Western Conservation Area

CMC – Conservation Monitoring Coordinator

Session I: Official Opening

1.0 Opening Remarks and Introduction *by Mr. Apollo Kariuki*

The Biodiversity Training Workshop was called to order at 0800 hours by the Acting Head Planning and Environmental Compliance, KWS. The workshop started with a word of prayer from one of the participants which was then followed by self-introduction of the participants present.

In his opening remarks, H-PEC pointed out that the main purpose of the GBIF project named "*Organizing and mobilizing biodiversity information from KWS*" is to ensure that the biodiversity related data generated by KWS over the years is organized and shareable with the wider global conservation community. He mentioned that Global Biodiversity Information Facility—'is an open-data research infrastructure funded by the world's governments and aimed at providing anyone, anywhere access to data about all types of life on Earth' https://www.gbif.org. He reminded them of the workshop on the same that was held at CUCK, Nairobi in September, 2016. Under GBIF, he explained, that KWS with other stakeholders, Nature Kenya and National Museums of Kenya (NMK), received a funding from the European Union (EU) to a tune of the 60,000 Euros, under the project theme 'Organizing and mobilizing biodiversity information from KWS' a concept of the DDBRM and former Head of GIS.

KWS has a biodiversity research department that has been in existence since the 1960s and through this department substantial data has been collected through its research and ecological monitoring activities. Some of this data has been published but some has not been published. Further, the historical biodiversity information generated by researchers is not readily available to managers and planners. The project therefore offers a timely opportunity where current and historical information can be organized to inform wildlife management decision making.

The project is funded by European Union to the tune of 60,000 Euros. This funding was based on a proposal that was prepared by the previous Head-GIS in collaboration with the Deputy Director, Biodiversity Research and Monitoring, National Museums of Kenya.

The H-PEC asked the following questions:

- What archival biodiversity data does KWS have?
- Who are the users of this data and how is it disseminated to them?
- What is the quality of the data collected?
- What tools exist for collecting and handling spatial and non-spatial data?

Workshop aims and Objectives

The workshop is aimed at training participants in tools that can be used to handle spatial data and mobilizing data from field scientists.

Specific workshop objectives were:

1. To sensitize workshop participants on application of GIS and RS
2. To assess the status of both spatial and non-spatial biodiversity information in KWS
3. To analyse problems and opportunities that the biodiversity information should be addressing to enhance biodiversity conservation
4. To Introduce researchers to ornithology and biodiversity informatics

Welcome remarks by Principal KWSTI *by Dr. Charles Musyoki*

In his welcoming remarks, the Principal, Kenya Wildlife Service Training Institute (KWSTI) emphasized the importance of having well organized data which is factual, relevant and up to date. He said scientists should display their professionalism and knowledgeability by disseminating information that is supported by data.

Plate 1: KWSTI Principle during workshop opening

He said that an institution like KWSTI that teaches wildlife management courses also needs biodiversity inventory data. He informed participants that KWSTI is also holding biodiversity monitoring data as it carries out monthly wildlife censuses with the help of its environmental and wildlife management students. The KWSTI is also willing to share the data. He reminded the participants that data collection is very expensive and therefore the GBIF project should be capitalised on to ensure that biodiversity data is organized and shareable and disseminated to support conservation.

Session II: Introduction to GIS & Remote sensing and Assessment of GIS needs

2.1 Introduction to GIS *by Mr. Peter Hongo*

He gave ESRI's definition of GIS as an *"organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information (i.e. geo-referenced information)"*

Objectives of the GIS training

This training was aimed at equipping participants with basic knowledge on GIS, and in particular the open source Quantum GIS (QGIS). Adoption of QGIS by field scientists would reduced reliance on the KWS HQ GIS staff for spatial data analysis and cartographic production of maps.

Plate 2: Facilitator training introducing participants to GIS

The topics that were covered were:

- Overview of GIS
- Data collection, tools, equipment, data types and required skills
- Datasets required by the GBIF project
- Introduction to QGIS
-

This was delivered by use of;-

- PowerPoint presentation
- Tutorial with screenshot of demonstrations
- QGIS software installation to laptops of all participants
- Manuals on QGIS application were shared

- Training data was shared
- Demonstration and participants practicals

Plate 3: Facilitator assisting participants during QGIS practicals

2.2 Introduction to Remote Sensing *by Mr. Peter Maina*

The facilitator gave participants a brief introduction to remote sensing for natural resource management. Remote sensing is a technique to measure/detect something without touch or physical contact, typically from aircraft or satellites.

Plate 4: Faciliator introducing to remote sensing

Objectives of the training in RS

- To familiarize participants on theoretical and practical concepts of Remote Sensing (RS).
- To equip participants with the ability to apply computational techniques for the collection, analysis and visualization of spatial data using RS.
- impart skills to participants to assist them in solving conservation problems

The topics covered during the RS training were;-

- Introduction to Remote Sensing – Land Impact Tool
- Spatial Data Preparation
- Processing an image using Land Impact Tool

Mode of delivery of the RS training

Participants were taken through installation of the Land Impact Tool software and introduced on application using:

- PowerPoint presentations
- One on one demonstration
- Tutorial with screenshot of demonstrations as the one shown below;-

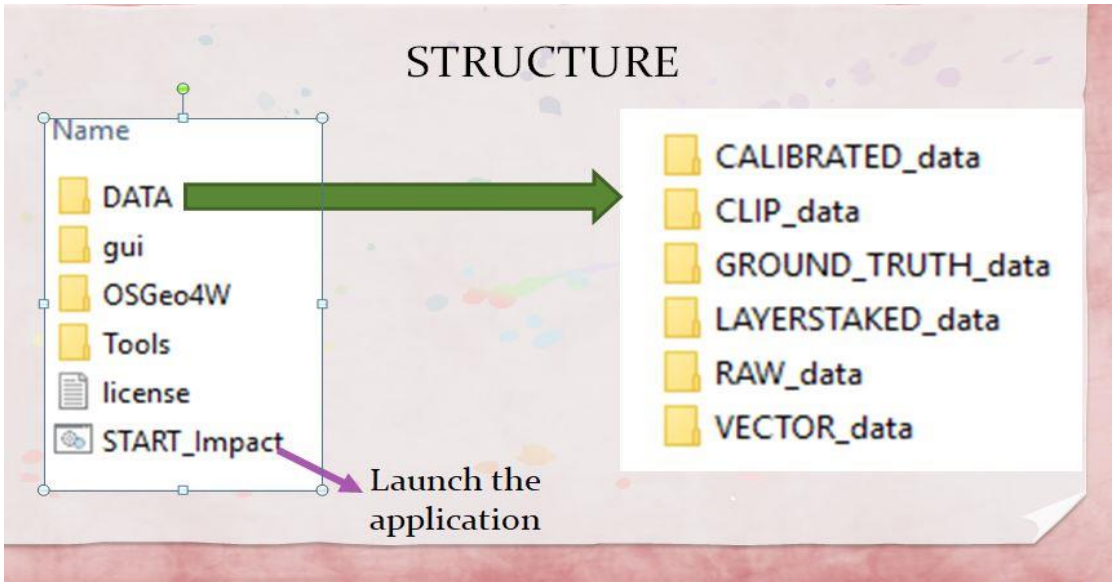

Plate 5: Participants during the remote sensing practical

Session III: Status of Biodiversity Information at KWS

3.1 KWS Field Data Mobilization *by the Field Scientists*

This session involved the participants sharing the datasets held in the various KWS conservation areas and research stations. The researchers from these field stations also gave electronic copies of the datasets held in their various stations to the KWS-HQ GIS team as part of data mobilization under the GBIF project.

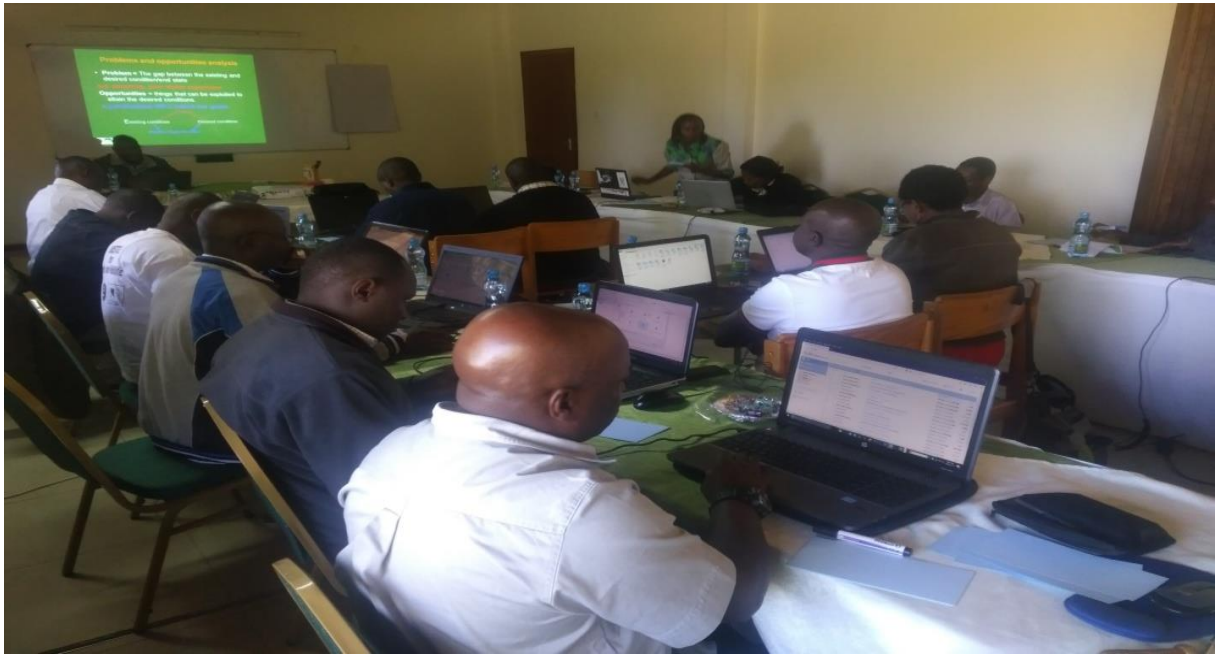

Plate 6: Participants during the workshop

Table 1: Datasets mobilized from field scientists

Conservation Area	Data sets provided	Remarks
Coast Conservation Area	Birds, invertebrates, plants, (Ecological Monitoring Data sea grass and coral cover for Watamu, Malindi, Kisite and Mombasa MPAs to be requested from Dr. Gamoe), reports and maps	Data Available was provided
Tsavo Conservation Area	Elephant mortality, rainfall data, collared elephants, data on underpasses of the Standard Gauge Railway, sighting of endangered wildlife, Human Wildlife Conflict(HWC), Invasive species data, fence data, tourist visitation, Rhino data, census data, vegetation data	Some data was provided by Cedric and Kimutai but Kimutai will bring the bulk of the data to KWS Hqs at a later date
Southern Conservation Area	17 years census data that is collected 6 times per year for carnivores, reptiles, ungulates and birds, lion collaring in Nairobi National Park for the last 3 years, plants data to be shared by SRS	Data provided had gaps. More data of the conservation area to be provided later
Eastern Conservation Area	Carnivore monitoring data, cheetah, lion, wild dog monitoring, elephant, Grevy's zebra monitoring, HWC, Ornithology data, mortality, rainfall, river, tsetse fly data, temperature data, data from 1970s provided	All the data was provided
Northern Conservation Area	Weather data 2015-2017, visitor data 2000-2016, HWC 2000-2017, Elephant mortality 2000-2017, biodiversity inventories (plants, mammals, invertebrates, reptiles and amphibians, birds, aquatic fauna), infrastructure kills 2016-2017 (data might not be consistent), elephant migratory	The data was provided

Conservation Area	Data sets provided	Remarks
	corridor, camera traps data for small mammals, Sibiloi mammals, birds of lake Turkana, researchers database, maps on transects and elephant mortality	
Central Rift Conservation Area	Data covers Lake Nakuru National Park, Maasai Mara, and Hell's gate. Water fowl counts data, water quality monitoring data, lion identification datasets, rainfall data, wildlife kills data (lots of gaps) HWC Data, specific mammal species count data (waterbucks, giraffes, buffalo), Maasai Mara data: HWC, elephant mortality up to 2017 feb, rainfall data from 2002 much of it is in hard copy, road count data (use the existing transects so we can provide spatial information) from 2006 to 2013, vegetation biomass assessment, collared elephants datasets, collared cheetahs, wildebeest and lions datasets (data might be limited in terms of permission to access the data)	The data provided covered Hell's gate and Maasai Mara NR. The rest of the data to be provided by the SRS at a later date
Western Conservation Area	Biota project data, maps, checklists, Ecological Monitoring, Problem Animal Control, Rainfall data, revenue statisitics, invasive species	The data is not up to date. There is need to update the data with other colleagues and present it at a later date.
Mountain Conservation Area	Not represented	**To be collected from the SRS-MCA**

Session IV: Assessment of GIS Data Needs

The H-PEC started the session by reiterating on the importance of having good and credible data that can address varied needs of the different users. He noted that once a good database management system is set up, it would be easy to generate the information that can support problem solving.

4.1 Information management problem and opportunity analysis *by Mr. Apollo Kariuki*

The objective of the problem and opportunity analysis was to identify the problems and opportunities that the information management system should address. The participants were asked to first identify and write on pink cards the problems that affect KWS and the wildlife sector. **One card one problem**. All the cards were then collected and the facilitator read the contents written on each card for the plenary to agree on the identified problem. Those that were agreed were pinned on the wall based on thematic areas of ***ecological monitoring and research, community wildlife service and benefit sharing, human resource management, infrastructure and equipment management.*** The cards were then numbered from 1 to 80 and the participants asked to identify and rank 5 problems that they felt were the most important and the Biodiversity Information System being developed should address. Thereafter each participant ranked the problems from 1 to 5, with 5 being the most important and 1 being the least important. The participants were then asked to identify the existing opportunities that can be used to address the identified problems. Further participants also carried pout a stakeholder analysis for the KWS Biodiversity Information System. The outputs from the problem and opportunity analysis and the stakeholder analysis are presented in annexes….

Plate 7: Participants ranking identified problems

SESSION V: GIS & RS APPLICATIONS

5.1 Applications of GIS & RS in Watershed Management *by Mr. Joseph Edebe*

The objective of this presentation was to demonstrate the application of GIS & RS in watershed management. The presenter showed the participants some examples of database from IUCN, Birdlife International, and the UNESCO World Heritage. He noted that remote sensing in watershed management can be used to determine catchment delineation, soil structure while GIS would be used to demonstrate rainfall and temperature variables.

The presenter described a case study of Marsabit Forest Ecosystem (MFE), where monitoring is done using camera traps, and land cover change detection is done using remote sensing techniques. In addition inventories of large mammals, small

mammals, arthropods, birds, insects have been carried out. Water quality data is also available. This data is being organized in a biodiversity database for Marsabit Forest Ecosystem database. Below is a link to the web based MFE database demo;

www.mocreativity.com/kwsdemo/KWS/

The presenter recommended that for an effective biodiversity database several things are required such as:

- Proper equipment for data acquisition and processing;
- An inter disciplinary team should be included in data collection;
- Standardized data collection mechanisms;
- Interlinking various datasets;
- Partnerships and networking among researchers; and
- Resource allocation

5.2 Application of GIS in EIA *by Mr. Peter Njiiri Mwangi*

The objective this presentation was to demonstrate the applications of GIS in EIA. EIA is a tool used to make informed decisions. He explained the 5 main questions in EIA that GIS answers as;-

Location: Where is the project located?

Condition: What is at the project site?

Trends: What will or has changed since?

Patterns: What spatial pattern exists?

Model: What if?

He explained that GIS is applicable in the various stages of an EIA process: a) screening (whether a project requires EIA or not), b) scoping (establishing the baseline), 3) impact analysis, 4) impact mitigation and management, and 5) the EIA statement development and auditing phase which is done one to two years after the project.

He gave the strengths of GIS in EIA as;-

- It stores large multidisciplinary datasets
- It identifies complex interrelationships between environmental characteristics
- It evaluates changes over time
- It can be systematically updated and used for more than one project
- It summarizes large data into information
- It serves as a database for a variety of mathematical models
- It serves the interests of the general public as well as for technical analysts
- GIS has a capability for site impact predictions of cumulative effects

5.3 Application of GIS and RS in Protected Area Planning *by Ms. Martha Nzisa*

The objectives of this presentation were:

- To demonstrate the use of GIS and RS in resource planning
- To highlight some of the spatial and non-spatial datasets important to resource planning

The presenter demonstrated how resource planning uses lots of data. She noted that effective resource planning is greatly dependent on available quality data that can be subjected to GIS and RS analyses. Some of the datasets used in protected

area planning are;- wildlife population and distribution data, wildlife movement data, wildlife translocation data, animal breeding sites, vegetation monitoring data, hydrology data, human wildlife conflict data, infrastructure data, among others.

GIS is very important in defining the plan area as well as the protected area zonation scheme.

Session V: Introduction to Ornithology and Biodiversity Informatics

5.1 Introduction to ornithology *by Mr. Fred Barasa*

The presenter took the participants through a session on the basic information on Ornithology. He explained that Kenya has listed about 1060 bird species (11 endemic birds, 278 migrants, among them). The high number of bird species is attributed to diverse habitats as well as 8 endemic bird areas such as the Kakamega and Nandi forests. Kenya also has 6 biomes (Somali-Masai biome, East African coast biome, afro-tropical forest biome, Lake Victoria basin biome). Kenya is also part of the flyways of Palearctic migrants which adds to the birds species recorded; with a total of 170 species of which 11 breed locally. Migrants come in from November to March.

Kenya's major habitats that support high diversity of bird species include: Coastal forests (Sokoke scopes Owl, Clarke's weaver), highland moist forests mosaic and bamboo, montane forests specialistss, Guinea-Congolean forests (e.g. Kakamega forest and Nandi forests), highland dry forests (Taita hills, Mt. Marsabit, Mt. Kulal, Chyulu Hills), the plains and the grasslands (e.g. Kinangop plateau), the savannas stretching from Tsavo to Amboseli and North Western Kenya, hostile arid areas (semi-deserts), wetlands (fresh water bodies, mangroves and coral reefs).

The presenter took the participants through some basic bird identification techniques. An identification toolkit (notebook, pen/pencil, binoculars, guidebook, playbacks or skills of attracting birds) is required to identify birds. He explained that birds can be identified by observing the parts of a bird's body, by the shape (birds of the same family have similar shape), by the stance and posture (birds from the same family have a similar posture), by the bill, by plumage, by habitat, by distribution, by voice calls, and through the use of a bird guide book. The terms used to describe the plumage, the trunk, tarsus and the rest of the body are skills that are required to be known. There are about 28 terms used to describe a bird. For beginners at least 20 terms would be a good start. Record keeping and information exchange is important in bird identification.

He explained the importance of bird ringing which helps in tracking Palearctic birds. Telemetry is also a new technology used to monitor the migratory route of different bird species. Bird ringing is coordinated by the National Museums of Kenya, Ornithology section.

Plate 8: Participants being introduced to ornithology

5.2 Biodiversity informatics *by Dr. Mwachala*

The presenter started off by explaining the difference between Bioinformatics and Biodiversity informatics. Bioinformatics is mostly used in the context of biotechnology while biodiversity informatics involves the application of informatics tools to

biodiversity information. It addresses lack of information problems. It is guided by what, who (describes the collector and his/her history in the field), when (date and trends), where (locality – geo-referencing, elevation, and habitat).

Uses of primary occurrence data (linked to a species preserved somewhere) include:

- Taxonomy – research, indices, flora, fauna, field guides, phylogenies
- Biogeography – distribution atlas, special distribution modeling, species decline
- Life histories and phenology
- Endangered, migratory and invasive species
- Impact of climate change
- Ecology, evolution and genetics – habitat loss
- Environmental planning
- Health and public safety
- Bioprospecting
- Border control
- Education and public outreach
- Ecotourism
- Society and politics – data repatriation
- Recreational activities

He explained that the data is made available through data collection, data preparation, data digitization, and data standardization (different database systems, different formats, and different languages).

Plate 9: Facilitator introducing participants to biodiversity informatics

He gave a brief history on the importance of having standards in Biodiversity Information management. Biodiversity information standards (TWDG) realized in the 80s the need for taxonomic information to have standards that are similar worldwide. The Darwin core XML schema is the most common standard used. It contains so many terms and stores information in the Darwin core archive. The link below is an example of the NMK database *www.ipt.museums.or.ke/ipt*

Biodiversity informatics organizations include the Biodiversity Information Standards (TDWG), Encyclopedia of Life (EOL), Atlas of Living Australia, GBIF, and Ocean Biogeographic Information System (OBIS). In Kenya, the Kenya Biodiversity Information Facility where NMK renders the service on behalf of the Kenyan government, is the Kenyan node of GBIF. He explained that setting up a collection is easy but consistently updating and improving the database is the hard part.

Session VI: Workshop Closing

The workshop was officially closed by Dr. Mohamed on behalf of the Deputy Director BRM. He noted that the data collected by the research team helps in making informed management decisions, so it is key to have organized data in a database. He indicated that KWS is looking forward to have the data available and shared with the relevant people.

Plate 10: The Head of Ecological Monitoring giving his closing remarks

Annex

List of Participants

No.	Name	Designation	Institution	Est/ID

1	Vasco Nyaga	ART- 11	KWS- Mara	9575
2	Timothy Ikime	ARS	KWS- HGNP	9505
3	Anastacia Mwaura Sikoyo	RS	KWS- WCA	9351
4	Cedric Khayale	RS	KWS- TWNP	9071
5	Jacquiline Bernard	RS-11	KWS	9311
6	David Kimutai	RS	KWS- TENP	1938
7	Evans Muriithi	ARS	KWS	8570
8	Peter Maina	GIS TECH	KWS- HQ	9518
9	Linus Kariuki	SS	KWS- HQ	7168
10	Isaac Lekolon	SVO	KWS	7756
11	Jane F. Wamboi	SS	KWS- HQ	7866
12	Benard Ogwoka	RT	KWS- NCA	9504
13	Grace Waiguchu	GIS TECH	KWS- HQ	9561
14	Faith Muchiri	GIS TECH	KWS- HQ	8030
15	Martha Nzisa	RS	KWS- HQ	8572
16	Apollo Kariuki	ASHPEC	KWS	4495
17	Peter N. Mwangi	SRS	KWS	9047
18	John M. Kariuki	RS- 1	KWS	5282

19	Elphas K. Bitok	RS- 1	KWS	6936
20	Geoffrey Mwachala	Chief of Research	NMK	4654213
21	Fred Barasa	CMC	Nature Kenya	13286541
22	Peter N. Mwangi	SRS	KWS	9047
23	Joseph Edebe	SS	KWS	6768
24	Peter Hongo	GIS TECH	KWS	9104

Workshop Program

Day	Time	Item	Responsibility
Monday, 18/12/2017	4.00pm - 5.00 pm	Arrival and Registration	F. Muchiri
		Session I: Introduction to GIS & Remote Sensing and Assessment of GIS needs	
Tuesday, 19/12/2017	8.00 am – 8.30 am	Introduction of participants, workshop objectives and opening remarks	A.Kariuki
	8.30 am – 9.30 am	Introduction to Geographic Information Systems(GIS)	P. Hongo
	9.30 am–10.30 am	Introduction to Remote Sensing(RS)	P. Maina
	10.30am– 10.45 am	**Tea Break**	
	10.45 am –1.00 pm	GIS and RS (Image processing using Land Impact Tool) Tutorial	P.Hongo/P.Maina

	1.00pm – 2.00 pm	**Lunch**	
		Session II: Status of Biodiversity information at KWS	
	2.00pm – 3.00 pm	Situational analysis of spatial and non spatial biodiversity information at KWS HQ and the Field Research Stations	All
	3.00 pm – 4.00 pm	Biodiversity information management: Problems and Opportunities analysis	All
	4.00 pm–4.15 pm	**Tea Break**	All
	4.15 pm – 5.15 pm	Group discussions-Biodiversity information user needs assessment	All
	5.15 pm-6.00 pm	Group presentations	All
	6.00pm	Day 1 ends	
		Session III: GIS&RS Applications	
Wednesday 20/12/2017	8.30 am – 9.30am	Application of GIS in EIA and protected area planning	P. Mwangi/M. Nzisa
	9.30-10.00 am	Application of GIS in management of Human Wildlife Conflict	M. Maloba
	10.00 am – 10.15 am	**Tea Break**	
	10.15 am – 10.45 am	Application of GIS in Wetland Management	J. Edebe
	10.45 am– 11.15 am	Information needs for the National Wildlife Conservation Status Report	W. Ouna
	11.15 am– 12.00 am	Plenary Discussions	All
		Session IV: Introduction to Ornithology	

		and Bioinformatics	
	12.00 pm – 1.00 pm	Introduction to Ornithology	NK
	1.00 pm – 2. 00 pm	**Lunch Break**	
	2.00 pm– 4.00 pm	Introduction to ornithology(continued)	NK
	4.00 pm – 4.15 pm	**Tea Break**	
	4.15 pm – 5.00 pm	Introduction to Bioinformatics	NMK
	5.00 pm –5.30 pm	Workshop Closing	DDBR&M-Dr. Kasiki
Thursday, 21/12/2017	9.00 am	**Departure**	All

Problem and Opportunity analysis

ECOLOGICAL MANAGEMENT

Habitat management

1. Drought 74
2. inconsistency of frequency of data and methods 76
3. climate change 77
4. insufficient data for management 78
5. lack of specialization on certain species 79
6. need to include smaller species not just big ones 80
7. lack of valuation for wildlife ecosystems 41
8. spread of invasive species 45
9. weather variability 75

Species management

1. loss of wildlife dispersal areas 59

2. habitat loss 60
3. habitat fragmentation 61
4. habitat degradation 62
5. pollution of water bodies 63
6. protected area encroachment 65
7. livestock incursion in PA's 66
8. national park insularization into big zoos 67
9. infrastructure development in conservation areas 68
10. wildfires in key habitat 69
11. biomass changes in protected areas and the cause of change in biomass 70
12. Fencing causing corridor blockage in protected areas of Kenya 71
13. habitat encroachment and te level of degradation in inter-phase between wildlife and livestock 72
14. water scarcity during dry spells 73
15. encroachment into wildlife range areas by growing human population 64
16. species genetics (inbreeding) 51
17. wildlife diseases outbreaks 52
18. species loss 53
19. population dynamics of lions in savannah and problems facing their conseravtion services 54
20. wildlife mortality (road kills) 55
21. loss of genetic biodiversity 56
22. increased tsetse fly population in PA's 57
23. movement patterns of elephants across Kenyan ecosystem clearly showing the existing corridors that should be protected and gazetted 58
24. lack of endangered species survival strategies 50
25. lack of animal welfare standards 7

Research & monitoring

1. no networking /very individual 26
2. lack of standardized ways of data collection 31
3. insufficient tools and equipment data collection and analysis 32
4. inadequate funds to maintain scientific equipment 33
5. lack of national wildlife status report 36
6. Lack of population trends of elephants in all Pas over the years NB. Should show the changes both in numbers and habitat change 37
7. lack of spatial data infrastructure 35
8. lack of data on wildlife carrying capacity 34
9. inadequate information on wildlife numbers/population in specific Pas 19
10. inadequate capacity of running or maintaining the database 20
11. lack of linkage to other databases both national and international levels 29
12. data organizational and storage problems/ lack of data equity, sharing & storage protocol30
13. lack of complete documentation of threats to species conservation 38
14. lack of wildlife data outside KWS protected areas 39
15. no information on status of wildlife habitats 40
16. lack of quality data 27
17. incomplete datasets 21
18. scattered data (data in different areas, institutions) 22
19. data hoarding 23

COMMUNITY WILDLIFE

1. Human wildlife conflict
2. Community value for wildlife 6
3. poor information dissemination/ public awareness on data available and competencies 25
4. Lack of benefit sharing for communities living with wildlife 5

OPERATION

1. Management and Administration Resources
2. limited tools of trade and skills - no refresher16
3. lack of updated technology and skills to conserve wildlife 17
4. poor resource mobilization 18
5. inadequate resources for wildlife conservation 24
6. lack of mentoring by seniors to junior staff 8
7. lack of motivation among BR&M staff (staying in one job group for long 9
8. inadequate capacities to undertake some programs 10
9. inadequate human resource capacity 11
10. poor staff morale 12
11. low levels of capacity building 13
12. poor working conditions 14
13. lack of collaborations between departments eg park management and biodiversity towards contribution to the organizing mandate 15

Institutional Collaboration

1. High expectation from the public on wildlife issues 3
2. lack of communication strategy for research findings 28
3. poor relations working with stakeholders 2
4. lack of implementation strategies to conservation trade 1

Wildlife visitor security

1. visitor security 44
2. insufficient forensic evidence for trophies and bush meat 4

3. bush meat poaching 49
4. wildlife security /poaching of elephants and icons and the spatial relationship to human settlement 47
5. government priorities in conservation42
6. lack of priority areas for research 43
7. trophy hunting/poaching 48

OPPORTUNITIES

1. Support from donors
2. Funding opportunities
3. Space for research
4. Revenue from visitors
5. Availability of natural resources
6. Good will from GoK
7. Existing good collaboration with partners and stakeholders
8. Data sharing protocols
9. Networking with stakeholders
10. Clear data collection procedures for various needs
11. Technical skills in GIS, RS and data management skills
12. Availability of data
13. Availability of hardware and software
14. Availability of internal connectivity
15. Law enforcement
16. Skilled personnel
17. Strengthened Wildlife Act
18. Employ and promote staff
19. Update softwares and staff skills

20. Information sharing
21. High tourism potential
22. Network of protected areas
23. Enabling policy framework
24. Two training institutions (Manyani LEA and KWSTI)
25. Good infrastructure
26. Robust human resource
27. Internal workshops and seminars to share ideas
28. Internal trainings on different skills
29. Management support in implementing various strategies
30. Good governance
31. Guidelines in wildlife research
32. Partnership with local communities
33. Marketing parks for visitors to generate revenue
34. Scattered information
35. Political good will in conservation
36. Conservation education
37. Technology available
38. Diversification of tourist/visitor products and experiences
39. Develop climate change adaption strategies
40. Capacity building at all levels
41. Habitat rehabilitation
42. Identification of alternative livelihoods
43. Inclusion of park management and security personnel in biodiversity monitoring
44. Drugs and veterinary supplies

45. Aircrafts, Vehicles, plant and machinery
46. Skilled and unskilled personnel
47. Weaponry
48. Staff motivation through upward movement
49. Standardization of data collection for integration in the GBIF
50. Scientific equipment for monitoring
51. Regular trainings and career development courses
52. Mentoring and supervision from seniors
53. Community consolation and compensation
54. Cross border linkages
55. Security

Problems Ranking

PROBLEMS	**Allocated Number**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
lack of implementation strategies to conservation trade	1					3	1						1						
poor relations working with stakeholders	2												2	2					
high expectation from the public on wildlife issues	3																		
insufficient forensic evidence for trophies and bush meat	4																		
lack of benefit sharing for communities living with wildlife	5																		
Community value for wildlife	6			5															
lack of animal welfare standards	7																		
lack of mentoring by seniors to junior staff	8					4													
lack of motivation among BR&M staff (staying in one job group for long	9	3		1								1	3			3		4	

inadequate capacities to undertake some programs	10																	
inadequate human resource capacity	11																	
poor staff morale	12						1			5								
low levels of capacity building	13												3					
poor working conditions	14												4					
lack of collaborations between departments eg park management and biodiversity towards contribution to the organizing mandate	15																	
limited tools of trade and skills - no refresher	16				5													
lack of updated technology and skills to conserve wildife	17											1						
poor resource mobilization	18				1			2										
inadequate information on wildlife numbers/population in specific Parks	19						4				5						2	
inadequate capacity of running or maintaining the database	20																	
incomplete datasets	21			2														5
scattered data (data in different areas, institutions)	22		2						3			3				5		
data hoarding	23													4				
inadequate resources for wildlife conservation	24					3	5			4			5					4
poor information dissemination/ public awareness on data available and competencies	25					2				1							3	
no networking /very individual	26				2													
lack of quality data	27								5									
lack of communication startegy forresearch findings	28																	
lack of linkage to other databases both national and international levels	29		1						4									
data organizational and storage problems/ lack of data equity, sharing & storage protocol	30	2		4	3			5			4			2	1		3	
lack of standardized ways of data collection	31										2			1				
insufficient tools and equipment data collection and analysis	32				1													
inadequate funds to maintain scientific equipment	33																	

lack of data on wildlife carrying capacity	34																	
lack of spatial data infrastructure	35								2						5			
lack of national wildlife status report	36																	
lack of population trends of elephants in all Pas over the years NB. Should show the changes both in numbers and habitat change	37																	
lack of complete documentation of threats to species conservation	38																	
lack of wildlife data outside KWS protected areas	39																	
no informtion on satus of wildlife habitats	40							3										
lack of valuation for wildlife ecosystems	41															4		
government priorities in conservation	42									2						3		
lack of priority areas for research	43							1										
visitor security	44																	
spread of invasive species	45																	
Human wildlife conflict	46		3		2								4					1
wildlife security /poaching of elephants and icons and the spatial relationship to human settlement	47																	
trophy hunting/poaching	48											4						
bushmeat poaching	49																	
lack of endangered species survival strategies	50																	
species genetics (inbreeding)	51																	
wildlife diseases outbreaks	52																	
species loss	53	5	4		5		4						5					
population dynamics of lions in savannah and problems facing their conseravtion services	54																	
wildlife mortality (road kills)	55																	
loss of genetic biodiversity	56																	
increased tsetse fly population in PA's	57																	
movement patterns of elephants across Kenyan ecosystem	58																	

clearly showing the existing corridors that should be protected and gazetted																			
loss of wildlife dispersal areas	59																		
habitat loss	60	4	5	3			5	2			3				2		5		
habitat fragmentation	61																		
habitat degradation	62				4					2		3							2
pollution of water bodies	63																		
encroachment into wildlife range areas by growing human population	64																		
protected area encroachment	65												5					1	
livestock incursion in PA's	66	1															2		
national park insularization into big zoos	67																		
infrastructure development in conservation areas	68																		
wildfires in key habitat	69							4											
biomass changes in protected areas and the cause of change in biomass	70																		
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water scarcity during dry spells	73																		
Drought	74																		
weather variability	75																		
inconsistency of frequency of data and methods	76							3											
climate change	77														1				
insufficient data for management	78																		
lack of specialization on certain species	79																		
need to include smaller species not just big ones	80																		

