



23-25th July, 2007

Serena Hotel, Kigali, Rwanda

Organized by:

Republic of Rwanda



The Office of the President

Ministry of Science, Technology and Scientific Research

In collaboration with:

IDRC, CI, NEPAD, UNESCO, TWAS, NSF, IRST, NUR, REMA, ORTPN ISAR, ISAE, DFGFI, RDGG

This conference is organized by The Office of the President, Ministry of Science, Technology and Scientific Research in collaboration with:

The Institute of Scientific and Technological Research (IRST)

The National University of Rwanda, (NUR)

Rwanda Environmental Management Agency (REMA)

Rwandan Office of Tourism and National Parks (ORTPN)

Rwanda Agricultural Sciences Institute (ISAR)

Institute for Agriculture and Animal Husbandry (ISAE)

The Dian Fossey Gorilla Fund International (DFGFI)

United Nations Educational, Scientific and Cultural Organization (UNESCO)

The New Partnership for Africa's Development (NEPAD)

International Development Research Center (IDRC)

Conservation International Foundation (CI)

Third World Academy of Sciences (TWAS)

Rwanda Development Gateway Group (RGG)

National Science Foundation (NSF)

The University of Illinois



International Research Conference on Biodiversity and the Sustainable Management of Natural Resources

“Rwanda’s development will ultimately depend on the development of our human resource base and that of the people, with whom we share our destiny.”

“We will continue to invest in our people and we will strive to open up the frontiers of science, technology and research as we broaden our trade links with our neighboring countries and beyond.”

Address by His Excellency Paul Kagame, President of the Republic of Rwanda, at a New Year’s Reception, Hosted in Honour of the Diplomatic Corps Accredited to Rwanda

Village Urugwiro, 24th January 2005

The Government of Rwanda welcomes participants to the first international research conference on biodiversity conservation and sustainable natural resource management in Rwanda.

Bringing together both leading national and international conservation and natural resource management professionals, the conference will provide a forum for the exchange of research findings and ideas focusing on the importance of knowledge based approaches for the long-term conservation of biodiversity.

Through a network of national parks, water bodies and lands, Rwanda hosts a wealth of biodiversity and natural resources. Many endangered fauna and flora are part of trans-boundary ecosystems; threatened wetland networks and highland forests are important catchments for the Nile and Congo rivers. This gives a truly international dimension to conservation and natural resource management in Rwanda.

The success of the conference will be a cornerstone in the use of research information to inform and develop sound policies and practices towards biodiversity conservation and natural resource management in Rwanda.

This conference is organized by the Rwandan Ministry of Science, Technology and Research in President’s Office (MINISTR), in collaboration with the Science, Technology and Research Institute (IRST), National University of Rwanda (NUR), Rwanda Environmental Management Agency (REMA), Office of Tourism and National Parks (ORTPN), Rwanda Agricultural Sciences Institute (ISAR), Institute for Agriculture and Animal Husbandry (ISAE), and the Dian Fossey Gorilla Fund International (DFGFI).

International Scientific Committee: An international scientific committee has been formed with the role of overseeing the Scientific and Technical input to the conference. The committee members comprise of:

Chair: Professor I Kakoma, Illinois University
Vice Chair: Dr Rose Mukankomeje, REMA
Secretary: Dr Katie Fawcett, DFGFI

Members: Fidele Ruzigandekwe, ORTPN, Dr Mark Cyabuhiro Bagabe, ISAR, Dr Jean Baptiste Nduwayezu, IRST, Dr Daniel Ntirushwa Rukazambuga, NUR, Dr Eliane Ubalijoro, McGill University, Dr Beth Kaplin, NUR

Organizing Committee: An organizing committee has been formed with the role of overseeing and managing all administrative and logistical arrangements for the conference. The committee members comprise:

Chair: Dr Jean Baptiste Nduwayezu, IRST
Vice Chair: Dr Katie Fawcett, DFGFI
Secretary: Dr Daniel Ntirushwa Rukazambuga, NUR
Members: Dr Amy Vedder, REMA / PAB project / GEF, Fidele Ruzigandekwe, ORTPN, Dr Mark Cyabuhiro Bagabe, ISAR, sub-committee team IRST.

Conference Themes

Conservation Biology Focusing on the biology, behavior and ecological processes of threatened species and their habitats participants in this symposium will discuss the role of research to inform conservation strategies in the three national parks in Rwanda (Volcanoes National Park, Akagera National Park and Nyungwe National Park). Topics to be discussed include the mountain gorilla, and other endemic flora and fauna of the Albertine Rift.

Sustainable Management of Natural Resources This symposium will discuss the results of biological, economic and social research to inform the sustainable management of natural resources in critical ecosystems in buffer zones and other areas outside of the gazetted protected area networks, including rivers, lakes, wetlands and forests. The use of GIS as a research tool will be highlighted

Ecosystem Health: the interface between ecosystem, human, domestic animal and wildlife health. Presentation of current research and theory discussion of the health linkages across ecosystem processes, species, human, wildlife and domestic animals, and the transmission of major diseases, including parasitic, vector-borne and a wide range of other contagious diseases

Economics, Tourism, Conservation and Communities. Participants will present research on the role and nature of tourism and ecosystem services in biodiversity conservation and social and economic development at a national and local community level. Contributions are sought both on the situation in Rwanda and how international experience may guide tourism, payments for ecosystem services, and other economic policies and development in Rwanda

International Research Conference on Biodiversity and the Sustainable Management of Natural Resources.

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Conference Program

Monday, 23 rd July 2007		
Opening Ceremony Master of Ceremony: Director General, Rwanda Environmental Management Authority, Dr. Rose Mukankomeje		
Time	Activity	Speaker
7.30-9.00	Arrival and Registration of participants	
9.30-10.00	Arrival of invited guests	
10:30	Arrival of the Guest of Honor	
10.30-10.35	Remarks by President Conservation International	Dr. Russell Mittermeier
10.35-10.40	Remarks by Minister in the President's Office in Charge of Science and Technology.	Hon Prof. Romain Murenzi
10.40-11.00	Opening Address by His Excellency the President of the Republic of Rwanda	
11.00-11.30	Tea/Coffee Break	
11.30-12.15	Plenary: Conservation International: the Hotspots Approach to Biodiversity Conservation	Dr. Russell Mittermeier, President Conservation International
Session I: Conservation Biology Chair: Minister of State in Charge of Land and Environment, Hon. Mrs. Patricia Hajabakiga Co-Chair: President, Conservation International, Dr. Russell Mittermeier		
12.15	Rwanda's Forests Importance for the Conservation of Biodiversity in the Albertine Rift.	Plumptre, A.
12.25	Vegetal Diversity of two Albertine Rift Valley Bogs.	Bizuru, E., Bigendako, M.J., and Fischer, E.
12.35	Loss of Tropical Forest and Avian Extinction and Decline.	Patten, M. A. and Smith-Patten, B. D.

12.45	Mountain Forests Dynamics in Rwanda: Effects on Bird Biodiversity.	<u>Ruzigandekwe, F.</u> and Hockey, P.
12.55-1.10pm	Discussion	
1.10-2.40pm	Lunch Break	

Session II: Conservation Biology		
Chair: Minister of State in Charge of Agriculture, Hon. Dr. Daphrose Gahakwa		
Co-Chair: Director Karisoke Research Center, Dr. Katie Fawcett		
2.40pm	Paternity and Relative Reproductive Success in Multimale Mountain Gorilla Groups: Using Genetic Analysis to Elucidate Reproductive Success of Male Mountain Gorillas.	<u>Robbins, M.</u> , Fawcett, K. and Vigilant, L.
2.50pm	Infant Behavior in Gorillas: Behavioral Research in Immature Gorillas and Implications for Conservation.	<u>Fletcher, A.</u> , Nowell, A., Fawcett, K. and Uwingeli, P.
3.00pm	A Comparison of the Nutrition of Mountain Gorillas in Two Habitats: Implications for the Conservation of Biodiversity.	<u>Rothman, J.</u> , Plumptre, A., Dierenfeld, E. and Pell, A.
3.10pm	Comparative Behavioral Ecology of Mountain Gorillas.	Nkurunungi, J., Ganas, J., and <u>Robbins, M.</u>
3.20pm	An Update on the Post Conflict Status and Distribution of Grauer's Gorilla (<i>Gorilla beringei graueri</i>) in Eastern Democratic Republic of Congo (DRC).	Nixon, S. C., <u>Mufabule, K.</u> , Bolamba, D., Matitsi, D., Simm, H., Kakule, P., and Musumba, T.
3.30pm	Current Status of Gorilla Populations in Africa: Census Techniques and the Numbers Game.	Mehlman, P.T.
3.40-4.00pm	Discussion	
4.00-4.30pm	Tea/Coffee Break	
Session III: Conservation Biology		
Chair: Minister of Education, Hon. Dr. Jeanne d'Arc Mujawamariya		
Co-Chair: University of Illinois, Prof. Ibulaimu Kakoma		
4.30pm	The Role of Primates in the Maintenance of Biodiversity in Tropical Forests.	<u>Kaplin, B.A.</u> , Mulindahabi, F., and Gross-Camp, N.
4.45pm	Golden Monkeys Decline in Mgahinga Gorilla National Park Despite Increased Protection.	<u>Twinomugisha, D.</u> , and Chapman, C.A.
5.00pm	Variation in Feeding Behavior among Two Split Ring-tailed Lemur Troops Relative to Introduced Exotic Plant Species at Berenty Reserve, Madagascar.	Soma, T.
5.15pm	A Multi-Criteria Approach to Protected Area Zonation in Nyungwe Park, Rwanda.	<u>Masozera, M.</u> , and Forrest, J.
5.30pm	Texas Spring and Cave Salamanders: Discovering and Conserving Biodiversity in a Rapidly Urbanizing Landscape.	Chippendale, P.
5.45pm	The Role of Zoos in Biodiversity Conservation.	Stoinski, T.S.
6.00-6.30pm	Discussion	
	Evening Welcome Message	Prof. Kakoma

7.30pm	Message from the Executive Secretary Convention on Biological Diversity	CBD Focal Point
	Keynote Dinner Speech followed by dinner	Moustapha Soumare, Resident Representative for UNDP Rwanda
9.30pm	Entertainment	Rwanda Traditional Dance

Tuesday, 24th July 2007

Session IV: Sustainable Management of Natural Resources
Chair: Secretary General, Ministry of Agriculture, Hon. Dr. Agnes Kalibata
Co-Chairs: Director General, Higher Institute of Agricultural Research, Dr. Mark Cyubahiro Bagabe and Dr. Eliane Ubalijoro, McGill University

8.00	Development of Sericulture Enterprises for Rural Communities in Rwanda.	<u>Nguku, E.</u> , Raina, S., Kioko, E. and Adolkar, V.
8.15	Quality of Honey Harvested and Processed using Traditional Methods in Rural Areas of Kenya.	Muli, E., Munguti, A., Raina, S.K. and <u>Macharia, J.K.</u>
8.30	Molecular Genetic Variation in the African Wild Rice <i>O. longistaminata</i> A. Chev. et Roehr. in Relation to Climatic and Environmental Factors: Implications for Biodiversity Conservation.	<u>Kiambi, D.</u> , Newbury, H., Maxted, N. and Ford-Lloyd, B.
8.45	Bioprospecting as a Means to Conservation of Biodiversity: Examples from East Africa.	<u>Lwande, W.</u> , Bagine, R., Mwangi, J., Mukonyi, K. and Mungai, P.
9.00	Food and Bioproducts: Vehicles of Sustainability in Africa.	Ubalijoro, E. and Ngadi, M.
9.15	Biodiversity and the Sustainable Management of Resources: Case Study in Hohoe District, Ghana.	Achemdey, J.K.
9.30	Role of Certification in Conservation of Biodiversity in Commercial Forest Estates of Zimbabwe: A Case Study of Chimanimani Estates.	<u>Mujuru, L.</u> , Jimu, L., Nyamugure, T., Kundhlande, A., Gwenzi, D. and Katsvanga, C.
9.45	Tree Species Composition for Biodiversity in Gishwati, Rwanda.	Uwimana, M. F.
10.00-10.30	Discussion	
10.30-11.00	Tea/Coffee Break	

Session V: Sustainable Management of Natural Resources
Chair: Rector, National University of Rwanda, Prof. Silas Lwakabamba
Co-Chair: Director General, Institute of Research, Science and Technology, Dr. Jean-Baptiste Nduwayezu and Dean of Agriculture, National University of Rwanda, Dr. Daniel Rukazambuga

