

**The eastern Africa DNA barcode meeting
18th and 19th October 2006
Panafric Hotel, Nairobi, Kenya**

Report of a Regional Meeting

**National Museums of Kenya
(Nairobi CBOL Secretariat)**



November 2006

Summary

The National Museums of Kenya hosted a two-day regional meeting that introduced DNA barcoding to relevant researchers and policy-makers in Eastern Africa. Participants received presentations on the scientific and technical aspects of barcoding and its application to scientific research and socioeconomic applications. After discussing the opportunities and obstacles associated with the use of DNA barcodes in Eastern Africa, participants identified approximately 20 priority barcoding projects whose potential leaders and users in the region were also identified.

Introduction

A regional meeting on DNA barcoding was held in eastern Africa on 18th and 19th October 2006, hosted by the National Museums of Kenya at the Panafic Hotel in Nairobi (see Appendix I, meeting announcement, and Appendix II, meeting agenda). The meeting was co-organized by the National Museums of Kenya (NMK), the Consortium for the Barcoding of Life (CBOL), BioNET-EAFRINET, and its parent organization, BioNET-International.

The main goals for the regional meeting were to:

- Raise awareness of DNA barcoding in eastern Africa;
- Explore potential applications of barcoding in the region;
- Assess the greatest needs and opportunities in the region;
- Identify the highest priorities and begin the process of developing national and regional action plans associated with these priorities; and
- Start intra-regional networks and intercontinental partnerships.

The workshop was attended by 61 participants from 15 countries, including five eastern African countries: Kenya had 26 participants; Ethiopia, 5; Tanzania, 5, Uganda, 5; and Rwanda, 1. Participants from other parts of Africa included three from South Africa and one from Nigeria. Participants came beyond Africa represented seven countries: Brazil had 2 participants; UK, 5; Argentina, 1; France, 2; Netherlands, 1; Australia, 1; and USA, 3 (see Appendix III, participant list; and Appendix IV, photo).

Participants represented diversified institutions in the region. They included biodiversity researchers and policymakers, taxonomists with and without experience in molecular bio-markers, ministries of agriculture and environment, public health scientists, and private sector companies who use, or are potential users of barcoding technology. The majority of participants from overseas were CBOL officials who made presentations. Representatives from South Africa reported on activities sparked by the first regional barcode meeting held in Cape Town, South Africa, in April 2006. The Nigerian participant attended the meeting for the purpose of learning lessons for adoption while preparing for a possible regional barcode meeting in west Africa.

Acknowledgements

This meeting was supported by contributions from CBOL, BioNET (through a grant from the Swiss Agency for Development and Cooperation), NMK, the International Centre for Insect Physiology and Ecology (ICIPE) and BOZONET (BOtanical and ZOological NETwork). The meeting was co-sponsored by the Research Programme on Sustainable Use of Dryland biodiversity (RPSUD) and the Kenya Wildlife Service (KWS), and additional contributions were provided by Kenya Airways and Africa Online. The organizers thank all the contributors for their support, and the meeting attendees for their enthusiastic participation.

Background of DNA barcoding and CBOL

DNA barcoding is a technique for identifying biological species using a short gene sequence taken from a standardized portion of the genome. Barcoding is therefore a tool in basic taxonomic research, to be used in combination with other characters. For example, electric fish of the genus *Steatogenini* in the Amazon region of Brazil are very similar morphologically, and their patterns of electric discharge and variation in some molecular markers do not give clear separation among species. DNA barcoding has proven very effective in clarifying the limits between closely related species. Biodiversity researchers who are looking for undiscovered species can also use DNA barcodes as a “trriage” tool for flagging potential new species.

Barcoding can also be used to identify species for more applied purposes, such as conservation of biodiversity, protection of threatened species, environmental quality assessments, and for control of disease vectors, agricultural pests, and invasive species. For instance, biocontrol of cassava mealybug in Africa had failed because the species was not identified correctly. DNA barcoding was used to identify the species correctly, which led to the identification of its natural predator in its home region. This discovery launched a successful biocontrol program that produced significant benefits to growers. Barcoding is being explored for other purposes as well, such as the control of disease vectors by proper identification of mosquitoes).

In all of these applications, DNA barcoding has some significant advantages. Barcoding uses the standard procedures and instrumentation of molecular biology and gene sequencing. As a result, identifications using barcode data does not require the involvement of expert taxonomists. Barcoding can be done on a tiny amount of biological material, allowing the identification of specimens that even an expert taxonomist could not identify (eggs, larval stages, damaged or incomplete specimens, or processed products made from organisms).

The mitochondrial “Folmer” gene region is emerging as the optimal barcode region for most (but not all) higher animal groups. The Folmer region encompasses 648 base-pairs in the cytochrome c oxidase 1 region (“COI”). COI is not an effective barcode region in some animal groups (e.g., trypanosomes, scale insects, Tsetse flies) and in land plants in general. Biologists have been using a variety of gene regions for taxonomic purposes in these groups (e.g., RBCL in plants, ITS 1 for Tsetse flies; small sub unit ribosomal RNA (ssu rRNA) for Trypanosomes). To make species identification more cost-effective, CBOL is promoting standardization on one or two regions for groups in which COI is not effective.