Stakeholder analysis

STAKEHOLDERS

1. NMK
2. Universities
3. community wildlife service
4. Ecological Monitoring and Species Department
5. Planning and EIA Department
6. Security department
7. Nature Kenya
8. NEMA
9. EIA & SEA Consultants
10. KFS
11. KeNHA
12. County Governments
13. Resource Planners
14. Kenya Bureau of Statistics
15. Park Managers
16. KWS Coorporate divisions
17. Ministry of lands/ National Land Commission
18. Ministrry of Mining
19. Ministry of Environment and Natural Resources
20. Community Conservancies
21. UNEP
22. UNDP

23. KWS Land Department
24. KWS Customer Care department
25. KWS Business Development Department
26. KWS Parks and Reserves department
27. National Biosafety Authority
28. KEARLO
29. Tourism Wardens
30. Northern Rangeland Trust NRT
31. Zoological Society of London ZSL
32. WWF
33. Grevy Zebra Trust
34. Learning institutions
35. European Union
36. IUCN & CITES
37. Security Wardens
38. NGOs
39. Central Government Departments
40. Law Enforcement Agencies, police
41. Local communities
42. KWS Finance department
43. International Researchers
44. The public
45. Ecosystems and landscape department
46. Conservation Education Department
47. Kenya Forestry Research Institute
48. East Africa Wildlife Society
49. Resource Mobiliztion Department

50. Africa Forest Forum
51. Center for International Forest Research (CIFOR)
52. DRSRS
53. Veterinary Department
54. Research Institutes
55. Marketing department
56. Research Institutes
57. Research Students
58. Interns and Attachees
59. Ministry of Tourism
60. Bilateral/ Multilateral partners
61. Investors and funders
62. Spatial ans physical planners
63. Ministries dealing with policy and MEAs
64. AWF
65. Tsavo Trust
66. David Sheldrick
67. STE
68. IFAW
69. Ranches
70. KWSTI
71. Wildlife Works
72. Human Resource Department
73. Nature Kenya
74. Kenya Water Towers Authority
75. Water Resources Management Authority
76. Kenya Tsetse and Trypanosomiasis Eradication Council

77. Born Free Foundation
78. Space for Giants
79. Save the Elephants
80. Fisheries Department
81. Problem Animal Management Unit
82. Ministry of works and infrastructure development
83. planning Ministry
84. Ministry of Agriculture
85. Mara Elephant Project
86. KWS Elephant programme
87. KWS Carnivore Liason department
88. Mara Lion Project
89. Mara Cheetah Project
90. Mara Hyena Research Project
91. Friends of Maasai Mara
92. Vi-Agroforestry
93. Office of the president
94. GBIF
95. GIS Department at KWS

Presentations

Biodiversity Training Workshop:

KWSTI, 19-20 December, 2017

Workshop Objectives

- Objective 1: Introducing workshop participants on the benefits of GIS and RS technology
- Objective 2: Assessing the status of both spatial and non spatial biodiversity information in KWS
- Objective 3: Assessing biodiversity information and GIS requirements for KWS
- Objective 4: Introducing researchers to ornithology

Workshop Structure

The workshop will be conducted through:

- Plenary presentations and discussions
  - Presentations by experts
  - Demos and Tutorials
- Brainstorming sessions

Summary of Workshop Agenda

The workshop agenda is as follows:

1. Session I: Introduction to GIS & Remote Sensing
2. Session II: Status of Biodiversity information at KWS
3. Session III: GIS&RS Applications
4. Session IV: Introduction to Ornithology

The GBIF-Funded Project

- Project Title: "*Organizing and mobilizing biodiversity information from the Kenya Wildlife Service*"
- EU Funding through GBIF-60,000 Euros
- Activities to date:
  - participation in the BID Capacity Enhancement Workshop that was held in Kigali, Rwanda from 22nd-25th August, 2016.
  - The second activity comprised the organization of an inception workshop which was held from 27th-30th September, 2016 in Nairobi, Kenya.
    - Understanding gained on biodiversity related datasets that exist in Kenya Wildlife Service's (KWS) field stations and also at Nature Kenya
    - Biodiversity data standards e.g Darwin Core

WHAT IS THE GLOBAL BIODIVERSITY INFORMATION FACILITY?

GBIF enables *free and open access to biodiversity data* online.

We're an international government-initiated and funded initiative focused on making biodiversity data available to all and anyone, for scientific research, conservation and sustainable development.

Status data portal
October 2012

388,680,911 indexed records
10,067 datasets
422 publishers

Access data portal

Slide developed by Donald Hobern

GBIF's unique role

- Registry of biodiversity data resources
- Tools and support for biodiversity data publication
- Network development at national, regional and global levels
- Global virtual natural history collection
- Cross-domain linkage between data from collections, ecology and genomics
- Access to biodiversity data for GIS analysis and environmental monitoring
  - Aggregated presence data
  - Site-based survey data (samples, presence/absence)

Project Activities covered by the Training Workshop

INCREASE AVAILABLE BIODIVERSITY DATA

- **Database Mobilization**
  - *Determine biodiversity information user needs*
  - *Identify data gaps viz a viz identified user needs*
  - *Constitute data management technical committee*

INCREASE AVAILABLE BIODIVERSITY DATA

- **Database Design:**
  - *Extract data from existing soft and hard copy records*

ESTABLISH OR STRENGTHEN FACILITIES

- **Biodiversity Training**
  - *GIS using QGIS*
  - *Image processing using Land Impact Tool and SPIRITS*
  - *Ornithology 101 for WPA biodiversity inventories (taught by Nature Kenya)*
  - *Bioinformatics 101 (NMK)*
  - *Botany 101 (NMK)*

Key Project Activities for the next six months

- Activities to be implemented in the next six months:
  - *Biodiversity training workshop*
  - *Data Mobilization*
  - *Data Base Design*- Design biodiversity database based on user needs
  - *Coding*- Develop a Web interface for data entry, queries, reports and data export
  - *Populate Database*
  - *Publishing data*
  - *National Workshop to disseminate information*

Contract with GBIF

Dataset title	Publishing institution	DOI or URL/Planned hosting institution	Date/ expected date of publication	Explanatory notes
Aerial Census	KWS	KWS	Pilot - Feb 2017 Full publish - Oct, 2017	Dataset is on large mammals that are counted during aerial censuses. It is for major ecosystems in Kenya and a bit of Tanzania. The ecosystems include Tsavo-Mkomazi, Amboseli-West Kilimanjaro and Laikipia-Samburu. The data are for the period 2000 - 2010. They are in ArcGIS Shapefile format.
Ground Census	KWS	KWS	Oct, 2017	Dataset is on large mammals for ground censuses conducted in various conservation areas that include Nairobi and Lake Nakuru National Parks. The data are for the period 2000-2013. They are in Microsoft Excel format. They do not have GPS coordinates
Marsabit Forest Ecosystem Plants	KWS	KWS	Oct, 2017	The checklist is for the Marsabit Forest Ecosystem which is in Nothern Kenya. It is in MS Word format. The checklist is for data collected in 2014-15.
Mt. Kenya Forest Ecosystem	KWS	KWS	Oct, 2017	The checklist is for Sirimon and Chogoria sectors of the Mt. Kenya Ecosystem. The checklist is for data collected in 2015 and is in MS Word.
Zoology collection data	NMK	NMK	Oct 2017	Birds, mammals, reptiles/amphibians, fishes, bones and invertebrates preserved as dry and wet collections
Botany collection data	NMK	NMK	Oct 2017	Reference collections preserved as herbarium materials, metadata, reports
Kenya Bird Map	NK	NK	Oct 2017	Data on birds at national level. Data is from 2014 to present. It is geo-referenced and is in MS Excel format
Bird Areas	NK	NK	Oct 2017	Data on birds at global level. Data is from 1999 to present. It is geo-referenced and is in MS Excel format

Biodiversity Information Management: Problem & Opportunities Analysis

Problems and opportunities analysis

- What specific biodiversity related problems and opportunities does KWS address to achieve its mandate?
  - Refer to KWS functions Section 7 of the Act and the organizational structure

Brainstorm ideas on the cards:
One idea per card
Large letters so all can read
Red for problems
Blue for opportunities

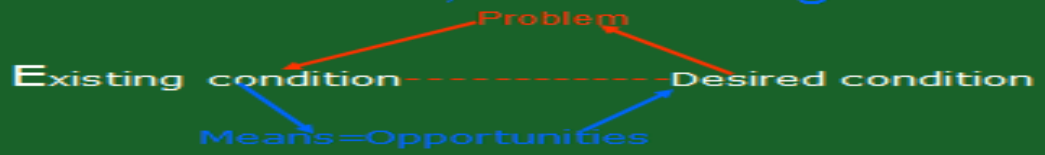
Problems and opportunities analysis

- **Problem =** The gap between the existing and desired condition/end state

e.g poaching, poor visitor experience

Opportunities = things that can be exploited to attain the desired conditions.

e.g professional WPU, trained tour guides



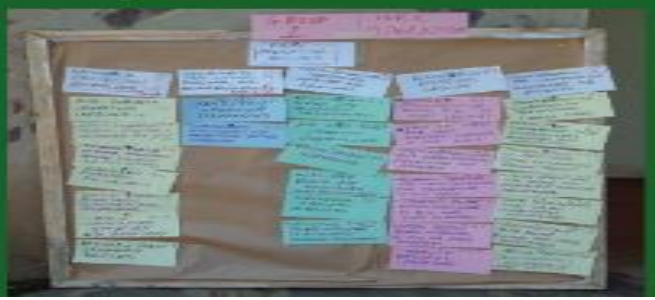
Group ranking of problems and opportunities

- Scan the board and note down the numbers of the five cards you think are most important
- Rank the five chosen cards in order of importance, 5 being most important, and 1 being the least

For example:

Top Card no.	Ranking
15	4
22	1
9	3
3	5
2	2

- Tools: zopp cards give flexibility
  - Capture results with photograph and transfer to workshop report.
  - Capture the discussion during the workshop



Identification of potential Management Components/themes and aligning with KWS structure

- Refer to the management structure of KWS (Divisions, departments etc.)
- Which problem and opportunity themes fall under the jurisdiction of the various Divisions/departments?

Example: Management Components & Programmes

Five Management Programmes:

Ecological Management	Tourism Development and Management	Community and Education	Security	PA Operations
▸ Habitat management ▸ Animal management ▸ Ecological monitoring	▸ Infrastructure development ▸ Product diversification ▸ Administration /management ▸ Marketing	▸ Human-wildlife conflict ▸ Community Mobilisation ▸ Community projects ▸ Education and awareness	▸ Revenue and asset security ▸ Visitor security ▸ Wildlife security	▸ Human resources ▸ Administration and finances ▸ Infrastructure development ▸ Communications ▸ Institutional collaboration





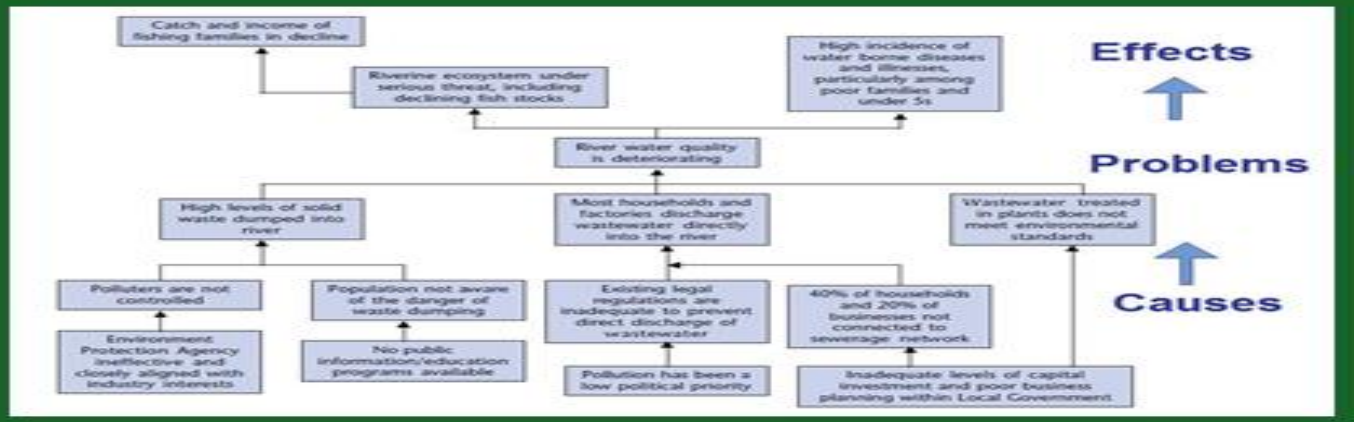
Information requirements for planning

- For each of the major problem and opportunity management component/theme identify:
  - What information is needed for wildlife management?
  - Does this information already exist, and if so where can it be found?
  - If this information needs to be collected, how can this best be done?
  - What stakeholder consultations are needed, and who should do them?

Management Component	Information Requirements for management	Sources of information	Availability/ where
Habitat management	Vegetation	Land cover map	Available at field station
Animal management	Wildlife trends	Population census reports	Available at KWS HQ EM Department
Ecological monitoring	rainfall	Rainfall records	Not available

Clarifying Management Problems

Problem tree analysis(example)



Problem Tree analysis

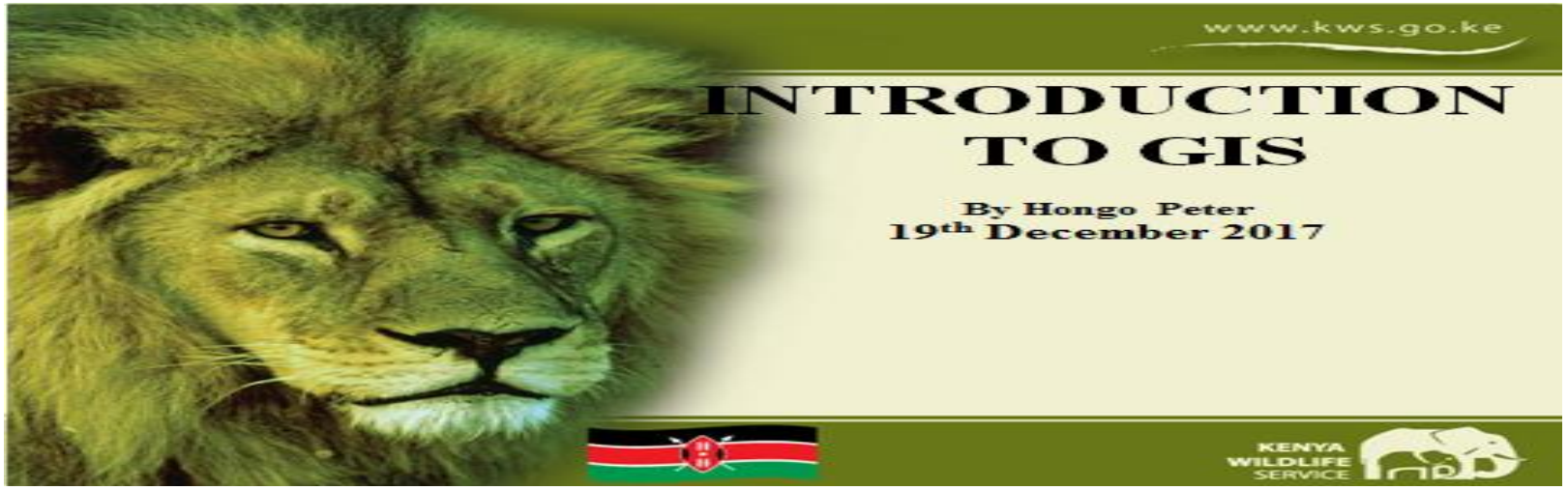
- From the problem ranking, select five problems that participants are passionate to have addressed.
- For each of these 'core problems' identify its "causes' and "effects"
- Identify sub-problems that BRM can intervene
- Identify the spatial and non-spatial information requirements for these sub-problems

Stakeholder Analysis

Stakeholder Participation strategy

- Brainstorm who you consider are the key departments at KWS and other organisations that will use your biodiversity information database as well as the GIS Database
- Categories of stakeholders to consider:
  - Supporters/Beneficiaries
  - Partners/Collaborators
  - Policymakers

Thank You



OUTLINE

- GIS Overview
- Data collection, tools, equipments, data types and required skills
- Datasets required by the project
- QGIS

GIS DEFINITION

www.kws.go.ke

- An organized collection of **computer hardware, software, geographic data, and personnel** designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information (*i.e. geo-referenced information*)

— *ESRI*

KENYA WILDLIFE SERVICE

GIS ORGANISATIONAL VIEW

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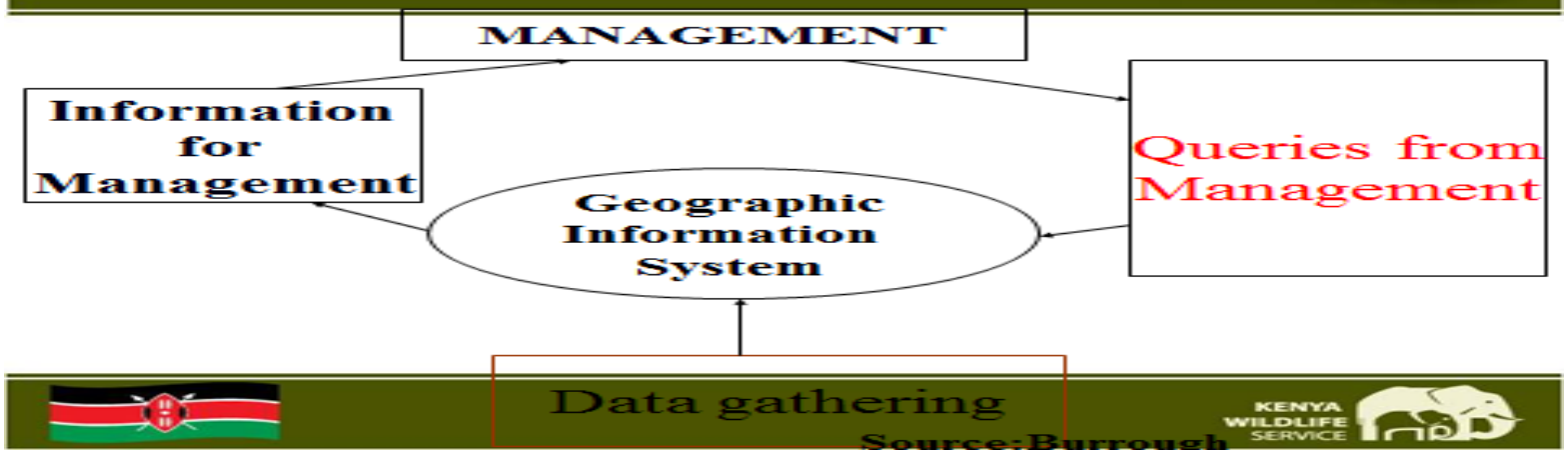

KENYA WILDLIFE SERVICE

A GIS ENABLES YOU TO ANSWER 5 TYPES OF QUESTIONS.

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I. What is at?

II. Where is it?

III. What has changed since?

IV. What spatial patterns exist?

V. What if...?

Complexity

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i. What is at?

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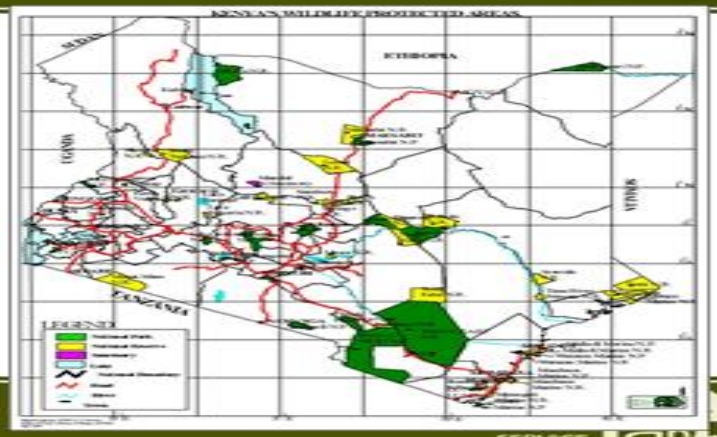
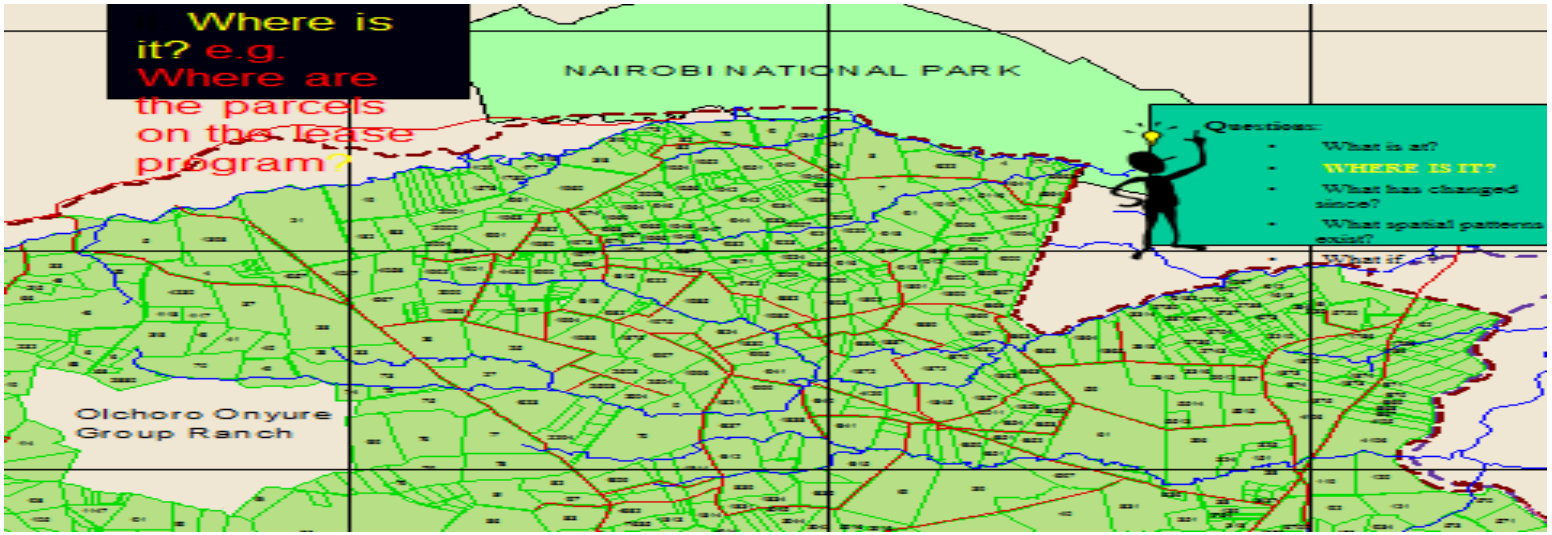
Questions:

- WHAT IS AT?
- Where is it?
- What has changed since?
- What spatial patterns exist?
- What if...?



SERVICE


Where is it? e.g. Where are the parcels on the lease program?
NAIROBI NATIONAL PARK
Questions:
What is at?
WHERE IS IT?
What has changed since?
What spatial patterns exist?
What if ?
Olchoro Onyure Group Ranch


NAIROBI NATIONAL PARK

iii. What has changed since?

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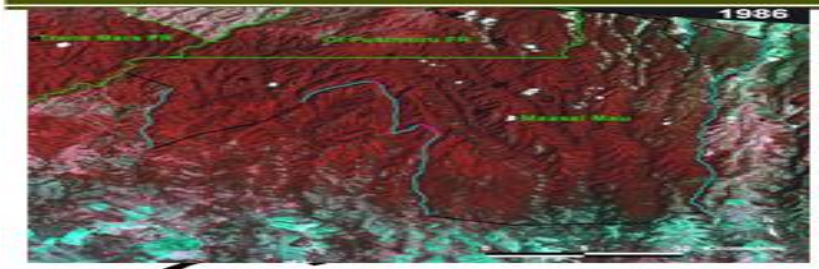

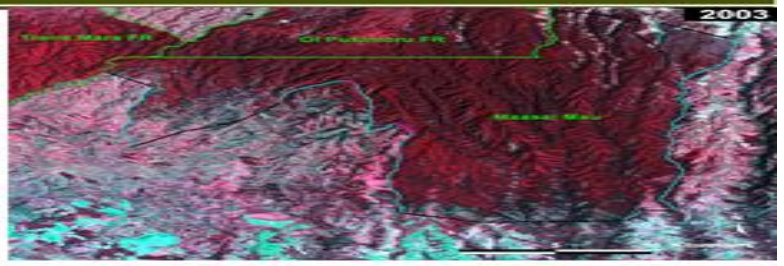

Questions:

- What is at?
- Where is it?
- WHAT HAS CHANGED SINCE?
- What spatial patterns exist?
- What if…?

KENYA WILDLIFE SERVICE

iv. What spatial patterns exist?

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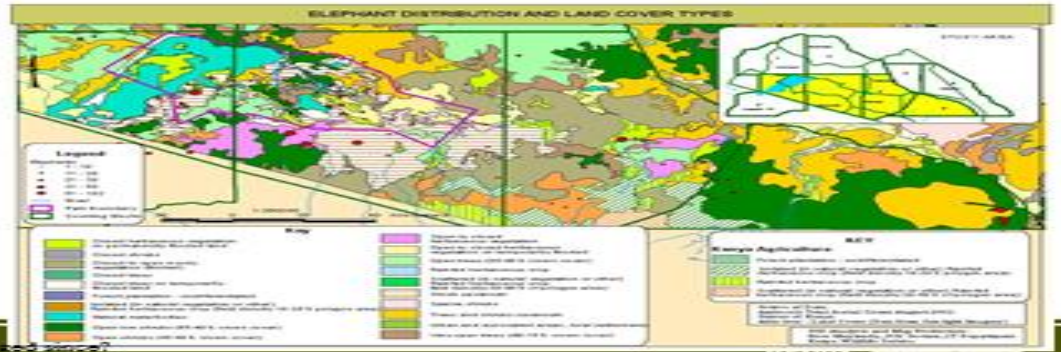
Is there a relationship between elephant locations and vegetation type?



Questions:

- What is at?
- Where is it?
- What has changed since?
- WHAT SPATIAL PATTERNS EXIST?
- What if…?

KENYA WILDLIFE SERVICE

v. What if?

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1. What if temperatures increased by 1 degree Celsius due to climate change.

How will this affect the wildlife habitats?

Questions:

- What is at?
- Where is it?
- What has changed since?
- What spatial patterns exist?
- WHAT If?

KENYA WILDLIFE SERVICE

Tools for data collection

www.kws.go.ke

1. Checklists: Can be simple lists of criteria that can be marked as present or absent, or can provide space for observer comments.

- These tools can provide consistency over time or between observers
- can be used for evaluating databases

2. Interviews: Conversation between two or more people where questions are asked by the interviewer to obtain information from the interviewee(s)

- The purpose of the interview is to probe the ideas of the interviewees about the phenomenon of interest.

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Tools for data collection Cont'd

3. Observation: This can be done directly or indirectly with the subject knowing or unaware that you are observing them

- KWS collects data through continuous observation e.g. by collaring or via set time periods depending e.g aerial censuses

4. Surveys or Questionnaires: Surveys or questionnaires are instruments used for collecting data in survey research

- A set of standardized questions are ask for the purpose of gathering information from respondents

Tools & Equipments for data collection

Types of Data (General)

www.kws.go.ke

GIS data type reflects the data found on a map

a). Spatial data: describes the absolute and relative location of geographic features – try to answer where is.

Spatial data format: Raster and Vector)

b). Attribute data: describes characteristics (quantitative and/or qualitative) of spatial features and can contain information about the what, where, and why.

- Eg: The coordinate location of a PA would be spatial data, while the characteristics of that PA , e.g. cover group, dominant species, crown closure, height, etc., would be attribute data.

c) Other data types, in particular image and multimedia data, are becoming more prevalent with changing technology.

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GIS Skills Required

www.kws.go.ke

Spatial Data and Algorithms understanding: Be familiar with how certain operations are carried out and when they are applicable

Data entry: Enter data into a database successfully with minimal errors.

Data conversion: The ability to convert data from either older sources (digitization) or from multiple sources to common format.

Data maintenance: Be able to maintain data, correctly archive and ensure quality control

Metadata creation and editing:

GIS Analysis: Be able to perform GIS Analysis as it is often used to solve common problems. R/Sensing skills required mainly for data collection

GIS Workflow: Understand the workflow to perform some procedure and be able to follow it and enhance it as needed. Also SOP

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GIS Skills Required Cont'd

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- Familiar with cartographic principles and design. Think of color, symbology, fonts, etc. Bad cartographic design will often make your analysis hard to interpret.
- **Basic understanding of programming**: Be able to understand what programming is and what it can do to solve certain problems
- **Web Services knowledge and experience**: Web services are everywhere these days, and GIS is not escaping. HTML, cascading style sheets (CSS), JavaScript, XML, etc.
- **Ability to translate user needs to solutions**
- **Formal training** (eg. Degree) or high level of experience with GIS
- Employers should have some Knowledge of Cartography /Geography (which way is North? what does a map projection really mean?)

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Examples of Datasets

www.kws.go.ke

- Aerial census (Amboseli-Kilimanjaro, Tsavo-Mkomazi, Laikipia-Samburu)
- Ground census - (NNP, LNNP)
- Marsabit Forest Ecosystem –(Plants, Large Mammals, Small mammals, Invertebrates, Reptiles/Amphibians, Birds, Aquatic Fauna)
- Mt. Kenya Forest Ecosystem –(Avifauna, Herpetofauna, Invertebrates)
- Zoology collection data
- Botany collection data
- Kenya Bird Map
- Important Bird Areas

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GIS SOFTWARE BRANDS (EXAMPLES)

www.kws.go.ke

- COMMERCIAL
- ArcGIS
  - Desktop
    - Basic
    - Standard
    - Advanced
  - Server
- IDRISI
- MAPINFO

- OPEN SOURCE & FREE
- QGIS
- ILWIS

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QGIS

www.kws.go.ke

QGIS – The Good

- Freely available desktop application
- Lots of features
- Works with different data types
- A strong community developing new features and plug-ins

QGIS – The Bad

- A bit bug-y sometimes
- Visual style is a little clunky (cumbersome)
- It will crash (but so will ArcGIS)

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QGIS - THE BUG-Y

www.kws.go.ke

- Sometimes things get topsy-turvy -> zoom out then zoom back in
- Things don't work properly -> close and restart
- Other problems that we'll find in class

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Remote Sensing Basic

Peter Maina,
KWS GIS

What is Remote Sensing ?

A technique to measure/detect something without touch
Detecting Electric Magnetic wave using sensors.

We need something which fries from sensor to target !