11.00	Status of Lake Victoria Capture Fisheries, their Management and Socio-economic Development in	<u>Mlaponi, E.</u> , Budeba, Y. L., Salehe, M. A., Ezekiel, C. N.,
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	Tanzania.	Waya, R., Musiba M. and Mbondo A.
11.15	Past, Present and Future: Perspectives in Landscape Dynamics as seen from Two Case Studies in Tanzania.	Backéus, I.
11.30	Rotational Woodlot Research in Tanzania: An Overview and a Way Forward.	Kimaro, A.A., Nyadzi, G.I., Kimaro, D.A., Kitalyi, A., and Mbwambo, L.
11.45	Landscape Fragmentation and Forest Cover Change in Malawi Based on Multispectral Satellite Imagery: 1973-2000.	Mlotha, M. J.
12.00pm	Application of GIS as a Tool for Determination of Ecological Preferences and Prediction of the Distribution of Wild Noctuid Stem Borer Genera in Africa.	Voise, J., Jiang, N., Le Rü, B., Moyal, P., Ong'Amo, G., Mailafiya, D., Le Gall, P., Calatayudm P., Ngala, P., Musyoka, B., Conlong, D., Cugala, D., Defabachew, B., Kauma-Matama, T. , Pallangyo, B., J. Van den Berg, J., Schulthess, F., and Silvain, J.
12.15pm	Mapping and Modeling Landscape-based Soil Fertility Change in Relation to Human-induction: A Case Study of Gishwati Watershed of the Rwandan Highlands.	Mukashema, I. A.
12.30pm	Assessing Wetland Functions and Values in the Kigali City Area under Land Pressure and Climate Change.	Rugege, D. and Mukankomeje, R.
12.30-1.00pm	Discussion	
1.00-2.00pm	Lunch	

<p>Session VI: Economics, Tourism, Conservation and Communities Chair: Minister of State for Industry and Investment Promotion, Hon. Mr. Vincent Karega Co-Chair: Wildlife Conservation Society, Dr. William Weber</p>		
2.00pm	Using Spatial Analysis and Economics to Identify Areas of Ecosystem Service Conservation.	Alger, K. and Wendtland, K.J.
2.15pm	Economic Importance of Forests to Local Users and the Implications for Protected Area Management in Uganda.	Bush, G.K., Plumptre, A.J., Nampindo, S., Aguti, C., Hanley, N.D., Ruffel, R.J., and Ackworth, J.
2.30pm	Forest Dependency and Some Policy Implications for Conserving Botswana Forest Reserves: A Case Study from Kasane Forest Reserve.	Lepetu, J., Alavalapati, J., and Nair, P.K.
2.45pm	Impact of Agricultural Activities on the Conservation of Ungulates, Akagera National Park, Rwanda	Minani, V., and Bizuru, E.
3.00pm	Ecotourism as a Potential Conservation Incentive for Local Communities Around Rwanda's Parc National des Volcans.	Sabuhoro, E.
3.15pm	The Science and Management of Water as a Means for Integrating Ecologic, Economic and Human Health Priorities: Possible Strategies for Rwanda.	Warner, R.E.

3.15-3.45pm	Discussion	
3.45-4.15pm	Tea/Coffee Break	
Session VII: Economics, Tourism, Conservation and Communities Chair: Minister of State for Water and Mines, Hon. Prof. Bikoro Munyanganyizi Co-Chair: University of Illinois, Prof. Richard Warner		
4.15pm	Putting People in the Conservation Equation: Rwanda in a Global Context.	Weber, B.
4.30pm	The Role of the Cultural Practices in the Conservation of the Biodiversity in Rwanda.	<u>Munyaneza, E.</u> , Bizuru, E., Nshutiyayesu, S., Bigendako, M.J., and Minani, V.
4.45pm	Limitations of Community Forestry towards Sustainable Management of Medicinal Plants in Tanzania.	Otieno, J.N.
5.00pm	Local Stakeholder's Strategies in Sustaining Wetland Resources in Dryland Ecosystems: Lessons from Semiarid Ecosystems of Central Tanzania.	<u>Shemdoe, R.S.</u> and Kingazi, S.P.
5.15pm	Key Biodiversity Areas: Local Custodianship of Global Standards for Conservation Planning for the 2010 Biodiversity Target.	<u>Knox, D.</u> , Gamys J., Keita, M.K., Ngari, A., John, J. and Rakotobe Z. L.
5.30pm	Agricultural and Forest Biodiversity, Nutrition and Population Health in Market-oriented Food Systems.	<u>Johns, T.</u> and Maundu, P.
5.45pm	Insects working for Conservation: a Case Study from Arabuko-Sokoke Forest, Kenya.	Sande, S., Fungomeli, M., Ngoka, B. and <u>Gordon, I.</u>
5.45-6.15pm	Discussion	
6.30-7.30pm	POSTER SESSION	
7.30pm	COCKTAILS	
End of Day Two		

25 th July 2007		
Session VIII: Ecosystem Health Chair: Director General Rwanda Environmental Management Authority, Dr. Rose Mukankomeje Co-Chair: Vice President Africa Programs, Dian Fossey Gorilla Fund International, Dr. Alecia Lilly		
8.00	Ecosystem Health: The Interface Between Ecosystem, Human, Domestic and Wildlife Health.	Aboyella, C.
8.15	Linking Wildlife and Human Health: Community Outreach and Involvement.	Kalema-Zikusoka, G.
8.30	A One Ecosystem Health Approach: Health and Disease Issues at the Interface.	<u>Mudakikwa, A.</u> , and Kock, M.
8.45	One-Health Mountain Gorilla Medicine.	Kinani, J.
9.00	Ecosystem Health: Potentiality for Cross-	<u>Magayane, A.</u> , Munyarugero, I.,

	Transmission of Intestinal Parasites between Gorillas and Human Beings, DRC.	Muyisa, A., Simm, H., and Lilly A.
9.15	Gastrointestinal Bacterial Exchange Among People, Domestic Animals, and Mountain Gorillas in Bwindi Impenetrable National Park, Uganda.	Rwego, I.B., Goldberg, T., Gillespie, T.R., and Basuta, G.I.
9.30	Ecosystem Health: A Cross-Sector Approach for Biodiversity Conservation and A Healthy Environment for Endangered Species and Humans Living Near Protected Areas.	Lilly, A., Magayane, A., Munyarugero, I., and Muyisa, A.
9.45-10.15	Discussion	
10.15-10.45	Tea/Coffee Break	
<p>Session IX: Ecosystem Health</p> <p>Chair: Director General, Rwanda Animal Resources Development Agency, Dr. Rutagwenda</p> <p>Co-Chair: Executive Director, Rwanda Wildlife Agency, Mr. Fidele Ruzigandekwe</p>		
10.45	Environmental Factors Associated with Distribution of <i>An. arabiensis</i> and <i>Cx. quinquefasciatus</i> in a Rice Agro-ecosystem in Mwea, Kenya.	Muturi, E.
11.00	A Novel Method for Identification of Mosquitoes of the <i>Culex pipiens</i> Complex (Diptera: Culicidae): Important Vectors of Endemic and Emerging Diseases.	Sanogo, Y.O., Kim, C. H., Lampman, R., Kakoma, I., and Novak, R.
11.15	Larval Control Of Anopholes Mosquitoes In Eritrean Semi-Arid Ecosystems	Shililu, J., Mbogo, C., Githure, J., Gebremeskel, T. and Novak, R
11.30	Assessment of Knowledge, Attitudes and Beliefs about Nutrition and Childhood Overweight: A Potential Model for Rwanda.	Adedze, P., Chapman-Novakofski, K., Witz, K., Orr, R. and Donovan, S.
11.45	Environmental Health Service in Rwanda: a Situational Analysis carried out by Ministry of Health/ World Health Organization 2006.	Bigirimana, Z.
12.00pm	Biodiversity under Threat from Climate Change: Implications for Tick-borne Diseases in Sub-Sahara Africa.	Olwoch, J.M.
12.15-12.45pm	Discussion	
Closing Ceremony		
12.45pm	Highlights Of The Conference	Prof. Ibulaimu Kakoma University of Illinois
1.00pm	Concluding Remarks	Dr. Francois Gasengayire IDRC
1.15pm	Closing Remarks	Hon. Prof. Romain Murenzi
1.30pm	End of Conference	

POSTER SESSION: 18.30-19.30pm DAY TWO

<u>Arinaitwe, J.</u> , Thompson, H., Ngeh, P., and Nsengimana, S.	Enhancing Participatory Protected Area Management Effectiveness in the Albertine Rift: the Case of Rwanda.
<u>Bizuru, E.</u> , Bigendako, M.J., and Lejoly, J.	Syntaxonomic revision of the <i>Dosero-Xyridetea</i> class Duvigneaud and Symoens, 1951.
<u>Clymer, G.</u>	Foraging Responses to Nutritional Pressures in <i>P. ursinus</i> .
<u>Clymer, G.</u> and Bash, K.	EthoTracker: A Novel Application for Handheld Electronic Ethological Data Collection.
<u>Eckardt, W.</u> , Fletcher, A. W., and Fawcett, K.	Going it Alone – Premature Separation of Mothers and Infants in Mountain Gorillas.
<u>Fawcett, K.</u>	Karisoke Research Center: Contribution of 40 years of Research to Mountain Gorilla Conservation
Gakwavu, R.J.	Preliminary Study of the Regeneration in Mountain Forest of Rwanda.
Gapusi, R.J., Backéus, I and Nduwamungu, J	Role of the Buffer Zone in Biological Diversity Conservation and Improvement of Local People Livelihood.
<u>Girinshuti, D.</u> , Gasogo, A. and Kaplin, B.A.	Primates coexisting with humans : The behavioral ecology of a group of vervet monkeys (<i>Chlorocebus aethiops</i>) living in Huye, Rwanda
Kalibana, M.	Diversity of the Gene Pool in Domestic Animals and Plants in Rwanda.
<u>Kamagaju, L.</u> , Bizuru, E., and Munyabuhoro, S.	Valorization of the Vegetal Biodiversity in Rwanda.
Kannan, N.	Relationship between Discharge- Sediment and Flood Control in Kinoni Stream at Byangabo in Rwanda.
<u>Kaplin, B.A.</u> , Gasogo, A, Musabe, T, K. Uwantege and William, A.	The Importance of Field Study in Training Future Conservation Biologists: Getting Students Outside to Learn.
<u>Manda, H.</u> , Gouagna, L., Hassanali, A. and Githure, J.	Plant-feeding of <i>Anopheles gambiae</i> s.s. : Discriminative Feeding Behavior on Different Plant Species and its Effects on this Vector's Fitness in a Malaria Endemic Area of Western Kenya.
<u>Masozera, A.B.</u> , Nzakizwanayo, E., Sindikubwabo, M.	Improving Post-Fire Regeneration in Nyungwe National Park.
<u>Nyirambangutse, B.</u> , Dhecthuvi, J., Fawcett, K.	Impact of Vegetation Type on Two Golden Monkey (<i>Cercopithecus mitis kandti</i>) Home Range and the Phenology: The Case of Two Habituated Groups in Volcanoes National Park.
Minani, V. Bizuru, E., Niyonsaba, B., Munyaneza, E., and Nshutiyayesu, S.	Phytogeographical and Ecological Study of the <i>Asteraceae</i> of Rwanda.
Mlotha, M. J.	Using Landscape Metrics to Analyze Spatial Patterns, Forest Fragmentation and Monitor Habitat Loss in Rwanda.
<u>Mucyo, S.</u> , and Fawcett, K.	Regeneration of Natural Forest Vegetation in Previously Cultivated Areas, Volcanoes National Park, Rwanda
<u>Mugiraneza, J.P.</u> , Mukamutara, J., Kabera, J., and Nkusi, H.	Comparative Study of Ethanolic Extracts from <i>Acacia sieberana</i> and <i>Mitragyna rubrossipilata</i> on some <i>Diarrheic Bacteria</i> .
Mugunga, C.	Performance of <i>Grevillea Robusta</i> Provenances in Ruhande Arboretum, Butare, Rwanda.
<u>Ndabaneze, P.</u> , Nsanzurwimo, A., Fawcett, K., and Hakizimana, E.	Bamboo Dynamics in the Afro-Montane Forests of Rwanda..
Ninziza, F.	A Study of <i>Alma Emini</i> (Oligochaetes, Microchaetidae)