DNA barcoding has generated different reactions since its inception. Some taxonomists have confused DNA barcoding with DNA taxonomy, which would replace traditional Linnean species with species based entirely on gene sequence data. CBOL promotes the use of DNA barcodes as another line of character data that should be integrated with morphology, behavior and other types of information. After this integrative approach has refined species boundaries, barcodes can be a useful standardized tool for identification and broader application. Several studies have appeared that have demonstrated more than 95% accuracy in assigning specimens to known species.

Barcoding was first proposed by Dr. Paul Hebert at the University of Guelph in Ontario, Canada. The Consortium for the Barcode of Life was started in early 2004 with a grant from the Alfred P. Sloan Foundation. CBOL’s Secretariat Office opened in the Smithsonian Institution’s National Museum of Natural History in September 2004. Since then, it has grown rapidly and currently has 135 Member Organizations in more than 30 countries, 20 of which are in developing countries. CBOL has a target to expand to 200 Member Organizations by 2008, and to double participation in developing countries. In order to reach its goal of increased participation, CBOL and BioNET have planned four regional meetings in developing regions in 2006/7; the Southern Africa, Eastern Africa, South America, and Southern Asia.. The first regional meeting (Southern Africa) has taken place in Cape Town, South Africa. The eastern Africa meeting was held in Nairobi in October 2006. In addition, an international barcode conference is planned for 2007 in east Asia. These workshops are meant to create awareness, assess needs and start networks.

CBOL's mission is to "promote DNA barcoding as a global standard for species identification". In pursuing its mission, CBOL works with international biodiversity organizations such as the Global Biodiversity Information Facility (GBIF). CBOL is dedicated to global participation in the Barcode of Life Initiative, and for that reason it works with international organizations such as BioNET International, and with international development agencies.

CBOL governance consists of an Executive Committee (EC) and a Scientific Advisory Board (SAB) selected from nominations by the Member Organizations. There are four CBOL Working Groups that are addressing issues related to database standards, DNA lab protocols, data analysis, and the search for a plant barcode region. The Chairs of the Working Groups are also members of CBOL's SAB. CBOL has launched global campaigns to collect DNA barcodes that represent all 35,000 species of marine and freshwater fish (FISH-BOL), all 10,000 species of birds (All Birds Barcoding Initiative, ABBI), and projects to create reference barcode libraries for mosquitoes and tephritid fruit flies. African researchers and research institutes are participating in all of these barcoding initiatives. Following CBOL's first regional barcode meeting in Cape Town (April 2006), a barcoding program on the plants of Kruger National Park has been started, and a project on African scale insects, a major agricultural pest, is being planned.

Overview of the meeting's structure

The two-day meeting was divided into four components (see Appendix II, meeting agenda; agenda with links to all presentations is available at http://www.barcoding.si.edu/Regional_Meeting_Nairobi.htm). The first half-day session was devoted primarily to presentations by CBOL officials who introduced DNA barcoding and the activities of the Consortium. These presentations also introduced the major uses of barcoding, with examples from Brazilian fish taxonomy, control of invasive, pest and disease vector species, a South African floristic survey, and studies of microorganisms. A speaker from South Africa described barcoding activities in that country following CBOL's regional meeting in Cape Town in April 2006.

The second half-day of the meeting was devoted to presentations on current and future applications of barcoding in Eastern Africa. The topics of these presentations were:

- The Eastern Africa experience with molecular techniques in taxonomy;
- Forensic science in controlling illegal trade of wildlife and their products;
- BioNET's EAFRINET LOOP as a CBOL partner in the Eastern Africa Region;
- Application of DNA barcoding in plant taxonomy, Eastern Africa Experience;
- DNA Barcoding - Parasites and Vectors in Eastern Africa;
- Potential for DNA Barcoding in the BOZONET project; and
- BecANet: An opportunity for capacity building in East and Central Africa

The third component of the meeting consisted of discussions in breakout groups during the morning session of the meeting's second day. These discussions explored the Eastern African region's technical capacity to do DNA barcoding, and the taxonomic issues in the region that might benefit from the use of DNA barcoding.

The final component of the meeting involved summarizing and sharing the output of the discussion groups, and synthesizing these ideas into a list of potential next steps. This synthesis was conducted as an open discussion of all meeting participants.

Overview of group breakout discussions

Barcoding is now widely used in developed countries, and virtually all universities, colleges, and biodiversity research institutes have the laboratory capabilities to obtain barcode data. In contrast, its application in developing countries is uncommon due to inadequate laboratory capacity and technicians with experience in molecular biology. Lack of access to the Internet and online biodiversity resources (journals,

databases) is also a significant barrier in Eastern Africa. For this reason, the meeting organizers devoted time on the agenda for a discussion of infrastructure issues.

During the second day of the meeting, participants were divided into three groups, each of which was asked to discuss one major theme related to the implementation of barcoding in the region:

- General taxonomic issues
- Capacity in molecular techniques, and
- Information access issues in the region

The organizers gathered data on laboratory and informatics capacity through an email questionnaire sent to the participants prior to the meeting. The results of the survey were compiled and provided to the discussion groups as an information resource. For each of these thematic issues, participants were asked to present a summary of their country's capacity for barcoding in terms of infrastructures, human resources and networks as highlighted below. Each group had a moderator and rapporteur who guided the session and noted information from the participants from different countries. The rapporteur notes from these breakout groups are presented in Appendix V, and are summarized below.