Sensor

Sound or
Sun energy

Target

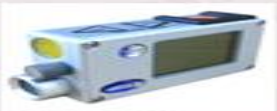
1/7/2018 3

Example of remote sensing

aa

ear
(sound)

Voice recorder



Vertex (Ultrasonic)

Sonar
(fishery)

So called " Remote sensing"

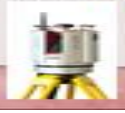
eye
(light)

camera

Leaser measurement

Thermogr
aphy

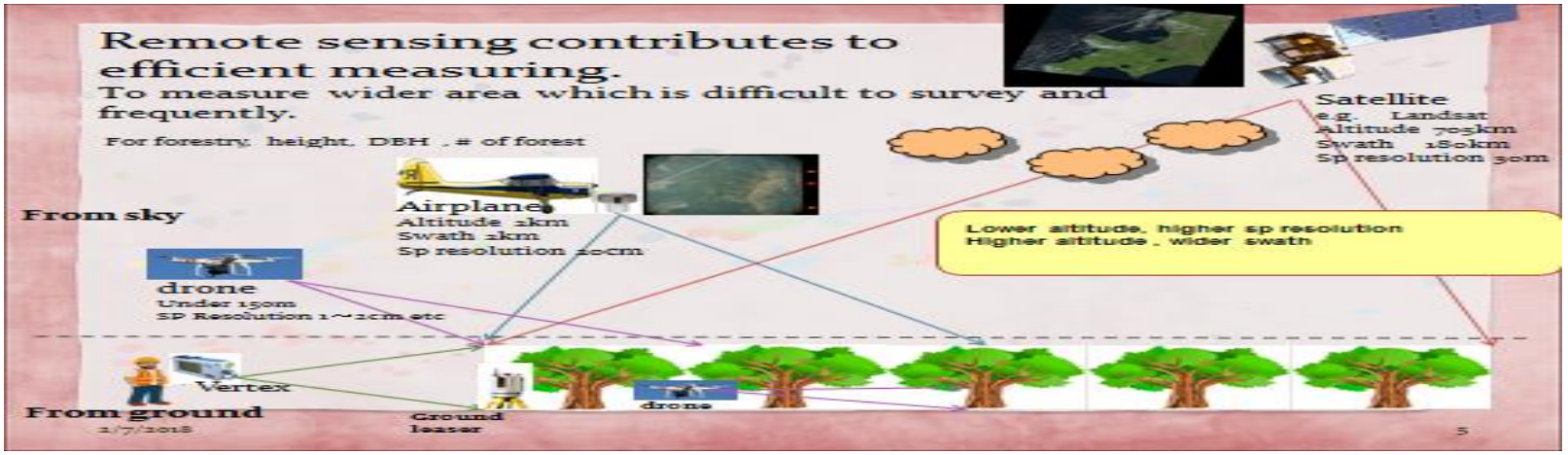
record



Ground leaser

distance

4


Remote sensing contributes to efficient measuring.
To measure wider area which is difficult to survey and frequently.
For forestry: height, DBH , # of forest
From sky
Airplane
Altitude 2km
Swath 2km
Sp resolution 20cm
drone
Under 150m
SP Resolution 1～2cm etc
Satellite
e.g. Landsat
Altitude 705km
Swath 180km
Sp resolution 30m
Lower altitude, higher sp resolution
Higher altitude , wider swath
Vertex
From ground
Ground laser
drone
1/7/2018
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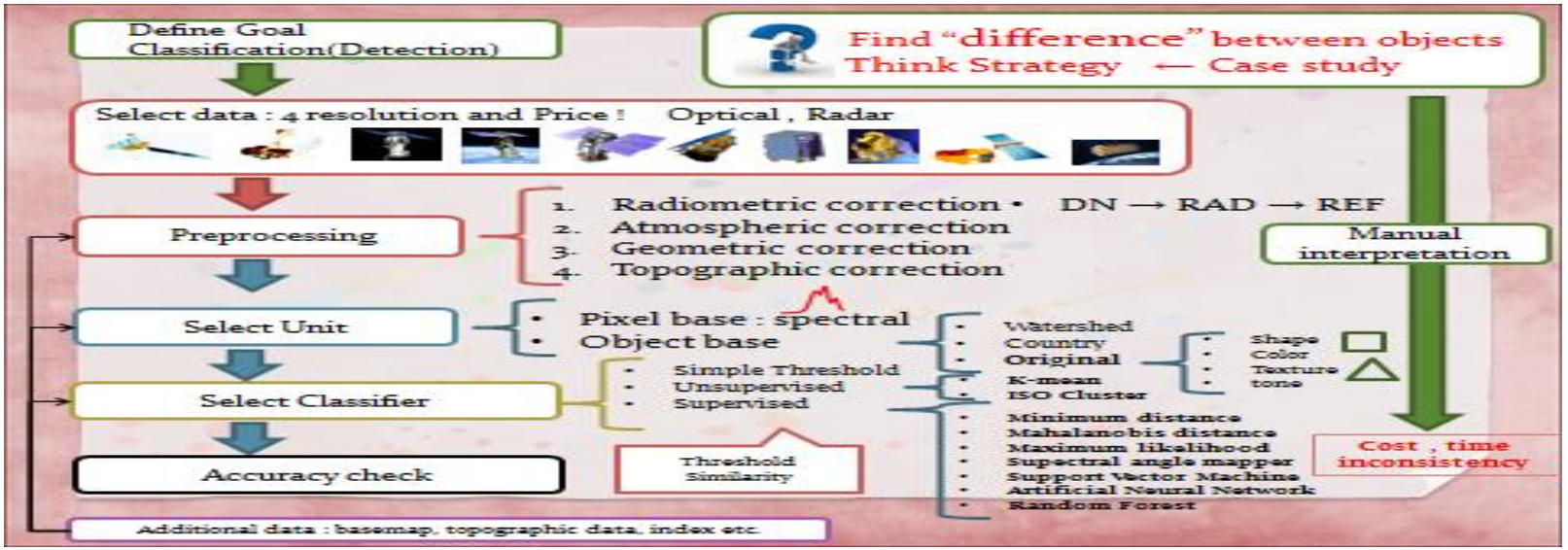
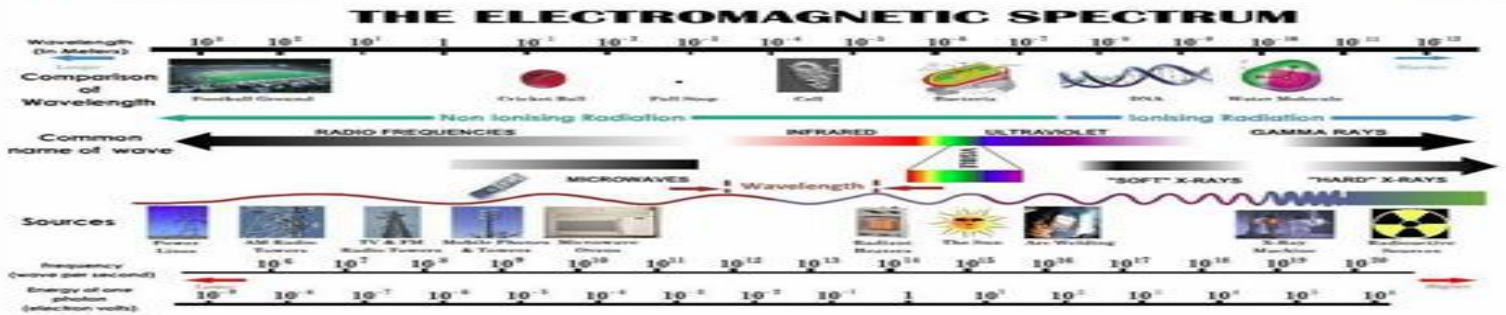

Define Goal
Classification(Detection)
Find "difference" between objects
Think Strategy ← Case study
Select data : 4 resolution and Price ! Optical , Radar
Preprocessing
1. Radiometric correction • DN → RAD → REF
2. Atmospheric correction
3. Geometric correction
4. Topographic correction
Manual interpretation
Select Unit
Pixel base : spectral
Object base
Watershed
Country
Original
K-mean
ISO Cluster
Shape
Color
Texture
tone
Select Classifier
Simple Threshold
Unsupervised
Supervised
Minimum distance
Mahalanobis distance
Maximum likelihood
Supectral angle mapper
Support Vector Machine
Artificial Neural Network
Random Forest
Cost , time inconsistency
Accuracy check
Threshold Similarity
Additional data : basemap, topographic data, index etc.

Type of Electric Magnetic Wave

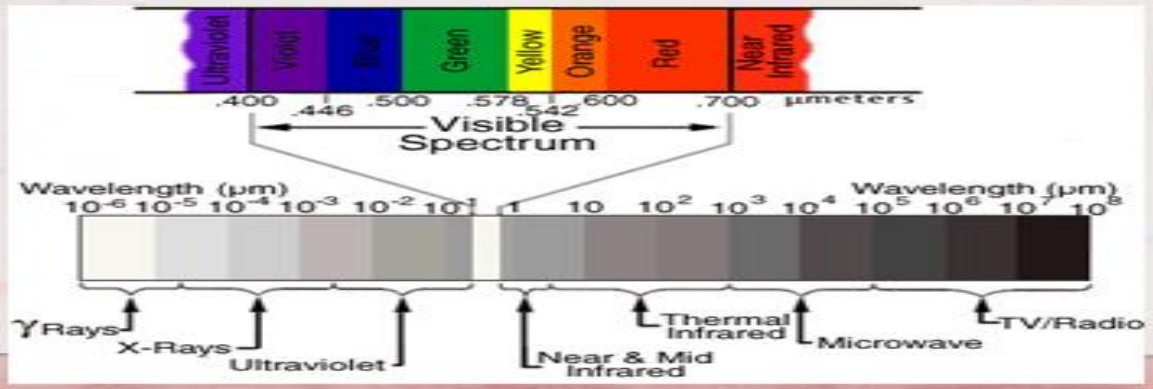
Depends on wavelength .



http://rfemissions.skmm.gov.my/Understanding-RF/What-is-Radio-Frequency-RF.aspx

Zoom into Visible range

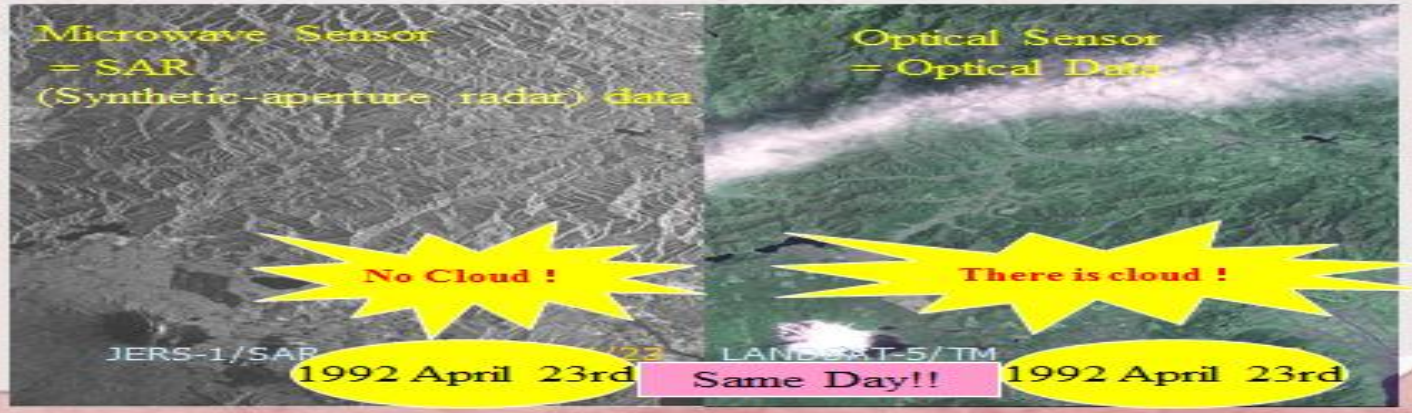
(1μm = 10^-6 m, 1nm = 10^-9m)



Type of Sensor

- Optical sensor
  →Easy to understand with our experiments.
  - Visible eyes , photos , satellite data
  - Near Infrared Satellite
- Thermal sensor
  → Easy to understand with our experiments
- Microwave sensor
  →Quite different from our feeling
  - Passive ..... Satellite data
  - Active ..... Satellite data

Difference between Optical and Microwave sensor

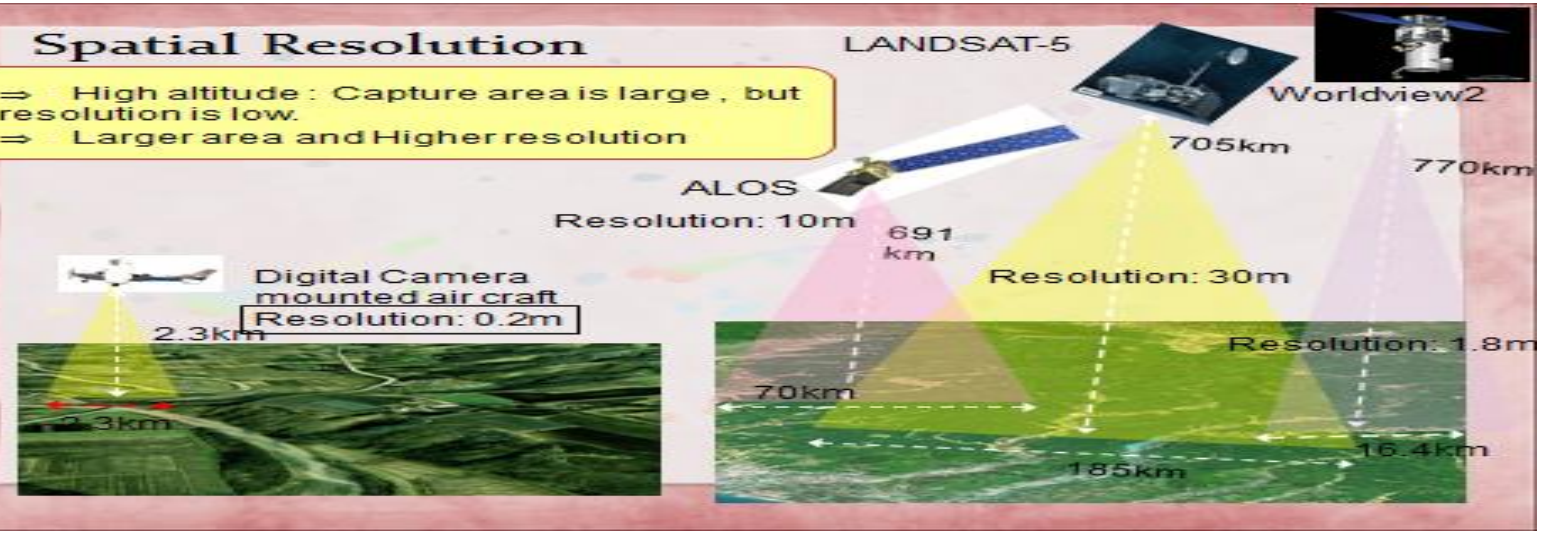


4 types of Resolution

1. Spatial Resolution
   - Cell Size
2. Spectral Resolution
   - No of Band
3. Temporal Resolution
   - How many times it can capture the same place per day / month
4. Radiometric Resolution
   - 8bit or 16bit

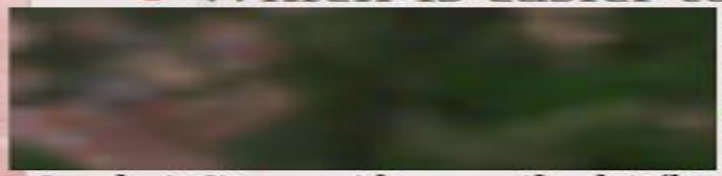
Spatial Resolution

⇒ High altitude : Capture area is large , but resolution is low.
⇒ Larger area and Higher resolution



High resolution vs Mid resolution

- Which is easier to classify ??



Landsat It can not be seen the detail

Worldview2 small shadow

Alos

1/7/2018

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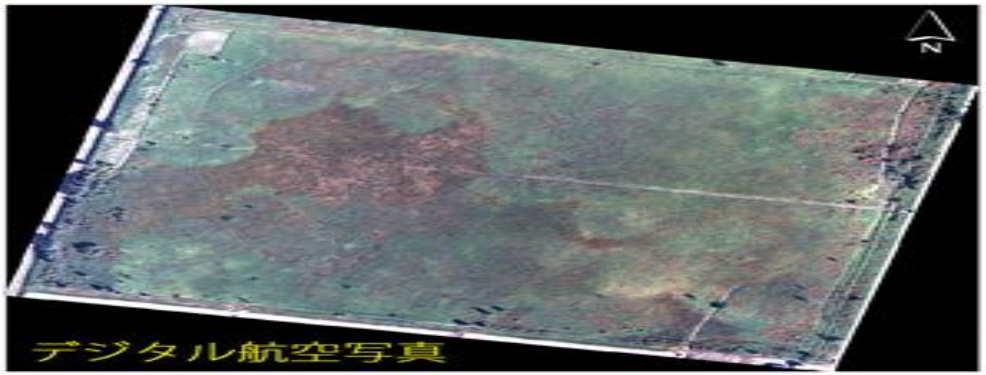
An Example



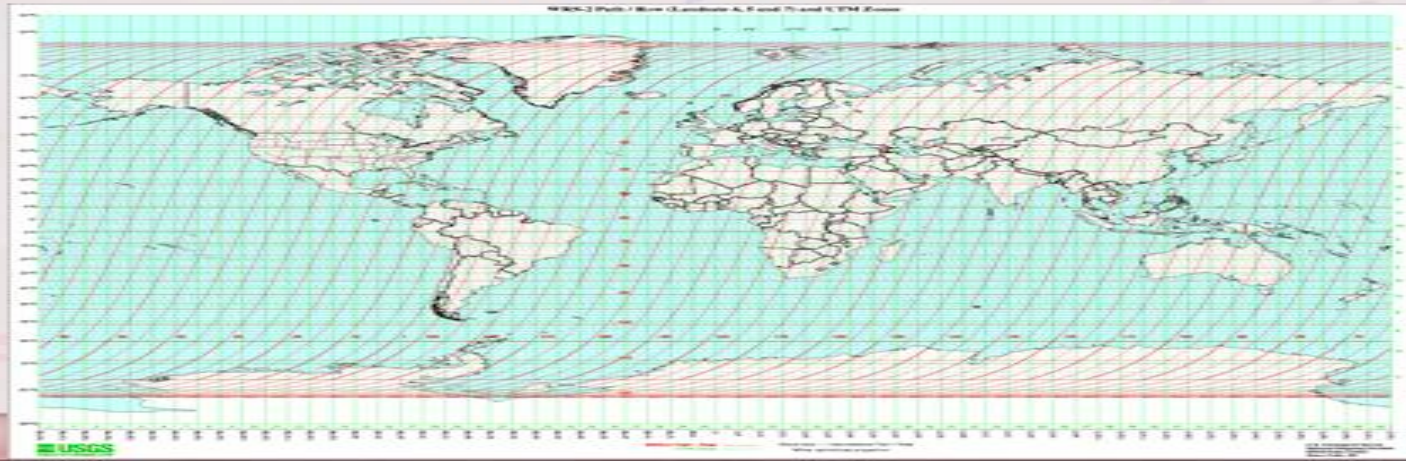
Name of satellite	Spatial Resolution
LANDSAT Color data	30m/Pixel
ALOS AVNIR-2	10m/Pixel
IKONOS Color data	4m/Pixel
Digital Airphoto image (UCD)	0.3m/Pixel

Air Photo is taken at Sep.23rd 2006

Sensor name	Landsat Multispectral Scanner (MSS)	AVNIR2	Landsat Thematic Mapper (TM)	Landsat Enhanced Thematic Mapper Plus (ETM+)	Landsat Operational Land Imager and Thermal Infrared (TIRS)	Aster	Sentinel-2A
Color/ Satellite name	Landsat4-5	ALOS(2006-09)	Landsat4-5 (1984-2013)	Landsat7 (1999-2003)	Landsat8 (2013-)	Terra(1999)	Sentinel
Coastal aerosol					B1		B1(0.44)
Blue	B1 (0.5-0.6)	B1(0.42-0.50)	B1(0.45-0.52)	B1(0.45-0.52)	B2		B2(0.49)
Green	B2 (0.6-0.7)	B2(0.52-0.60)	B2(0.52-0.60)	B2(0.52-0.60	B3	B1(0.52-0.60)	B3(0.56)
Red	B3 (0.7-0.8)	B3(0.61-0.69)	B3(0.63-0.69)	B3(0.63-0.69)	B4	B2(0.63-0.69)	B4(0.665)
Red edge							B5(0.705)
Red edge							B6(0.740)
Red edge							B7(0.783)
Near Infrared (NIR)	B4 (0.8-1.1)	B4(0.76-0.89)	B4(0.76-0.90)	B4(0.76-0.90)	B5	B3(0.78-0.86)	B8(0.842)
Red edge							B8A(0.865)
Water vapour							B9(0.945)
SWIR 1			B5(1.55-1.75)	B5(1.55-1.75)	B6	B4(1.60-1.70)	B11(1.61)
SWIR 2			B7(2.08-2.35)	B7(2.08-2.35)	B7	B6(2.145-2.185)	B12(2.190)
SWIR						B7(2.235-2.285)	
SWIR						B8(2.295-2.365)	
SWIR						B9(2.360-2.430)	
Panchromatic				B8(.52-.90)	B8		
Cirrus					B9		B10(1.375)
						B10(8.125-8.475)	
						B11(8.475-8.825)	
						B12(8.925-9.275)	
Thermal Infrared (TIRS) 1			B6(10.40-12.50)	B6(10.40-12.50)	B10	B13(10.25-10.95)	
Thermal Infrared (TIRS) 2					B11	B14(10.95-11.65)	

( ) unit is μm : Sentinel 2A shows center wavelength

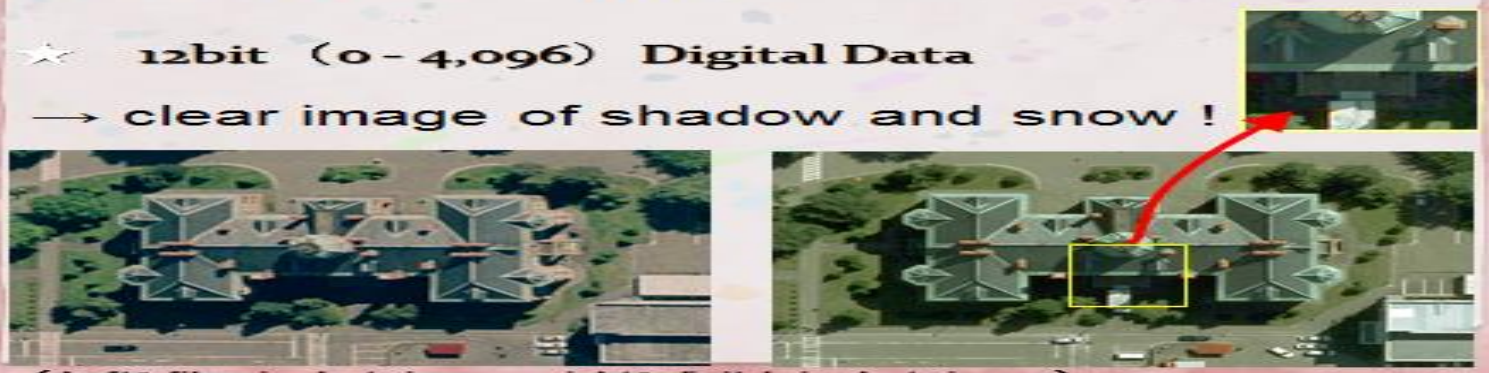
Temporal Resolution



Radiometric Resolution

☆ 12bit (0 - 4,096) Digital Data

⟶ clear image of shadow and snow !



(Left : film air photo image, right : digital air photo image)

Major Satellite Specification

Satellite	Year of launch	Spatial resolution	Swath dimensions	Temporal coverage	Spectral range	Radio metric
Landsat5 TM	1984-	M 30m,P 15m, T 60m	185km	16 days	7band	8bit
Landsat7 ETM+	1999-	M 30m,P 15m, T 60m	185km	16 days	7band,pan	8bit
Landsat8 OLI & TIRS	2013-	M 30m,P 15m, T 60m	185km	16 days	10band,pan	16bit
ALOS	2006-2011	10m,2.5m	70km	46 days(sub cycle 2 days)	4band,pan	8bit
ALOS2	2014-	3m-100m	25-490km	14 days	L band SAR	
SPOT4	1998-	20m,10m	60km	26 days	4band,pan	8bit
SPOT5	2002-	10m,5m,2.5m	60km	26 days	4band,pan	8bit
SPOT6, 7	2012-2014-	M 6m, P 1.5m	60km	26 days	4band,pan	
Quickbird	2001-	2.44m,0.61m	16.5km	1-3.5 days	4band,pan	11bit
GeoEye1	2008-	1.64m,0.41m	15.2km	11 days	4band,pan	11bit
Worldview2	2009-	1.85m,0.46m	16.4km	1.1-3.7 days	8band,pan	11bit
Worldview1	2007-	0.50m	17.6km	1.7-5.9 days	pan	11bit
Worldview2	2009-	1.85m,0.46m	16.4km	1.1-3.7 days	8band,pan	11bit
Worldview3	2014	1.24m-30m,0.3m	13.1km	1-4.5 days	8band(multi,SWIR,12Band,CAVIS,pan	11bit 14bit

Major Satellite specification

Satellite	Year of launch	Spatial resolution	Swath dimensions	Temporal coverage	Spectral range	Radiometric
Aster	1999-	VNIR 15 m SWIR 30 m TIR 90 m	185km	16 days	14band	8bit
IKONOS	1999-	4m,1m	11km	11 days	4band,pan	11bit
Rapideye	2008-	5m	77km	5.5 days	5band	12bit
Sentinel 1A,B	2014- 2016-	5m	- 400km	5 days with constellation	C-band SAR dual pola	
Sentinel 2A,2B	2015- 2016-	10,20,60m	290km	5 days with A,Bconstellation	12band	

References
- Satellite sensor information
  - http://www.satimagingcorp.com/

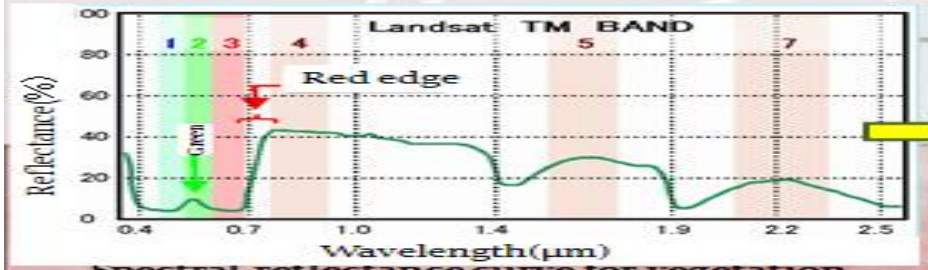
Taking 4 resolution into consideration ! Which satellites are good for you purpose ?

- Forest change , landcover change (spatial , temporal :cloud free)
- Detect many type of tree, distribution of coral reef (spectral, spatial)
- Understanding farm land, what kind of crops) (spectral , spatial ,temporal)

↑Radiometric resolution should be considered in all cases. (Snow area , mountain area with many shadow.)

Each material has each Spectral reflectance curve.

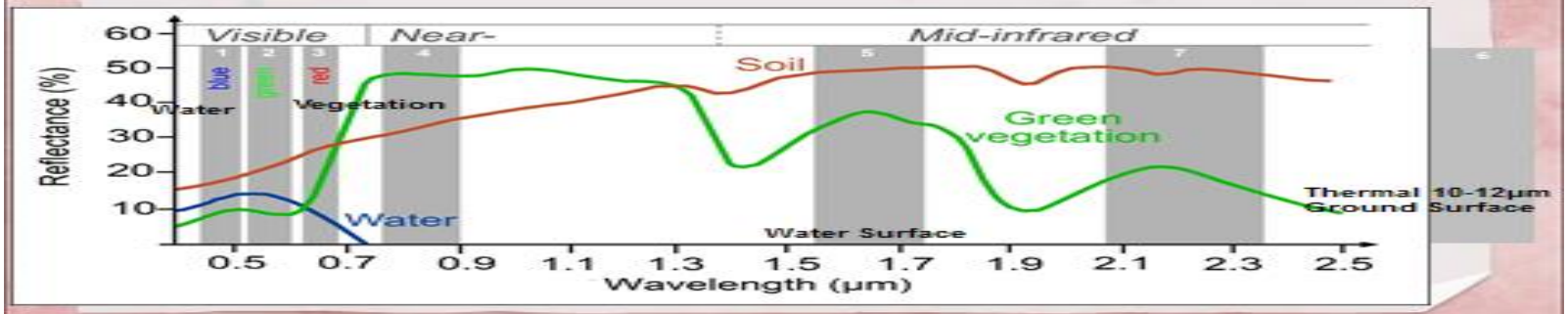
Why can we see plants as green ?



Spectral reflectance curve for vegetation

Landsat

Each band can capture defined range of wave length



To Understand Band combination with spectral profile

- **Make band combination with Landsat , Sentinel2 , Aster**
- **e.g landsat8**
  - Agriculture: Highlights agriculture in bright green. Bands 6,5,2
  - Natural Color: Sharpened with 15m panchromatic band. Bands 4,3,2+8
  - Color Infrared: Healthy vegetation is bright red. Bands 5,4,3
  - SWIR (Short Wave Infrared): Highlights rock formations. Bands 7,6,4
  - Geology: Highlights geologic features. Bands 7,4,2
  - Bathymetric: Highlights underwater features. Bands 4,3,1
  - Panchromatic: Panchromatic image at 15m. Band 8
  - Vegetation Index: Normalized Difference Vegetation Index (NDVI). (Band5-Band4)/(Band5+Band4)
  - Moisture Index: Normalized Difference Moisture Index (NDMI). (Band5-Band6)/(Band5+Band6)

Understanding spectral characteristic

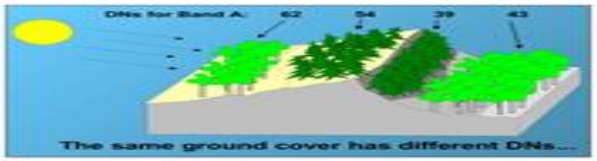
- **Check spectral profile of the objects using multispec**
  Or http://landsatapp.s3-website-us-west-2.amazonaws.com/

Image Preprocessing

Topographic Correction
Radiometric Correction
Atmospheric Correction
Geometric Correction

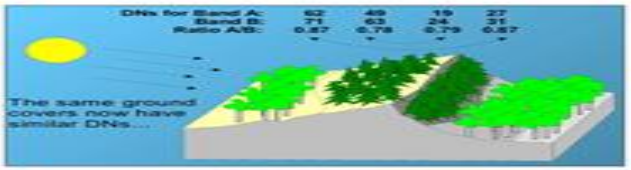
Ratio (reflectance or index) is good for remote sensing.

Problem of Varying Illumination



Band B has the Same Problem

Ratio of Band A to Band B



- Topography
- Different weather condition

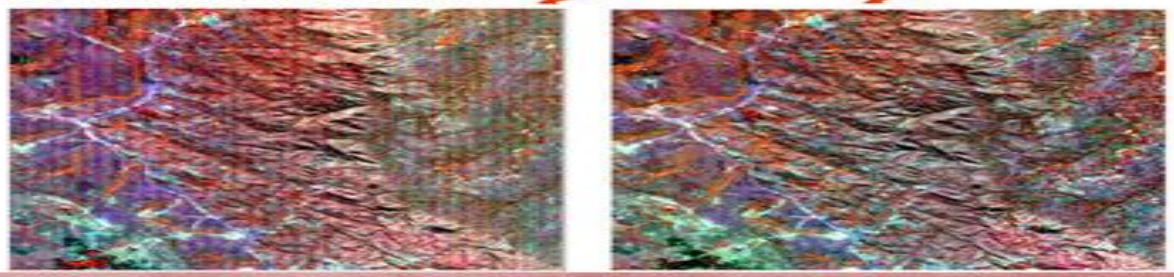
Results of Topographic correction

Not Corrected

Corrected
Minnert correction

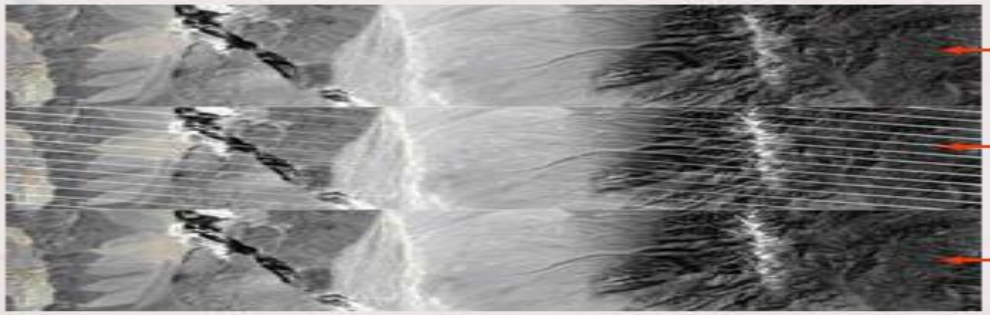
Radiometric Correction

- Line Dropout
- Striping or banding (detector out of adjustment)
- Line Start problems
- Sensor Saturation



Landsat-7 Scan Line Corrector Failure

Error first noticed during May, 2003

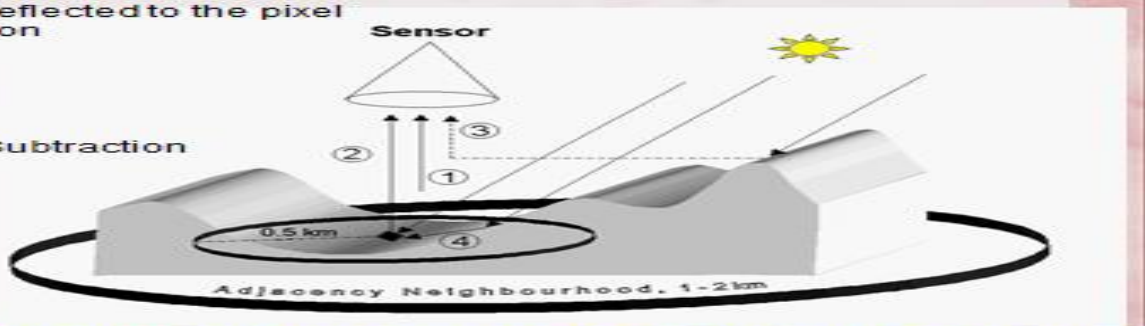


Landsat-7 image of Railroad Valley

Atmospheric correction

Remove ①、③、④ and get ② from the viewed pixel

- Affected by Atmosphere
  - ① Path radiance
  - ③ terrain radiation reflected to the pixel
  - ④ adjacency radiation
  - X ≒ (①+③+④)
- Method
  - MODTRAN
  - 6S
  - Dark Object Subtraction
  - And many



Ref. NASA: http://landsathandbook.gsfc.nasa.gov/data_prod/prog_sect11_3.html

Google Earth Engine and Remote Sensing

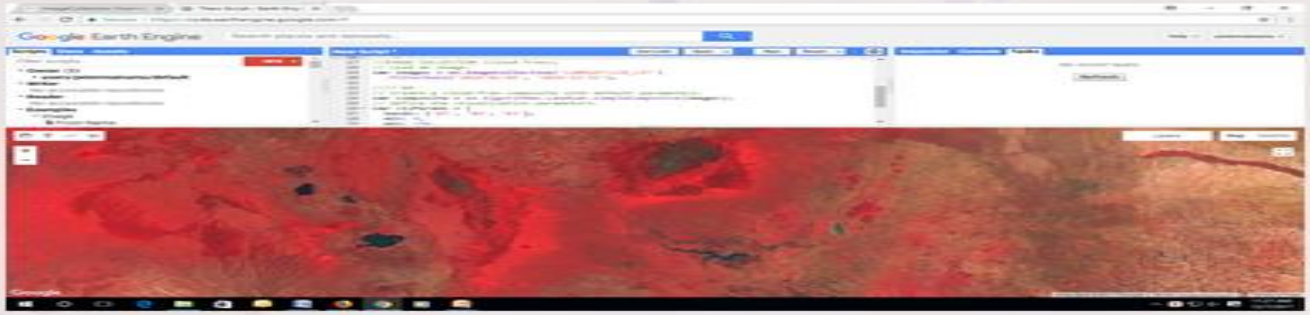
- The advantages of Google earth
  - Satellite imagery such as Landsat, sentinel etc. is prepared in the server
    You do not have to worry about storage.
    Time-consuming download process is no longer required.
  - All processing will be done in the google server.
    A high performance pc is not necessary.
    Sufficient Internet speed is required.
  - ➢ You can write your script in the code editor.
  - ➢ You can see the samples codes in the script manager then copy them to code editor.