	Populations in Munyazi Wetland, Rwanda
<u>Nsabagasani, C.</u> and Fawcett, K.	Population Density and Habitat Requirement of Grauer's Swamp Warbler (<i>Bradypterus Graueri</i>) in Volcanoes National Park, Rwanda.
<u>Nshutiyayesu, S.</u> , Bizuru, E., Munyaneza, E.,	Ecology and Phytogeography of the Orchids of Rwanda.
<u>Ntare, N.</u> , Gasogo, A. and Kaplin, B.	<i>Cercopithecus hamlyni</i> in Nyungwe NP, Rwanda
Nyiragaruka, C., Bajyana S. E. and Mugiraneza, J. P.	A study of the Antibacterial and Antifungal Activity of Three Species of Aloe Native to Rwanda.
<u>Ole Kwallah, A.B.</u> , Muigai, A.W., Mburu, D., Okeyo, A.M., Imbuga, M., and Hanotte, O	Characterization of the indigenous sheep of Kenya: The diversity status
<u>Otieno-Ayayo, Z.N.</u> , Ben-Dov, E, Manasherob, R., Khasdan, V., Zaritsky, A., Cahan, R. and Boussiba, S.	Emerging Alternative Approach to Mosquito Biocontrol using Recombinant Bacteria Expressing Mosquitocidal o-endotoxin from <i>Bacillus thuringiensis israelensis</i> .
<u>Rizinjirabake, E.</u> , Dhetchuvi, J. B, and Ntaganda, C.	A Study of Natural Tree Regeneration in the Nyungwe Forest.
Takuo, J.M.	Seasonal Variation of Leaf Litter Fauna around the Grey Necked Picathartes Site in the Yaoundé Massif Forest.
<u>Tomani, J.C.</u> , Bizuru, E., and Kajangwe, V.	The Diversity of Plants Used to Treat Snake Bites in Rwanda.
<u>Tomani, J.C.</u> , Kabera, J., Kagangwe, V., Ndagijimana, A., and Nyetera, P.	The Valorization of the Aromatic Plants of Rwanda
<u>Tuyisingize, D.</u> and Fawcett, K.	Feeding Ecology of Golden Monkey (<i>Cercopithecus mitis kandti</i>) in the Volcanoes National Park, Rwanda.
<u>Uyisenga, J.</u> , Bajyana, S.E. and Gasana, N.	Algae and human health: important antibacterial and antifungal properties of <i>Spirulina platensis</i> , an algal species found in Congo
<u>William, A.</u> , Gasogo, A. and Kaplin, B.A.	The Ecology of Black and White Angolan Colobus (<i>Colobus angolensis ruwenzorii</i>) Isolated in Montane Forest.

POSTER SESSION: 18.30-19.30pm DAY TWO

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<u>Fawcett, K.</u>	Karisoke Research Center: Contribution of 40 years of Research to Mountain Gorilla Conservation
Gakwavu, R.J.	Preliminary Study of the Regeneration in Mountain Forest of Rwanda.
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Kalibana, M.	Diversity of the Gene Pool in Domestic Animals and Plants in Rwanda.
<u>Kamagaju, L.</u> , Bizuru, E., and Munyabuhoro, S.	Valorization of the Vegetal Biodiversity in Rwanda.
Kannan, N.	Relationship between Discharge- Sediment and Flood Control in Kinoni Stream at Byangabo in Rwanda.
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<u>Manda, H.</u> , Gouagna, L., Hassanali, A. and Githure, J.	Plant-feeding of <i>Anopheles gambiae</i> s.s. : Discriminative Feeding Behavior on Different Plant Species and its Effects on this Vector's Fitness in a Malaria Endemic Area of Western Kenya.
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<u>Nyirambangutse, B.</u> , Dhecthuvi, J., Fawcett, K.	Impact of Vegetation Type on Two Golden Monkey (<i>Cercopithecus mitis kandti</i>) Home Range and the Phenology: The Case of Two Habituated Groups in Volcanoes National Park.
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<u>William, A.</u> , Gasogo, A. and Kaplin, B.A.	The Ecology of Black and White Angolan Colobus (<i>Colobus angolensis ruwenzorii</i>) Isolated in Montane Forest.

Ecosystem Health: The Interface between Ecosystem, Human, Domestic and Wildlife Health.

C. Aboyella

The ecosystem describes the nexus of interrelationships ramifying nature's biological components of plants, animals including micro-organisms, and the physical interface of land, water, temperature among others. Substantial scientific, social and economic research, strongly indicate a direct and indirect interconnection of life in this ecosystem. Invariably there is a beneficial symbiotic interplay between some elements of the ecosystem, and a rather pathogenic or yet still neutral relationship within others in the ecological niche. This gives rise to some ecological classifications that translate the kind of plant and animal species associated with it. The influence of the physical environment on plants and animals and the vice versa presents an overriding complex scientific and economic phenomenon which, suggests that the survival and advancement of man must directly check the sustainable management both the biological and physical parameters within the ecosystem. Today the socio-economics of human life simply rotates on not only the theory and practices of sustainable supplies from plants and animal resources, and the prudent exploitation of the natural resources of the sea, rivers, lands and mines. This mismanagement of the natural environment by man over the years now poses a long term threat to humanity, and a healthy sustainable management of the natural resource pool is sine-qua-non, if man is to escape from the impending social and economic deadlock, following any disequilibrium in the natural ecosystem. Scientist, researchers and development planners the world over continue to lament the rate of environmental degradation and the incumbent consequences, and continue to suggest alternative measures for sustainable economic and social advancement. The time has come for drastic steps to safeguard the few species of lives left in the waters and forest; and a comprehensive global policy, closely matched by a strong legislative commitment is the way.

Key words: ecosystem health, sustainability, species conservation

Biodiversity and the Sustainable Management of Natural Resources: Case Study in Hohoe District, Ghana.

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The diversity of different species of plant and animals, and the genetic variation within each species, provides the vital resources which enables life on earth to change and adapt. Besides, biodiversity also provides food, shelter, leisure (tourism), and a means of income generation and employment. The Ghana National Association of Farmers and Fishermen (GNAFF) is implementing an information and communication project as a private sector approach to use ICT to bridge the information gap due to the government withdrawal of essential support services to agricultural producers. The Hohoe district, in the east of Ghana has been selected as pilot base for this project. The district is at the forefront of the country's community-based ecotourism destinations. The District covers an area of 1,172km² and has a population of about 154,000. Ecotourism sites include mountains, waterfalls, caves and the rare Mona Monkeys. The project objective is to conserve natural resources for the socio-economic benefit of the local economy

through sustainable use of the forest resources. The project has outlined a long term strategy in partnership with the Center for Tropical Agriculture and with wide stakeholder participation. Activities include environmental education, community and enterprise development and technology transfer. This paper illustrates how the creative use of media cuts the constraints of illiteracy and sets the model for how biodiversity can be conserved for generations to come.

Key words: biodiversity conservation, natural resource management, communities, education, development

Assessment of Knowledge, Attitudes and Beliefs about Nutrition and Childhood Overweight: A Potential Model for Rwanda.

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The knowledge, attitudes and beliefs about nutrition, physical activity, and health risks related to childhood overweight was assessed in low income participants using the Social Ecological Model. A self-administered questionnaire consisting of 40 questions was developed and tested (n=166) and analyzed using the SPSS protocol. We found that 90% of participants were knowledgeable about causes and health risks associated with overweight. The responses to the belief that "some people are born big or thin and nothing can be done" were significantly influenced by ethnicity and education level. Among those with < 12 years of education, 54% of Caucasians (p<0.05) and 70.6% of African Americans agreed with the statement (p<0.05). With regard to activity, 53.5% of Caucasians reported their children spend 2-3 hours/day watching TV and playing video games and 9.9% reported 4 hours or more. Children of African American parents were more sedentary; 69% reported 2-3 hours and 21.4% reported 4 or more hours/day (p< 0.05). Participants displayed a high level of nutritional knowledge, beliefs related to the risk of overweight and activity level was significantly influenced by the ethnic group. The model has potential applicability to Rwanda to mitigate malnutrition and ensure capacity building to maintain sustainable diversity and resource management.

Keywords: knowledge, attitude, beliefs, overweight, children, low income, education

Using Spatial Analysis and Economics to Identify Areas of Ecosystem Service Conservation

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A recent analysis of Madagascar revealed where the greatest quantities of ecosystem services occurred in the country and suggested places to use alternative conservation policy tools such as payments for ecosystem services to fund biodiversity *plus* ecosystem service conservation. In

Amazonia, we are using spatial analysis and economics to show where new protected areas could bring both biodiversity benefits and protect people from malaria that could result from the conversion of forests for development projects. Conservation interventions in areas susceptible to malaria epidemics has shown that the national government would save close to \$120 million in gross domestic product by investing in protection of these biodiversity areas, offsetting management costs. Similar analyses identifying where biodiversity conservation in Rwanda would protect services important for human well-being and measuring the economic value of this protection could be used to spur policy interest in conservation, fundraise for biodiversity protection, and suggest appropriate conservation management interventions. These data clearly demonstrate the significance of sound policies in ensuring the critical balance between conservation, protection and economic returns with special emphasis on Africa in general and Rwanda in particular.

Keywords: conservation, biodiversity, human health, policy-makers, protection, sustainable management, global

Enhancing Participatory Protected Area Management Effectiveness in the Albertine Rift: the case of Rwanda.

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The Albertine Rift is one of Africa's most important sites for the conservation of biodiversity with 39%, 52% and 14% of all the mammals, birds and plant species that occur on the African continent. Over 42 Protected Areas have been identified as the main strategy for the conservation of this rich heritage. Most are in areas of high human population density and good agricultural potential and consequently, there is huge enticement for encroachment and unsustainable harvesting of resources.

BirdLife has acquired knowledge and experience in motivating and empowering local communities to participate in the management of natural resources at key sites for biodiversity conservation (Important Bird Areas). The Site Support Group (SSG) approach is based on the idea that people living near these sites often have a vested interest (economic, cultural, social, aesthetic) in its conservation and also extensive knowledge relating to the site, its biodiversity, its history and its management. The approach shows similarities to other initiatives in Community Based Natural Resource Management. Already, 11 SSGs are active in the Albertine Rift engaged in developing income-generating activities with benefits for local livelihoods and biodiversity, monitoring of biodiversity and threats, and implementing education and awareness-raising program.

Past, Present and Future: Perspectives in Landscape Dynamics as seen from Two Case Studies in Tanzania

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Ihombwe village is apparently sustainable land-use amidst a matrix of more or less degraded land. Another such pocket is found in the Mbulu highlands in Northern Tanzania, where it has been explained to be a result of intensification of agriculture. In this study we observed a gradual expansion of the area under shifting cultivation in an area where land is not limiting. A historical explanation for this development is the fact that this village was little involved in the colonial economy and the villagization program during the 1970s. Therefore, the population has remained relatively homogenous with continuity in governance. Population growth has been moderate with continuity in traditional land-use in a sustainable way. Today, however, the situation is rapidly changing. Strong economic interests from outside tend to marginalize the influence the villagers have on their own forest resources. External forces are now more important than the internal resource use. An important task is to find a way out of this squeeze, but that assumes a better knowledge of people's motives for acting the way they do and their perceptions of change, sustainability and development, i.e. an understanding of the local development discourse.

Keywords: Landscape Dynamics, Sustainability, Shifting Agriculture, Internal and External Influence, Community Motives

Environmental Health Service in Rwanda: A Situation Analysis carried out by Ministry of Health/ World Health Organization 2006

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The study was conducted to achieve a clear understanding of the environmental health situation in Rwanda and the study results would form basis for developing the National Environmental Health Policy. The scope of the study was guided by the definition Environmental Health Services as "the theory and practice of assessing, correcting, and preventing those factors in the environment that can adversely affect the health of present and future generations". The study methodology covered review of official policies, strategies and other related documents, a field survey on delivery of environmental health services, food hygiene audits, interviews and discussions with government officials, focus group discussions with community representatives and workshops organized and attended by environmental health workers.

Keywords: Rwanda, health policy, field survey, health services, environmental health

Vegetal Diversity of Two Albertine Rift Valley Bogs

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The Albertine Rift's valley flora and vegetation has been well studied. However, there are few detailed studies on the bogs, even though there are many in the region and they contain a particular vegetal diversity. The main aim of this study was to contribute to the greater scientific understanding of bogs. This study was conducted in two bogs: Kashiru in Burundi and

Kamiranzovu in Rwanda. 58 plots were investigated; 32 at Kashiru and 26 in the Kamiranzovu bog. The community partition was performed by the detrended correspondence analysis with the MVSP software. The result of the analysis showed the community of *Xyris valida* and *Sphagnum slooveri* and the community of *Cyperus denudatus* var. *lucenti-nigricans* and *Hypericum humbertii* in the Kashiru bog. In the Kamiranzovu bog, communities of *Cyperus latifolius*, *Lobelia mildbraedii* and *Erica kingaensis* subsp. *Rugegensis* and *Cyperus denudatus* var. *denudatus* and *Alchemilla ellenbeckii* have been identified. This study shows that the bogs of Kashiru and Kamiranzovu contain different communities caused by their geographic spatiality.