Breakout Group 1. General taxonomic issues. With some exceptions, participants concluded that there is inadequate human capacity and infrastructure related to the taxonomy of fish, plants, invertebrate, birds, and microorganism in the region. However, Kenya was mentioned as having good collections at the National Museums of Kenya, and Uganda had good plant reference materials in herbarium at Makerere University. Databasing and access to information in the region was found to be generally wanting. In general, the local, regional and international networks/collaboration mechanisms related to plant taxonomy are better developed than those related to other groups. Participants identified some taxonomist networks and infrastructure (e.g., equipments, legislation, policies) in their institutions, countries and in the eastern Africa region that would improve work on taxonomy and could apply DNA barcoding. These were considered the best opportunities to embrace the barcoding technique. The group pointed out the need to strengthen existing networks and to establish connections with individuals in the region for long term collaboration and sustainability of projects. In addition, the group emphasized the need to explore opportunities with funding agencies.

Breakout Group 2. Capacity in molecular techniques. The group discussed the region's equipment and expertise in molecular genetics. Research in molecular genetics is being conducted in a few institutions in eastern African countries. Some institutions have PCR machines, however, they lack DNA sequencers. Only ILRI in Kenya was identified as well-equipped with laboratory and expertise for DNA sequencing. Generally there is poor networking among these institutions. It was noted that ILRI has high charges for sequencing of samples, hence most scientists send their samples for sequencing to overseas laboratories. Some government institutions with strong capabilities (e.g., Kenya's government chemist) are not connected to other research institutions. Moreover, their primers have standardized loci for human identification and not for other uses. As such, they cannot provide services for other uses in biodiversity research/taxonomy.

Breakout Group 3. Information access issues in the region. The group observed that there are libraries in the region but information cannot be easily accessed due to poor databases, catalogues, and internet-based documentation. Institutional and national policies also affect access to information. A number of networks exist in the region on different aspects of biodiversity conservation, and these provide opportunities for exchanging information on taxonomy and molecular genetics. Each network can act as a conduit for integrating barcoding into other projects in the region. In order to sort out the problem of acquiring information, the group concluded that awareness should be raised, training on information technology should be enhanced, information on the availability of internet facilities should be disseminated, and access to websites (e.g., GBIF) should be improved.

There is very little work that has been done in eastern Africa on barcoding. However, it was clear that there are potential areas for applying barcoding. These include conservation, control of disease vector and invasive

agricultural pests, etc. Generally, the region lacks sufficient expertise and technology to embrace the technique. However, the workshop presented opportunities for strategizing on how the region could face the above challenges. CBOL highlighted possibilities of regional institutions utilizing existing networks for incorporating barcoding, linking them with international initiatives of DNA barcoding to acquire information on barcoding related areas. International initiatives mentioned during presentations were Global Biodiversity Information Facility (GBIF), taxonomic databases (Species 2000, ITIS), voucher specimens databases, BioNET, SABONET and BOZONET, Digital library initiatives and Genbank/EMBLDDBJ.

Synthesis of breakout discussion

Rapporteurs and moderators of the three breakout groups presented summaries of the respective discussions. Participants agreed that there are important resources available in their institutions and countries which reflect the following strengths of the region:

- Each country has universities and other training/research institutions
- There is scattered level of expertise (trained manpower) in various taxonomic groups and molecular biology.
- There are some reference collections with facilities for taxonomy
- There are existing networks, and political will in the region
- There is curricular on taxonomy and molecular biology in some training institutions.

Participants also identified the following common challenges:

- Insufficient human resources, expertise, and equipment in molecular technology and taxonomy across all taxonomic groups. The lack of expertise in microbiology was highlighted;
- Poor links to local, regional and international networks/initiatives, and databasing;
- Few expertise in taxonomy and molecular technology (laboratory equipments)
- Poor access to information via internet (due to slow internet access) and libraries
- Inadequate systematic collections;
- Lack of electronic identification keys;
- Few institutions for taxonomy and molecular technology;
- Lack of commitment and involvement by individual and institutions;
- Lack of policy on data and information sharing
- Incompatible database softwares for DNA analysis;
- Political issues, e.g., instability;
- Lack of support by government for research;
- Fear of bio-piracy;
- Power (electricity) failure; and
- Fragmented and inadequate sources of information in the region.

Ways forward

In order to address the above challenges, participants in the meeting agreed unanimously on the need to provide technical training on DNA barcoding in the region, as well as the following categories of other ways to address the challenges listed above:

Training:

- Organizing regional conferences and meetings to create awareness and as a stage for promoting barcoding;
- Building capacity on biotechnology, microbiology, molecular biology at undergraduate level;
- Providing short courses/training workshops;

Infrastructure:

- Establishing and supporting local journals;
- Creating mailing lists for dissemination of information;
- Strengthening collaboration in training and information sharing;
- Interacting with companies and suppliers for support and maintenance of equipment;
- Relying on renewable energy (solar/wind);

Networking:

- Strengthening existing networks;
- Forming professional networks and societies;
- Linking individuals and updating each other on emerging issues;
- Having collaboration between Universities, local and international research institutions;
- Promoting participation in network initiatives to potential members (besides the officers involved);
- Institutionalizing information about the networks;
- Making commitment and having motivation towards the barcoding technique;

Policy and funding:

- Promoting transparency in existing capacity, ongoing projects, scientific information etc.;
- Establishing connections with funding agencies;
- Cost sharing of expenses;
- Standardizing payments across institutions for analysing samples;
- Developing and harmonizing policies; and
- Lobbying policy makers at political levels, and marketing taxonomy to local, regional and international institutions.