Sample Code (All Images for Kenya)

```
// Load an image.
var image = ee.Image('LANDSAT/LC8_L1T_TOA/LC80440342014077LGN00');

// Define the visualization parameters.
var vizParams = {
  bands: ['B5', 'B4', 'B3'],
  min: 0,
  max: 0.5,
  gamma: [0.95, 1.1, 1]
};

// Center the map and display the image.
Map.setCenter(36.9786, -0.2443, 10); // San Francisco Bay
Map.addLayer(image, vizParams, 'false color composite');
```

```
IMAGE COLLECTION (cloud free)
// Load an image.
var images = ee.ImageCollection('LANDSAT/LC8_L1T')
  .filterDate('2016-01-01', '2016-12-31');

//// 04
// Create a cloud-free composite with default parameters.
var composite = ee.Algorithms.Landsat.simpleComposite(images);
// Define the visualization parameters.
var vizParams = {
  bands: ['B5', 'B4', 'B3'],
  min: 0,
  max: 400,
  gamma: [0.95, 1.1, 1]
};

// Center the map and display the image.
Map.setCenter(36.9786, -0.2443, 10); // mt kenya
Map.addLayer(composite, vizParams, 'false color composite');
```

Google Earth Engine (Code Editor)



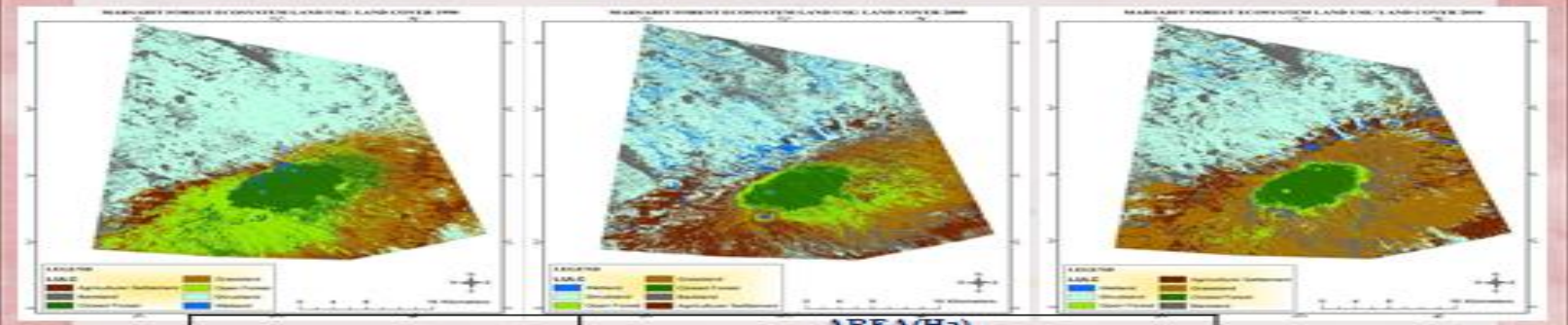
https://code.earthengine.google.com/

Simple Programming (R)

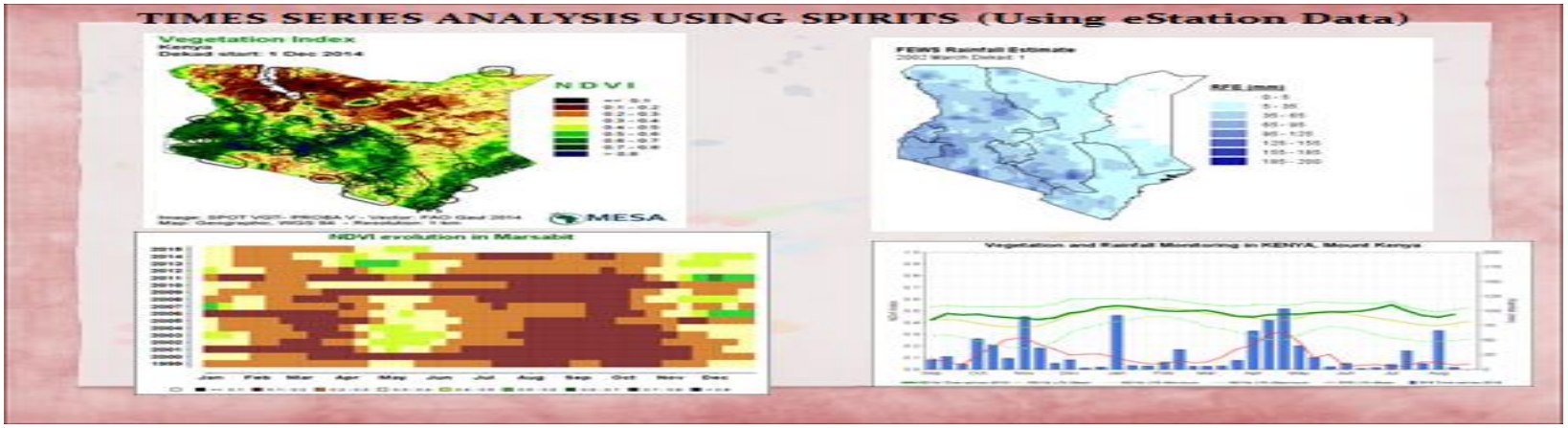
- Use of RS toolbox a remote sensing toolset for R.

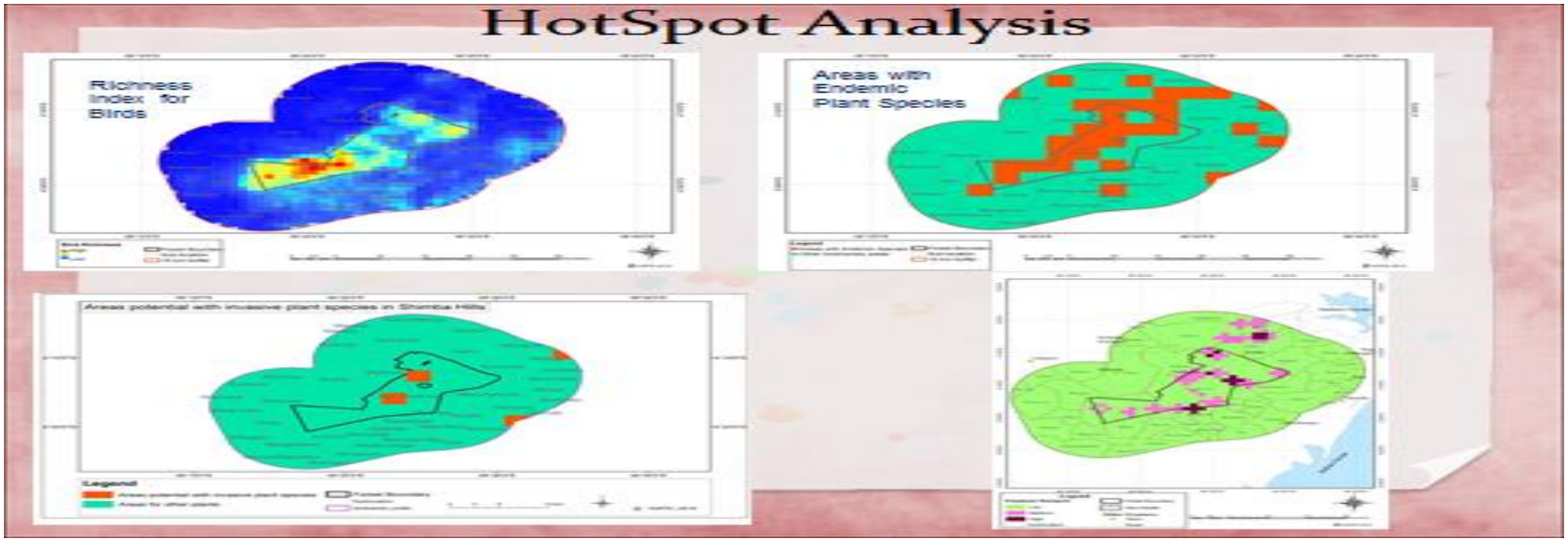
APPLICATIONS/ OPPORTUNITIES

Land use land cover



LAND USE/ LAND COVER	AREA(Ha) Year 1990	Year 2000	Year 2010
Closed Forest	19599	10215	9275
Open forest	30214	13013	7345
Shrubland	83288	72453	65212
Grassland	35323	24090	56066
Wetland	2198	11511	5362
Agriculture/ Settlement	12842	36378	24072
Bareland	19565	35367	35691


TIMES SERIES ANALYSIS USING SPIRITS (Using eStation Data)
Vegetation Index
Kenya
Dekad start: 1 Dec 2014
NDVI
MESA
FEWS Rainfall Estimate
RFE (mm)
NDVI evolution in Marsabit
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Vegetation and Rainfall Monitoring in KENYA, Mount Kenya


HotSpot Analysis
Richness Index for Birds
Areas with Endemic Plant Species
Areas potential with invasive plant species in Shimba Hills
Legend

Modeling

- Providing management solutions
  - Viable Corridors
  - Provision of watering holes for wildlife or areas suitable for flash floods harvesting (water pans)

Vegetation Maps

- PA specific Vegetation maps (updated)

Acknowledgements

- KWS Scientists
- ICPAC
- Nobuhiko Yoshimura

Goals for QGIS Session

www.kws.go.ke

- Review basic geospatial principles and GIS tools
- Discuss spatial data formats
- Demonstrate and practice how to load, filter, and select data in QGIS
- Demonstrate and practice how to style spatial data
- Demonstrate and practice how to export data from QGIS

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Basic Map Elements

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Points – Point Geometry (indicates the x, y and z position of a feature)
Point attributes describe the feature
Example of point geometry: tree
Lines – Polyline Geometry (a series of connected vertices that do not form an enclosed shape)
Example: footpath
Polygon – Polygon Geometry (a series of connected vertices that do form an enclosed shape) Example: School boundary

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Let's Get Started

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1. Copy Biodiversity Training data to your desktop
2. Open QGIS

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Lets Get Started Cont...

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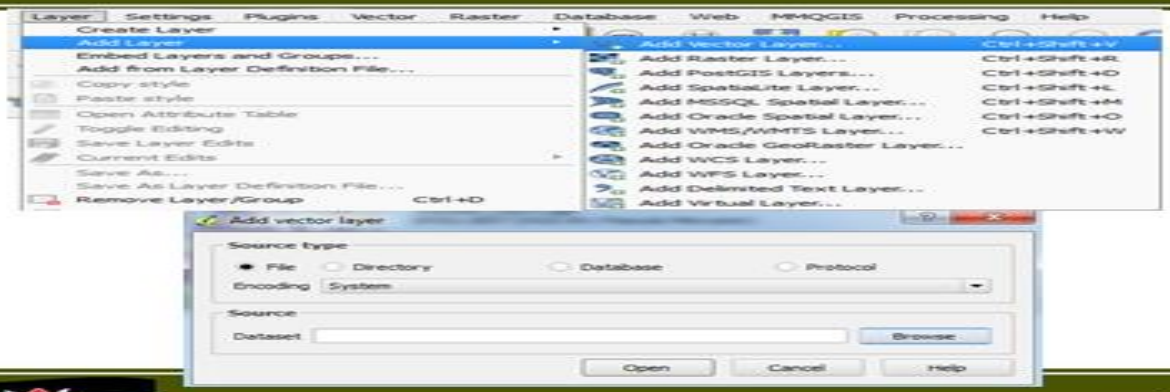

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Open attribute table (right click the layer)

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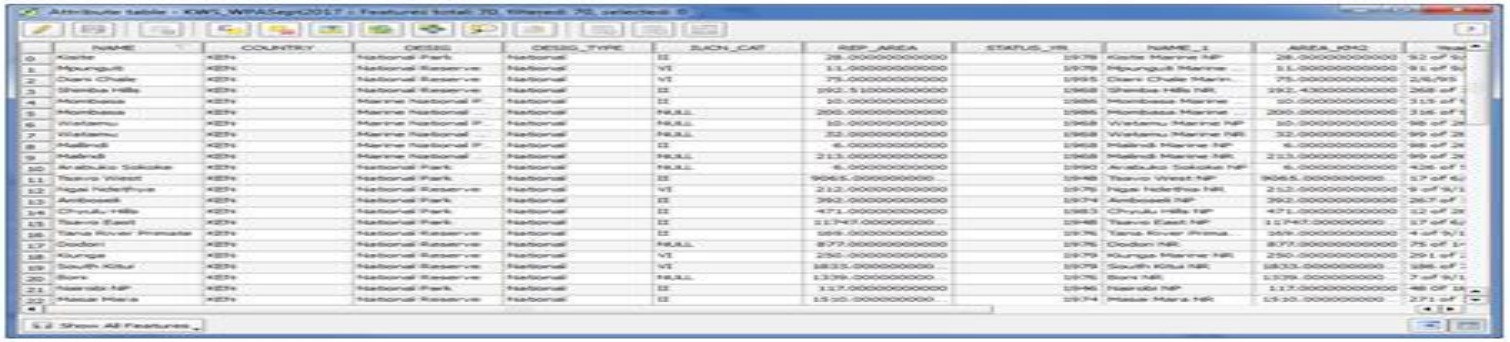

Styling Features

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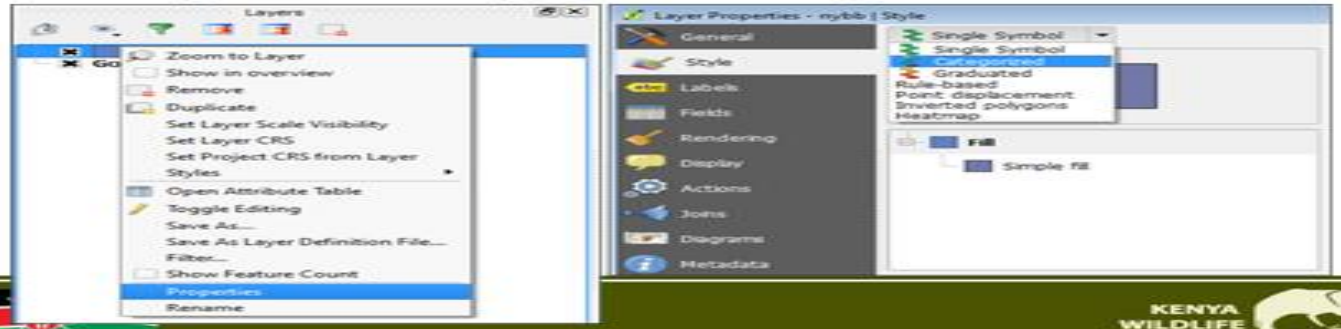
- Right-click the layer and select the Properties option
- Select "Style," and finally, choose "Categorized":



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Styling Features

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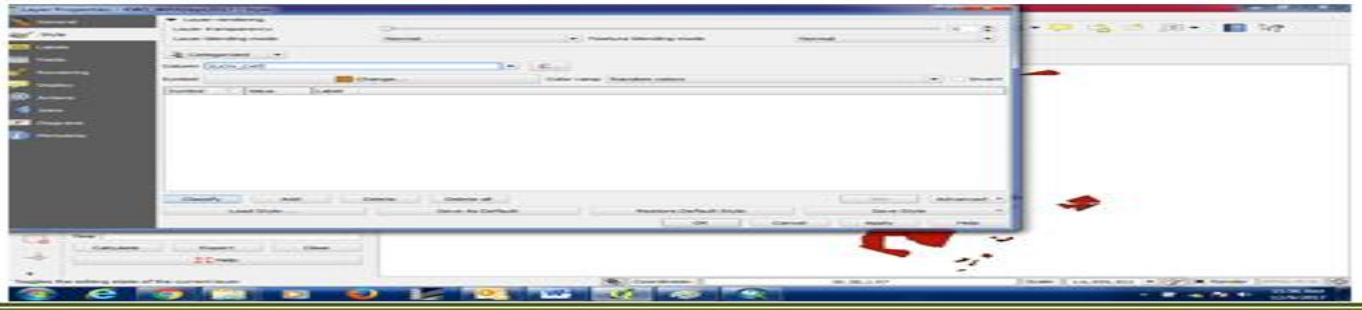
- Select the column that has the data you want to style:



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Styling Features

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Styling Features

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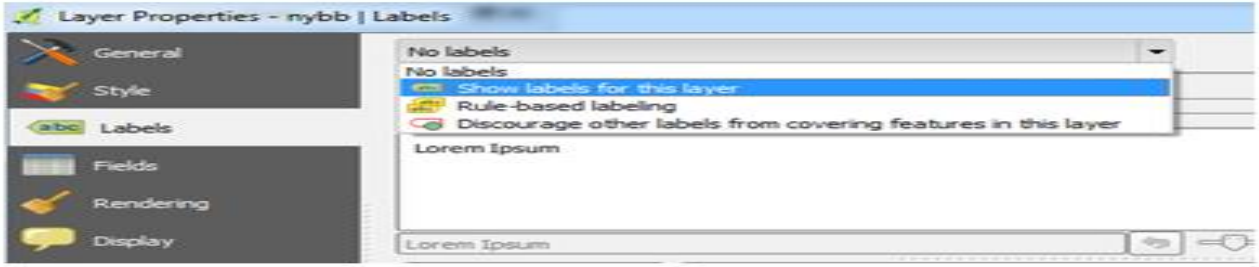
Add labels to data

www.kws.go.ke

- From Properties, select "Labels", "Show labels for this layer"



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Add labels to data

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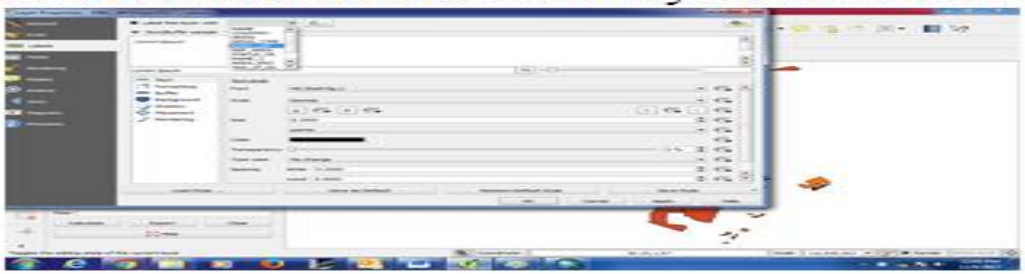
- Select the column that has the data you want to use for labels



- Click "Apply", "Ok"

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Add labels to data

www.kws.go.ke

Your turn

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- Style the polygons however you'd like
- Change the outline color or add a pattern
- Style the labels
- Change the font, the font size, or other attributes

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Layers

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Layers (Vector Data)

Basemap (Raster Data)

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Shapefiles

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- Basic file for storing map elements
- Stores spatial data, like points, lines, and polygons
- Multiple files comprise a "shapefile"

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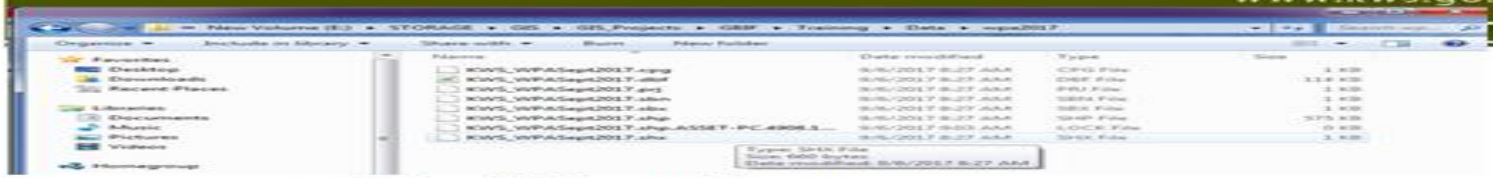

- .shp—The main file that stores the feature geometry
- .dbf—The dBASE table that stores the attribute information of features
- .prj—The file that stores the coordinate system information
- .shx—The index file that stores the index of the feature geometry
- You might also see
- .cpg—Identifies the character set to be used
- .sbn and .sbx—The files that store the spatial index of the features

Shapefiles

- Have a few limitations
- One geometry type (Point, Line, Polygon) per shapefile

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So sometimes you end up with this

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Name	Size	Type	Modified
osm_line.dbf	24.7 MB	Document	Feb 4
osm_line.prj	143 bytes	Unknown	Feb 4
osm_line.shp	1.5 MB	Unknown	Feb 4
osm_line.shx	37.1 kB	Unknown	Feb 4
osm_point.dbf	4.8 MB	Document	Feb 4
osm_point.prj	143 bytes	Unknown	Feb 4
osm_point.shp	24.9 kB	Unknown	Feb 4
osm_point.shx	7.2 kB	Unknown	Feb 4
osm_polygon.dbf	939.4 kB	Document	Feb 4
osm_polygon.prj	143 bytes	Unknown	Feb 4
osm_polygon.shp	4.6 MB	Unknown	Feb 4
osm_polygon.shx	1.5 kB	Unknown	Feb 4

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Shapefiles

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- Column names can only be letters, numbers, and underscores "_"
- Column names can only be ten characters long

OBJECTID	C_DIG1	C_DIG1DESC	C_DIG2	C_DIG2DESC	C_DIG3	C_DIG3DESC	LU_CURRENT
40	9	Vacant or ...	92	Other/Unk...	0	NULL	2010
41	3	Industrial	31	Industrial	0	NULL	2010
42	9	Vacant or ...	92	Other/Unk...	0	NULL	2010
1	9	Vacant or ...	92	Other/Unk...	0	NULL	2010
2	9	Vacant or ...	92	Other/Unk...	0	NULL	2010
3	9	Vacant or ...	92	Other/Unk...	0	NULL	2010
4	9	Vacant or ...	92	Other/Unk...	0	NULL	2010
5	7	Park/Open ...	71	Park/Open ...	711	Park/Open ...	2011
6	9	Vacant or ...	92	Other/Unk...	0	NULL	2010

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Let's add another layer

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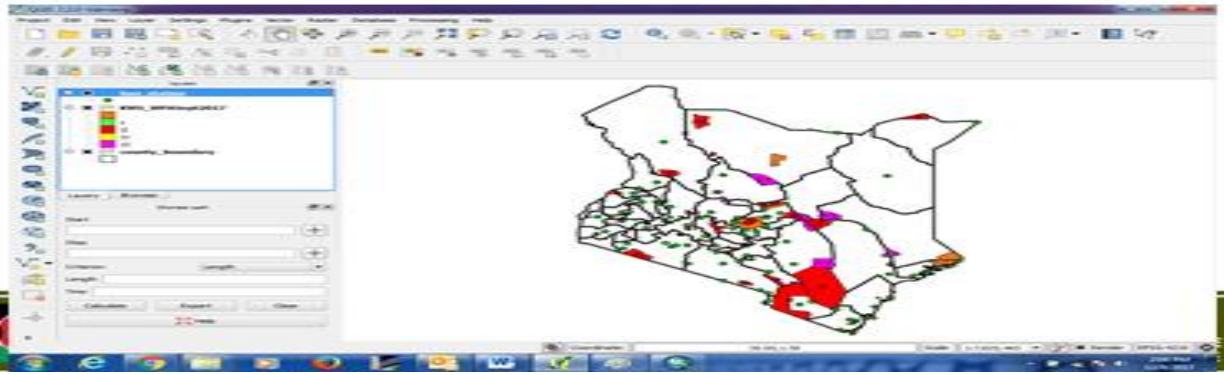
Add county layer
Add station layer



Layer Ordering

www.kws.go.ke

- Layers on top are drawn on top
- Just drag and drop within the Layers Panel to change order
- Try it now

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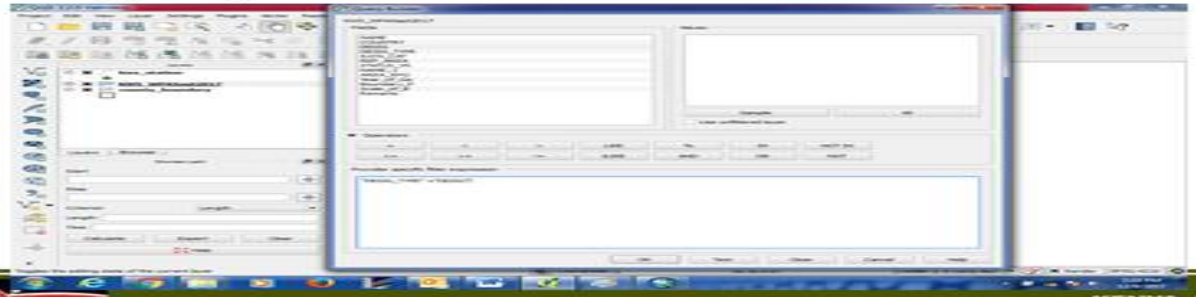
Filter and Query

www.kws.go.ke

- Right-click on the layer and select "Filter" to open the Query Builder



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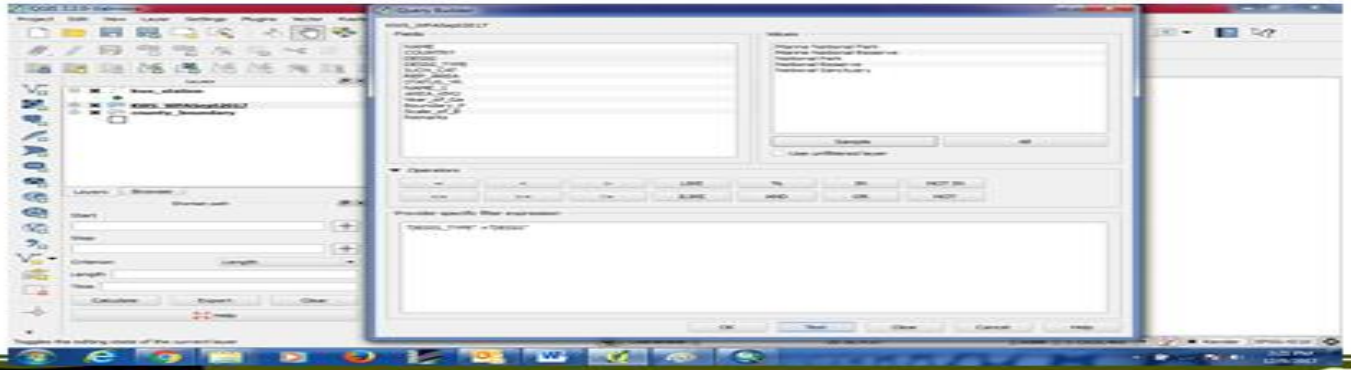
Filter and Query cont..

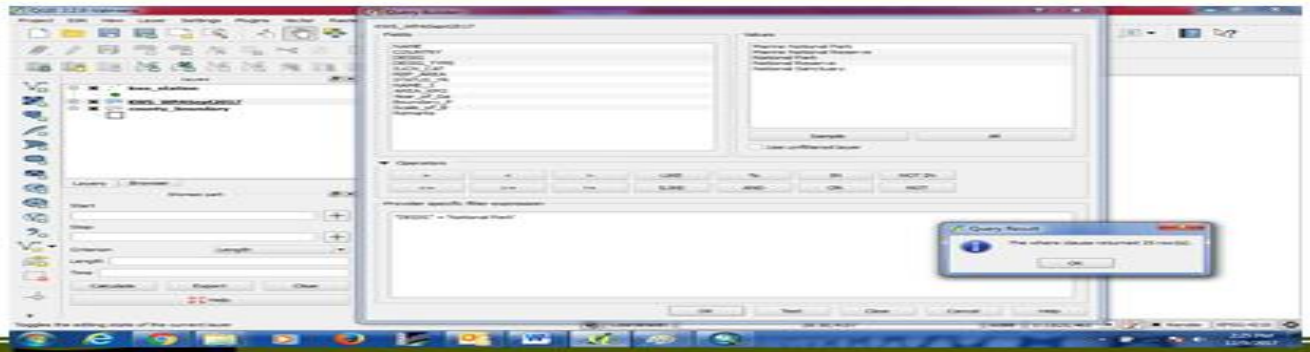
www.kws.go.ke



KENYA WILDLIFE SERVICE

Filter and Query cont..