Keywords: vegetation community, bogs, Albertine Rift

Syntaxonomic Revision of the Doser-Xyridetea Class

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Until now, there have been so few detailed botanical studies on the vegetation of the African highland marshes, which are generally peat lands. That is why it is still difficult to make classification of various syntaxa of those ecosystems. This study proposes to classify the associations between syntaxa, as well as reclassify previous syntaxonomical associations. The revision concerns the *Doser-Xyridetea* class which includes the oligotrophic peat land vegetation of tropical Africa. This study suggests that the current single order of that class, *Sphagno-Xyridetea*, is divided into three new orders. These orders correspond separately to the large mountain peat land vegetation, the vegetation of humid sands in the low lands and the vegetation of inselberg and rocs wetlands. A new alliance including the large mountain peat lands has also been proposed.

Keywords: *Doser-Xyridetea*, syntaxa, peat lands

Economic Importance of Forests to Local Users and the Implications for Protected Area Management in Uganda.

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Research on the economic value to local users of natural forests can provide useful information for policy makers and forest managers. How forests contribute to national economic development and poverty alleviation is important in how central government plans expenditure on their conservation. We examined key economic relationships between income and natural forest use in order to quantify the economic role of Uganda's natural forests in poverty reduction and sustainable economic development. A stratified random sample survey was employed representing forest users surrounding the four major forest types in Uganda. We measured net annual household income and consumption from forest and non-forest sources and found that across all forest types and income groups, households derived 20.2% of their overall income

from forest with 75.6% of the value of goods harvested from forests consumed in the home. Amongst income groups, high income households appropriated a greater overall proportion of the value of forest goods. These results indicate that imposing reductions in forest use on environmental grounds may increase poverty amongst local people; increasing household income will not necessarily reduce forest exploitation. This paper contests the assumption in integrated conservation and development approaches that there is a positive link between improving household welfare and sustainable use of natural resources.

Keywords: Uganda, forest income, forest use, livelihoods, poverty alleviation, forest policy, forest management

Texas spring and cave salamanders: Discovering and conserving biodiversity in a rapidly urbanizing landscape

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The Hill Country of central Texas, USA is characterized by ancient limestones, underground waters, and many surface springs. Numerous organisms are endemic to this region, including aquatic salamanders of the genus *Eurycea* (Plethodontidae: Spelerpinae). Nearly all are paedomorphic (mature reproductively while retaining larval morphology). Most occur in spring outflows, but others are subterranean, exhibiting seemingly bizarre features such as loss of pigment and functional eyes, and extreme modifications of the skull/skeleton. The combination of lack of metamorphosis and repeated invasions of cave habitat (followed by convergent evolution of cave-associated morphologies) has made understanding of species boundaries very difficult, and until recently only five species were recognized with almost all populations assigned to the supposedly widespread species *Eurycea neotenes*. Molecular studies have revealed a complex evolutionary and biogeographic history and much greater species diversity, at least tripling the number of species previously recognized. Several species occur partly or entirely within fast-growing cities such as Austin and San Marcos and are in critical danger of extinction. This illustrates how application of molecular genetic and phylogenetic methods can reveal cryptic ("hidden") species, forming the basis for conservation prioritization and implementation.

Keywords: Conservation Biology, Conservation Genetics, salamander, amphibian

Foraging Responses to Nutritional Pressures in *P. ursinus*.

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Papio ursinus are dietary generalists that exploit a diverse repertoire of food resources. While baboons may travel and forage as a group, factions of the group are affected by differing nutritional pressures resulting from differences in ontogenetic, social and reproductive demands. This study explored the foraging strategies of a group of *Papio ursinus* and the foraging differences between subgroups classified by maturity and sex in order to ascertain whether the subgroups tended to tailor their foraging behaviors to meet expected nutritional demands.

Behavioral observation was conducted during June and July of 2006 in Table Mountain National Park, South Africa. Ethological data were collected for one previously habituated *P. ursinus*. All observed herbaceous food sources were documented, and identified where possible. Food resource preference, nutritional properties of food resources, and nutritional demands were examined to test the hypotheses that the foraging strategies exhibited by the subgroups would differ and that food selection is driven by nutritional demands. Adult females and juveniles were found to seek out food resources higher in proteins, while adult males were found to prefer food resources higher in carbohydrates. The findings support the alternative hypotheses and suggest that nutritional pressures are the best predictor of foraging optimization.

Keywords: foraging behavior, *Papio ursinus*, South Africa, nutrition, optimal foraging strategy.

EthoTracker: A Novel Application for Handheld Electronic Ethological Data Collection

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In all of its methods, ethological data collection in the field is traditionally conducted by recording of observed behavioral events with a pen and paper medium. In order to analyze hand-recorded quantitative data with contemporary statistical analysis software applications, a second manual process must be conducted to transpose written data to an electronic format. Both the initial collection of hand-recorded data, as well as the transfer to electronic formats, are vulnerable to human error and deviations in standardization of recorded data. Additionally, this redundant process of written collection and later data entry can be highly inefficient. In order to address these concerns of inefficiencies and potential error, the researchers designed, developed, and field-tested a novel software application (named EthoTracker) for collection of ethological data. Considerations were also given to non-volatile backup of data collected in the field, device availability, ease and efficiency of use, and preparation of raw data for analysis in common statistical software packages. Following final development and field testing, the EthoTracker application was found to be as efficient in initial recording of quantitative data as hand-written methods while enforcing data standardization. Furthermore, the efficiency of initially collecting data in the field in an electronic format and eliminating the need for redundant data-entry without concern for data-entry error proved remarkably effective, even allowing statistical tests to be conducted the same day as data were collected.

Keywords: electronic data collection, ethological techniques, data entry errors.

Going it Alone – Premature Separation of Mothers and Infants in Mountain Gorillas

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The effects of separation and reunion upon an infant's behavior and the mother-infant relationship in great apes have been documented only in captivity. Observations of such events under natural conditions are extremely rare and very difficult to observe. This study documents a separation incident observed in the largest known group of mountain gorillas (*Gorilla beringei beringei*) in the Virunga massif (Rwanda) during the rainy season in November 2006. Following a temporary group split, three infants (22, 29, 30 months old) became separated from their mothers providing a unique perspective on infant survivorship and the importance of maternal investment during a life-stage when infants are still physically and nutritionally dependent on their mothers to varying degrees. Only the oldest infant, Agahozo, survived the 18 day-period of separation and was reunited with his mother.

Keywords: premature separation, reunion, maternal investment, mountain gorilla.

Karisoke Research Center: Contribution of 40 years of Research to Mountain Gorilla Conservation

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This paper illustrates the importance of long term behavioral and demographic research to gorilla conservation. Effective conservation requires a comprehensive understanding of a species behavior, ecology, population dynamics and life history. Established in 1967, by Dr. Dian Fossey, the mountain gorilla behavior and demographic records represent one of the longest running databases for any long lived mammal. The results of four decades of demographic research at Karisoke together with regular census have resulted in detailed information of population dynamics and life history patterns of the mountain gorillas. These results together with discrete studies of gorilla behavior, diet and habitat use have furthered our scientific understanding of great ape social organization, contributed significantly to the development of socioecology theory and provided data critical for the design of appropriate conservation and management strategies for an endangered great ape species. Research at Karisoke has also played an important role in gorilla conservation through 1) direct gorilla protection and monitoring efforts, 2) the provision of local economic benefits, 3) the development of education programs and 4) through the media brought international attention to mountain gorillas. Long term research on the gorillas and their habitat continues today to be a fundamental component of a successful conservation strategy.

Keywords: long term research, mountain gorilla, conservation, education

Infant Behavior in Gorillas: Behavioral Research in Immature Gorillas and Implications for Conservation

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Reproductive success in adulthood ultimately depends upon the ability to survive beyond the early years of life. Maternal investment and care of offspring is of prime importance in this period, with factors such as offspring sex and parity of mother influencing investment. Ecological pressures are associated with differences in immature behavior between similar species and, when combined with knowledge of 'normal' variation within a habitat, should enable predictions to be made about immature survival under unusual circumstances. Data will be presented on infant development in mountain gorillas in the Virunga Volcanoes. These will be contrasted with data from western gorillas at Mbeli Bai, Republic of Congo to highlight effects of differing social and ecological pressures. Behavior under 'normal' circumstances in the Virunga Volcanoes will then be compared with behavior observed in surviving twin offspring, a rare phenomenon. Use of such knowledge of infant behavior in predicting survival under unusual circumstances will be discussed.

Keywords: *Gorilla gorilla beringei*, *Gorilla gorilla gorilla*, infancy, behavioral development

Preliminary Study of the Regeneration in Mountain Forest of Rwanda: Case of Eight Tree Species Illegally Exploited in Nyungwe Forest.

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Our study aims to determine the impact of illegal tree exploitation on the biodiversity of trees in Nyungwe Forest. The concerned species are *Entandrophragma excelsum*, *Podocarpus latifolius*, *P. falcatus*, *Faurea Saligna*, *Strombosia scheffleri*, *Newtonia buchananii*, *Ficalhoa laurifolia* and *Symphonia globulifera*, which were illegally exploited before 1994. After the choice of five study zones and survey plots were established, seedlings and young plants < 130 cm were counted to determine their abundance. The results for the 8 species indicates that Nyungwe Forest was affected by illegal timber making activities around Uwinka, Kitabi and Gisovu at which species *Entandrophragma excelsum*, *Ficalhoa laurifolia* and *Podocarpus latifolius* have become rare. Our study also demonstrates that *Podocarpus falcatus* has not regenerated in all study zones. Meanwhile, the regeneration curves are globally normal in Nyungwe Forest.

Keywords: Rwanda, Nyungwe Forest, trees, biodiversity, regeneration

Role of the Buffer Zone in Biological Diversity Conservation and Improvement of Local People Livelihood

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Biodiversity has been degraded in many ecosystems due to various factors including human activities. In Rwanda one way among many others which has contributed to conservation of biological hot spot areas was the creation of protected areas. Nyungwe forest, today National Park, is surrounded by densely populated areas and the community has been for a long time in search of agricultural specie and forest products. This state contributed then to the reduction of the forest size. The buffer zone was established with exotic species in order to stop the abuse of the forest reserve. Can these plantations play any role in improvement of local people's livelihood and contribute to the biological diversity? The study was conducted in the eastern part of the Nyungwe National Park aiming to find mechanisms of conservation of this ecosystem based on the present and future generation's needs. A survey was carried out in Nameable and Nyaruguru districts in order to collect local people's perceptions on the various benefits they get from the buffer zone. Findings showed what the surrounding communities acquire from the buffer zone in various aspects, environmental, economic and social and the perspectives.

Keywords: biodiversity, buffer zone, exotic species, Nyungwe National Park, surrounding community.

Primates Coexisting with Humans : The Behavioral Ecology of a Group of Vervet Monkeys (*Chlorocebus aethiops*) Living in Huye, Rwanda

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Vervet monkeys (*Chlorocebus aethiops*) have adapted to living in close proximity to humans, often along natural forest edges, exotic tree plantations, and agricultural zones within villages and cities, outside of protected areas. The present study, conducted from May to November, 2006 in Huye, Southern Province, Rwanda, was aimed to understand the behavioral ecology of a group of vervet monkeys, including their diet and habitat use, to highlight the interactions between these monkeys and the bordering population of the arboretum. The results of our study showed that these monkeys frequent an area of 70 ha which varies according to the availability of food. The vervets were omnivorous, consuming 53 types of foods during the study, of which the first 10 occupied 61.5% of the total items consumed. Fruits comprised 24% of the diet. The vervets were semi-terrestrial and the most dominant activity we observed was moving, mainly in search of food. They spent the majority of time in the understory for moving and foraging, while resting was observed mainly high in the canopy of large trees. The animals used many different non-native species in the arboretum for food and resting habitat. The group was also observed feeding on crops of the bordering populations outside the arboretum; thus they live in permanent conflict with the local population. We suggest that I.S.A.R., which manages the arboretum, add fruit trees to the arboretum to reduce the frequency with which these monkeys forage in the local populations' fields.

Keywords: vervet monkeys, behavioral ecology, human-wildlife conflict

Agricultural and Forest Biodiversity, Nutrition and Population Health in Market-oriented Food Systems.