Participants asked CBOL and BioNET to:

- Intervene in addressing some of the technical and funding challenges the region would face in their attempt to embrace the technique;
- Refer regional institutions to potential funding sources; and
- Facilitate proposal development and implementation of barcode projects.

General opportunities and priorities for barcoding in the region

Participants underscored the need to initiate tangible barcoding projects in the region, as well as addressing more general challenges. Potential projects were discussed, and the most likely lead institutions and participants in each initiative were noted. The projects identified by the participants fell into the following categories.

Conservation projects:

- Trade of protected wildlife/plant products (especially bushmeat); monitoring movement of protected species; use of barcoding for forensic evidence, link to CITES, CBD, CMS (law enforcement users);
 - Potential project leaders/participants: Makerere University, NMK, Dar Es Salaam Univ., KWS, enforcement agencies, Field Museum, Tanzania Wildlife Research Inst
- Birds in conservation regions
 - Univ. of Dar Es Salaam (taxonomy, collections), NMK, Birdlife International, Nature Kenya, Nature Uganda, Tanzania, Ethiopia
- Lake Victoria fish fauna (native and introduced) — impact on 3 countries; fits with ongoing project
 - Univ. Dar Es Salaam (Zanzibar), NMK (Ichthyology)
- Dryland plants – seedbanks, existing collections
 - Univ. Addis Ababa, NMK, RBG Kew, Univ. Dar Es Salaam (RPSUD), National Gene Banks of Ethiopia and Kenya
- African grasses ID system, cereals
 - Univ. Addis Ababa, NMK, RBG Kew, Univ. Dar Es Salaam
- Pollinators – strong international taxonomic community
 - African Pollinators Initiative (BioNET LOOPS)
- Marine protected areas (KWS managed); inventory for species management
 - NGISA/COML, western Indian Ocean, KWS (see Amsterdam meeting report)
- Inventory of KWS parks
- Coastal forests, eastern arc

Environmental projects:

- Invasive species (plants, freshwater species), marine ballast water
 - Ethiopian Institution Agricultural Research and KWS

Projects related to economic issues:

- Mycotoxin producers, food contaminants (health/standards/food users)
- Microbial diversity (industrial/medical enzymes), industrial interest, biomining (NCST, CABI); need BRCs, protection of genetic stocks
- Fungi as potential food source, ID for edible species
 - Kenya Society for Microbiology; Univ. Dar Es Salaam (Department of Molecular Biology), Institute of Biodiversity & Conservation and Addis Ababa Univ.
- Lake Victoria fish fauna (native and introduced) – Ichthyology – NMK – impact on 3 countries, fishing industry
 - NMK (Ichthyology Dept) and FISH-BOL
- Aviation bird strike, potential source of specimens; aviation safety (fits with avian flu priority)
 - NMK (Ornithology Dept) and ABBI
- Indigenous livestock vs. introduced species (existing ILRI project); has training platform,
- Agricultural pests, livestock diseases
 - ICIPE, agricultural research institutes in 4 countries;
- African grasses ID system, cereals
- Pollinators – strong international taxonomic community

On health

- NMK, KWS, KEMRI, Dept. Veterinary Services
 - Migratory birds, avian flu
 - Epizootic diseases
 - Emerging infectious diseases (e.g., schistosomiasis) with CDC, WHO
 - Mycotoxin producers, food contaminants (health/standards/food users)

Appendix I: Meeting Announcement



DNA Barcoding of Biodiversity in Eastern Africa Call for Participation in a Regional Meeting 18-19 October 2006, Nairobi, Kenya

The National Museums of Kenya (NMK), in partnership with the Consortium for the Barcode of Life (CBOL), and BioNET-EAFRINET, announces a two-day regional meeting on “DNA barcoding” to be held in Nairobi, Kenya. Potential participants from Eastern African countries are invited to send expressions of interest to the organizing committee. Limited funds will be available to support participation in the two-day workshop.

The workshop is directed at upper research level and project manager/coordinators. The organizers seek the participation of

- Biodiversity researchers and policymakers
- Taxonomists with and without experience in molecular bio-markers
- Agriculture, environment, and public health scientists
- Private sector companies who use, or will use barcoding

DNA barcoding is a new technique that uses a short DNA sequence, from a uniform locality on the genome, used for identifying species. DNA barcoding can be used to help discover, characterize, and distinguish species, and to assign unidentified individuals to species. The enormous data sequences and associated specimen information can be used as a reliable cost-effective practical tool for species identification in taxonomic research, biodiversity studies and conservation, public health, controlling disease vectors, pest, and invasive species, and diverse applications that use taxonomic information in service to science and society. CBOL is an international initiative devoted to exploring and developing and using DNA barcoding. The consortium, which is hosted by the Smithsonian Institution in Washington D.C., USA, is supported by the Alfred P. Sloan Foundation. CBOL has 80 member organizations from more than 35 countries on six continents, and is devoted to full participation of developing countries.

Goals of the workshop are to:

- Introduce the concept of barcoding and applications thereof to research and end-user institutions.
- Raise awareness as to the uses of DNA barcoding, focusing on the responsible application of the technique.
- Explore the potential applications of DNA barcoding to environmental challenges facing countries in Eastern Africa.
- Explore funding opportunities for participation in barcoding activities.

In addition, a component of the workshop will be used to:

- Assess the greatest need and opportunities for DNA barcoding in the region. Some emphasis will be put on promoting barcoding in the Eastern African countries;
- Initiate formation of a steering committee for barcoding with the intent that this committee will draw up an action plan for eastern Africa, and establish an intra-regional network and intercontinental partnerships to implement the action plan.