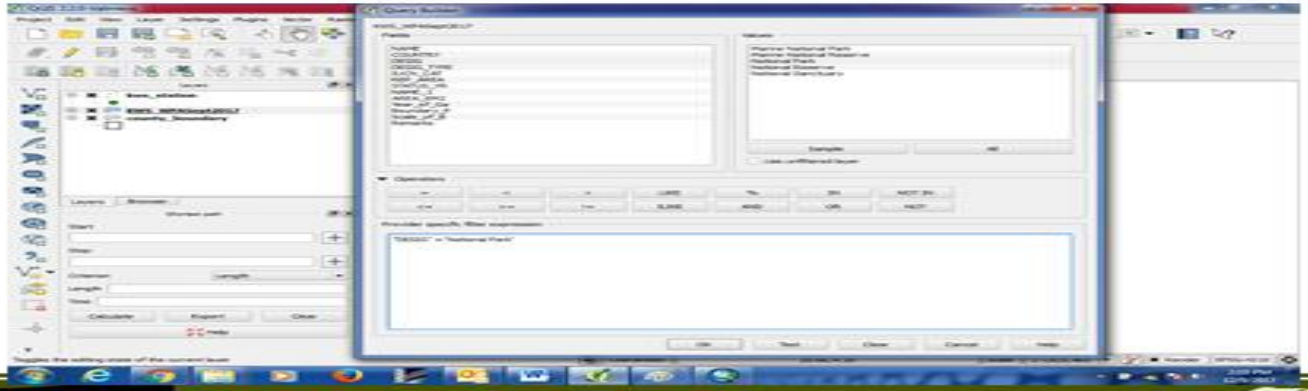
www.kws.go.ke



KENYA WILDLIFE SERVICE

Filter and Query cont..

www.kws.go.ke



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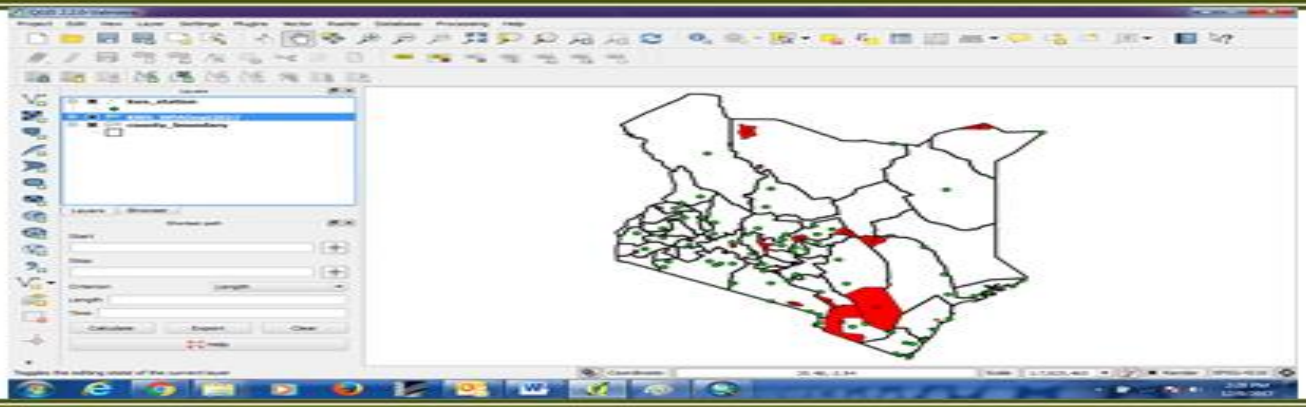
Query result

www.kws.go.ke



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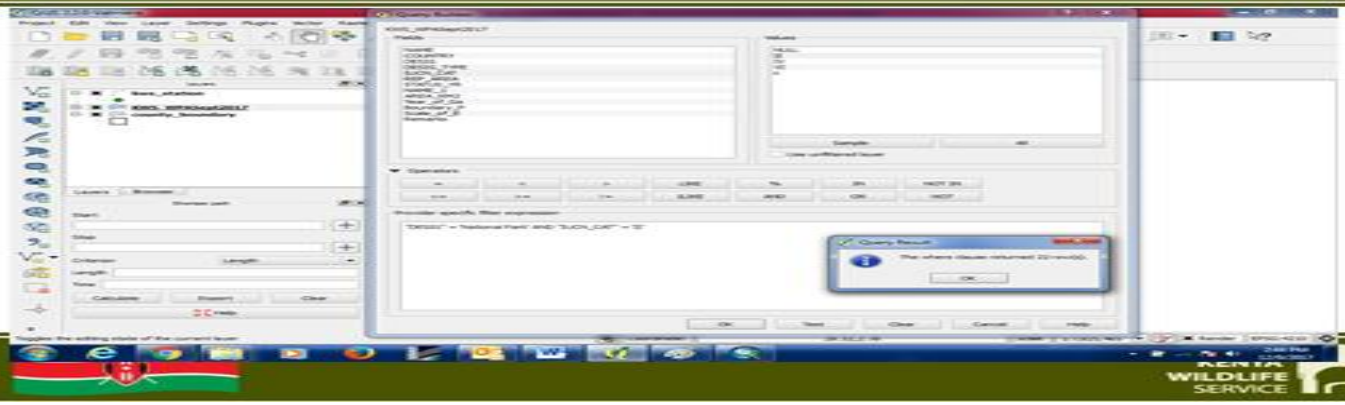
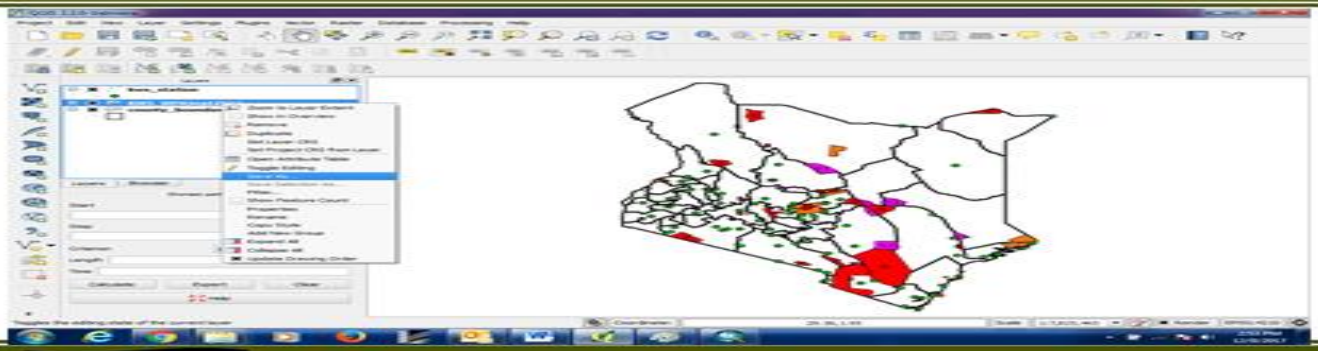
Filter and Query - Multiple Conditions

www.kws.go.ke



KENYA WILDLIFE SERVICE

Exporting Data



Your Turn

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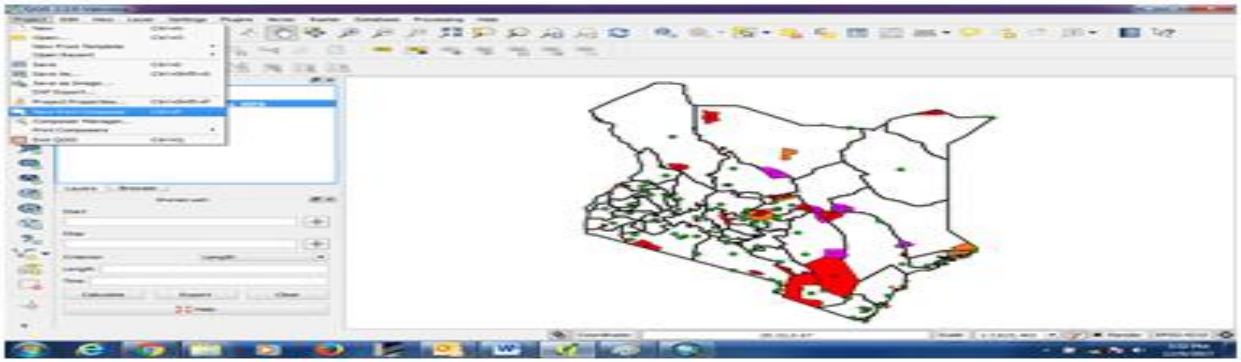
- Filter for National Reserve in WPA
- Try and find something interesting
- Change the style of the polygon, either to a different size line, or color
- Export your selection as a new shape file

• Print Composer

- How you make exportable and printable maps in QGIS
- Able to add map elements (legends, scales, text, etc)

www.kws.go.ke



You are greeted with a blank slate

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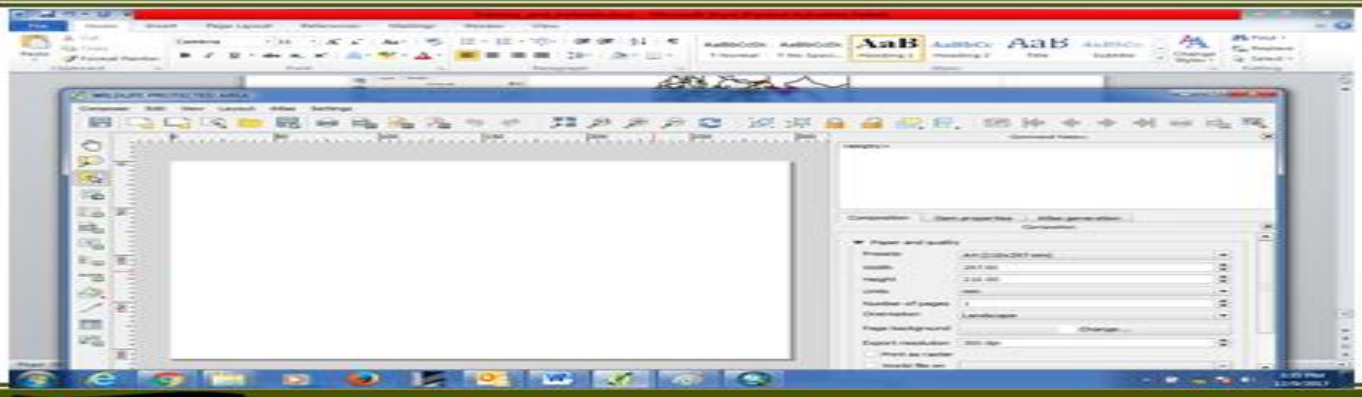

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Add New Map tool will add your current map

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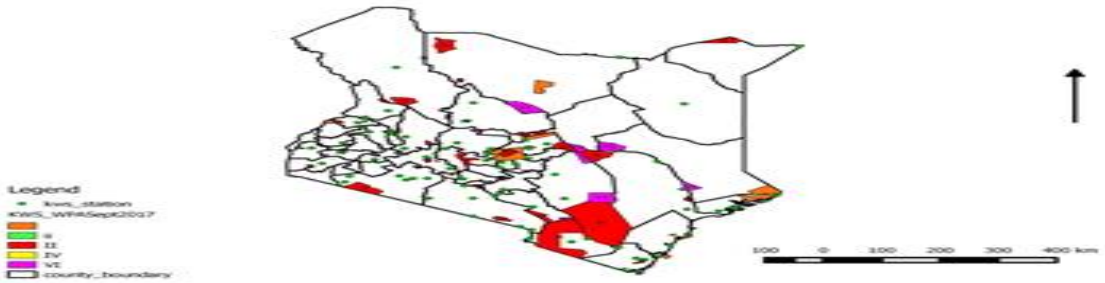
Now you can share your map or print it

www.kws.go.ke



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References

www.kws.go.ke

- http://training.datapolitan.com/qgis-training/Introduction_to_GIS_Fundamentals
- GISgeography.com

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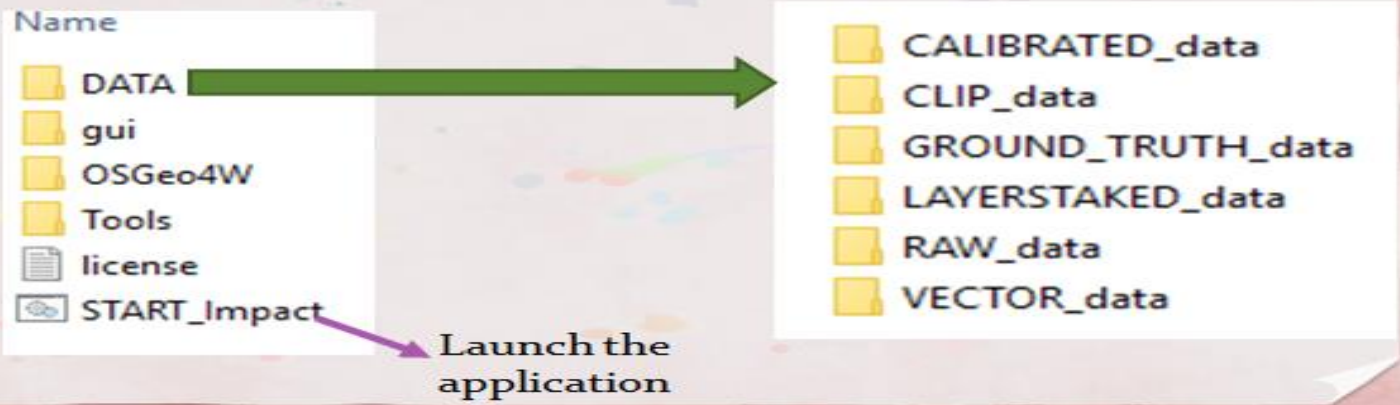
IMAGE CLASSIFICATION WITH IMPACT TOOL

Peter Maina,
KWS GIS

WHAT IS IMPACT TOOL?

- The IMPACT tool is a portable browser-based application for image processing, visualization and mapping running under Microsoft Windows (Xp,Vista,Win7,Win8,Win10).

STRUCTURE



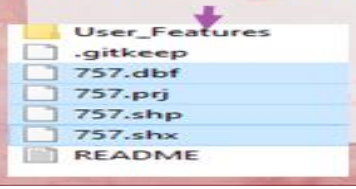
Data Preparation

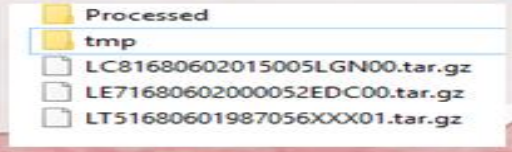
1. Copy "GBIF Training Naivasha" folder to your computer.

2. Ope

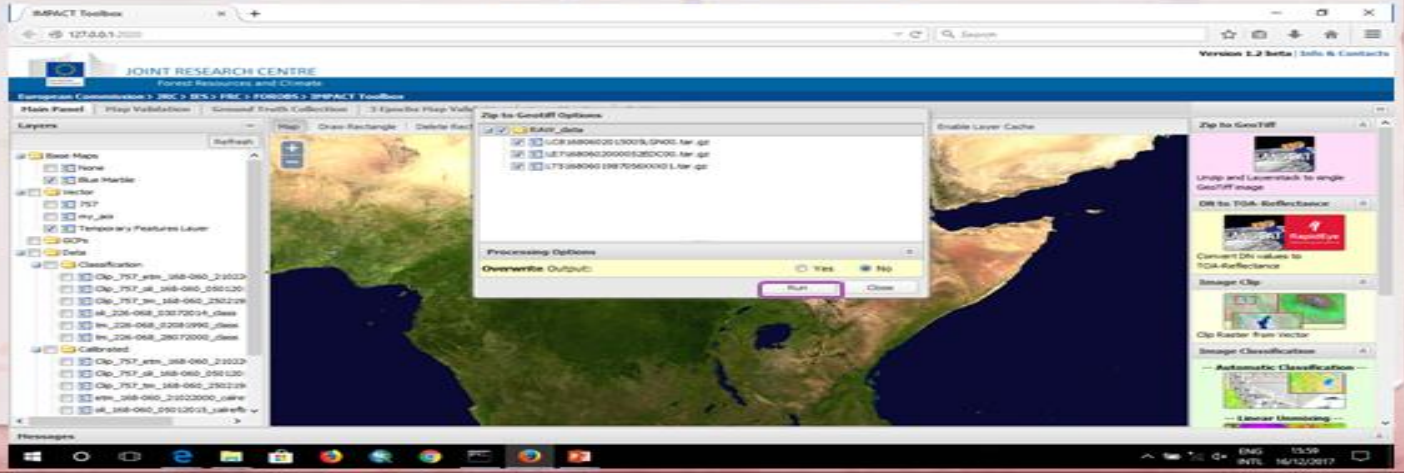
And copy Landsat images to "IMPACT_JRC-Toolbox_v1.2b -Data-Raw Data

3. Copy "757"files (Mt Kenya shapefile plus 20km buffer) to "Data-VECTOR Data"





ZIP TO GEOTIFF



DN TO TOA- REFLECTANCE

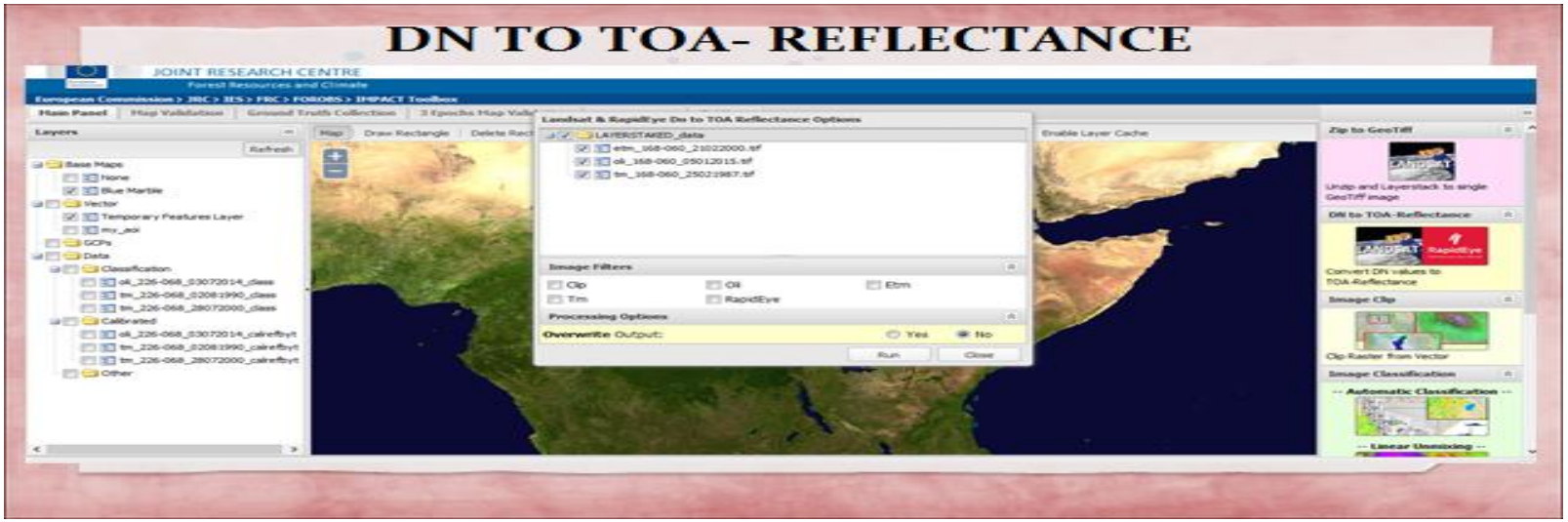
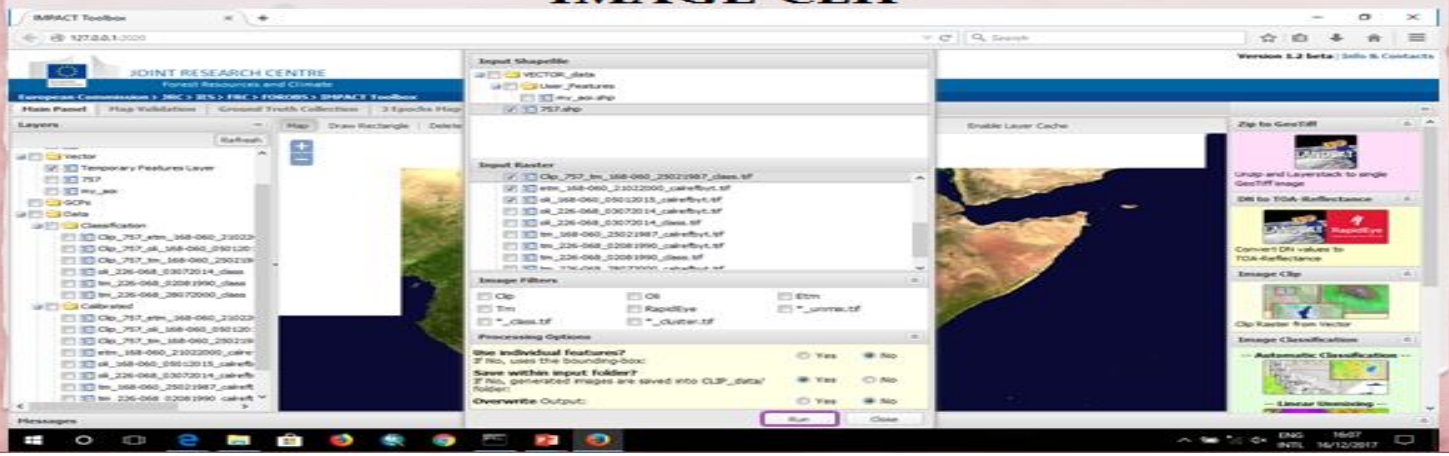


IMAGE CLIP



AUTOMATIC CLASSIFICATION

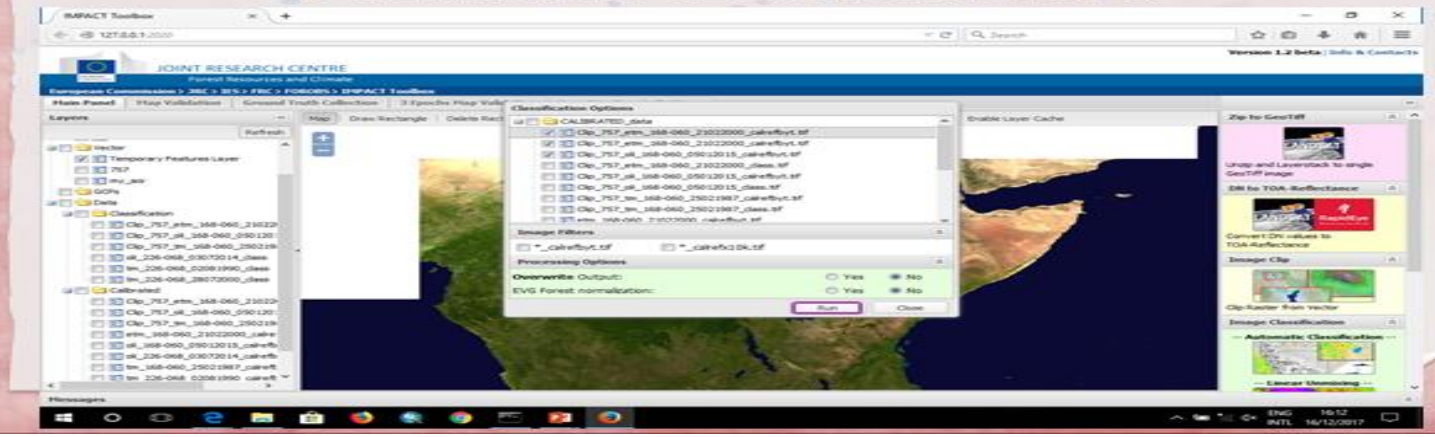


IMAGE SEGMENTATION

- Image segmentation is the process of partitioning a digital image into multiple segments on the base spectral, geometrical or computed properties (texture) together with user defined parameter describing the size, shape and similarity versus adjacent segments

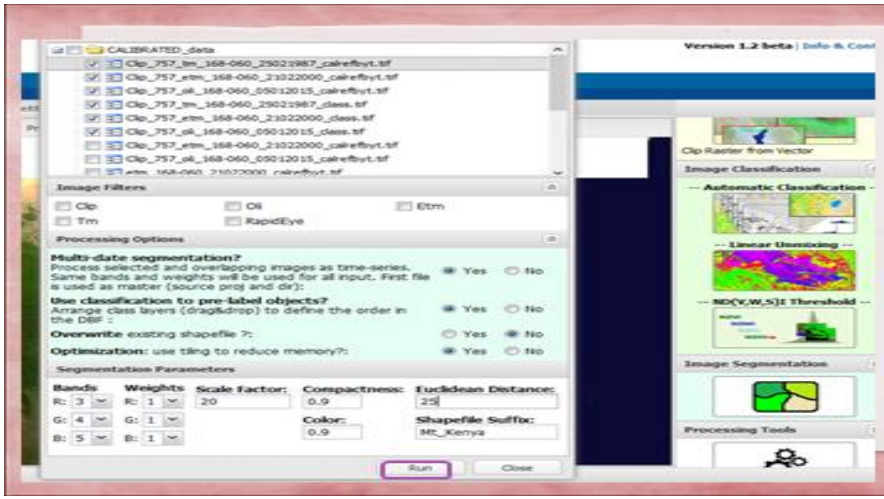


Image Segmentation

N/B

1. **Arrange the ".carefbyt.tiff" first starting with oldest image as T1 and the latest image as T3.**
2. **Arrange the ".class.tif"images starting with oldest image as T1 and the latest image as T3**

Scale factor: Controls the spectral heterogeneity of the image objects and is therefore correlated with their average size; smaller it is, more the objects

Euclidean distance: represents the minimum Euclidean Distance (expressed in DN values) to be used while merging segments crossing two adjacent tiles; higher values will allow aggregation of heterogeneous objects; lower values will keep the straight edges of the tiles.

3 EPOCS MAP VALIDATION

Classified images

Raw images

Recoding

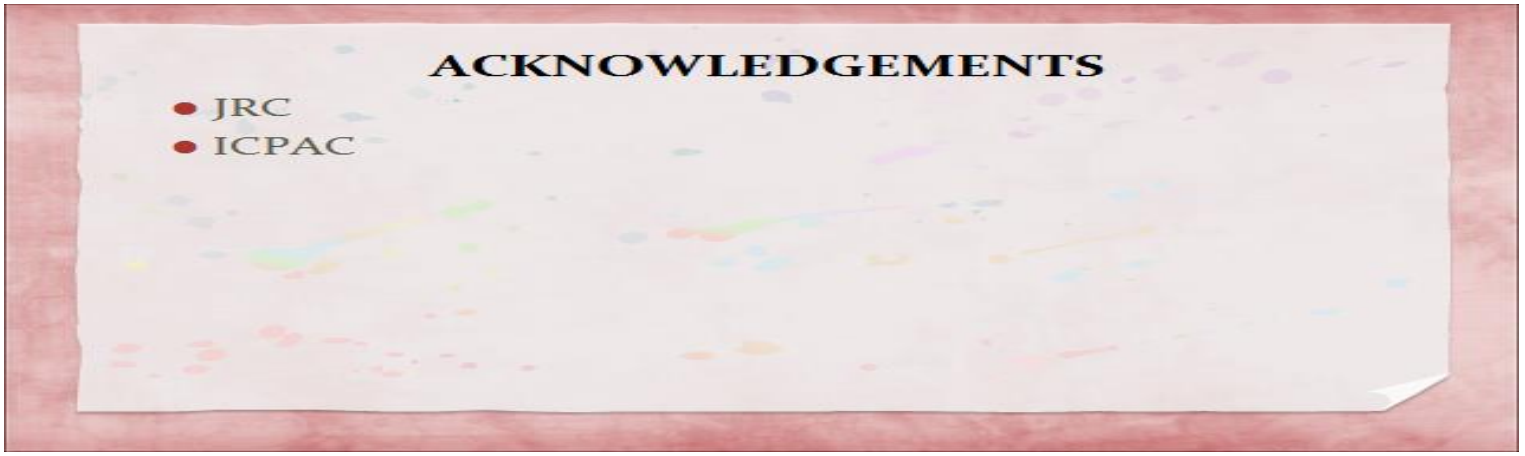
- Refer to the guide provided for more details.
- Use ground truth data to validate for more accurate results
- Generate final matrix for change maps

Validation approach for PAs on 3 date panel tool

- **The 10 "commandments"**

1. Identify the date in which the automatic classification is better than the others.
2. If the quality of the best classified date is considerably different and better from the worst (i.e. due to seasonality), then overwrite the best classification on the other (by class), one or two if the case.
3. If there's apparently at a glance a few/no land cover change, then also overwrite the best classification on the other one, or two if the case.
4. Otherwise if a more considerable change between the dates is visible at a glance then proceed on analyzing the more congruous/appropriate classes and proceed on overwriting it on the others dates, when better classified.
5. Start from the better classified class (the more congruous), if possible, at a whole scale. Otherwise start to identify regions where there is less/no land cover change and recode at one time as more polygons as you can, without eliminating changes that are already well classified.
6. Work by class if the classification is well done, otherwise use the cluster approach.
7. If a change is well identified in one date through a cluster, then use it also for the following dates where the changes persists.
8. If there's no good classification in any of the three dates then try to identify the most relevant classes thorough the cluster selection, looking in each date. Find the more appropriate cluster and recode it correctly. If possible overwrite it on the other dates.
9. Always start from a full extent selection to recode massively (and correctly) as much polygons you can. Otherwise zoom to one extent where the selection is consistent before recoding.
10. Combine different clusters from different dates in order to compose classes.

Application of GIS in EIA



Peter Njiiri Mwangi

What is EIA?

- EIA is a formal process to predict the environmental consequences of human development activities and to plan appropriate measures to avoid, eliminate or reduce adverse effects and to augment positive effects.

Project environmental aspects addressed in EIA

- biophysical and resource use
- social and cultural
- health and safety
- economic and fiscal
- landscape and visual
- indigenous peoples' rights and traditional areas
- Climate change

Purpose of EIA

- modify and or improve project design
- ensure efficient resource use
- Enhance positive ecological and social aspects
- identify key adverse impacts and measures for mitigating them
- inform decision-making and condition-setting
- avoid serious and irreversible damage to the environment
- protect human health and safety

The five type of questions that GIS can answer in EIA:–

1. Location: Where is the project site.?

- The first of these questions seeks to find out what exists at a particular location. A location can be described in many ways, using, for example place name, post code, or geographic reference such as longitude/latitude or x & y.

2. Condition: What is at the project site

- The second question is the converse of the first and requires spatial data to answer. Instead of identifying what exists at a given location, one may wish to find location (s) where certain conditions are satisfied

3. Trends: What will or has changed since.?

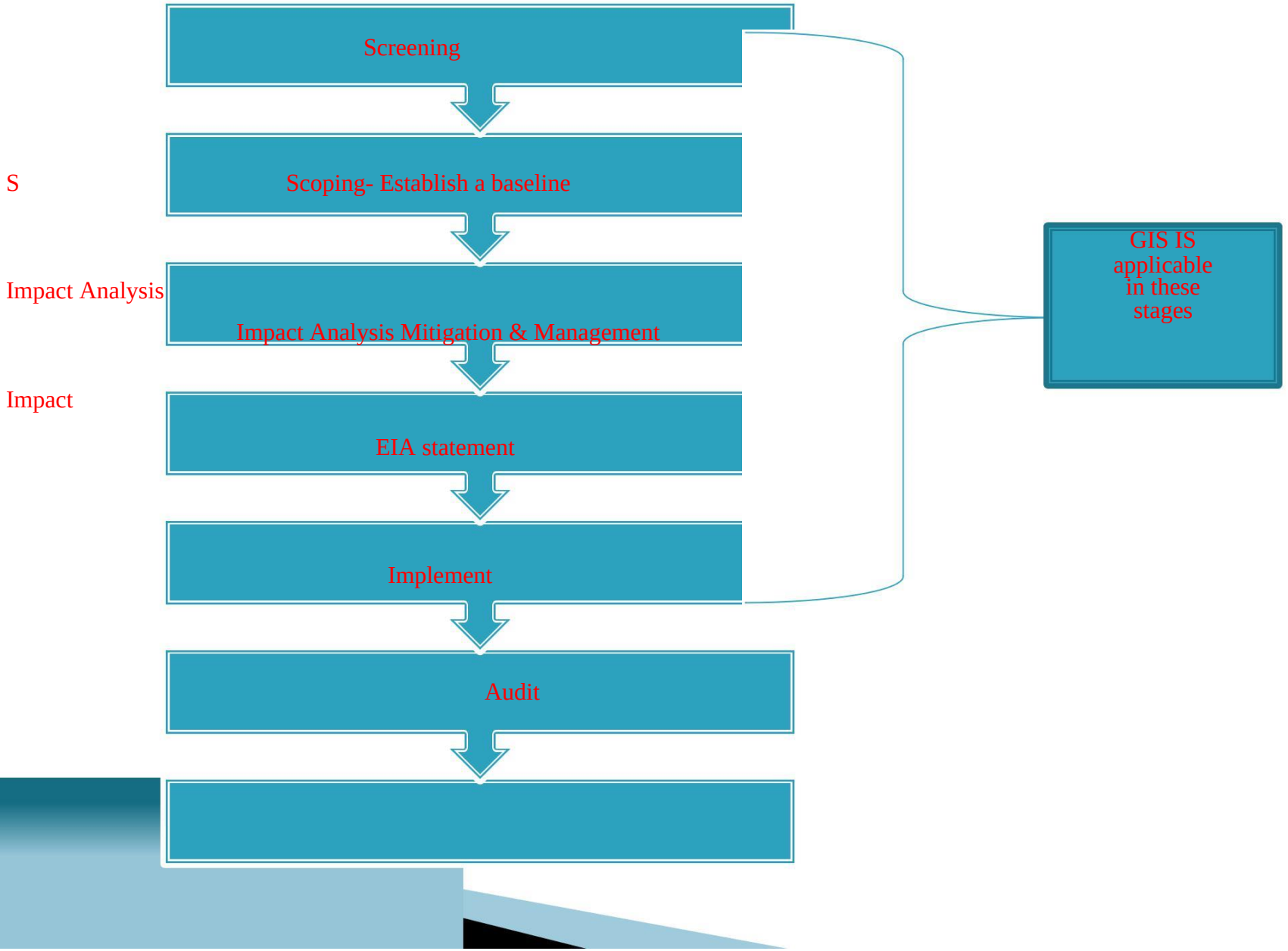
The third question might involve both the first two and seeks to find the differences (e.g. in land use or elevation) over time.

4. Patterns: What spatial patterns exists?

5. Modeling: What if……..?

- "What if…" questions are posed to determine what happens, for example, if a new road is added to a network or if a toxic substance seeps into the local ground water supply. Answering this type of question requires both geographic and other information (as well as specific models). GIS permits spatial operation.

Application in the EIA Process



Why is GIS an important tool in environmental assessment

- Stores large multidisciplinary datasets.
- Identify complex interrelationship between environmental characteristics.
- Evaluate changes over time.
- Can be systematically updated and used for more than one project.
- Summarizes large data and information into in to graphics(maps & graphs) that easily conceptualized even by laymen

Importance of GIS

- Serve as a data set for a variety of mathematical models
- Serve the interests of the general public as well as technical analyst
- GIS also have the capability for site impact prediction(SIP), wider area prediction(WAP), cumulative effect analysis (CEA),and environmental audits and for generating trend analysis within an environment

EIA Methods & GIS linkage

Checklists

- E.I.A methods and techniques are structured, formal frameworks which allow impact data to be identified, manipulated and presented.
- At the outset of an impact study the main task of the EIA expert is to identify and organize potential impacts in a systematic way.
- The techniques can be broadly categorized into three
  1. Impact Identification
  2. Impact prediction
  3. Impact evaluation and interpretation
  4. Communication(presentation methods)

EIA Techniques

i. Baseline studies
ii. Checklist
iii. Matrices
iv. Network diagrams
v. Map Overlays
vi. Mathematical modelling

Baseline studies & GIS

- Make use of available data
- Desktop research
- Literature review
- Data and local knowledge
- Defines the scope of the EIA
- Establishes need for further data or in-depth research

- Checklists are lists of the range of impacts associated with a particular type of a project.
- It is a one dimensional listing of potential environmental impacts of an action.
- In preparing checklists, it is advisable that impacts are categorized into those that may arise from the pre-construction, construction, operation and decommissioning phases of a proposed project.
- Phasing out a project ensures that the list of likely impacts is exhaustive.
- Checklist ranges from simple lists of items to more complex variations.

Examples of checklists

- Simple checklists- listing of environmental variables
- Questionnaire checklists
- Scaling/ranking checklists-listing of impacts with assigned numerical values of their likely magnitude.
- Weighting scaling checklists-address both magnitude by scaling and the importance of impacts by weighting.