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Successful food systems in transition draw on locally-available foods and traditional food culture within increasingly market-oriented economies. Environmental degradation, global trade, commercialization of cuisines, urbanization, cultural erosion and poverty simplify diets in developing countries. In guiding the reconstruction of healthy ecosystems and diverse diets, multi-sectoral research, policies and programs that build linkages between rural producers and urban consumers can couple socio-cultural values and livelihood strategies with attention to changing concepts of wellness and ecosystem health. Agricultural and forest biodiversity make essential contributions to food security, alleviation of micronutrient deficiencies and improving the quality of increasingly energy-rich diets. Concurrently, commercial food systems and market consolidation pose challenges in terms of public health, further marginalization of poor farmers, and sustainability of ecosystems. Guidelines and regulation that ensure the accessibility of locally-produced foods to consumers, supply-chain support that ensures their affordability and availability, and education and promotion that reinforces their value in health and socio-cultural terms deserve prompt attention. Research and integrated development activities focused on the value of biodiversity that are directed at disadvantaged farmers and include increased capacity of agricultural extension can directly improve the nutrition and livelihoods of the most marginalized communities, while revitalizing degraded ecosystems and enhancing biodiversity.

Keywords: commercial food systems, health, nutrition, locally-produced foods, biodiversity

Linking Wildlife and Human Health: Community Outreach and Involvement.

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Effective protected area management is undermined by zoonotic disease transmission between people, wildlife and livestock, exacerbated by problem gorillas and other wildlife leaving the park to forage in peoples' gardens. Two scabies skin disease outbreaks in Bwindi mountain gorillas traced to people living around the park triggered the formation of an NGO, Conservation Through Public Health (CTPH) whose goal is to control disease transmission at the human/wildlife/livestock interface while improving conservation and public health attitudes in local communities. CTPH brings together wildlife, medical and veterinary stakeholders to solve common problems with mutually beneficial solutions. CTPH partners with modern and traditional health practitioners and Uganda Wildlife Authority to conduct community outreach, a key activity within three integrated programs: Human Public Health, Wildlife Health Monitoring and Information, Education and Communication. Since 2004, CTPH has reached over 6000 people in Bwindi parishes with drama shows conveying the message of good health seeking behavior linked to gorilla health, ecotourism and sustainable livelihoods. Since 2005, over 40 people bordering the park have been enrolled in a TB CBDOTS (Community Based Direct Observation of Treatments Short Course Therapy) program. In 2007, Scabies, HIV and family planning started being added to the community based health care model.

Keywords: mountain gorilla, scabies, community outreach, public health

Diversity of the Gene Pool in Domestic Animals and Plants in Rwanda

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This situation favored the most frugal varieties and strains are the least productive. Furthermore, illegal fire practices and overgrazing have favored the flourishing of low nutrient-content plant species such as *Eragrostis spp.* The exploitation of grazing land (pasture) by cattle, coupled with the increase in parasites favored by the promiscuity of herds, is at the root of a selection within the bovine specimens of Rwanda for small size and weak production. These animals are referred to as "rustic" varieties. In goat and sheep husbandry, slaughtering involves the faster-growing males, therefore the most competitive; reproduction is left to specimens with slow growth rates and small size. It is concluded that in domestic animals and plants of Rwanda, the phenomenon known as "geographical dwarfism" (Sacchi and Testar, 1973) is prevalent. These data present an analysis of the causes and effects of geographical dwarfism in domestic animals and plants in Rwanda, relative to the changes in Rwanda's environmental and economic conditions, and associated evolutionary changes in genetic diversity.

Keywords: geographical dwarfism, genetic diversity, domestic, rural, selection.

Valorization of the Vegetal Biodiversity in Rwanda.

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In article 10, the Convention on Biological Diversity envisages the encouragement of the authorities and the sectors deprived to develop methods supporting the durable use of the living resources. It is accordingly that the Institute of Scientific Research Technological initiated research on the valorization of medicinal plants to educate Rwandans and even regional populations of their medicinal properties. Among the studied plants, we can quote: *Capsicum frutescens* (antirhumatisme), *Calendula officinalis* (anti-inflammatoire), *Néorautanenia mitis* (antigale), *Plantago lanceolata* (expectorant), *Datura stramonium* (reducing the acidity of the stomach), *Eucalyptus globulus labill* (against acute and chronic bronchitides with spittles), *Syzygium parvifolium* (all cases of amoebiasis), and *Iboza riparia* (treatment of the anginas). Other plants such as *Pelargonium graveolens* (Géranium) produce an essential oil used in the manufacture of the anti-mosquito candles. The large majority of plants were preserved ex-situ to decrease degradation in the natural environments.

Keywords: plants, medicinal, valorization, conservation

Relationship between Discharge, Sediment and Flood Control in Kinoni Stream at Byangabo, Rwanda.

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Most rivers and streams in Rwanda are ungauged and therefore a method is needed to estimate the rates of flow at specific locations in streams. Kinoni is a small perennial stream originating in Buhoma sector and drains through a subsurface outlet in the Mugogo swamp of Byangabo. When the flow rate in the stream exceeds the capacity of subsurface outlet, ponding of water takes place in the swamp causing flooding. This results in damage to >100Ha of agricultural land and degrades the natural environment around the swamp. In order to quantify the problem of flood control in Kinoni stream, a study of rainfall, discharge, sediment relationships was conducted. Variations of discharge and sediment concentration are more appreciable beyond 6mm rainfall. Rainfall beyond 12mm does not result appreciable increase in sediment concentration. Discharge at zero rainfall is the flow rate due to seepage water from the catchment and it is observed as 46lps with a sediment concentration of 100ppm. Rainfall, discharge and sediment relationships can be expressed well by linear equations. To improve accuracy of the models, more data has to be collected on a long term basis. This study proposes a two way diversion structure to allow optimal discharge of 200lps to Mugogo swamp and to divert the remaining discharge to Rukoro swamp which acts as flood control reservoir and fish pond.

Key words: rainfall, flooding, sediment, water resource management, hydrology

The Importance of Field Study in Training Future Conservation Biologists : Getting Students Outside to Learn

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Training the future generation of professionals in complex biodiversity and environmental issues is demanding. Teaching ecological and conservation biology research skills is virtually impossible without time outside. We report on the revision of the 4-year undergraduate curriculum in the Biology Department at the National University of Rwanda. Academically sound and practical biology (undergraduate conservation) is needed. We seek to increase the capacity to conduct applied research in the Albertine Rift ecoregion to help solve the region's environmental problems, and an increased interest among students to conduct applied research. The revised curriculum emphasizes natural history of Rwanda, and includes field trips as a component of at least 14 courses ranging from applied ecology, hydrobiology, to research methods. With the increased field trips in the curriculum, the number of memoire projects related to biodiversity conservation has increased, as well as studies in Rwanda's national parks that contribute to effective conservation. Field courses have offered NUR students the opportunity to observe first hand the biodiversity problems in their national parks, an opportunity most students otherwise would not have. We recommend greater financial support from the Rwandan government for these field trips, better linkages between field trips and ORTPN and other management agencies, and more training opportunities for instructors for more effective field trips as learning events.

Keywords: field training, conservation, biodiversity, outside students, student needs, National Parks

The Role of Primates in the Maintenance of Biodiversity in Tropical Forests

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The majority of tropical forest trees produce fruits whose seeds are dispersed by animals. Primates are important seed dispersers and play a significant role in maintaining biodiversity. Rwanda has an exceptionally rich primate fauna, and the Nyungwe National Park is home to at least 13 species, the majority of which are fruit-eaters and seed dispersers. We report on the contribution of various primate species, including endangered species, to forest regeneration in Nyungwe NP. We found dispersal by primates enhances germination probability in some tree species, including Albertine Rift endemics. Different seed species are handled differently by each primate species: some seeds are ingested and defecated intact, others are chewed and digested, and others are spat out. Chimpanzees wadge some seeds, which appears to be an important mode of seed dispersal for some tree species. Each primate seed handling method has specific implications for where seeds arrive in the forest, as well as seed survival and germination. Our findings highlight the importance of primates to the functioning of tropical forest, and the urgency of protecting the remaining primate populations in Rwanda, not only for economic and tourism value, but for their role in maintaining biodiversity.

Keywords: forest regeneration, Nyungwe National Park, primates, seed dispersal.

Molecular Genetic Variation in the African Wild Rice *O. Longistaminata* A. Chev. Et Roehr. In Relation to Climatic and Environmental Factors: Implications for Biodiversity Conservation.

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The conservation and sustainable utilization of biodiversity is vital for sustenance of livelihoods. In this study molecular markers, complemented by Geographical Information System (GIS) software packages were utilized for mapping the geographical distribution of genetic variation and assessing its relationship with environmental variables. The objective of the study was therefore to investigate the relationship between genetic diversity and eco-geographic variables using *Oryza longistaminata*, as a case study. The methodology used combines hierarchical cluster analysis of both molecular diversity and climate data via GIS and spatially manipulated data from GIR and UNEP. The geographic distribution of *O. longistaminata* genetic diversity was generated using Amplified Fragment Length Polymorphism (AFLP). There was a close relationship between genetic diversity and eco-geographic variables. A linear relationship between genetic diversity and

environmental heterogeneity was also revealed. There was also a relationship between genetic diversity and level of annual rainfall. Data is discussed in the context of prediction of climate change and global warming, conservation and genetic erosion. The value of this knowledge in the development of conservation measures to mitigate the effects of genetic erosion through climate change is also discussed.

Keywords: geographical distribution, genetic variation, conservation, biodiversity, climate change, global warming

Rotational Woodlot Research in Tanzania: An Overview and a Way Forward.

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Rotational woodlot (RWL) systems may reduce deforestation and sustain site productivity through fuelwood supply and soil fertility replenishments. However, highly productive Australian acacias species, predominantly used in these systems, may deplete nutrient and water resources. Studies were carried out to address these concerns by screening tree species with high nutrient and water use efficiencies, and rapid soil nutrient replenishment capacities. This paper reviews the progress made and identify gap(s) for future research. Australian acacia, especially, *Acacia crassicarpa*, *Acacia leptocarpa*, and *Acacia mangium* produced the highest wood biomass at low nutrient “costs” due to high nutrient use efficiency thereby reducing nutrient exports. On-farm fuelwood production was sufficient to meet household firewood demands for 6 to 17 years, demonstrating high potential of RWL systems to conserve forest. Despite the highest biomass yield, *A. crassicarpa* probably uses soil moisture efficiently because water content under this species was similar to those in soils under other tree fallows and higher than that of the natural fallow after rainfall. Tree fallows improved soil nutrients and maize yield to levels similar to those of inorganic fertilizers. Given the right species, RWL system can produce both fuelwood and maize without adversely effecting site productivity. It is imperative to assess impacts of tree fallows on water budget at landscape level and tree spacing effects on components performance.

Key words: Fuelwood, maize yield, Miombo woodland, site productivity.

One-Health Mountain Gorilla Medicine

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The Mountain Gorilla Veterinary Project Incorporated (MGVP, Inc.) provides health care for the mountain gorillas of the Virunga Massif and Bwindi Impenetrable Forest. The staff includes seven field veterinarians and one research veterinarian who work in partnerships with the protected area authorities of Rwanda, Uganda, and the Democratic Republic of Congo. Though most health problems among the wild gorillas involve individual cases of illness or injury, the potential exists for a disease outbreak to occur. Research has shown that people, cattle, and mountain gorillas

share genetically identical intestinal pathogens, e.g., Giardia. Viral screening performed on samples collected from wild gorillas also reveals a range of antibody titers to select human pathogens, such as hepatitis and influenza; the population appears naïve to such diseases as polio, measles, and TB. These findings support what we observe daily: most habituated gorillas live close to park boundaries; both domestic animals and local people move in and out of the parks. They also underscore the importance of a “one-health” approach to gorilla medicine. MGVP project activities thus include: gorilla health monitoring using standardized data collection, lifesaving veterinary care, relevant health studies of other wildlife and domestic animals, employee health programs (park staff and researchers), and information sharing.

Key Biodiversity Areas: Local Custodianship of Global Standards for Conservation Planning for the 2010 Biodiversity Target

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Key Biodiversity Areas (KBAs) are sites of global conservation significance for biodiversity conservation. They are identified locally with the best available data using globally standard criteria and thresholds, based on the framework of vulnerability and irreplaceability widely used in systematic conservation planning. These sites are based on and form an umbrella around the identification of important sites for single taxa, such as Important Bird Areas and Important Plant Areas, as pioneered by BirdLife International and Plantlife International respectively. Here, we describe a bottom up process using local data and custodianship that has driven KBA identification with global standards, criteria and thresholds in five African countries. These sites are delineated using land management units that are currently or can potentially be managed for conservation. KBAs can provide an international conservation currency for the identification of globally significant sites, an essential element in securing resources for important but hitherto, overlooked sites. The identification and protection of KBAs helps governments in meeting their commitments to the Millennium Development Goals and the CBD 2010 Biodiversity Target.