CBOL and BioNET-EAFRINET anticipate working with government agencies, NGOs, private sector companies and other organizations that use, or will use DNA barcoding in Eastern Africa to implement the resulting action plan, and to cooperate with regional partners through;

- In-country training activities such as short courses for researchers and advanced students on technical aspects of DNA barcoding and associated curation;
- Research training fellowships that will allow researchers and technicians to spend adequate periods of time in partner laboratories for advanced training and pilot research projects;
- Infrastructural improvement such as equipment acquisition; and
- Other forms of high-priority capacity building initiatives.

Send expression of interest to Dr. Helida Oyieke (cbd@museums.or.ke) before end of June/2006.

Please indicate if you wish to apply for travel funding, as some funding may be made to a limited number of participants (contingent upon availability of funds).

For more information on CBOL: www.barcoding.si.edu

For more information on BioNET: www.bionet-intl.org

Appendix II: Meeting Agenda

DRAFT PROGRAMME FOR THE DNA BARCODING IN EASTERN AFRICA 18TH – 19TH OCTOBER 2006: PANAFRIC HOTEL, NAIROBI - KENYA

Wednesday 18th October 2006 [Day I]

Registration: 8.30 –9.00 am

Opening Session

Chair: **Helida Oyieke**, National Museums of Kenya

Rapporteur: **Ian Gordon**

- 9.00 am: Communication from the Chair and self introductions
- 9.30 am: Introduction to the Consortium for Barcode of Life
David Schindel – CBOL Executive Secretary
- 9.45 am: Overview of role DNA Barcoding, its relation to other biodiversity initiatives and its use in taxonomy and biodiversity.
Scott Miller – Smithsonian Institute/ CBOL
- 10.00 am: Welcome remarks; **Idle O. Farah**: Director General, National Museums of Kenya
- 10.10 am: Opening Speech; **Mrs. Alice Mayaka**: Permanent Secretary, Ministry of State for National Heritage
- 10.30 am: Tea break

Session I: Application of DNA Barcoding: International experience

Chair: **Scott Miller**, Smithsonian Institute/ CBOL

Rapporteur: **Muchane Muchai**, National Museums of Kenya

- 11.00 am: Barcoding, bioinformatics and taxonomic research infrastructure.
David Schindel – CBOL Executive Secretary
- 11.15 am: National and International Networks for DNA barcoding
Simon Tillier – National Museums of Paris
- 11.30 am: Biodiversity Conservation and taxonomic application
José Alves – Gomes – Instituto Nacional de Pesquisas da Amazonia-Brazil(INPA)
- 11.45 am: Control of disease vectors.
Yvonne-Marie Linton– Natural History Museum, London
- 12.00 am: DNA Barcoding in Microorganisms.
Alexandre Soares Rosado - Instituto de Microbiologia-Brazil
- 12.15 am: Barcoding the flora of Kruger National Park
Olivier Maurine – Johannesburg University
- 12.30 am. Discussion
- 1.00 - 2.00 pm: Lunch

Session II: Application of DNA Barcoding: Eastern Africa experience

Chair: **Herbert Talwana**,

Rapporteur: **Charles Warui**

- 2.00 pm: DNA barcoding: -parasites and vectors
Dan Masiga – ICIPE
- 2.15 pm: Forensic science in illegal trade on wildlife and other products
Richard Bagine – Kenya Wildlife Services
- 2.30 pm: Application of DNA barcoding in plant taxonomy.
Muthama Muasya – University of Cape Town
- 2.45 pm: BioNET-EAFRINET Overview
Richard Smith BioNET-INTERNATIONAL and **Wanja Kinuthia** NMK/BioNET-EAFRINET
- 3.00 pm:Discussions
- 3.30 pm:Tea Break
- 3.50 pm:Potential role of BecA and ILRI in DNA barcoding in Eastern Africa
Bruno Kubata – ILRI
- 4.05 pm:Potential for DNA barcoding in BOZONET
Mathias Behangana – ICIPE
- 4.20 pm:Discussions
- 4.40 pm:Current barcoding initiatives **David Schindel** – CBOL Executive Secretary
- 6. 00 pm: Departure from Panafric for 18.30 pm dinner

Session III: Group Break-out

Chair: Wanja Kinuthia - National Museums of Kenya-EAFRINET

- 8.45 am: Overview of day one and break up group topics. **Dan Masiga** – ICIPE
- 9.00 am: DNA barcoding: Southern Africa experience since April regional meeting
Michelle Van de Bank – Johannesburg University
- 9.20 am – 10.30 am: **Breakout sessions organized according to topics**
Group 1: General Taxonomic Issues in the Region
Moderator: **Yvonne-Marie Linton** – Natural History Museums, London
Rapporteur: **Muchai Muchane** – National Museums of Kenya
Group 2: Capacity in Molecular Techniques Issues in the Region
Moderator: **Jose Alves-Gomes** - INPA
Rapporteur: **Hamadi Boga** – JKUAT
Group 3: Information Access Issues in the Region
Moderator: **Simone Tillier** – National Museum of Paris
Rapporteur: **Herbert Tawalna** – Makerere University

Topics for discussion in breakout groups

Each group will address issues given below under their specific thematic areas: -