Matrices

- This is an expansion of the checklist to a two dimensional matrix by listing a range of actions associated with the project along the second axis.
- Impact matrixes consist of a horizontal list of project activities arranged against a vertical list of environmental factors.
- Display tables of environmental variables arranged against impacting project activities.
- Used to predict envisaged impacts and are simple to use
- Require expert knowledge by multidisciplinary teams.
- Cause effect relationship between particular activities and environmental variables can be identified by placing a mark in the corresponding

Impact prediction matrix

For each environmental effect place a cross (X) in one of the columns	Positive impact very likely	Positive impact possible	No impact	Negative impact possible	Negative impact very likely	No judgement possible at present	Comments
		A	B	C	D	E	F
Hydrology	1-4 Fall of water table						
Pollution	2-2 Toxic substances						
Soils	3-1 Soil salinity						
Sediments	3-1 Local erosion						
Socio-economic	4-1 Population change						

	4-1 household income						
Ecology	6-1 Rare species						

Significance of Impacts				STAGES OF THE PROGRAMME				
				Equipment Production	Transport	Installation	Operation	Decommission
ENVIRONMENTAL CONDITIONS	PHYSICAL	SOIL	Soil Quality					
			Erosion					
			Landscape					
		WATER	Rivers					
			Costal Zone					
			Subsurface Water					
		AIR	Air Quality					
			Odor					
			Visual					
			Noise					
	BIOLOGICAL	FLORA						
		FAUNA						
		ECOSYSTEM	Quality					
			Destruction					

Project impact/Risk analysis

Likelihood	Consequences				
	Insignificant *Risk is easily mitigated by normal day to day process*	**Minor** *Delays up to 10% of Schedule Additional cost up to 10% of Budget*	**Moderate** *Delays up to 30% of Schedule Additional cost up to 30% of Budget*	**Major** *Delays up to 50% of Schedule Additional cost up to 50% of Budget*	**Catastrophic** *Project abandoned*
Certain *>90% chance*	High	High	Extreme	Extreme	Extreme
Likely *50% - 90% chance*	Moderate	High	High	Extreme	Extreme
Moderate *10% - 50% chance*	Low	Moderate	High	Extreme	Extreme
Unlikely *3% - 10% chance*	Low	Low	Moderate	High	Extreme
Rare *<3% chance*	Low	Low	Moderate	High	High

Network analysis

- This method is used to consider secondary, tertially and higher order impacts that can arise from an initial impact.
- Environmental factors are diverse and interconnected.
- Matrices are not adequate for describing all the interrelationships that exist in nature but networks allow for a cause-condition-effect relationship to be identified.
- The method provides a roadmap type of approach to the identification of second and third order effects.
- The idea is to start with a project activity and then identify the type of impacts which would initially occur.
- The next step is to select each impact, identify the impacts which may be induced as a result of these, then select each of these impacts and identify, which may be further induced as a result.
- This process is repeated until all possible impacts are identified. Sketching this in a network is commonly referred to as an impact tree.

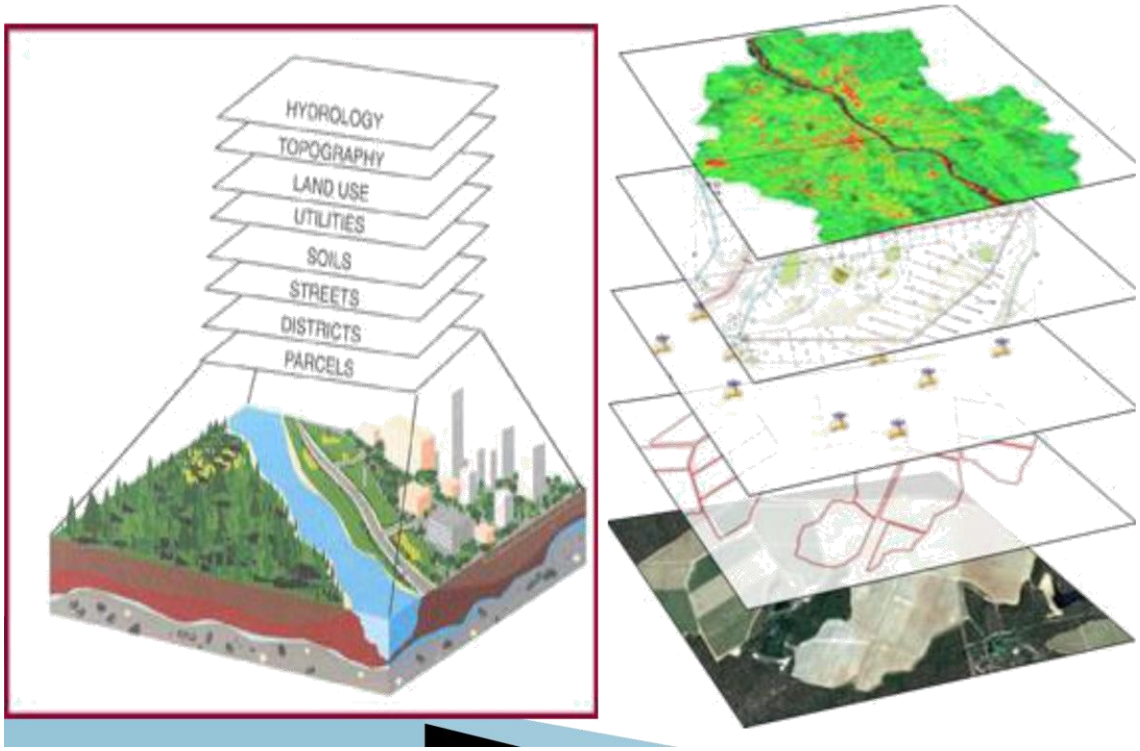
Example of network effect

Initial conditions	Consequent conditions	Effects
Increased surface run off	Flooding	Gullying and Erosion
Pollution of Ground water	Degradation of water supply	Health hazard
Removal of top soil	Decreased fertility	Death of flora

Map Overlay and GIS

- Overlays provide a technique for illustrating the geographical extent of different environmental impacts.
- This method is used to show the spatial distribution of impacts.
- Overlays are important for land-use planning and they involve the mapping of various land use options and then overlying them in order to identify potential conflicts.
- Each overlay is a map of a single impact.
- The original technique used transparencies which is somewhat cumbersome.
- The development of Geographic Information Systems (GIS) makes this technique particularly suitable for comparing options, pinpointing sensitive zones and proposing different areas or methods of land management.

Map overlays



Vulnerability Analysis

- Used in Strategic Environmental Assessment (SEA)
- Evaluate how different development scenarios affect vulnerability of receiving environment
- Combine GIS and Multi Criteria Analysis(MCA) to assess impacts of a project on a vulnerable area
- Identify environmental components for the VA e.g fauna or flora, landscape and habitats, settlements etc
- Prepare maps that show sensitivity of each environmental component e.g protection designation(locally , nationally of internationally)
- Integrate vulnerability of and risk of impact to each component in a map and bring the maps together into an overall map
- Useful in comparing alternatives and making a choice of preferred alternative

Example of ranking alternatives based on weighted scores

Criteria		A		B		C		D	
	Weight (w)	Score(a)	a x w	Score(a)	a x w	Score(a)	a x w	Score(a)	a x w
Noise	3	0	0	+1	+3	-2	-6	-3	-9
Landscape	1	+2	2	-2	-2	+1	+1	+2	+2
Biodiversity	1	-2	-2	0	0	0	0	+3	+3
Total			0		+1		-5		-4

Modelling

- Aim to predict likely future environmenytal conditions with and without a proposed project
- Makes a series of assumptions under various scenarios
- Deals with quantifiable impacts such as air pollution noise and traffic
- E.g Likely noise and air pollution of proposed road network can be calculated
- Modelling is scientific and rigorous and is useful in analysis cumulative and indirect imacts

Case Study Identifying alternatives

Case Study Identifying alternatives

It has been decided to build a new Road between Kiboga and Masindi in Uganda.

A BIG requirement:

- Money is scarce – do it least expensive!

26

The shortest route to follow is Masindi-Bukwiri-Kiboga

- The distance is 95 km. At 400 Million Uganda shilling/km + 1 small bridge = 45,000 Million

But a young engineer, that grow up in the area, says there is an alterantive route.

- Masindi-Kibangya-Budzi-Kiboga

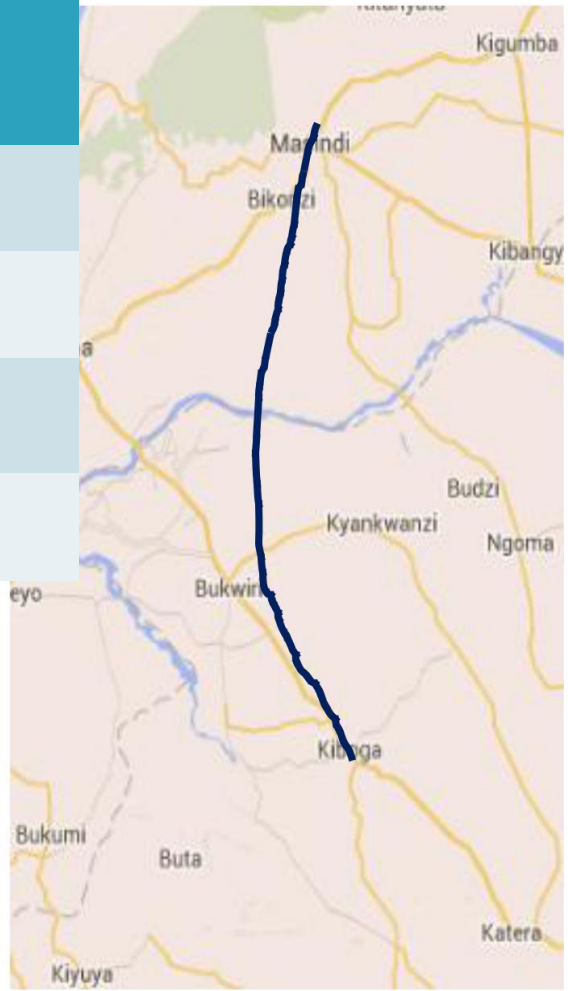
Everybody says: Much longer, much more expensive.

Forget it!

- …. but, based on Uganda's new SEA legislation, it is decided to make a SEA review.

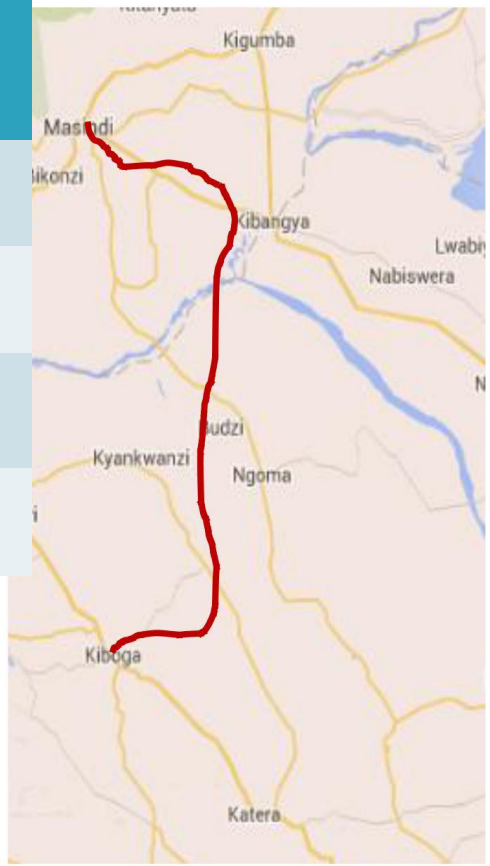
A consultant makes a study and presents the results.

Criteria	Million UGX
95 km road	38000
1 small bridge	6000
Maintenance 25 years at 500/ year	12500
GRAND TOTAL over 25 years	**56500**



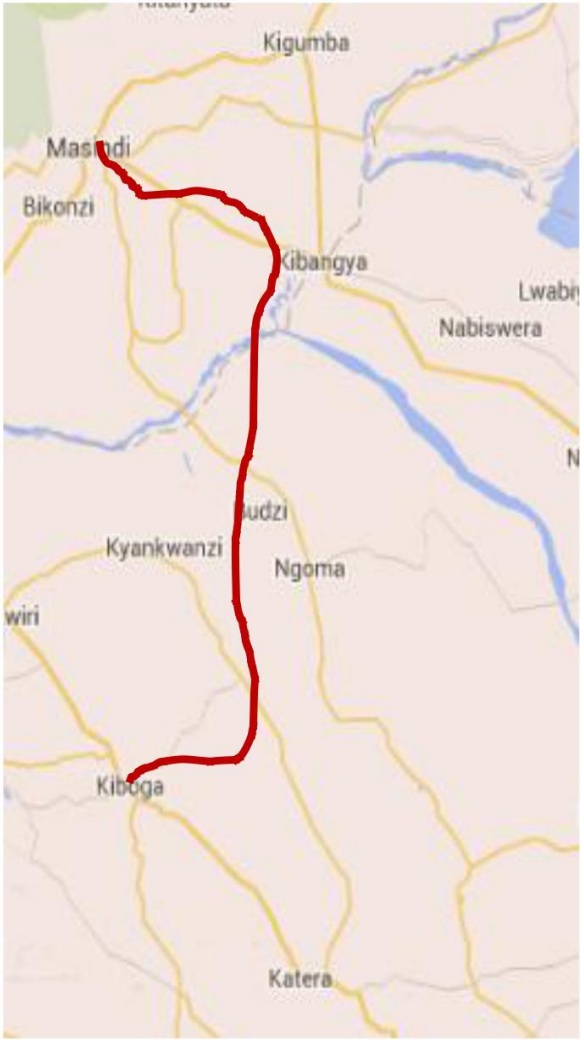
A consultant makes a study and presents the results.

Criteria	Million UGX
125 km road	50000
1 medium bridge	9000
Maintenance 25 years at 600/ year	15000
GRAND TOTAL over 25 years	**74000**

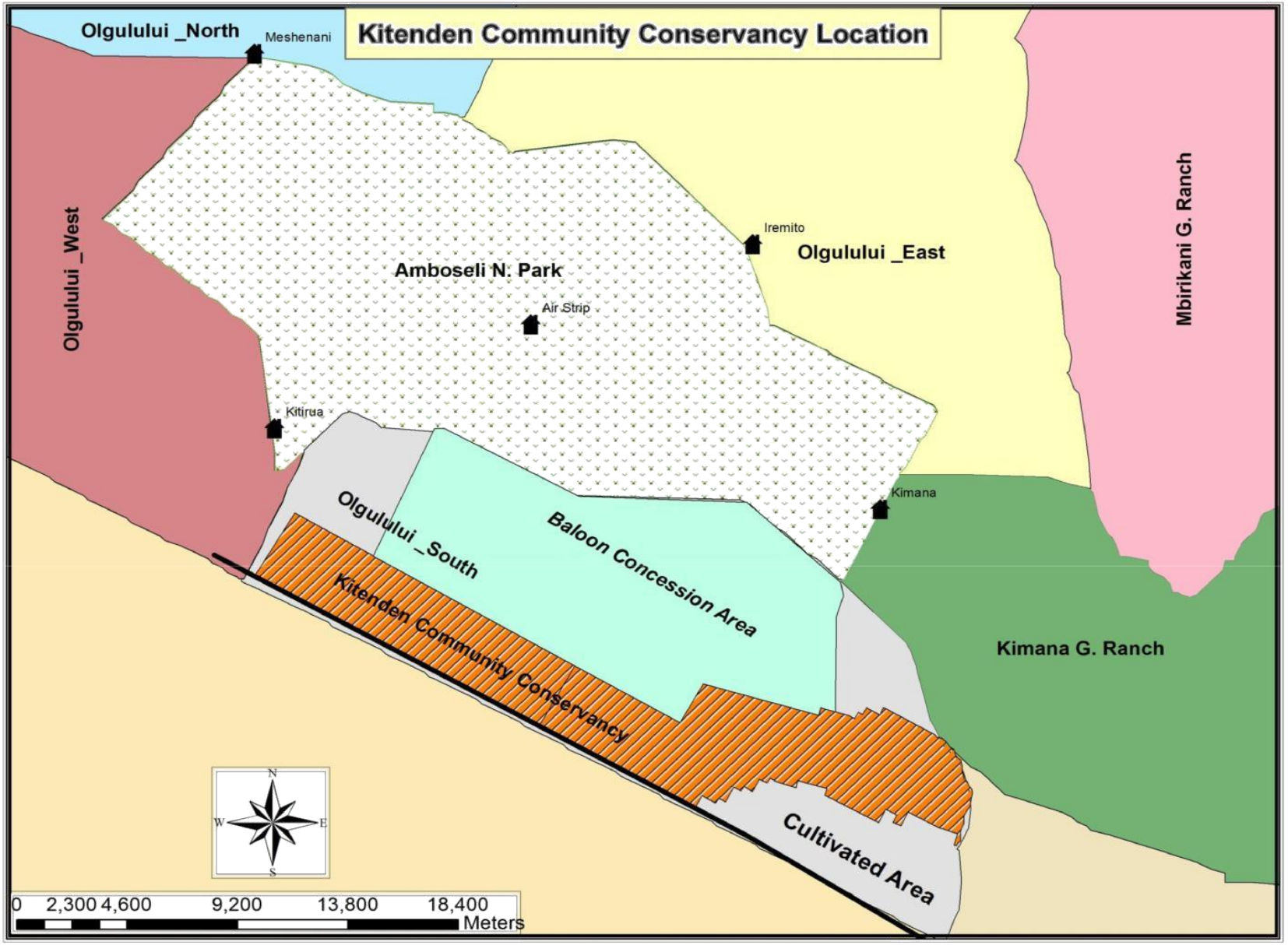


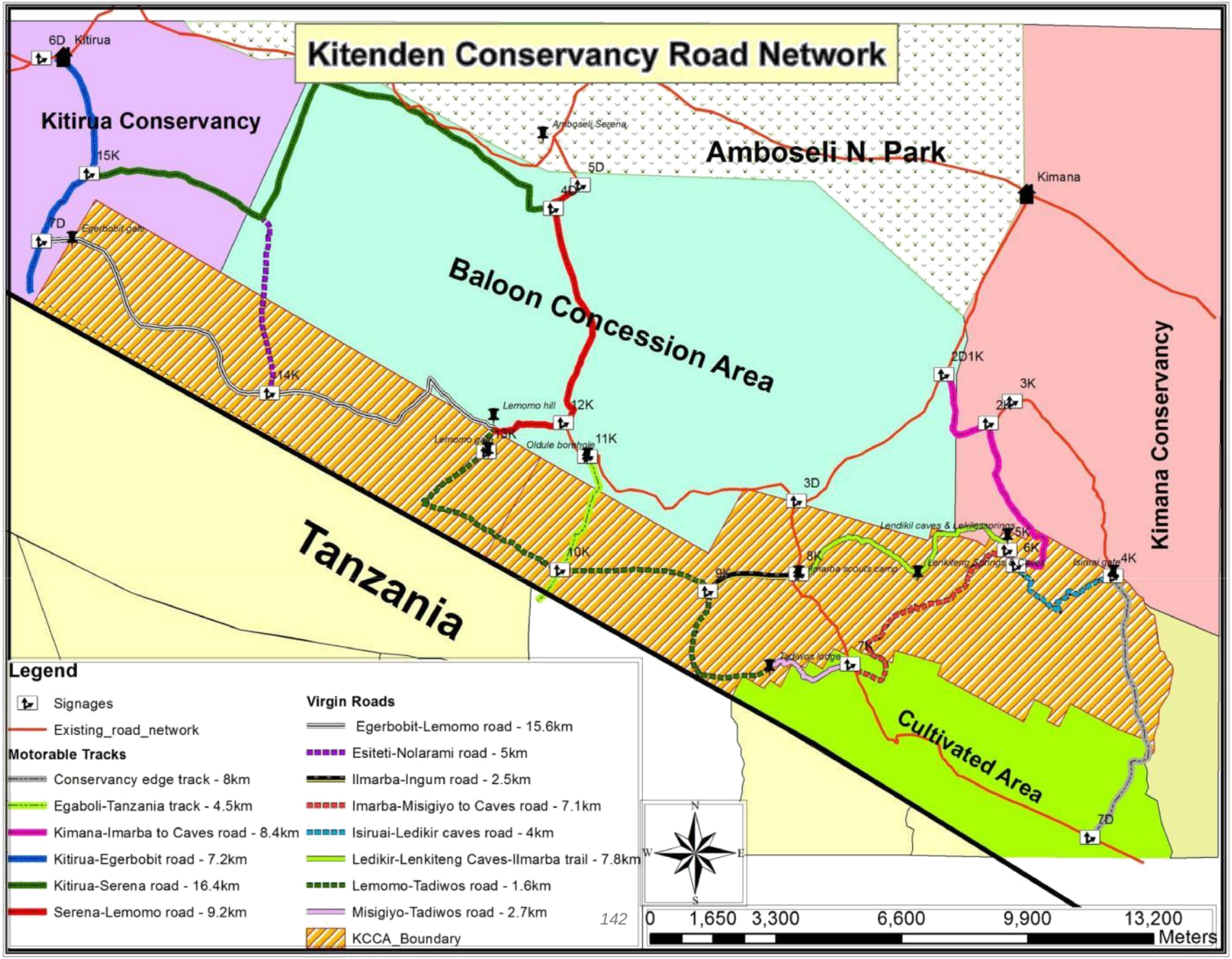
A consultant makes a study and presents the results.

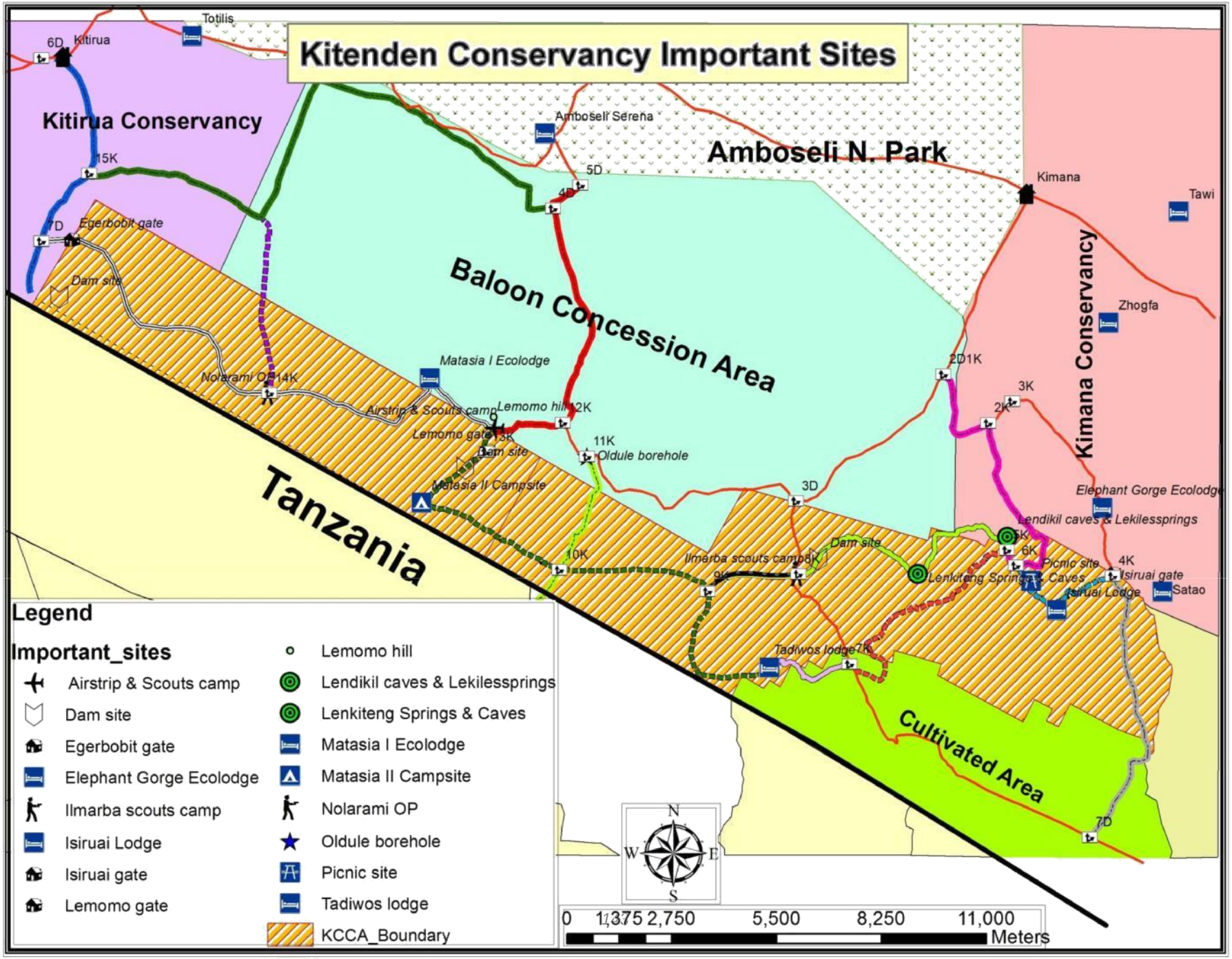
Criteria	Million UGX
125 km road	50000
1 medium bridge	9000
Maintenance 25 years at 600/ year	15000
Risk: No need to climate secure of bridge against flash floods	
Road is built on poor land, moderate loss of agriculture prod.	2000
No villages to resettle.	
Circumvents forests, no loss of ecological services	
GRAND TOTAL over 25 years	**76000**



Case study: Applications Project Location map




Kitenden Conservancy Road Network
Kitirua Conservancy
Amboseli N. Park
Baloon Concession Area
Kimana Conservancy
Tanzania
Cultivated Area
6D Kitirua
15K
7D
Egerbobit gate
Amboseli Serena
5D
4D
Kimana
14K
Lemomo hill
12K
Lemomo gate
11K
Oldule borehole
10K
9K
8K
3D
2D1K
3K
2K
Lendikil caves & Lekiessprings
5K
6K
4K
Isiriai gate
Imarba scouts camp
Lenkiteng Springs
Tadiwos lodge
7K
7D
Legend
Signages
Existing_road_network
Motorable Tracks
Conservancy edge track - 8km
Egaboli-Tanzania track - 4.5km
Kimana-Imarba to Caves road - 8.4km
Kitirua-Egerbobit road - 7.2km
Kitirua-Serena road - 16.4km
Serena-Lemomo road - 9.2km
Virgin Roads
Egerbobit-Lemomo road - 15.6km
Esiteti-Nolarami road - 5km
Ilmarba-Ingum road - 2.5km
Imarba-Misigiyo to Caves road - 7.1km
Isiruai-Ledikir caves road - 4km
Ledikir-Lenkiteng Caves-Ilmarba trail - 7.8km
Lemomo-Tadiwos road - 1.6km
Misigiyo-Tadiwos road - 2.7km
KCCA_Boundary
N
W
E
S
0 1,650 3,300 6,600 9,900 13,200
Meters


Kitenden Conservancy Important Sites
Kitirua Conservancy
Amboseli N. Park
Baloon Concession Area
Kimana Conservancy
Tanzania
Cultivated Area
Totilis
6D
Kitirua
15K
7D
Egerbobit gate
Dam site
Amboseli Serena
5D
4D
Kimana
Tawi
Zhogfa
2D1K
3K
2K
Matasia I Ecolodge
Nolarami OP14K
Airstrip & Scouts camp
Lemomo hill 12K
Lemomo gate 13K
Dam site
11K
Oldule borehole
Matasia II Campsite
3D
Elephant Gorge Ecolodge
Lendikil caves & Lekilessprings
5K
6K
Picnic site
4K
Isiruai gate
Isiruai Lodge
Satao
Dam site
Ilmarba scouts camp8K
9K
10K
Lenkiteng Springs & Caves
Tadiwos lodge7K
7D
Legend
Important_sites
Airstrip & Scouts camp
Dam site
Egerbobit gate
Elephant Gorge Ecolodge
Ilmarba scouts camp
Isiruai Lodge
Isiruai gate
Lemomo gate
Lemomo hill
Lendikil caves & Lekilessprings
Lenkiteng Springs & Caves
Matasia I Ecolodge
Matasia II Campsite
Nolarami OP
Oldule borehole
Picnic site
Tadiwos lodge
KCCA_Boundary
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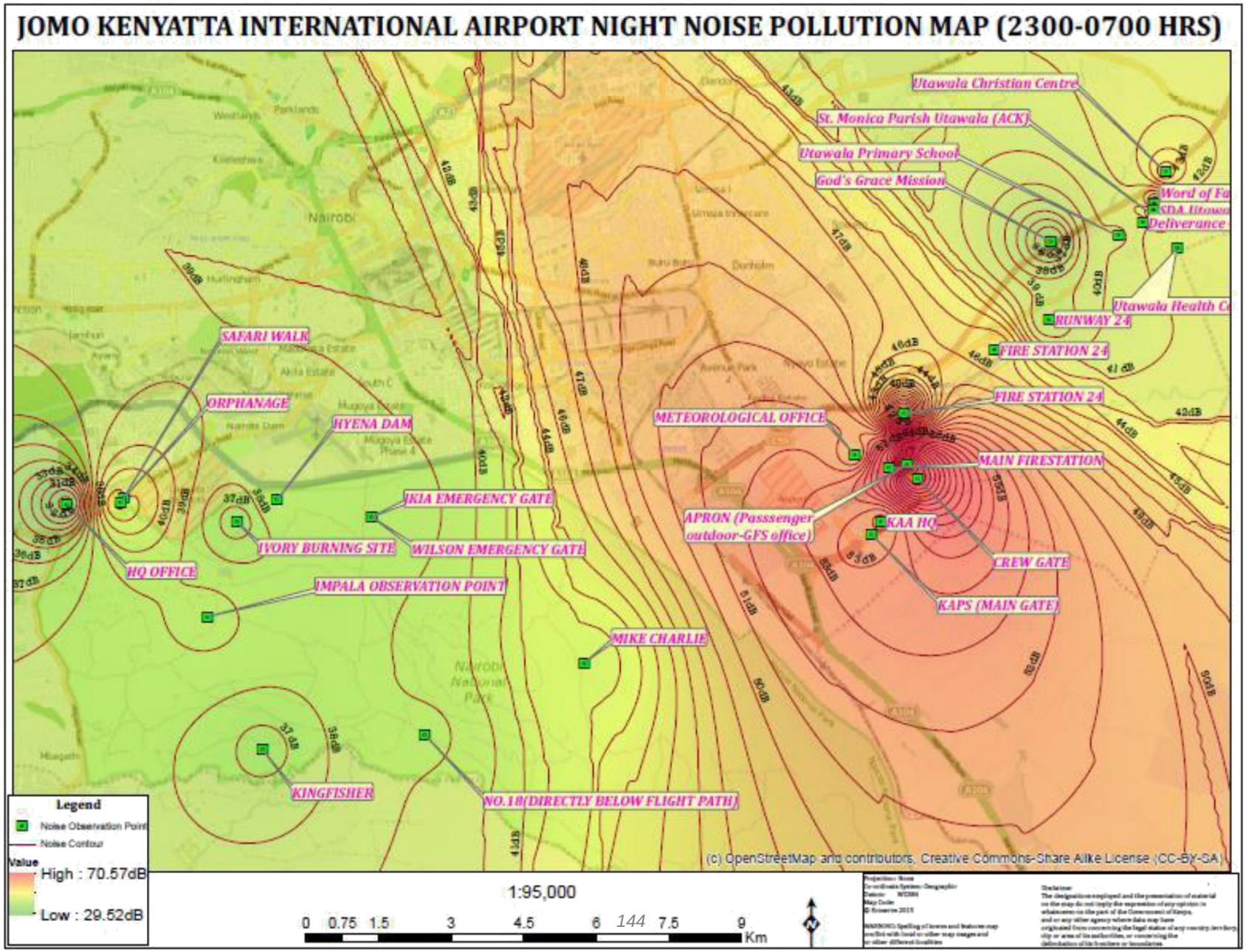
0
1,375
2,750
5,500
8,250
11,000
Meters


JOMO KENYATTA INTERNATIONAL AIRPORT NIGHT NOISE POLLUTION MAP (2300-0700 HRS)
Utawala Christian Centre
St. Monica Parish Utawala (ACK)
Utawala Primary School
God's Grace Mission
Word of Fa
KDA Utawa
Deliverance
Utawala Health C
RUNWAY 24
FIRE STATION 24
FIRE STATION 24
METEOROLOGICAL OFFICE
MAIN FIRESTATION
APRON (Passsenger outdoor-GFS office)
KAA HQ
CREW GATE
KAPS (MAIN GATE)
SAFARI WALK
ORPHANAGE
HYENA DAM
IKIA EMERGENCY GATE
IVORY BURNING SITE
WILSON EMERGENCY GATE
HQ OFFICE
IMPALA OBSERVATION POINT
MIKE CHARLIE
KINGFISHER
NO.18(DIRECTLY BELOW FLIGHT PATH)
Nairobi
Nairobi National Park
Legend
Noise Observation Point
Noise Contour
Value
High : 70.57dB
Low : 29.52dB
(c) OpenStreetMap and contributors, Creative Commons-Share Alike License (CC-BY-SA)
1:95,000
0 0.75 1.5 3 4.5 6 7.5 9
Km

Conclusion

- GIS link attribute data to map data
- Map data (points ,lines & polygons)
- Attribute data (characteristic of map features such as land use of an area, population density, slope of a road, biodiversity etc.
- Link between map data and attribute data allow maps of attribute data to be displayed
- Results can easily be used in public participation exercises in an interactive manner
- Project location and area of influence are part of spatial data
- Impacts are part of attribute data