Keywords: biodiversity, conservation, criteria, thresholds, bottom-methods, policy, custodianship, Africa

Characterization of the Indigenous Sheep of Kenya: The Diversity Status

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Small ruminants play a major role in the resource-poor indigenous people and pastoralist system. Kenyan indigenous sheep can be classified as either fat-tailed or fat-rumped. They include the

Red Maasai, East African fat-tailed and Somali Blackhead Persian. In this study, nine sheep populations were characterized using 15 autosomal micro-satellite markers. The data generated was used to estimate the genetic diversity, population structure and relationship. A total of 179 alleles, relatively high mean number of alleles (6.27 - 7.6), H_E of 0.68 and H_O of 0.63 indicated a high level of genetic diversity. Assessment of the population differentiation showed moderate but significant values of $F_{ST} = 0.053$ ($P = 0.001$). An AMOVA test showed that the genetic variation among populations was 5.3% while within populations it was 94.7%. Genetic diversity was highest within the sheep populations rather than between the populations as supported by AMOVA tests. The populations consistently displayed divergence when subjected to phylogenetic and principle component analysis. The exotic sheep clustered together in one group whilst the indigenous sheep clustered together in the other group. However Kajiado population deviated from expectation by clustering together with the Dorpers' indicating that crossbreeding was rife in this area.

Keywords: Indigenous Kenyan sheep, molecular markers, diversity

Forest Dependency and some Policy Implications for Conserving Botswana Forest Reserves: A Case Study from Kasane Forest Reserve.

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In resource dependent rural areas of developing countries, the use of common property resource management has been considered as one of the most viable options for combining poverty reduction, enhancement of local economic development and biodiversity conservation. The Kasane Forest Reserve (KFR) in Botswana is of great significance to the local people and environment of the region. Currently a comprehensive KFR management plan is being developed to meet the various needs and aspirations for the present and future. Recent evidence on failures of integrated conservation and development projects highlight the need for more research on this area. Dependency of local communities on forest resources has been identified as a major obstacle in implementing forest protection programs. This study estimated forest dependency and identified factors influencing dependency for households living around KFR. A random sample of 237 households was used in this empirical study. Descriptive results demonstrate the very different resource use of the population and the diversity of the local people in terms of socioeconomic interests, demographic history. Logistic regression suggests that forest dependency is positively and significantly associated with family size. However asset rich households were less dependent on forest resources. Thus, policy makers need to consider the needs and economic options of the local people in the periphery, so as to create a win-win relationship between conservation and local rural development options.

Keywords: Botswana, protection, forest dependency, Kasane Forest Reserve.

Ecosystem Health: A Cross-Sector Approach for Biodiversity Conservation and A Healthy Environment for Endangered Species and Humans Living Near Protected Areas.

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The Dian Fossey Gorilla Fund International, USA.

The Dian Fossey Gorilla Fund International, Ecosystem Health Program (EHP) was started in Central Africa in 1998 in collaboration with Ministries of Health and National Park Services. Our data are showing, throughout the landscapes in which we work, 95-99% of people living outside of protected areas are infected with intestinal parasites and that the gorilla groups living closest to villages have the highest prevalence of intestinal parasites. Because of this, the EHP has grown to include 4 basic goals for creating a healthy environment: 1) De-Worming and Hygiene/Conservation Education; 2) Basic Clinic Rehabilitation; 3) Clean Water Access; and 4) Protein Access. When people have a poor health environment, they are not interested in promoting conservation initiatives, they are interested in personal survival and often resent projects that promote the survival of animals (endangered or not). A project which promotes a healthy environment for both humans and endangered animals is understood, well-received, and reduces stakeholder-conservation conflicts. Our EHP goals to achieve a "Healthy Environment" are simple, easily accomplished with help from the communities, provide a convenient venue for conservation education, are sustainable, and lower the risk of disease for all concerned (great apes and people).

Keywords: disease cross-transmission, intestinal parasites, gorillas, hygiene, clean water access, healthcare education

Bioprospecting as a Means to Conservation of Biodiversity: Examples from East Africa

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Bioprospecting is a complex process. It integrates many diverse activities. The activities include discovery of potential products involving collection and inventorying of biological samples and species, ethnobiology, extraction, bioassay screening of samples, and identification of active chemical constituents. Bioprospecting is a long-term and expensive venture. The International Centre of Insect Physiology and Ecology (ICIPE) and its partner institutions have initiated model projects in Kenya, Uganda and Tanzania to demonstrate the potential role of bioprospecting in promoting conservation of biodiversity. The projects address issues of alternative income generation and technology transfer to communities living adjacent to biodiversity-rich areas, access to genetic resources, fair and equitable sharing of benefits, and intellectual property. Several commercial natural products have been developed by the institutions and communities, some of which are on sale. Communities living adjacent to biodiversity-rich areas have been mobilized to cultivate and process indigenous medicinal and aromatic plants on a commercial basis for manufacture of the natural products. Kenya Wildlife Services and ICIPE have also initiated model projects to discover, develop and commercialize more advanced natural products from arthropods, plants and microorganisms that can generate substantive revenue to support management and protection of wildlife in Kenya.

Key words : bioprospecting, biodiversity, commercialization, genetic resources, conservation

Ecosystem Health: Potentiality for Cross-Transmission of Intestinal Parasites between Gorillas and Human Beings, DRC

A. Magayane, I. Munyarugero, A. Muyisa, H. Simm and A. Lilly.

The Dian Fossey Gorilla Fund International, USA

In the Democratic Republic of Congo (DRC), our Ecosystem Health Program (EHP) seeks to reduce the threat of disease cross-transmission between humans and at-risk fauna by analyzing the levels of intestinal parasitism in gorillas and humans near protected areas, and providing free treatment and prevention education for the latter in conjunction with the Ministry of Health and National Park Service. We have analyzed the data from villages around Virunga National Park and four protected areas (Tayna Nature Reserve, Kisimba-Ikobo Nature Reserve, RECOPRIFOL and Itombwe) and have found higher levels of a potentially dangerous intestinal parasite (*Entamoeba histolytica*) in gorillas living closest to the human populations. Treatment of villages is, in general, successful in reducing intestinal parasite infestation, but insecurity greatly affects sustainable health care and hygiene projects. We have found that villages which have remained relatively secure have, in follow-up analyses, experienced a decrease in intestinal parasitism (50%), but villages which have been frequently subjected to civil unrest are unable to sustain reductions. Also, we believe that access to clean water, basic nutrition, and medical care, are crucial for ensuring a healthy environment and have included these components in our program.

Keywords: disease cross-transmission, Volcanoes National Park, gorillas, intestinal parasitism, disease prevention education, Tayna Nature Reserve, *Entamoeba histolytica*, healthcare, hygiene

Plant-feeding of *Anopheles gambiae* s.s.: Discriminative Feeding Behavior on Different Plant Species and its Effects on this Vector's Fitness in a Malaria Endemic Area of Western Kenya.

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For most mosquito species, floral nectar and extra-floral plant fluids are the female's primary sources of dietary sugar and the male's only source of nutrients, yet the influence of plant-feeding on mosquito fitness remains poorly understood. This may be a gap in our knowledge of factors that affect the biotic potential and population dynamics of the malaria vector *Anopheles gambiae* s.s. Feeding responses of *Anopheles gambiae* on 13 common plants species growing in a malaria endemic area of western Kenya, Mbita, were evaluated. *Anopheles gambiae* exhibited a preferential feeding pattern on different plant species, with five plant species being more preferred. Mosquitoes that fed on four of the five more preferred plant species lived significantly longer, laid more eggs and had a short gonotrophic cycle, when compared with those fed on the least preferred plant species. Sugar composition and concentration of these preferred plants were largely responsible for these effects. These results indicate that preferential feeding behavior by mosquitoes on different plants species has fitness benefits (increased longevity and fecundity), and this suggests that the availability of certain plant species in malaria endemic area can increase or reduce malaria transmission by affecting the competence of the vectors.

Key words: *Anopheles gambiae* mosquito, feeding, plant preference, Kenya, benefits, malaria

Enhancing Post-fire Regeneration in Nyungwe National Park through Manual Removal of *Pteridium aquilinum* Ferns.

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Wildlife Conservation Society, Rwanda

In 2004, remote sensing and GIS analyses calculated that 128 km², or 12% of Nyungwe National Park had been affected by fire in the previous decades, much of which was burned in extensive wildfires in 1997. A fern, *Pteridium aquilinum*, is an initial colonizer of burned areas growing rapidly and densely from existing rhizomes in the soil and from air-borne spores, inhibiting the regeneration of native tree species. The Wildlife Conservation Society Project for the Conservation of Nyungwe Forest initiated a research project in 2001 to assess if and how the periodic clearing of these ferns may enhance forest regeneration. At three sites, research plots were established on the upper, middle, and lower slopes with fern cutting treatments of 2-, 4-, and 6-month intervals. Data from these plots were collected for over three years and compared to control plots. Cutting treatments significantly assisted forest regeneration resulting in more trees (2-month= 5,600 trees/ha vs. control= 1,100 trees/ha), taller trees (2-month= 3.2 m vs. control= 1.6 m) and more tree species (2-month= 5.4 species/plot vs. control= 1.7 species/plot). The implications for implementation of large-scale post-fire restoration of Nyungwe National Park will be discussed, based on the specific results of this study.

Keywords: *Pteridium aquilinum*, post-fire restoration, regeneration, Nyungwe

A Multi-Criteria Approach to Protected Area Zonation in Nyungwe National Park, Rwanda

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Nyungwe National Park in Rwanda is an ecosystem of global importance, supporting a vast species diversity, including 13 species of primates, over 275 species of birds, and more than 1200 species of plants, many of which are found only in the Albertine rift. Together with neighboring Kibira National Park, this ecosystem forms the largest block of remaining tropical montane forest in east Africa between 1500 and 2300 m. We report on a recent effort to zone the national park and surrounding human landscape for park management purposes using a geographic information system to incorporate information on the biological, geological, and human landscapes. We first mapped the biological landscape by assigning ranks to sensitive species and habitats, species richness, irreplaceability of Albertine rift endemic species, landscape heterogeneity, and degraded areas. Human landscape features and threats data were overlain on the biological base map to recommend 8 major zones within the park for different management strategies ranging from strict protection, to potential tourism, to restoration. Districts adjacent to the park comprise the ninth management zone, and were ranked according to their level of conflict with the protected area. As a conclusion we suggest that there are certain critical methodological differences and data indicators necessary for conservation planning at the regional and local levels.

Keywords: Nyungwe National Park, landscape threats, conservation, human land management

Current Status of Gorilla Populations in Africa: Census Techniques and the Numbers Game

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Designing conservation management programs for the four known gorilla taxa requires: 1) western lowland; 2) Cross River; 3) Grauer's; 4) Virunga mountain; and 5) Bwindi mountain gorillas. These are done by several census techniques: prospection, line transects, reconnaissance transects, point transects, or complete censuses (e.g., Virunga mountain gorillas). From baselines, we can design repeat studies to determine rates of loss (or gain) over time in distribution and abundance and by understanding trends, further refine our conservation programs. Unfortunately, these techniques, mostly relying on nests as a proxy for individuals, have wide margin of errors ($\pm 30\%$), and are expensive and time consuming. As a result, we have many gaps in the current data for western lowland and Grauer's gorillas, although we clearly detect a crisis: over 50% of western lowland populations have disappeared in large expanses of their range, and 25% of the occupancy range of Grauer's gorilla's has been lost. Total population size is more elusive: the former may number between 27,000 and 67,000 individuals; the latter between 5,500 and 27,000. The Cross River gorillas are estimated at between 250-300 individuals. The data is discussed in relation to Rwanda and her neighbors.

Keywords: gorilla populations, Africa, techniques, limitations, distribution abundance

Impact of Agricultural Activities on the Conservation of Ungulates, Akagera National Park, Rwanda

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Rwandan biodiversity never ceases being degraded from demographical pressures. The protected areas are not safe from this degradation of which one consequence is the loss of diversity in flora and fauna. This study makes it possible to propose new orientations and strategies to avoid or reduce the loss of the biodiversity of the ungulates of the Akagera National park. The methods of ground observation, carried out by 4 route samples and a survey questionnaire near the agri-stockbreeders and managers of the park gave results, were analyzed, and then interpreted by the comparison of the frequencies by the X^2 test. The loss of the biodiversity of the ungulates occurs through acts of poaching, drive out, uncontrolled bush fires, conditions of cohabitation between wild and domestic animals which exceeds the load capacity of the medium expressed by the dryness, hydrous and wind erosion, and the trampling around the water points and soil compaction. The solutions considered take account of the passage of the extensive with the intensive agriculture, of the speculative breeding to the breeding in ranches. The later studies should lead the researchers to consider methods of rehabilitation of the degraded biotopes and biocénoses

Keywords: ungulates, conservation, biodiversity

Phytogeographical and Ecological Study of the Asteraceae of Rwanda.