- i) What capacity, technology and technical abilities exist in the region?
ii) What are the gaps?
 - i) What networks exist in the region (strengths, weaknesses and possibilities)?
ii) How can we strengthen and utilize these networks?
 - i) What general opportunities are available in the region? (Capacity building, Institutions, infrastructure, trained manpower, collaborative ventures and funding etc)
How best can we tap these opportunities?
ii) What are the bottlenecks on material, data and information sharing in the region?
How best can we address them?
- 10.45 am: Tea break
 - 10.30 am – 12.45 pm: **Breakout group discussions continue**
 - 12.30 – 2.00 pm: Lunch
 - 2.00 pm: Plenary

Session Chair: Felista Urasha- Kigali Institute of Science & Technology

Rapporteur: Mathias Behangana

Report back from Group 1,2 & 3

Group 1: General Taxonomic issues in the region

Report: Muchai Muchane – National Museums of Kenya

Group 2: Capacity in Molecular Techniques

Report: Hamadi Boga– JKUAT

Group 3: Information Access

Report: Herbert Tawalna – Makerere University

General Discussion

- 3.30 pm: Coffee/Tea break
- 4.00 pm: **Synthesis of DNA barcoding issues in the Eastern Africa region and the way forward**

Moderator: Dr. David Schindel – CBOL Executive Secretary

Rapporteur: Mathias Behangana

- √ **Priorities** and needs
- √ Formation of regional networks
- √ **Synergy** with other biodiversity initiatives (e.g. GTI, GBIF, BioNET/ EAFRINET, BOZONET etc)
- √ Long and short-term goals

Summary and closing remarks: – **Scott Miller**

- 6.00 pm: Vote of thanks – **Helida Oyieke**

7.00 pm: Dinner at Panafric Hotel for All Participants

Appendix III. Participant List

1	Dr. Tamirat Bekele	Addis Ababa University	Ethiopia	tambek@bio.aau.edu.et
2	Dr. Tubaro Pablo	MUS. Argentino De Cs. NATRDIEJ MDCN SAB	Argentina	ptubaro@interlink.com.ar
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10	Dr. Simon Tillier	National Museum of Natural History, Paris	France	tillier@mnhn.fr
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12	John K. Mungai	Government Chemist. Dept	Kenya	jkmkimani@yahoo.com
13	Dr. Dan Masiga	International Centre for Insect Physiology and Ecology (ICIPE)	Kenya	dmasiga@icipe.org
14	Dr. Dan Masiga	International Centre for Insect Physiology and Ecology (ICIPE)	Kenya	dmasiga@icipe.org
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18	Dr. Richard Bagine	Kenya Wildlife Society	Kenya	kws@kws.org
19	Dr. Evans Olonyi Sikinyi	KEPHIS	Kenya	esikinyi@kephis.org
20	Mr. Dickens Odeny	Nairobi CBOL/NMK Intern	Kenya	dodeny@yahoo.com
21	Mr Bernard Agwanda	National Museums of Kenya (NMK)	Kenya	Ben_risky@yahoo.co.uk
22	Dr. Helida Oyieke	NMK	Kenya	cbd@museums.or.ke
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Appendix IV: Group Photo



Appendix V: Rapporteur Notes from Breakout Group Discussions

Group 1: General Taxonomic Issues in the region

Capacity, technology and technical abilities in the region and the gaps

Fish:

Ethiopia

- Ethiopia has only one fish taxonomist and no specialists
- No active collection going on

Rwanda

- Rwanda = nothing happens on fish taxonomy or curation

Kenya

- No proper curation in the region (But in NMK, proper referenced correction)
- Lots of collection but no proper database
- However a running database at NMK & KEMFRI
- No labs, equipments

Tanzania

- Not enough capacity in fish taxonomy in TZ
- Lack of proper database, e.g., in Univ. of Dar es Salaam

Uganda

- Not enough capacity in fish taxonomy

Plants:

- Not enough human capacity in plant taxonomy
- Generally few experts (very few) in taxonomy
- Strong network (AETFAT)
- Very strong collaborations, locally and international

Ethiopia

- The plant taxonomy work in Ethiopia started only 25 years ago
- Ethiopia has very strong capacity

Kenya

- Kenya started plant taxonomic work 60 years ago
- Kenya has specialists for most taxonomic groups
- About 90% of floral work is done by the EA Herbarium
- Very active curation in NMK
- Kenya has medium capacity, technology and technical abilities
- Information availability is mainly hardcopy; specimens not all data based; there is an ongoing project to digitize the collection

Tanzania

- Tanzania's capacity is bottom up
- National herbarium in TZ has no trained curator/taxonomists
- TZ sometimes has wrong identifications of specimen
- Other countries very little capacity in taxonomy – need training
- Information availability is mainly hardcopy,

Rwanda

- Rwanda (KIST), Herbarium in bad shape: no taxonomists, no active collection, curation, no species lists available
- No electronic plant identification keys
- Information availability is mainly hardcopy, specimens not all data based, ongoing project

Uganda

- Good reference herbarium in Makerere
- Flora not very well covered
- No taxonomists, no active collection, curation, no species lists available
- No electronic plant identification keys