THANK YOU

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GIS Application and Data Needs in Protected Area Planning

KWSTI
20th December, 2017

M. Nzisa

Protected Area Planning Data Needs

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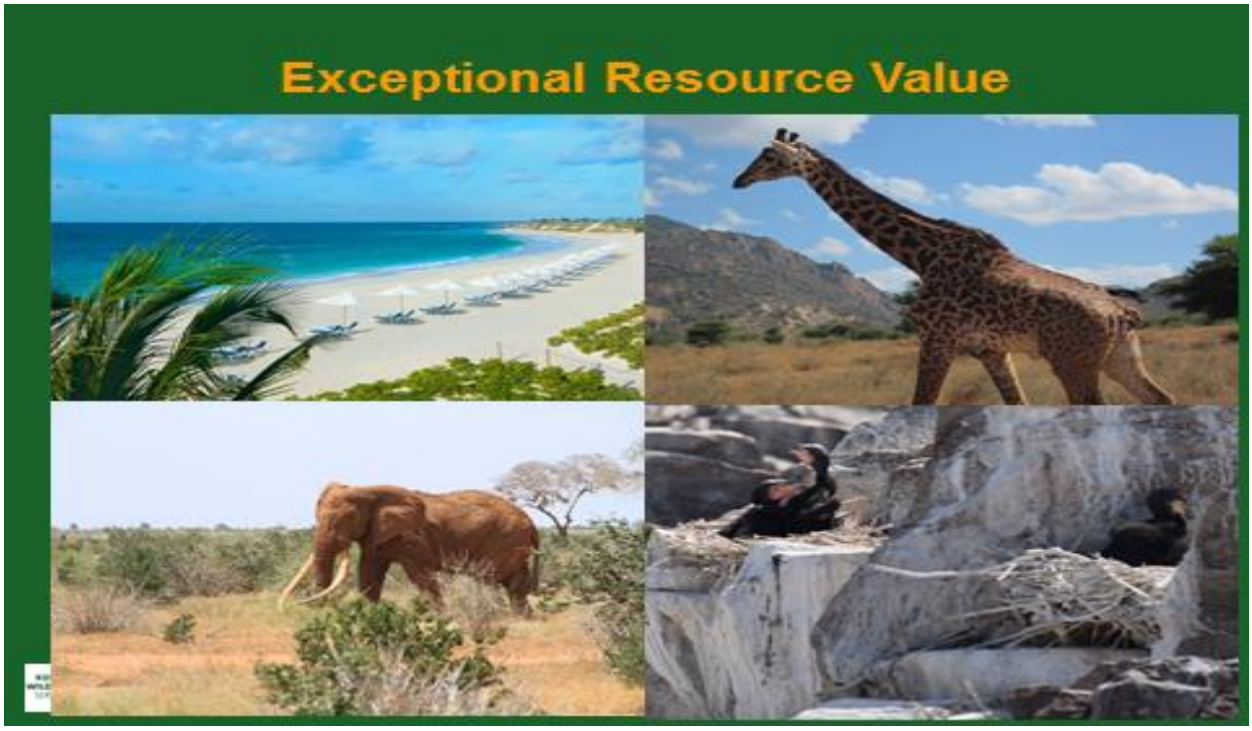

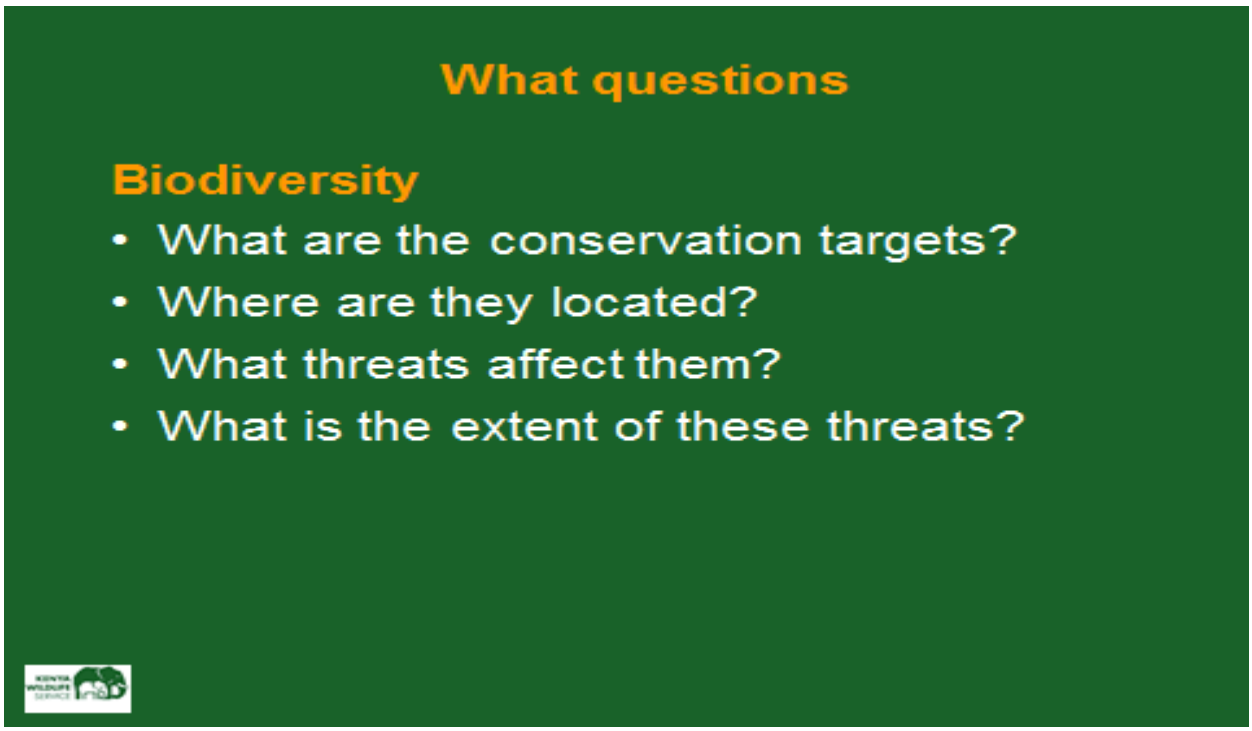

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PA Planning Data Needs

- Wildlife (population trends, distribution, movement, translocations, breeding sites)
- Wildlife
- Vegetation
- Water points, Rivers
- Human wildlife conflict
- KWS facilities (Gates, offices, residential buildings, outposts, airstrips, etc.)
- Road
- Human impacts (Threats)
- Tourist facilities (Location, Bed capacity)
- Visitor trends & feedback

Importance of GIS in PA Planning

- The biggest strength of using GIS in planning is that it is very quick and outputs good results
- However, the level of detail in a GIS analysis is dependent on the availability of data in the correct format and standard
- GIS is important in defining plan area

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PA Zonation

Typical visitor use zones

- High Use zone
- Low Use Zone
- Wilderness Zone
- Controlled zone

Criteria for defining the zones is based on available data

Tourist Facility Site Selection

Factors	Selection Criteria	Justification for the Criteria
Proximity to road network	Within 10Km from a road	(Ouiambao, 2001)
Proximity to water source/body	Within 2Km from a water body	Water bodies attract wildlife
Proximity to urban area	Should be 3Km from urban/town	To avoid urban noise, congestion
Size	Should be at least 1Km²	
Proximity to a breeding area	Within 5Km	
Proximity to attraction sites	Within 1Km	(Mejia, et al. 2000)

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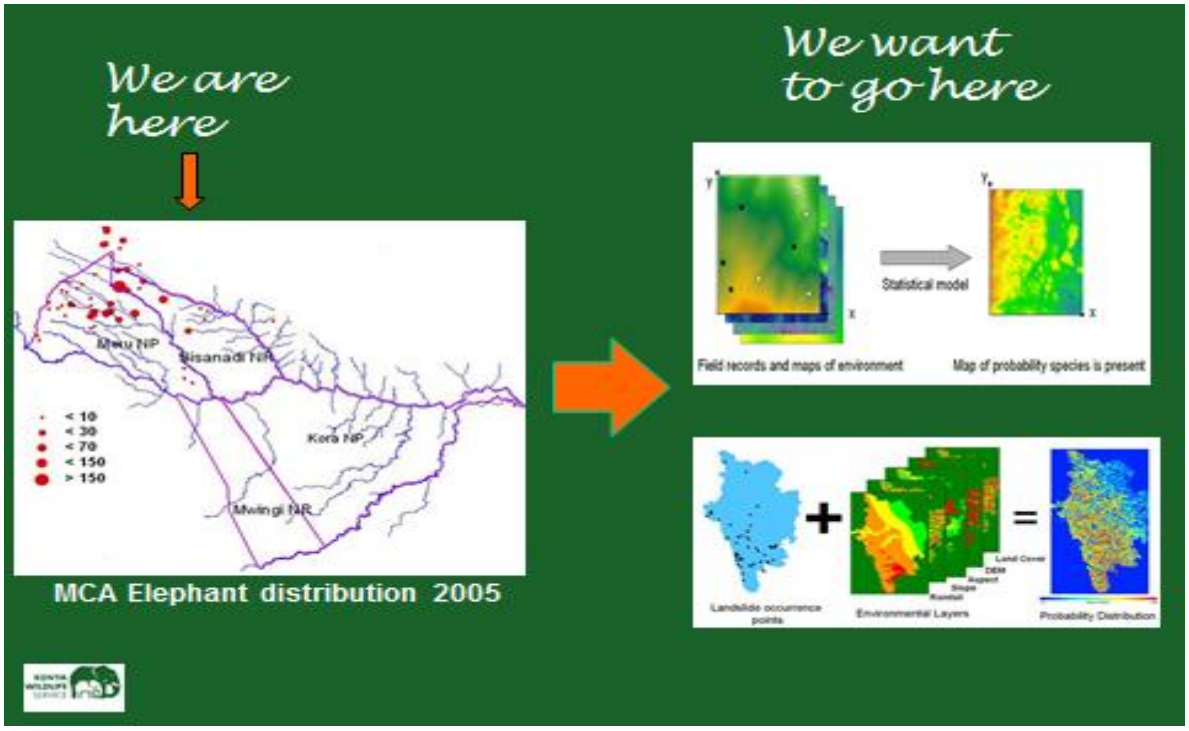

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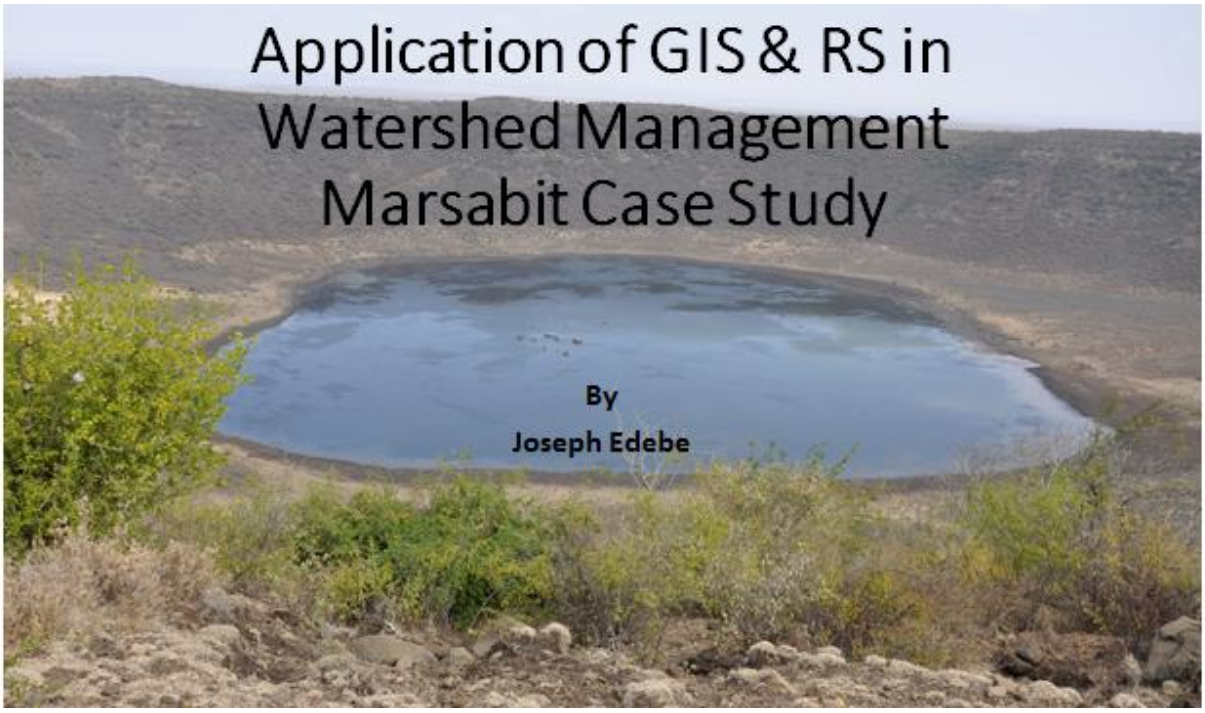

Introduction

- Definitions
- Marsabit Case
- Recommendations

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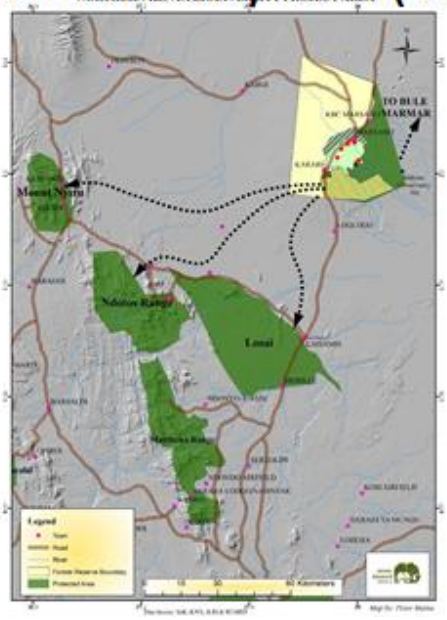
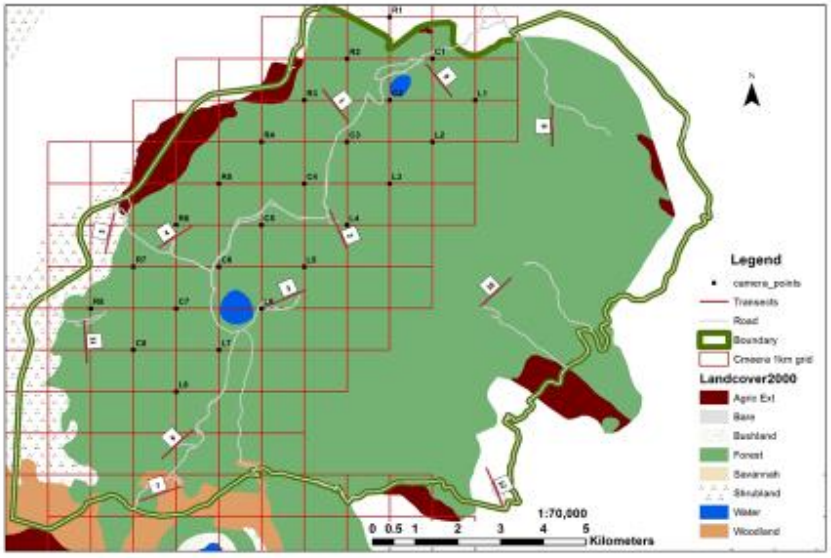
Definitions: Geographic Information System (GIS)

GIS

- a system designed to *capture, store, manipulate, analyze, manage,* and *present spatial or geographic data*
- Answer questions such where is it? What relationships are there? *Integrates, Stores, Edits, Analyzes, Shares*, and
- *Displays* geographic information Examples: Cartographic map



Marsabit Map Transects



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Definitions: Database

- A database is an organized collection of data.
- A relational database, more restrictively, is a collection of schemas, tables, queries, reports, views, and other elements.
- Examples of Databases
- http://www.iucnredlist.org/search
- http://datazone.birdlife.org/home
- http://whc.unesco.org/en/list/
- http://www.mocreativity.com/kwsdemo/KWS/

Definitions: Wetlands

- A wetland is a land area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem.
- The primary factor that distinguishes wetlands from other land forms or water bodies is the characteristic vegetation of aquatic plants,
- Wetlands play a number of roles in the environment,
  - principally water purification,
  - flood control,
  - carbon sink and shoreline stability.
- Wetlands are also considered the most biologically diverse of all ecosystems, serving as home to a wide range of plant and animal life.
  - Food production
  - Ecological Hotspots
- Integrated management (catchment approach + wise use principles)

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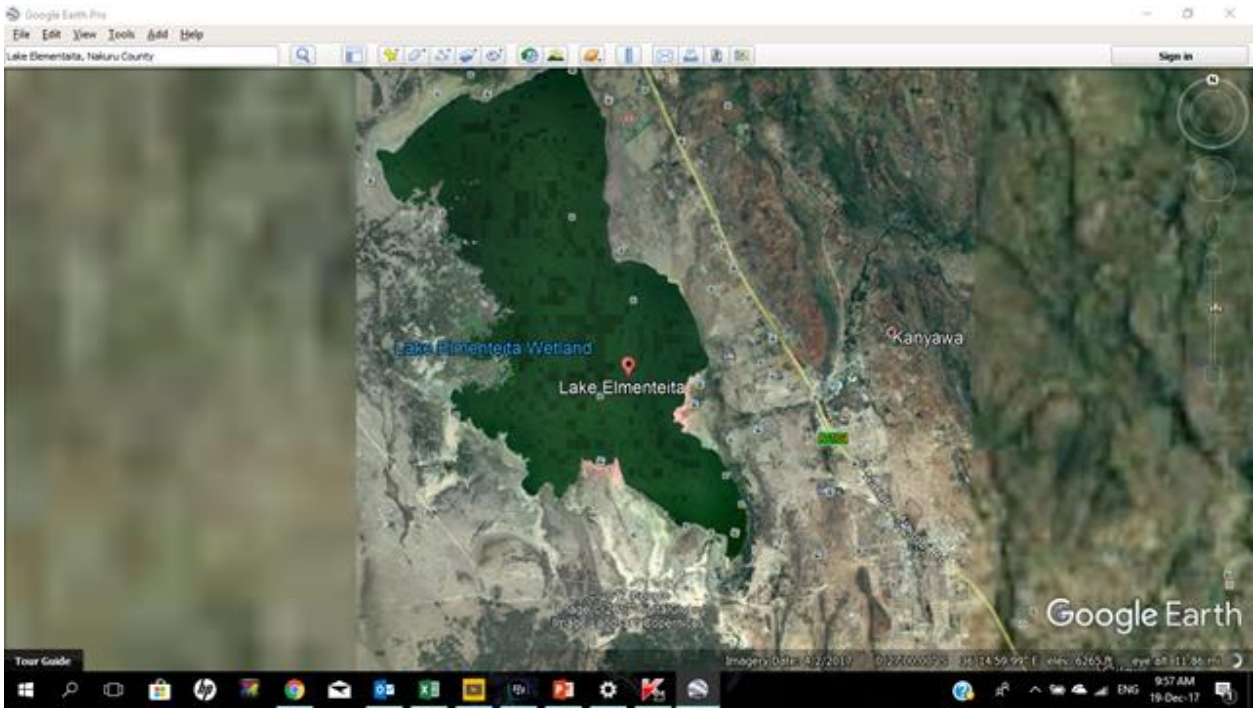

Definitions: Remote Sensing

- Remote sensing is the acquisition of information about an object or phenomenon without **making physical contact with the object** and thus in **contrast to on-site observation**.
- Remote sensing is used in geography, land surveying and most Earth Science disciplines including hydrology, ecology and geology);
- it also has military, intelligence, commercial, economic, planning, and humanitarian applications.
- generally refers to the use of satellite- or aircraft-based sensor technologies to detect and classify objects on Earth, including on the surface and in the atmosphere and oceans, based on propagated signals (e.g. electromagnetic radiation).
- "active" remote sensing (i.e., when a signal is emitted by a satellite or aircraft and its reflection by the object is detected by the sensor) and "passive" remote sensing (i.e., when the reflection of sunlight is detected by the sensor).

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Remote Sensing

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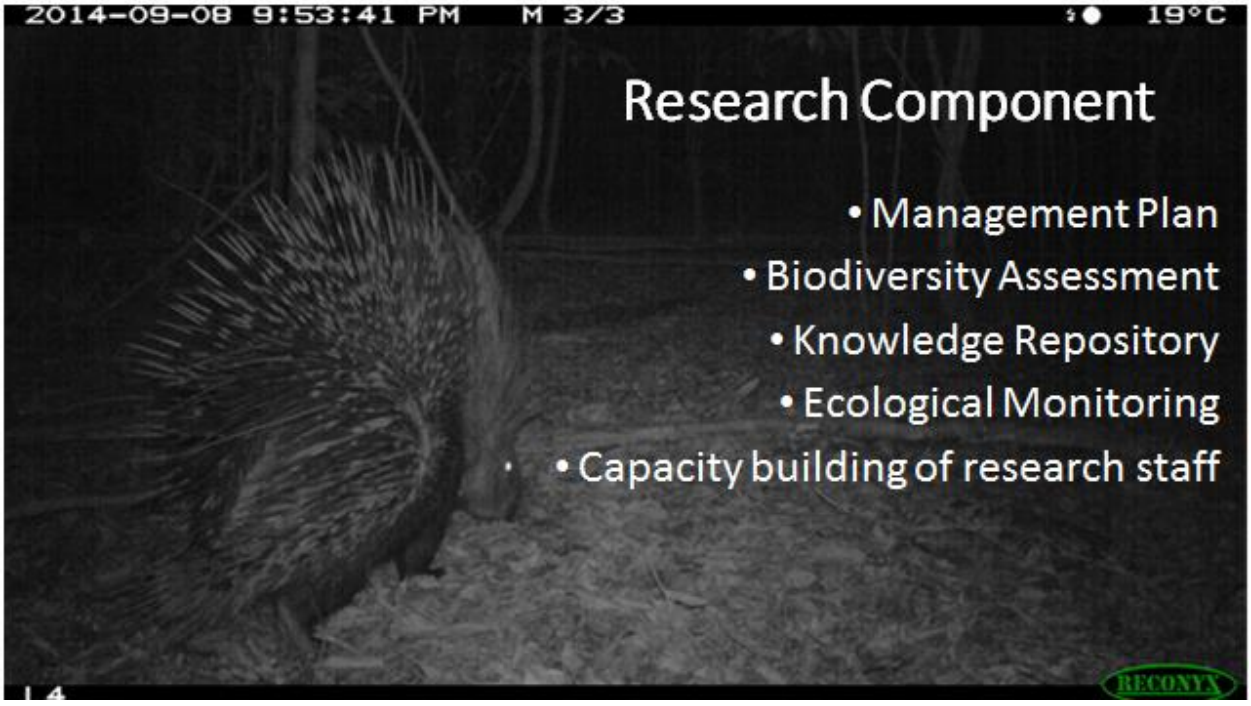

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Progress to date

- Management Plan Gazzetted (March 2016)
- Biodiversity Assessment of Marsabit Forest Ecosystem
  - Wet & dry in 2014
  - Plants, Arthropods, Reptiles, Amphibians, Birds, Mammals,
  - Water Quality and fauna, (LULC), Social perceptions
  - Carbon study, Non Timber Forest Products, Alternative Sources of Energy
- Basic research equipment procured and is in use
  - Computers, Office Furniture, GPS, Digital Cameras.
- Data Collection ongoing
  - HWC, Wildlife Movement, Elephant Mortality, Road Kills, Weather
- Capacity building
  - Research staff attended basic GIS/RS course
  - Rangers given refresher on GPS use
    - (40 rangers and scouts from KWS, Milgis Trust & Ndottos Conservancy)

GPS training in Ngurunit

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Next Steps

- Specific Studies
  - Human Wildlife Conflict hotspot identification & mapping.
  - Total Valuation of Mt Marsabit Forest Ecosystem.
  - Governance and sustainability of PES in Conservation
  - Land degradation studies (deforestation, soil erosion).
  - Climate change impacts on Marsabit Forest Ecosystem
  - Impacts of Livestock on Marsabit Forest
- Operationalization of Knowledge Repository
  - GIS laboratory, Data collection from partners
  - http://mocreativity.com/kwsdemo/KWS/index.php?r=site/index
- Biodiversity assessment on targeted species
  - Large mammals, Vegetation,
  - Water Quality Monitoring
- Payment of Ecosystem Services
  - Partnering with Conservation International

Payment Of Ecosystem Services

- Community Sensitization about 800 people living around Marsabit Forest
- Visited Chyullu and Kasigau REDD+ projects
- Team from Conservation International visited Mt Marsabit in November 2016
- Exploring ecological connectivity between Marsabit Forest Ecosystem and the Matthews.

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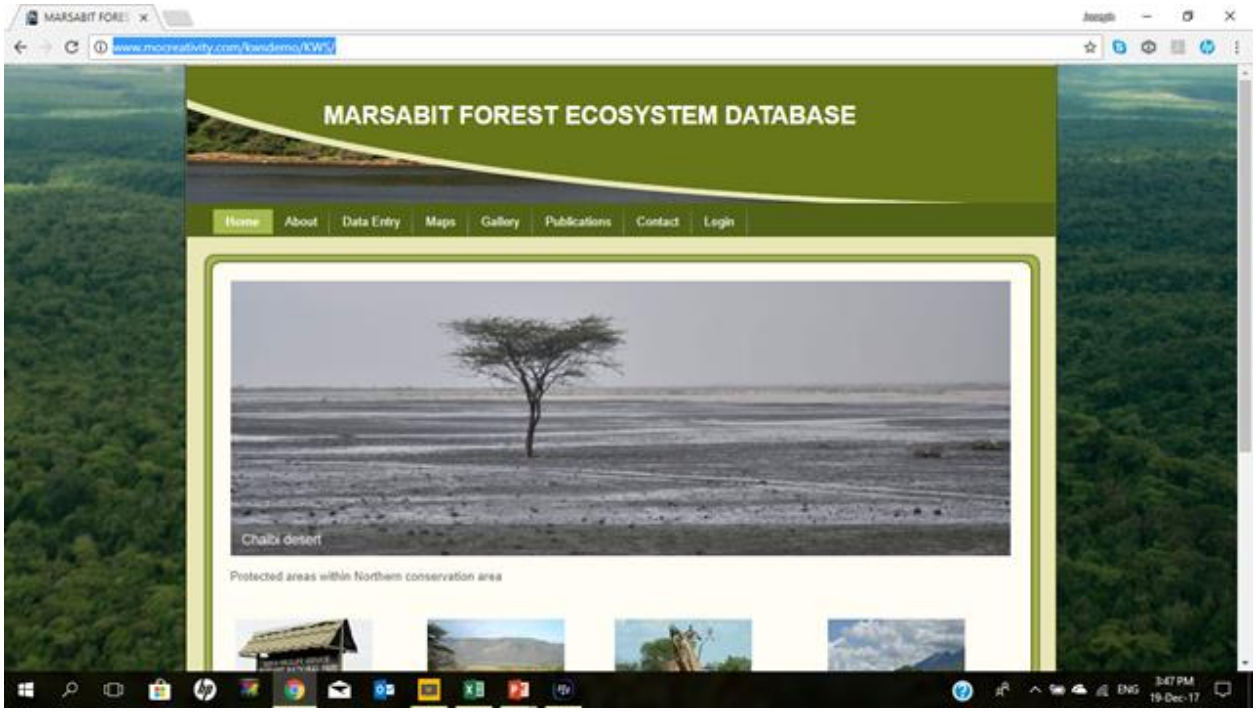

Recommendations

- Equipment for data acquisition & processing.
  - Automation, ODK. GPS
- Inter disciplinary team
- Training
  - (new technologies & refresher courses).
- Partner/Network amongst stakeholders
  - Avoids duplication & saves costs.
- Standardization of data collection
  - (forms, templates, Ecological Monitoring Manual)
- Interlinking the data sets
- Resource allocation

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Introduction to Ornithology

✓Bird Identification

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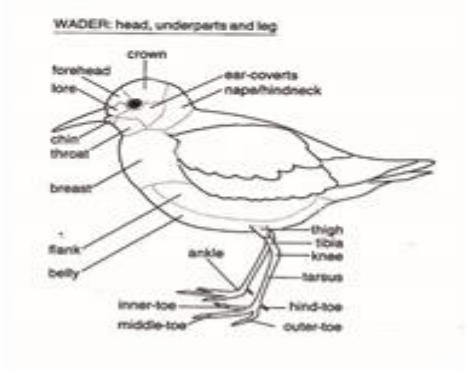
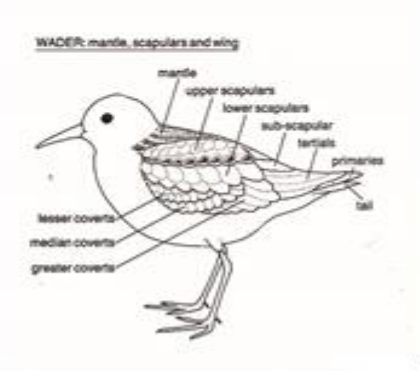
Identification Toolkit-what to have

- Notebook-for keeping records
- Pen/pencil-for recording
- Binoculars-without one may not enjoy
- Guidebook-
- Playbacks or Skills of attracting birds

Part of a Birds Body - Wader





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Bird Topography and Identification

- Terms used to describe parts of head.
- Terms used to describe plumages
- Terms used to describe the trunk
- Terms used to describe the tarsus
- At least 28 terms are used describe a bird
- Know at least 20 to be safe.
- Draw a rough picture of the bird you se

Bird Identification by Sizes

- Birds are identified by appearance and calls.
- Follow these steps for a bird with no clue
- **Size of the Bird**-Make COMPARISONS!!!!
  - With other birds / objects
  - with other parts of the bird
- What other bird has the same size as the bird you see.
- Is the bird the size of Black Smith Plover?
- Is the bird the size of Grey Heron?

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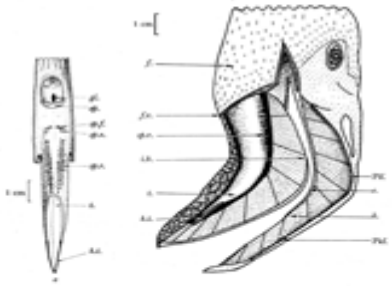
Bird identification by Bill characteristics

- The bills guides us to what the bird eat.
- Bill shape-curved, long & thin, hooked etc.
- Bill size-same descriptions as above
- Bill color-young/adult birds bills differ in color.

Make notes if the bird is new and go on.