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Institute of Scientific and Technological Research, Butare, Rwanda

The flora of Rwanda includes approximately 200 families in which Asteraceae, Poaceae, Fabaceae are the most diversified. A phytogeographical and ecological study of the one of the greatest families will make it possible to locate the places of high specific diversity and to define the suitable methods of conservation. Our study is based on the data of national Herbarium and the monographs relating to the flora of central Africa. A repertory of the geographical co-ordinates of the located areas was drawn up (Bamps, GI and given herbaria). A projection of these places on a topographic bottom and the analysis by calculation of the degree of similarity were carried out. The adaptation of Asteraceae was given according to these factors: water, light, pH and altitudinal variation. Areas of high diversity in Asteraceae being: forest-clearings, savannas, fields and fallow; this testifies their preference in the most enlightened mediums (savanized, ruderalized or cleared) and not submerged. Diversity in Asteraceae is not homogeneous. Their phytogeographical distribution shows an insufficiency in the botanical prospection and a small degree of similarity. We recommend defining a zone of conservation of Bugesera to ensure the perenniality of species in general and those of Asteraceae in particular.

Keywords: phytogeography, ecology, Asteraceae, Rwanda

Balancing Biodiversity Conservation and Sustainable Natural Resource Management.

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Conservation of biological diversity must be seen as an essential underpinning to sustainable development strategies for all nations. However, certain regions are exceptionally rich in biodiversity, but under extreme threat. They therefore require special attention from the global community. Conservation International uses two principal approaches to setting conservation priorities: 'Hotspots' and 'High Biodiversity Wilderness Areas'. Wilderness areas, such as the Amazonian Forests, contain at least 70% of their original habitat. Hotspots, those areas rich in biodiversity and under threat, have particularly high numbers of endemic species, but have already lost more than 70% of their original, natural vegetation. Thirty-five such areas have been identified for the Earth's land masses, with what remains in them occupying only 2.3% of Earth's terrestrial surface. Despite this, they harbor at least 50% of all endemic vascular plants and more than 40% of all endemic vertebrates. Africa has nine such hotspots. One hotspot, the Eastern Afromontane Hotspot, is one of the world's highest conservation priorities. It contains the western portion of Rwanda, the Albertine Rift, including Nyungwe Reserve and Volcanoes National Park. This presentation explores the critical importance of Hotspots in global efforts to conserve biodiversity, and the many ways in which conservation is being achieved in these regions using

several Hotspots examples in which Conservation International is particularly active, such as Madagascar and the Atlantic Forest Region of Brazil.

Keywords: Conservation International, hot spots, global, lost species, Africa, Rwanda

The Role of Farmer Groups in Managing Forest Reserves: The Case of Kilosa District, Eastern Tanzania.

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After recognizing the ever increasing environmental degradation and loss of forest resources, Tanzania developed National Policy, which is implemented by National Forest Program (NFP) initiated in year 2001. Some of it's objectives include: sustainable supply of forest products and services ensured to meet the needs at the local and national levels; and increased economic contribution, employment and foreign earnings through sustainable forest-based industry development and trade of forest products. In Kilosa District, Participatory Forest Resources Management and Gender Aspects is sub-program in implementing the NFP in 12 villages through farmer groups. Sensitization workshops were conducted to improve farmer's awareness to participatory forest conservation. This led to all the participating villages to set aside village land for forest reserves which has been surveyed and boundaries established. Also in some villages participatory forest reserve assessment has been conducted to ascertain the type of tree species available, uses, and set conservation strategies. Some of the villages involved in the program have started bee-keeping and fisheries projects. The implementation of the program is however affected by long distances from the villages to the forest reserve and low prices offered for the honey produced. Use of farmer groups seems to be effective in managing forest reserves.

Keywords: forest resources, community participation, sustainable forest management, farmer groups

Status of Lake Victoria Capture Fisheries, their Management and Socio-economic Development in Tanzania.

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Recent studies conducted in Lake Victoria point out a fluctuation in increasing in species diversity and relative abundance of species after a period of decline. Free access to the fisheries, illegal fishing gears and methods, introduction of exotic fish species and environmental degradation, are among the reasons of the decline. These negative trends in the lake fisheries and poor water quality led to loss of livelihoods of many thousands households who are directly or indirectly

dependent on the lake. From the current stock assessment survey, a total of 15 fish taxa were recorded, *Lates niloticus* dominated the catch by weight at 85.43±17.96%. A total number of 36 zooplankton and 73 phytoplankton species were identified from the 69 sampled stations, Nile perch fishery stock size is still dominated by juveniles by over 90% being below the size at first maturity, indicating high recruitment in the Nile perch fishery. Therefore sustainability of the resources will contribute to poverty eradication and sufficient supply of protein. With responsible fishing and effective monitoring control and surveillance (MCS) system on Lake Victoria the sustainability of the resources is assured.

Key words: fisheries management, biodiversity conservation, capture fisheries, stock assessment, catch, policy, illegal activities

Using Landscape Metrics to Analyze Spatial Patterns, Forest Fragmentation and Monitor Habitat Loss in Rwanda

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Landscape metrics are widely applied in landscape ecology to quantify landscape structure. The major causes of disturbances in a landscape and forest fragmentation are mostly associated with the impacts of human population growth, unsustainable utilization of resources, climate change and introduction of exotic species. This is particularly true for forestlands and mountainous regions of Rwanda where forests under communal areas are seriously degraded due to human activities in search of food and raw materials. It is estimated that 90% of the population engages in agriculture and therefore, conservation of scarce land resources is essential in order to protect habitats and ensure food security in Rwanda. The advancement of information technology and development of high speed computer systems have tremendously enhanced the applications of remote sensing (RS) and geographical information sciences (GIS) in monitoring land use/land cover changes. In this paper I investigate the effects of scale on a number of forest class metrics and identify a subset of metrics that capture the majority of variation in forest fragmentation in Rwanda. Unsupervised classification, using cluster analysis was employed in order to generate land use/land cover classes. Land use and land cover maps were produced through interpretation of false color composite images derived from Landsat Thematic Mapper (TM) satellite images and ASTER images. Various landscape metrics, namely mean patch size, largest patch, patch density, number of patches were used to analyze the land cover maps. The outputs of the spatial analysis were linked to socio-economic analysis in order to validate the impacts of human population in causing forest fragmentation. The results of this study will be useful in policy formulation and planning natural resource management for sustainable development.

Key words: land cover, Landscape metrics, ASTER, spatial patterns Landsat TM, forest fragmentation

Landscape Fragmentation and Forest Cover Change in Malawi Based on Multispectral Satellite Imagery: (1973-2000)

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Remote sensing and Geographic Information Sciences techniques using Landsat Multispectral Scanner (MSS) and Landsat Thematic Mapper (TM) were employed to conduct spatial analysis and to map forest cover for the two time periods. Landscape pattern was analyzed with FRAGSTATS v3.3. Five landscape metrics indices were used, namely total number of patches, total area of patches, largest patch size, mean patch size and patch density. The total number of landscape patches served as an overall measure of landscape fragmentation. The results of landscape fragmentation and forest cover change for the two time periods indicate that Malawi's forests declined from 46% of total land area in 1973 to 28% in 1991 and then increased from 28% in 1991 to 38% in 2000. The highest number of forest patches was recorded in 2000, representing the highest forest fragmentation of the three times. The causative factors of these changes include poverty, population increase, and political development. The results of this study will provide useful information in designing sustainable utilization of forests and an integrated approach to forest conservation with an emphasis on rural communities.

Keywords: landscape, fragmentation, forest cover conversion, patches, land use, change detection

Regeneration of Natural Forest Vegetation in Previously Cultivated Areas, Volcanoes National Park, Rwanda

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The vegetation of previously cultivated lands in the Volcanoes National Park was studied between the end of November 2005 until mid-January 2006. Two neighboring areas within the park, a disturbed area (abandoned farm land) and an undisturbed area (non cultivated land) were chosen for comparison. Plots were delineated in the lower altitude mixed forest zone where cultivation had previously occurred. In total, the area sampled covered 112 acres in the disturbed area and 2 acres in the undisturbed area. There was no significant difference in species composition between the two zones studied, 101 species in the disturbed area and 98 in the undisturbed area. *Neoboutonia macrocalyx* was the predominant tree species in both areas. Overall, the species list revealed 11 endemic species. The results on the distribution of individual species in class diameter showed that the small class (2.5-9 cm) was composed of many more individuals than other classes, suggesting relatively good regeneration. The correlation of the bush with the canopy cover showed that the secondary succession of the previously cultivated land was in its third stage, as a young secondary forest.

Keywords: vegetation, disturbed area, *Neoboutonia macrocalyx*, succession, regeneration

A One Ecosystem Health Approach: Health and Disease Issues at the Interface

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Infectious diseases are increasingly being recognized as important “emerging issues” by health specialists, disease ecologists, conservation biologists, wildlife managers, and protected area planners. Throughout the world, people, their domestic animals and wild animals are coming into ever more intimate contact. No where is this as stark as in Rwanda. Since 1997 Akagera National Park has lost over 1500 km² of area through degazetting. Akagera’s current western border is the classic interface with human communities and their livestock interacting with wildlife. Diseases such as tuberculosis, foot and mouth disease, anthrax are a high priority in terms of health in its broadest sense. Little data are currently available and without adequate scientific knowledge the consequences can be detrimental. An Ecosystem Health monitoring program in and around Akagera should facilitate development and conservation success. This should be part of an integrated inter-disciplinary applied monitoring and surveillance program of wildlife, people and livestock disease issues. The issues related to people and wildlife reflect an African reality. Health is considered a key and with the right mix of expertise armed with the tools that the animal health sciences provide - conservation and development objectives have a much greater chance of being realized. This is particularly true at the critical wildlife/livestock interface of Akagera where conservation, human livelihoods and agricultural interests are meeting head-on.

Key words: Ecosystem Health, Akagera National Park, Rwanda, zoonotic disease transmission

Comparative Study of Ethanolic Extracts from *Acacia sieberana* and *Mitragyna rubrossipilata* on some Diarrheic Bacteria.

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The powders of *Acacia sieberana* and *Mitragyna rubrossipilata* species are traditionally used for treatment of symptoms related to diarrhoeal diseases . We have tested the extracts and their fractions for their efficacy in inhibiting the growth of the following enteropathogens *in vitro*: *Escherichia coli*, *Salmonella B*, *Salmonella typhi*, *Shigella flexineri*, *Shigella sonnei*, *Shigella dysenteriae*, *Candida albicans* associated with diarrhoea. We have also tested the anti-trichomonas activity (in aqueous middle Kupferberg) and the antiprotozoal activity (in aqueous middle Jones) of *Entamoeba hystolytica*, *Entamoeba coli* and *Girardia* The results from the tests demonstrated that the *Mitragyna rubrossipilata* extract had an excellent inhibitory effect than *Acacia sieberana* extract perhaps due the high concentration of saponoside. Nevertheless, in all

cases, *Salmonella B* seems to be inhibited at high concentrations of the extract. There was a good correlation between the clearance rate of mobile parasites and the concentration used. After absorbing the polyphenols, followed by testing on the same micro-organisms, the results lead us to conclude that tannins and flavonoids (polyphenols) are bioactive compounds attributed to the above activities. Note that all these bioactives play a great role in antioxidant and radical scavenging activities into cells and presumably in prevention of cancer.

Keywords: anti-diarrhea plants, biological activity, enteropathogens, antiprotozoal activity.

Performance of *Grevillea robusta* Provenances in Ruhande Arboretum, Butare, Rwanda.

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A trial involving *Grevillea robusta* comprising of seven Queensland (Australia) provenances and one land race on a ferralsol at Ruhande Arboretum, Butare, Rwanda was carried out. The species is the commonest on farm tree species in Rwandan agroecosystems and serves many functions. On-farm wood productivity is known to decline progressively when tree germplasm used is collected from landrace populations of exotic species. This study intended to evaluate the performance of seven provenances and one landrace in terms of wood yield. Although the outstanding provenances reported elsewhere are not represented in the Rwandan trial which is very small and with a design that is not most appropriate, useful results are obtained. Significant differences were obtained for tree height and branching pattern at 13 years. All traits indicated strong juvenile-mature correlations. Trait-trait phenotypic correlation was also observed to be strong in all traits. The correlations were observed to increase consistently with age, indicating the possibility of predicting yield at maturity by using early tree dimensions. High value germplasm may be produced from seed production areas using the best provenances from the species' natural range. Conservation stands are suggested for further breeding and for seed production using seed from natural Australian sources.

Keywords: *Grevillea robusta*, agrosystems, biodiversity, germplasm, conservation, Butare, Rwanda

Role of Certification in Conservation of Biodiversity in Commercial Forest Estates of Zimbabwe: A Case Study of Chimanimani Estates.