Invertebrates

Kenya

- NMK has 5 PhDs: specialists in spiders, mollusks, bees
- ICIPE has high human capacity
- Universities have high human capacity
- ICIPE has a small reference collection
- NMK has the biggest collection, > 2 million specimens
 - More material from Kenya but other countries are well represented (fairly regional)
 - Records are data based
 - Ongoing project on collection database; projects on digitizing the collection
 - Well trained technicians
 - Very active collection
 - No individual electronic keys (depend on keys from published journals)
 - On-line spider catalog, well updated.
 - Reference collection used by universities for teaching
 - Lot of links with local and international collaborators
 - Free access to the collection to users (small bench fee charges sometimes)
 - Some gaps in some taxonomic groups

Ethiopia

- Only one University involved
- No institutes committed
- No collections

Rwanda

- Focus in science not taxonomy
- No collections

Tanzania

- No capacity in invertebrates taxonomy
- No collections

Uganda

- Museum very poor in terms of invertebrates
- No capacity in invertebrates taxonomy
- No collections - Scant collection

Birds

Kenya

- Collection in Kenya represent the whole region with 30 000 study skins, and some tissue, blood and eggs specimens
- Majority of staff are ecologists, but have transformed into taxonomy
- Few PhD taxonomists,
- NMK collaborate with International, local and regional taxonomists/researchers working research associate with NMK,
- No active collecting but there is a strategy to do more collecting involving tissues
- Existing database has about 15000 records
- BIOTA is helping develop a running and global compatible Dbase
- NMK also have record Dbase running in the internet (Kenya bird finder)
- Shares information with universities for free
- NMK works with Aviation Industry
- NMK trains students, regional people
- Offers courses for handling birds; awards ringing permits in collaboration with Nature Kenya
- NMK is the hub in E, Central, North and west Africa in avian taxonomy

Fungi, bacteria and other microbial organisms

- A small collection on mycorrhiza and mushrooms and other belowground taxa
- Collaborations with ICRAF, universities, WIOSA, Zanzibar (IMS)etc
- Some capacity in fungi
- Need training in taxonomy

Networks in the region:

- Plants: AETFAT, RBG Kew, BOZONET, EAFRINET, BecA, ASARECA, EANHS.
- Fish: IUCN – species survival group, GTI Belgium nod, EANHS
- Invertebrates: AFRAS (African arachinological society), and EANHS
- Birds: EANHS

Strengthening networks in the region will require:

- Linking individuals
- Updating each other on information dissemination
- Popularization of the networks initiatives to potential members besides the officers involved
- Institutionalizing information about the networks
- Commitment and motivation

General opportunities available in the region (capacity building, institutions, infrastructure, trained manpower, collaborative ventures and funding etc.)

- a) Each country has Universities and other training and research institutions
- b) There are scattered levels of expertise (trained manpower) in various taxonomic groups
- c) Reference collections with facility for taxonomy
- d) Existing networks and institutions: BIOTA, RPSUD, BirdLife International, RSPB, ASARECA, WIOMSA
- e) Political will in the region
- f) Link with Scandinavian - Uppsala, Copenhagen, Oslo Universities
- g) Collaborative ventures with Local, International Universities and Institutions e.g. Lake Victoria Fisheries Organization, KU, UoN, Moi, Makerere, KWS, KARI, Desert locust control, CDC, Field Museums, Chicago, Smithsonian Institution, ILRI, ICRAF, RMCA Tervaren, Natural History Museums, National Museums of Whales, Royal Botanic Garden Kew,

Funding agencies

- CEPF, CI, IFS, RPSUD, Royal Society, World Bank, WHO, FAO, BES, KMS, EAC

The bottlenecks of inadequate material, data and information sharing in the region

- Permits for collecting and exporting specimens are restrictive
- Lack of clear policy on data and information sharing
- Lack of funding
- Incompatible database software
- Lack of expertise across all taxonomic groups
- Political issues, e.g., security, stability

How the above can be addressed best

- Strengthen existing networks
- Develop and harmonize policies
- Strengthen collaboration in training and information sharing
- Increase transparency of existing capacity, ongoing projects, available capacity, scientific information, etc.
- Cost sharing
- Lobbying/marketing with policy makers at political level and international, local and regional institutions to popularize taxonomy
- Revise curriculum in training institutions
- Sustained training (both short courses and long term courses)
- Motivate taxonomy students
- Solicit funding
- Create a database of experts and capacity
- Standardize database software

CBOL can help:

- To identify resources, donors and collaborators
- As a reference in funding proposals
- In facilitating proposal development and implementation of barcode projects

Group II - Capacity in Molecular Techniques

Kenya

NMK

- Liquid nitrogen, -70oC, -20oC, 3 PCR machines, DNA extraction.
- Projects-Fish, Malaria. Not linked to museum business
- Phenol-chloroform extraction procedure
- Expensive consumables (PCR tubes, tubes, tips)
- Store for toxic chemicals exists
- Routine since 1992

Government Chemist Department-Kenya

- DNA extraction and quantification, PCR
- Several kits for crime scenes and paternity disputes.
- 2-sequencers (ABI), Gene mapper software
- FLP-Fragment length polymorphism
- No software for sequencing
- Primers from company-standardized loci for human identification
- Collaboration with outside institutions ongoing
- Big potential in Government chemist

- MSc-training for na officer
- criminal DNA database for the region
- Poor connection
- Poor networks
- Very little information on networks
- Capacity exists
- Limited government support
- Poor networking
- ILRI, KEMRI, NMK, ICRAF, ICIPE, UNEP
- Brain drain
- Equipment not used