NatureKenya

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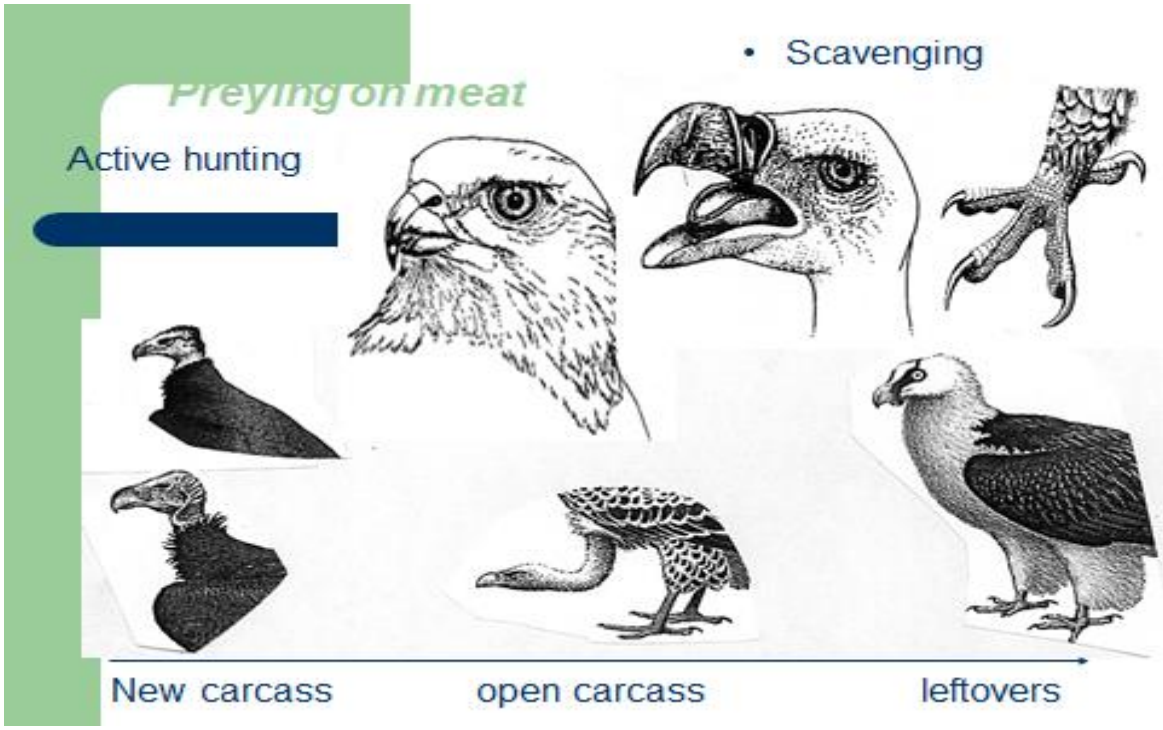

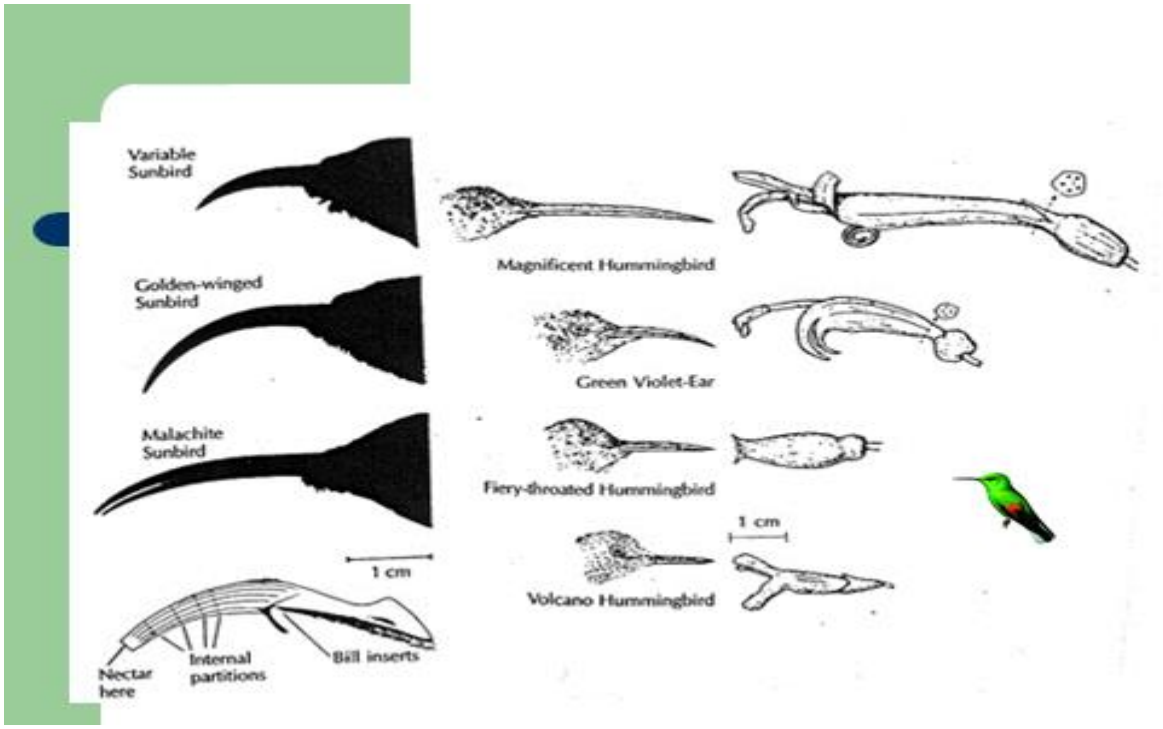

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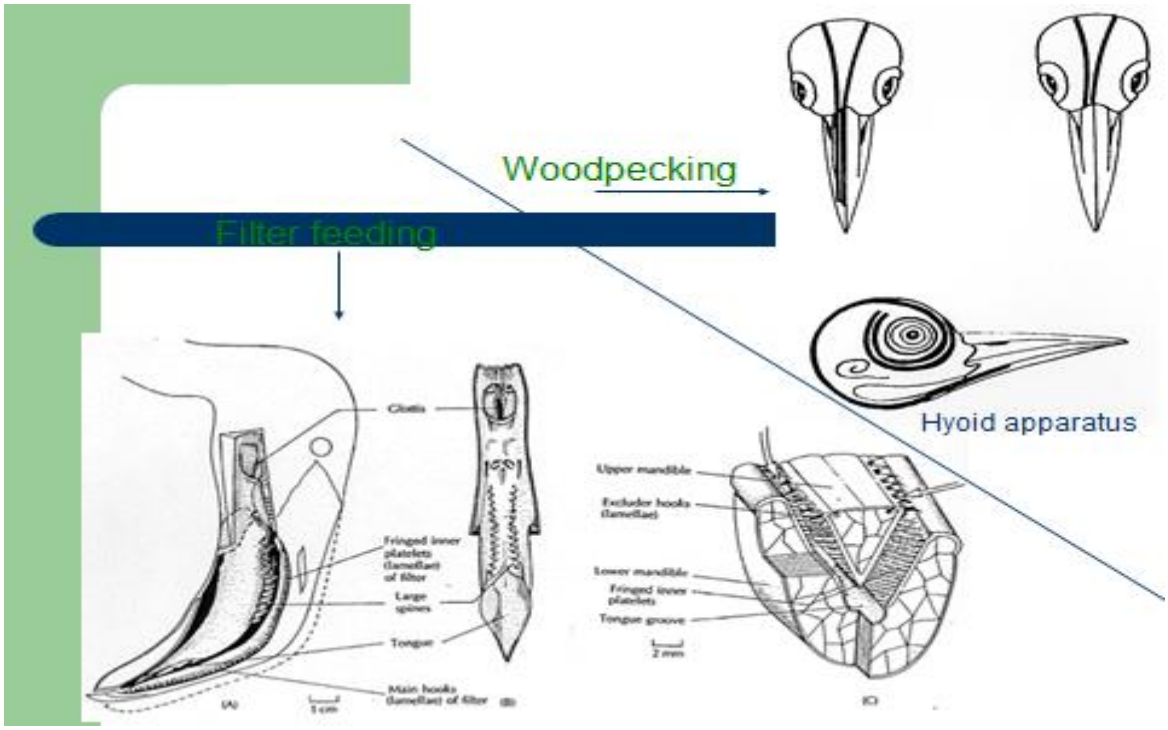

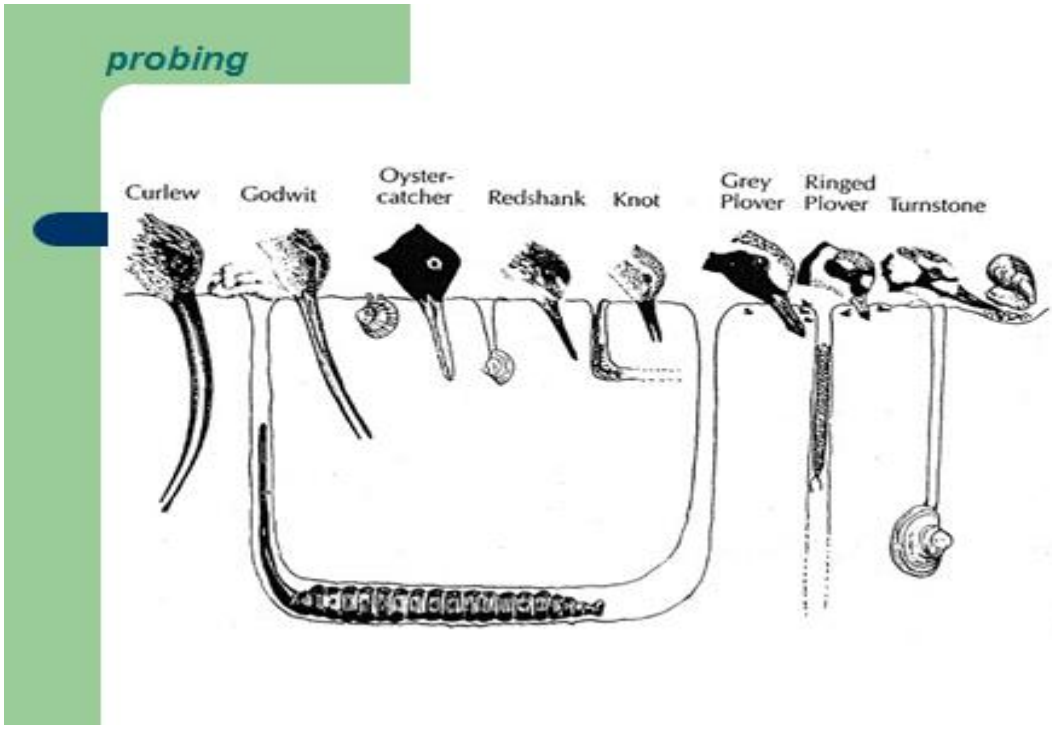

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Bird identification by Stance and Posture

Birds of the same family show same posture and stance. Eg.

(The way and bird perches, flies, walks, stands, swims, feeds etc...can be crucial in ID.)..

- **Flycatchers sit very upright on a branch**
- **Plovers stand with a head high**
- **Mouse birds hang upside down on branches**
- **Most Raptors stand/sit on a perch upright.**
- **Make notes if the bird is new and go on**

Bird identification by Shape

- **Birds of the same family have same overall shape, eg.**
- **Is it slender, long tail and wags it- wagtails.**
- **Is it tailless and stout like-Crombecs**
- **Or just describe the shape yourself in prose**
- **Or just draw a rough sketch of the bird**

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Bird identification by Plumage Colour

Describe the bird colour e.g.

- **What is main colour striking you?**
- **What part/s has the striking colour?** note where on the bird
- Body patterns – e.g. spots on breast vs. streaks(Nubian vs. Golden-tailed Woodpecker)
- **Note: males are more colorful than females.**
- **Young birds have different colors than adult birds.**

Bird identification by Habitat

- **Bird families have distinct choices of habitat. E.g Bitterns, Crakes prefer to hide**
- **Within the general habitat specific locations are chosen**
- **Eg in waders on the shores**
- **Can sandpipers occur in deep waters?**

Make notes if the bird is new and go on.

- some species are generalists, but many species are specialists
- Macro habitat and Micro habitat

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Bird identification by Distribution

- Many bird species are confined to particular habitat types. Eg
- Coastal birds,
- Inland waters
- Marine
- Some coastal birds have never been in inland and vise versa-

- Range – where a species is likely to occur(map)
- Occurrence – a measure of the likelihood of seeing a given species e.g. Palaearctic migrant in July

Bird identification by Voice

- Birds make two types of sounds: Calls and Songs, not easy to differentiate.
- There two types of calls, 1) Contact call- short and simple mainly for communication BTW members of a flock.
- Alarm Calls-are for warning of danger. They are short note, harsh sounding.
- Critical in certain habitats esp. forests

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Bird identification by Voice

- Birds songs are used for territorial defense and to attract mates.
- Males tend to sing more than females especially during the breeding season.
- Songs and calls of are unique to each species but some are imitated.
- Forest birds are heard singing/calling more than seen
- Knowledge of their call is crucial for their identification.

Bird identification Using Bird Guide

- Have a clue of the family the bird belongs to
- Find the right plate in the guide
- Select the bird picture in the plate
- Read the text about the bird in the book
- Make sure the habitat is correct
- Make sure the location-distribution is right

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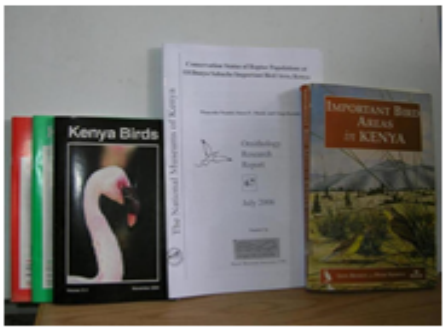
Reference material

- Field guide ; Birds of east Africa –Steveson and Fanshawe (2002)
- Birds of Kenya and Northern Tanzania-Zimmerman, Turner and Pearson (1996)
- Photographic guide to birds of East Africa-Richards (1995)
- A bird atlas of Kenya –Lewis and Pomeroy (1989)
- Birds of Africa Volumes 1-11
- Tanzania Bird Atlas

Keeping Records and Information Exchange

- **Its is important to keep a list of all birds you see when you go birding**
- **Its important to keep records of notes**
- **You can use the records to fill bird checklists**
- **The checklist can be handed to NK/Ornithology Sec for updating the Bird Distribution Atlas**



Keeping records

- What to record
- Location
- Date, time, Names of other observers, weather
- List of species and numbers of birds seen.
- Any notes e.g. nest building, displaying, unsure of identity e.t.c
- All species! Not just the unusual ones

Keeping records

- Where to keep records?
  - Logbook in safe place at home (how safe?)
  - Computer database (Regular back up copies)
- When to update? Same day-possibly later if in a detailed field-notebook
- When to do with them? Store securely, look at ways to summarize them and make them accessible to others.

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Benefits of good record keeping

- Contribute to future atlas projects
- Baseline monitoring of birds distribution changes
- species list
- Potential IBA designation/updates
- Identify eco-tourism hotspots
- Habitat monitoring

Going about bird identification…

When identifying a bird look at:

- 1. Size & Shape
- 2. Colours & Patterns
- 3. Movement & Behaviour
- 4. Habitat
- 5. Calls
- 6. Range and occurrence

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Asanteni

Introduction to Ornithology

✓Kenya's Birds, their Habitats & Distribution

✓Bird Identification

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- Kenya has one of the richest birdlife in Africa.

- 1060 bird species presently listed.

✓ Landbirds
✓ Seabirds
✓ Waterbirds
✓ 42 GT:
✓ 11 are endemic in Kenya
✓ 278 are migrants

Why high number of species

- Diverse Habitats

- Presence of 8 endemic bird areas (EBAs) e.g. KK and Nandi Forests, Kenyan Mountains.

- 6 Biome-level representation

✓ 92/130 Somali-Masai biome
✓ 30/36 E. African Coast biome
✓ 67/224 Afrotropical Highlands biome
✓ 9/12 L. Victoria Basin biome
✓ 43/273 Guinea-Congo Forests biome
✓ 13/54 Sudan & Guinea Savannah biome

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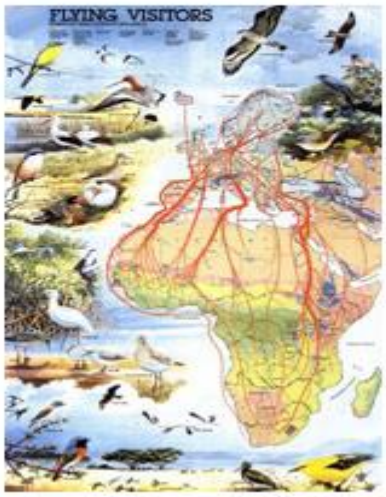
Migratory Birds

- Major flyway of Palaearctic migrants
- Total 170 species (11 with local breeding population)
- 60 regular Afrotropics



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Topography and habitats

- Kenya lies across the Equator
- Altitude varies (0 –5199 m asl)
- Climate determines natural vegetation
- Much of Kenya is semi arid

Kenya's major Habitats

Forests

- Most important and threatened habitats for bird conservation in Kenya
- Majority of Kenya's globally threatened species are forest dependent

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Coastal Forests

- Occur along narrow coastal strip
- Small forest pockets e.g. Kayas
- 6 globally-threatened species.
- 7 out of the 8 species of East African coastal Forests EBA occur here

Special birds of the coast

- Globally threatened species: Sokoke Scopes Owl and Clarke's Weaver
- Others include: Southern Banded Snake Eagle, Amani Sunbird, East Coast Akalat, Tiny Greenbul, Green-headed Oriole, Spotted Ground Thrush

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Highland Moist Forest

- Occur between 1500 – 3000 m asl
- Mosaic of forest and bamboo
- Few threatened or near-threatened species than other forests.
- Important water catchments.
- Include the Mount Kenya, Aberdares and the Elgon and Mau Hills where little is known

Montane Forest Specials

- Montane species include:
- Hartlaub's Turaco
- Jackson's Francolin
- Montane Oriole
- Brown-capped Weaver

- Abott's Starling
- Aberdare Cisticola

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Guinea-Congolean Forests

Kakamega Forest

- ✓ Unique mix of lowland and afro-montane species
- ✓ West African species find their eastern most limits in Kenya.

Kakamega specials

- Turner's Eremomela
- Chapin's Flycatcher (Montane Forest Species)
- Great Blue Turaco
- African Crowned Eagle
- Black-billed Turaco

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Nandi Forests

- They are smaller and higher than Kakamega
- Birds include: Turner's Eremomela, White-browed Crombec

Highland Dry Forests

- Include; Taita Hills, Mt Marsarbit, Mt. Kulal and Chyulu Hills
- Small forest fragments about 600-700m.
- Heavily disturbed but holds important biodiversity components.
- Endemic birds occur here

✓ Taita Thrush
✓ Taita White-Eye
✓ Kulal White-eye
✓ Taita Apalis

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The plains and grasslands

The highland grasslands of the Kinangop plateau and the Mara plains stronghold threatened migratory Corn crakes and the near threatened, range restricted Jackson's Widowbird

Savvanahs

- Thorn bushland & woodlands represents the extensive vegetation type in Kenya (41.7%).

✓ Stretch from Amboseli through Tsavo to North-East and North-West Kenya

✓ True characteristic of African Acacia woodlands & bushlands which grades into semi-arid wooded & bushed grasslands (Samburu)

✓ Rich & diverse in birdlife. Represent the Somali – Maasai Biome.

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Savvanah Birds

- ✓ Game birds e.g. Helmeted Guineafowl, Francolin,
- ✓ Raptors
- ✓ Weaver colonies, seed eaters & relatives
- ✓ Smaller Hornbills & migratory persserines

Hostile Arid Areas

- Semi-deserts
- ✓ Areas around L. Turkana with less vegetation
- ✓ Quite few but unusual species eg Wiliams's Lark

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Wetlands

- ✓ Rift Valley lakes support large populations of Afrotropical species
- ✓ Lesser Flamingos & White Pelican
- ✓ Important for dense concentration of passage and wintering waterfowl and waders during Palaearctic Winter.
- ✓ Turkana, Nakuru, Elementaita are saline
- ✓ Lake Victoria & Naivasha- Fresh water.

Fresh Water bodies

2.1% of Kenya's Surface Area

- Include: L. Victora, L. Naivasha
- Important for fish dependant waterbirds

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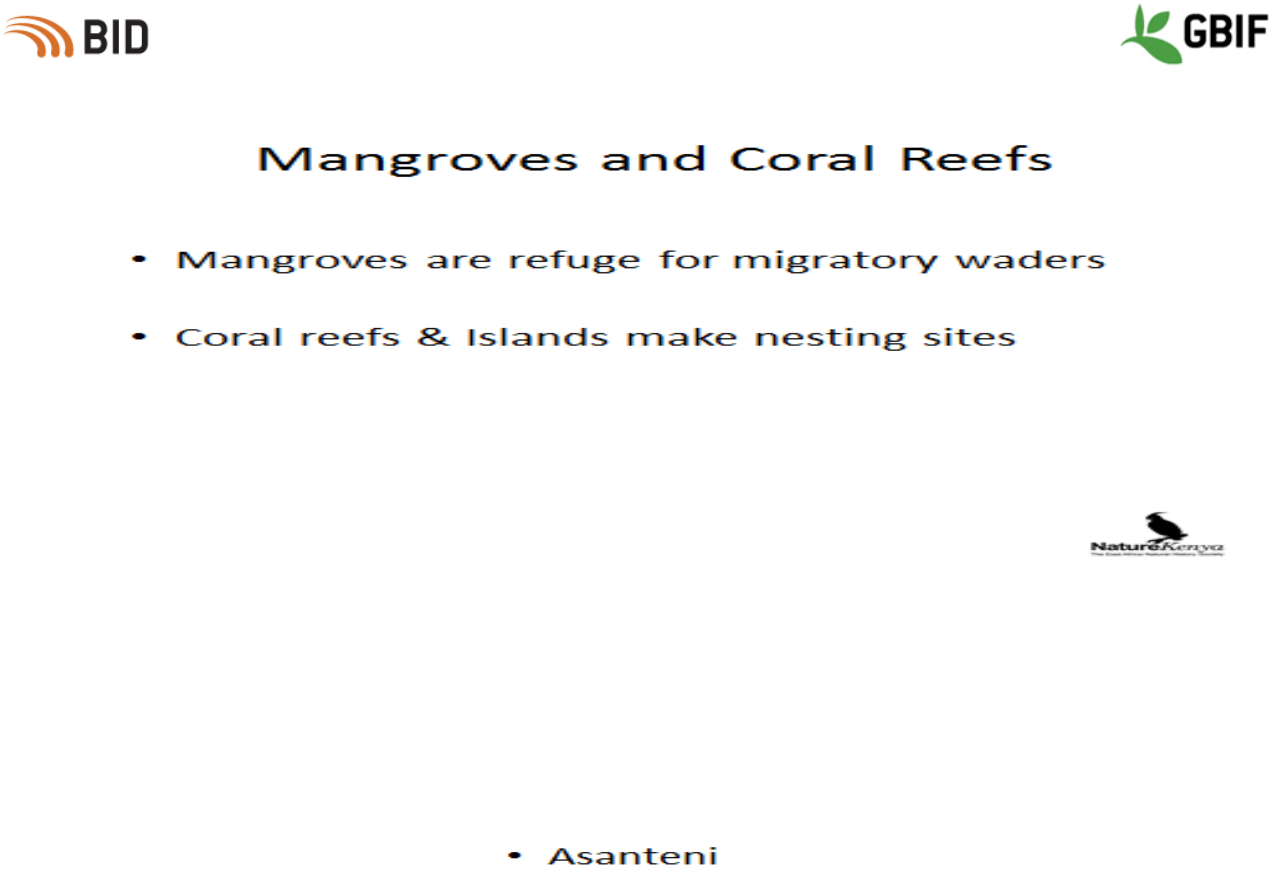

Sources of verification

Power point presentations, Photographs and attendance list

4.2. Goal 2: Increase available biodiversity data, within and beyond the grant period

Activity 1 name: Data Mobilization

Description of any implementation during the reporting period

1. **Create awareness about the project and including its objectives;**

Under this activity an inception workshop was held at The Cooperative University College of Kenya from 27th-30th September, 2016. The workshop drew participants from KWS and Nature Kenya. Although the National Museums of Kenya were invited to the workshop they did not attend. They said that all their key people that would have attended the workshop were busy elsewhere.

Verification: Power Point presentation that was done during the workshop (attached).

2. **Demonstrate GBIF and KenBIF data;**

First, created awareness about GBIF during the above presentation. Later in the workshop, showed how a GBIF dataset looks like by going through the metadata of a published GBIF dataset.

Did not demonstrate KenBIF as this was supposed to have been done by National Museums of Kenya and who did not attend the workshop;

Database development is still a challenge since Mr. Mutero went on retirement. We are in the process of identifying a competent person to develop the database. We will report on the monitoring and evaluation after the biodiversity training.

Verification: Above Power Point Presentation.

3. **Determine biodiversity information user needs for policy makers, national priorities, Protected Area Managers, GBIF, KenBIF, researchers and other stakeholders that include communities living adjacent to WPAs**;

Determined the user needs for KWS Researchers by listing the datasets that they considered to be the most important and which need to be better organized. Did not get to determine the user needs for the other stakeholders. Will determine the needs of the other stakeholders in the next 3 months.

Other partners are now actively engaged in training as per the schedule in Biodiversity training. We have also compiled a list of datasets to be provided by the partners as shown below:

Organization	Dataset	Details	Extent
Nature Kenya	Bird Tracking data	Migration patterns of birds	Kenya
	Waterfowl Census data	Diversity per counting blocks	Naivasha, Elementaita, Bogoria, Magadi, Nakuru, Olbollosat
	Important Bird and Biodiversity Areas (IBAs)	Birds density	IBAs
	Biodiversity (Birds) Threats	Spatial data indicating the level of threats	
National Museums of Kenya	Birds Richness / Diversity	Distribution of birds species across landscapes	Wildlife Protected Areas
	Reptiles and amphibians Diversity	Distribution of species across landscapes	Wildlife Protected Areas

	Invertebrates (insects) Diversity	Distribution of species across landscapes	Wildlife Protected Areas
	Small mammals Diversity	Distribution of species across landscapes	Wildlife Protected Areas
	Plant species diversity	Distribution of species across landscapes	Wildlife Protected Areas
	Species(Plants, Insects, small mammals, reptiles/ amphibians) of conservation concern	Spatial distribution / densities of species listed in the CITES categories	Wildlife Protected Areas

Verification: The list of prioritized datasets by Researchers is to be found at the bottom of the Draft Workshop Report.

4. **List biodiversity data holdings for KWS and its partners;**

As indicated in the Workshop Programme (attached), KWS Scientists from 5 Conservation Areas made presentations on the datasets that they have under their custody. One Scientist from the KWS Headquarters also made a presentation. In addition, Nature Kenya presented on its datasets.

Verification: Presentations are attached except for three KWS presentations for the Mountain Conservation Area, Southern Conservation Area and Western Conservation Area. The Mountain Conservation Area Scientist did in fact make a presentation but did not provide a copy. A reminder has been sent to him to provide the presentation.

5. **Identify data gaps viz a viz identified user needs**;

This was not done explicitly. However, when determining which were the most important datasets for which KWS needed to organize data, the user needs were addressed to a reasonable extent.

Verification: The list of prioritized datasets at the end of the Draft Workshop Report.

6. **List formats for existing datasets**;

From the presentations made, it came out that KWS datasets in its field stations are in MS EXCEL format. The Nature Kenya datasets are in a database format and on a Web platform.

Verification: By going through the Power Point Presentations, one learns that the datasets are in MS EXCEL. From the Nature Kenya presentation one can deduce that the datasets are in a database format and on a Web platform.

7. **List quality of available datasets:**

The quality of the datasets was to a large extent not addressed except in the case of KWS Central Rift Conservation Area. Data quality will now be addressed again during the data cleaning stage.

Verification: From the Central Rift Conservation Area presentation, one can see a statement on quality.

8. **Determine accessibility of data and mainly under 3 categories (confidential, restricted and open**)

This was not done directly. The change in plan was to avoid a protracted discussion before participants had appreciated the objectives of the project and the importance of GBIF and BID.

9. **Formulate data sharing policy**

This was partially done though verbally. Participants agreed that the sharing would be concretized in writing at a later date. This will be scheduled for April, 2017.

10. **Determine the frequency to update data**

There was agreement on this and the frequency varies from dataset to dataset.

Verification: See Data Organization template at the end of the Draft Workshop Report (attached).

11. **Constitute data management technical committee**.

Participants agreed that for KWS, this should comprise the 8 KWS Senior Scientists that are found in KWS' eight Conservation Areas. For Nature Kenya, Paul Gacheru will be the representative. For National Museums of Kenya it will most likely be Dr. Oguya but this is still to be confirmed. It should be possible to get the confirmation by the end of December, 2016.

12. **Write inception workshop report**

A draft was done. The final report is now scheduled to be done by end of March, 2017.

Verification:

Activity 2 name: Database Design

Not done

Activity 2 name: Populate Database

Not done

Activity 2 name: Coding

Not done

Activity 2 name: Database Operationalization

Publish into GBIF

Not done

Goal 3: Apply biodversity data in response to naional priorities

The Kenya Wildlife Service is a partner institution under the Ministry of Environment and Natural Resources which is implementing a Data Integration Platform. In this platform data is being shared with Government but is yet to be open access.

Source of verification

A website link will be provided soon (next week)

5. Updated calendar for the BID project implementation and evaluation period

The calendar should be completed in the same way as in the Full Project Proposal, but should include any expected changes. Provide reasons for any expected changes in section 5.1 'Explanatory Notes'.

Implementation period (maximum 24 months, starting 1 June 2016 at the earliest)																									
Implementation period start date and end date (dd/mm/yy)																									
Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	**Notes**
BID Capacity Enhancement workshop 1		X																							
6-month progress analysis						X																			
Mid-term evaluation & reporting														X											
INCREASE AVAILABLE BIODIVERSITY DATA																									
Preliminaries:																									
Database Mobilization																									
● Create awareness on project																									
● Demonstrate GBIF and KenBIF data																									
● Determine biodiversity information user needs																									
● List biodiversity datasets for KWS and partners																									
● Identify data gaps viz a viz identified user needs																									
● List formats for existing datasets																									
● List quality of available datasets																									
● Determine accessibility of data (open, restricted,																									

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confidential)	
• Formulate data sharing policy	
• Determine on frequency to update data	
• Constitute data management technical committee	
• Write inception workshop report	
Database Design:	
• Design biodiversity database based on user needs	
Populate Database	
• Extract data from existing soft and hard copy records	
• Mobilize data from partners and others where necessary	
• Clean data where necessary	
• Validate data where necessary	
• Export data into designed database	
Coding	
• Develop a Web interface for data entry, queries, reports and data export	
Database Operationalization	
Publish	
Pilot Publish	
Documentation	
Status and trends	
ESTABLISH OR STRENGTHEN FACILITIES	

Biodiversity Training	
• How to use Database System developed in this project	
• How to use GBIF and KenBIF	
• Bioinformatics	
• GIS using QGIS	
• Image processing using Land Impact Tool and SPIRITS	
• Botany 101 for WPA biodiversity inventories (taught by National Museums of Kenya)	
• Ornithology 101 for WPA biodiversity inventories (taught by Nature Kenya)	
Monitoring and Evaluation	
• Conduct Monitoring and Evaluation	
APPLY BIODIVERSITY DATA TO NATIONAL PRIORITIES AND DECISION MAKING	
• National priorities	
• Write workshop report	
• Disseminate workshop report and especially to policy makers	
• Non-specialists information	
• Disseminate user-friendly info to policy makers and other non-specialists	
• Enhanced Decisions	
Evaluation period (maximum 6 months, ending 31 December 2018 at the latest)	
Evaluation period start date and end date	01/10/18 - 30/11/18

(dd/mm/yy)							
Activity	1	2	3	4	5	6	**Notes**
Final financial and narrative reporting		X	X				

5.1. Explanatory notes:

In the calendar it will be noted that one of the activities whose timing has been changed is the data sharing policy. The reason for this is that before this BID Project, KWS had started on the development of a biodiversity information policy. This is bound to have a significant impact on the data sharing policy. It is likely that that the information policy will be completed by May, 2017. The strategy therefore is to develop the data sharing policy after the information policy is done.

The above data sharing policy formulation process has not been finalised by KWS. It requires approval by the KWS Board of Trustees which normally meets once every three months.

The most significant activities affected during this period and that were supposed to be implemented and not done were; database design and populating of the database, and publishing of one dataset into the GBIF portal.

The main reasons were attributed to: A) failure to procure a professional web-based database developer with necessary skills to carry out the work, even after aggressive search which continues, B) GBIF has not granted authority to KWS to publish their dataset after the Project Coordinator applied for permission. C) New policy by the government of Kenya policy on access and use of donor funds has been affected. This requires approval by the Ministry of Finance and we are still waiting for the necessary approvals from our National Treasury after making the required request for use of GBIF funds. As of the reporting date these funds are not accessible for use.

6. Beneficiaries/affiliated entities and other cooperation

6.1. Relationship with project partners

The relationship between KWS and its partners in this project (National Museums of Kenya (NMK) and Nature Kenya (NK)) is good. That said it is useful to mention that NMK did not attend the aforementioned inception workshop during which they were expected to make a detailed presentation on GBIF and also on the data holdings that are under their custody.

During the next few months of the project, KWS will be engaging NMK and NK more intensely with regard to the data records that we expect them to mobilize.

6.2. Links to other projects and actions

Traditionally, KWS has had strong links with its two partners in this project (National Museums of Kenya (NMK) and Nature Kenya (NK)). With the NMK it has conducted biodiversity inventories in places such as Marsabit Forest, Tsavo National Park and Shimba Hills National Reserve. With NK, KWS has continued to conduct water bird counts in Kenya's Rift Valley Lakes.

For this project and as mentioned above, NK attended the inception workshop and made a good presentation on their datasets. Since then KWS has met with NK's Executive Director, Dr. Matiku and agreed to meet in the next three weeks to discuss more closely on the activities that NK will be undertaking in this project.

Although NMK did not attend the inception workshop, KWS has since talked with Dr. Oguya, Kenya's GBIF Node Manager and agreed to meet to look at the activities that NMK will be undertaking in the project.

Whereas there will be one on one meetings with the two partners, KWS will also be convening a meeting where all the three partners can discuss together on the goals to achieve for this project. KWS will also be reaching out to those others who are involved in BID-funded projects in Kenya. These meeting have not happened and it is hoped it will happen soon.

7. Visibility

Please refer to the BID guidelines.

7.1. Visibility of the BID project

Short summary

During internal communications on this project to the KWS Director General and the Finance Division we have been creating awareness about BID, GBIF and the funding that the European Union has provided.

During the Inception Workshop referred to above, the following words were contained in the title of the Workshop Programme. "**FINANCIAL SUPPORT BY THE EUROPEAN UNION THROUGH THE GBIF-BID PROGRAMME**".

More visibility will come into being as we continue to engage more stakeholders in the ensuing months.

Sources of verification

Workshop Programme attached with the rest of the verification documents.

7.2. Visibility of the EU contribution

Short summary

To date the visibility has been through communicating to the KWS Director General, KWS Finance Division and KWS scientists that this project is being funded by the European Union.

NON CRITICAL ISSUES

1. BID Capacity Enhancement Workshop Activities

Have submitted the final assignment (see Final Assignment under Verification Materials). I however need mention that I had problems with publishing and adding higher taxonomy to the dataset provided in the exercise. I'm currently working at getting a solution to this and have also sought for assistance from Alberto and Nestor.

2. Data Organization Workshop

I have noted your comments on this issue. Have also read the guidelines contained on the link provided.

3. Institutional Representation on Technical Committee

Have already discussed with the other partner (National Museums of Kenya) and will be meeting with them in the next one month. They certainly will be in the Technical Committee

4. Data License Agreements with the BID Process

Have read the data licenses agreements with BID projects.

Signature

Name of the contact person for the BID Project:

Date report sent by email in Word format to bid@gbif.org for pre-approval: 31/08/2017

Date report sent by post to GBIF Secretariat: _____