Tanzania

- UDSM- Human Capacity. Trained to PhD level.
- Botany Dept-Molecular Taxonomist -3
- Museum for Plant materials
- DNA isolation at the teaching level (from Plant-Bacteria. Manual Sequencing. Collaboration with UoN. Samples sent outside to Sweden.
- Cheap sequencing in Korea/ILRI expensive
- Animal DNA-Sokoine University.
- Power problems, Lack of computers, -70oC freezer not used, Poor internet connections
- Supply of consumables is slow and unreliable
- Self-preparation of reagents. No technical support for equipments
- No facilitation from Government for research

Ethiopia

- Addis Ababa University
- Zoological museum, Botanical Museum
- Manpower-considerable
- PCR. Sequencer (problem, not used)
- Chemicals and related reagents, no access, no dealers, use colleagues abroad
- Limited internet access
- Armour Hanson institute-works on disease, well equipped, PCR, sequencers

Uganda

- Uganda National Council for Science and Technology
- Regulatory Agency. No funding, Registering Research.
- Herbarium at Makerere University
- Old zoological collection at Makerere
- National Museum-is more for culture and not science
- Collaboration with Kenya
- Molecular capacity-Institute of Environment and Natural Resources has a molecular Biology Laboratory.
- Genetic characterisation of animals.
- Plant breeding improvement, marker selection
- Private labs involved in research on Malaria. Molecular techniques
- No sequencer
- National Biotechnology Center-Crop improvement, addressing diseases
- Capacity for molecular transformation exists
- Uganda virus research insititute-Capacity

- National Agricultural Research Organisation –Fisheries institute, morphological characterization of fish.
- Fin clips, preserved, DNA extraction at Makerere, No taxonomic studies
- Limited genetic work (samples taken out)
- Limited capacity
- Slow internet access
- Human Resource Gaps

Nigeria

- Plenty of human resources
- Power, Consumables, Technologists
- Gaps-no coordination between institutions
- Brain drain
- National Biotechnology Development Agency
- Advanced Biotech lab, sequencer etc
- IITA
- Museums isolated from scientific community
- Fear of Biopiracy
- Traditional Taxonomy
- GeneBank

Addressing problems

- Regional conferences and meetings
- Professional Networks Societies
- Establishment and support for local journals
- Mailing lists
- Interaction with companies and suppliers for support and maintenance of equipment
- Capacity Building-New Degree courses (Biotechnology, Microbiology, Molecular Biology)
- Short courses/training workshops
- Collaboration between Universities, local research institutions and international research institutions
- Better and standardized pay for scientists across institutions
- Renewable energy (solar/wind)

Group 3: Information Access Issues in the Region

Capacity, technology and technical abilities in the region

Access to information:

- Libraries in many places, but info available only locally, often not databased or catalogue
- Access to ASFA possible
- Internet access to documentation
 - Limited by inability to pay. If no special arrangement, access to recent information limited to open access publications
 - Problem specific to taxonomy: large part of the documentation not available at all on the web
- Access to GBIF limited, or little used

Databases:

- Many local taxonomic databases
- Very heterogeneous in content and in level (quality, georeferencing).
- Standards?

- Curation is sometimes outsourced

Internet access:

- Problematic, very expensive
- Satellite only would be efficient
- Many institutions have no access or very limited.

Gaps

- Sources of information fragmented, not visible even regionally
- Specific training not needed for internet access, but need technical help with connections
- Policy problem with exportation of information and data (and DNA!)
- Training in databases needed
- Need for training in treatment of information: structuring, quality control, etc.
- Access to basic taxonomic valid information
- General problem is knowing what is available in terms of capacities, and avoiding fragmentation of information

Networks in the region

- Few networks are funded, issue newsletters, allow meetings or workshops, offer training grants
- Could be a major channel to disseminate information, to promote barcoding projects
- Marine and aquatic sciences: WIOMSA (Western Indian Ocean Marine Science Association) is a network of institutions and individuals
- RPSUD is a research programme on sustainable use of dryland biodiversity involving 3 countries: Kenya, Ethiopia, Tanzania
- ASARECA: members are countries, provides big grants but development oriented
- Nematology Initiative: members in 6 countries, coordinator in Zimbabwe
- Bozonet: GEF funding
- Possibly some networks associated with ICIPE and others
- Networks that are not funded, with memberships of individuals; serve as communication channels at individual level
 - EAFRINET
 - Network of students at regional level; not formal, but has a website

How to strengthen and utilize the networks optimally

- Each funded network can disseminate info on barcode, and catalyze inclusion of barcode in projects
- Weakness: communication between networks
- Possibility of having a group created by the various networks specific to DNA barcoding; each network would have someone promoting Barcode
- Question: how to use BECA optimally? BECA is just starting

General opportunities available in the region

- General problem of awareness of what exists
- Where to get training? Problems: lack of funding for training. How can training institutions attract the best students? African Virtual University is an opportunity for remote training
- Problem of training in IT: IT departments not very open to biologists who have to pay for training in basic databasing, etc. Kigali Institute of S&T is an opportunity
- Computer centre? BecA? Most generally, hardware in institutions is bought by projects, then no further support is available
- Computers should communicate, but often use different software
- RAPSUD has organized training in GIS, other training possible

What are the bottlenecks of material, data and information sharing in the region?

- Technically with standards and better internet access
- Policy: Institution policies on data sharing at institutional and international levels

How best can the bottlenecks be addressed?

- Technically through better internet access = technical problem,
- Financial solution by obtaining funding for higher connection capacities
- Data sharing is necessary and requires harmonization among different countries and institutions