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Biodiversity losses through fire, indiscriminate harvesting of flora and fauna, invasion by invasives, plantation forestry, agriculture, unplanned settlements and other habitat destroying activities are common in southern Africa. In Zimbabwe major areas of endemism are the Eastern highlands, the Central watershed and the Great dyke. A study was done to assess the biodiversity status of high

value conservation areas (HVCAs) within Chimanimani forest estates in the Eastern highlands and to build a model incorporating information on best management options. Conventional scientific vegetation inventories using stratified sampling were done to assess the biodiversity status in the HVCAs. Implications of management options under the conservation status were explored by simulation modeling using data from the field. ANOVA, hierarchical cluster analysis and ordination methods were used for data analysis. It was evident that HVCAs contain rare, threatened and endangered species. There were significant differences in plant species and family richness in woodlands and forests. However, there were no significant differences in bird and animal species. There is need to improve public awareness campaigns and simulation of understanding among the workers and surrounding communities to enhance sustainable conservation of HVCAs. There is also need to create data bases for biodiversity in these HVCAs.

Keywords: biodiversity, Zimbabwe, conservation, high value conservation areas

Mapping and Modeling Landscape-based Soil Fertility Change in Relation to Human-induction: A Case Study of Gishwati Watershed of the Rwandan Highlands.

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Changes in land use and land cover (LUCC) are central to the study of global environmental change. Among these changes is soil fertility degradation, which has become a major problem for agricultural management in Rwanda. We assessed human-induced soil fertility change in the Gishwati watershed. Multiple comparison analysis showed that all MSFI were highly affected by LUCC in Gishwati watershed. By computing the deviation of SFI from natural forest to other land uses, revealed the change of soil fertility over 25 years. The soil fertility deterioration index (DI), revealed that soil quality in Gishwati watershed has been significantly reduced in agricultural lands (-31%), pine plantations (-24%) and pasture land (-16%). Of the geostatistical analysis we modelled the spatial structure of soil fertility degradation due to LUCC using both MSFI and SFI. SFI was the best choice for representing spatial structure of soil fertility change in relation to LUCC. Prediction accuracy ranged from 91% to 93% in the entire Gishwati watershed. Therefore SFI maps differences enabled us to detect early land degradation caused by different change in land uses done in different time which could not be easily seen using individual MSFI.

Keywords: principal component analysis, soil fertility indicators, soil fertility Index, soil predictive component, regression Kriging, SFI Gaussian model.

Quality of Honey Harvested and Processed Using Traditional Methods in Rural Areas of Kenya

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Honey samples (n=72) were processed using traditional methods and on sale in various important beekeeping zones in Kenya: The quality of the honey was compared to international standards as proposed in the Codex Alimentarius. The quality markers analyzed were moisture, HMF, sugar

content, diastase, proline content, and free acidity. Moisture was determined using a honey refractometer, HMF and Diastase content were determined through spectrophotometry, sugars were determined by High Performance Liquid Chromatography (HPLC), proline was determined through spectrophotometry and free acidity quantified by volumetry - titration technique. Average constituent values were at 16.00 – 21.20% (moisture); 3.70 – 389.36 mg/Kg (HMF); 20.83 – 300.6 mg/Kg (proline); 8.03 – 56.98 Schade units (diastase); 57.03 – 102.66% (fructose and glucose levels) and 18.00 – 71.85 50 mq/Kg (free acidity). Most of the samples had constituent levels within the limits set in the Codex Alimentarius. Results on 3 honey samples obtained from Rwanda are also included. In an effort to promote beekeeping is an eco-friendly, sustainable alternate source of livelihoods, training in best apiculture practices, improved extension services and establishment of honey marketplaces are key to improving honey quality in Kenya and other African countries where beekeeping is still at the subsistence or semi-commercial level.

Keywords: honey quality, traditional processing methods, sustainable livelihoods, Codex Alimentarius

The Role of the Cultural Practices in the Conservation of the Biodiversity in Rwanda.

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We analyzed the role of some traditional practices and beliefs in the conservation of biodiversity. Fieldwork was carried out in various locations in Rwanda. The study focused on identifying the state of local biodiversity, and evaluating how traditional practices and beliefs affected biodiversity conservation. Particularly well-preserved areas include forest of Cyamudongo annexed to Nyungwe National Park and the forest reserves of Busaga and Buhanga. Also recorded were certain floral species which had almost become extinct in natural environments but could be found preserved in the gardens of traditional medicine practitioners and in privately owned gardens as a result of the cultural value of the plant species. Thus, the valorization of the traditional practices and the integration of the local population in the management and conservation of biodiversity is of great importance in safeguarding biological diversity.

Keywords: conservation, biodiversity, tradition, culture, Rwanda

Environmental Factors Associated with Distribution of *An. arabiensis* and *Cx. quinquefasciatus* in a Rice Agro-ecosystem in Mwea, Kenya

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A study was conducted over a 6-week period between May and June 2006 to investigate the factors affecting the distribution of *An. arabiensis* Patton and *Cx. quinquefasciatus* in a rice agro-

ecosystem in Mwea, on a 200 m radius from the periphery of the study village and 10 randomly selected paddies and canals within a 1 km radius. For each habitat, 13 environmental variables were recorded and a sample of mosquito larvae and other aquatic invertebrates was collected for enumeration and identification. The non-paddy aquatic habitats identified included pools (n=16) and marshes (n=8). Morphological identification of 1,974 larvae yielded 4 mosquito species predominated by *Cx. quinquefasciatus* (73.2%) and *An. arabiensis* (25.0%). Other species included *Cx. annulioris* Theobald (1.3%) and *Cx. tigripes* Grandpre and Charmoy (0.5%). Pools were associated with higher abundance of *Cx. quinquefasciatus* larvae and less diversity of other aquatic invertebrates compared with other habitat types. The abundance of *An. arabiensis* was not significantly different within habitat types. Regression and Chi-Square analysis showed that *An. arabiensis* larvae was associated with habitat type. Thus, both biotic and abiotic factors play a significant role in niche partitioning among *Cx. quinquefasciatus* and *An. Arabiensis* an important factor in integrated vector management potential in Rwanda.

Keywords: mosquito larvae, habitat, habitat agro-ecosystem, Kenya

Bamboo Dynamics in the Afro-Montane Forests of Rwanda

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Surveys of vegetation were conducted in the bamboo forests of high altitude protected areas in Nyungwe National Park (NNP) and Volcanoes National Park (VNP), Rwanda. The Braun Blanquet method was used to assess the floristic composition of bamboo communities in each forest. The DBH, bamboo canopy cover and inter-node length were measured. Forest and soil type, tree canopy cover, slope and altitude all influenced the distribution and dynamics of the bamboo community. In total 167 and 185 plant species were identified in the bamboo forests of NNP and VNP respectively. Whilst the floristic composition of the bamboo forest differed in each park, *Yushania alpina* was the dominant species. The extent of bamboo cover was determined by either negative associations with light-demanding plant species or positive associations with shade tolerant plant species. The bamboo forest in VNP is characterized by positive species associations with shade tolerant herbs and climbers. In contrast the bamboo forest in Nyungwe is characterized by negative species associations with lianas and trees, suppressing bamboo growth. The bamboo mountain forest in both forests are facing threats due to the effects of human disturbance making it necessary to strengthen protection to ensure the sustainability of these important wildlife ecosystems.

Keywords: Volcanoes National Park, Nyungwe National Park, vegetation survey, bamboo forest, *Yushania alpina*

Development of Sericulture Enterprises for Rural Communities in Rwanda

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Beneficial insects exist in the eco-system, which can contribute to poverty reduction in rural and urban areas in the developing world. Sericulture is an activity that involves mulberry cultivation, silkworm rearing, cocoon production, reeling of the cocoons and weaving of the silk cloth. This activity has been identified as a potential enterprise for the improvement of household livelihoods as it offers an opportunity for additional income generation. *Icipe* has developed innovative sericulture technologies under the Commercial Insects Program. In developing countries, such as Rwanda, poverty is responsible for most rural urban migration in search of employment. This can be addressed by creation of enterprises such as sericulture, where the rural communities can generate income in a sustainable manner for better livelihood. This important enterprise needs to be explored as an additional income generating opportunity and employment option for the rural communities. In Rwanda there is need to design and demonstrate innovative insect based practices as new options for poverty reduction and employment creation. The fundamental approach will be based on close integration of community participation in sericulture technology development and implementation process in a way that reduces pressure on the rural poverty index and the natural resources.

Keywords: sericulture, ecosystem, poverty alleviation, conservation, commercialization

A Study of *Alma Emini* (Oligochaetes, Microchaetidae) Populations in Munyazi Wetland, Rwanda

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The study focuses on the ecology of populations of *Alma emini* in their natural habitat. The study of the variation of the densities and the biomasses enabled us to determine the microclimatic and the seasonal aspects of population change. The analysis of the abiotic factors showed the adaptation of the oligochaetes to the various conditions such as soil pH. The study of the biological cycle of the worms collected in Munyazi marsh showed that their reproduction is influenced by climatic factors. Reproduction activity was higher during the relatively rainy period. The study of the intensity of the activity of the species *Alma emini* by the method of STOCKLI (1949); that of harvesting and weighing the turricules enabled us to realize of the width and frequency of all variations which reproduce according to age groups. The breeding activity varies with age group and differing conditions. Their activity average is estimated at 115.8 tons of ground buoy per year and per hectare for an average density of 53.1 worms per m². Their high protein content 47% and energy 3929cal/gr is impressive. This study concludes that their application in agriculture would contribute to the improvement of soil fertility.

Keywords: *Alma emini*, oligochaetes, soil fertility

An Update on the Post Conflict Status and Distribution of Grauer's Gorilla (*Gorilla beringei graueri*) in Eastern Democratic Republic of Congo (DRC)

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The current conservation status of Grauer's gorilla remains largely unknown. Based on new data collected through a combination of systematic forest surveys, community based wildlife monitoring patrols and remote sensing techniques, we divide the known range of Grauer's gorilla into three major regions and identify >14 local populations and update occupancy areas throughout its range. Recent surveys by DFGFI-ICCN (DRC Wildlife Agency) and UGADEC between the Maiko National Park and the Tayna Gorilla Reserve indicates that Grauer's gorilla has a significantly larger distribution in this region than has been reported in earlier studies. Continuing studies in and adjacent to the Tayna Gorilla Reserve reveal a local occupancy range of >500 km² for this area, with a minimum abundance of 275 individuals, but more likely a local population that is between 500 -1000 gorillas. Current distribution in the Itombwe mountains appears quite similar as was observed in 1995, although it is unknown at present whether gorilla densities there have declined. These studies indicate that there are several key sites for conservation of Grauer's gorilla, and that a combination of community- and park-based initiatives involving local, governmental, and international partners is needed to ensure its survival. Supported by DFGFI, Conservation International, USAID/CARPE.

Keywords: *Gorilla beringei beringei*, post-conflict distribution, population dynamics, policy, partnership, international

Comparative Behavioral Ecology of Mountain Gorillas.

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Studies of mountain gorillas (*Gorilla beringei beringei*) in the Virunga Volcanoes and Bwindi Impenetrable National Park (BINP), Uganda illustrate that even within the same sub-species living in close proximity (approx. 30 km apart), but with distinct ecological differences, there can be differences in their behavioral ecology. The Virunga Volcanoes are characterised by higher elevation, colder climate, and marked vegetation zones stratified along an altitudinal gradient. Within these habitats, there are very few fruiting trees, but fibrous plants are abundant and provide perennially available gorilla foods. Conversely, Bwindi is at a lower elevation, has many fruiting trees that are distributed patchily in time and space, but also has a high density of terrestrial herbaceous vegetation. As a result, species composition and food availability (particularly fruit) differs greatly between the two locations. This results in large differences in diet composition between the two gorilla populations. Furthermore the Bwindi gorillas have larger home ranges and travel more per day than their counterparts in the Virunga Volcanoes. We discuss how long-term comparative studies of gorillas and their habitats are critical for understanding their nutrition, socioecology conservation, biodiversity in general.

Keywords: gorillas, ecology, behavior, home range, biodiversity

Population Density and Habitat Requirement of Grauer's Swamp Warbler (*Bradypterus graueri*) in Volcanoes National Park, Rwanda.

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Grauer's Swamp Warbler (GSW) is an endangered bird species endemic to the Albertine Rift and restricted to highland swamps of Democratic Republic of Congo, Uganda, Rwanda and Burundi. Little is known about the biology of this species. We estimated the population size using point count transects and habitat requirements using vegetation quadrats, in eight swamps of Volcanoes National Park (VNP). Monitoring was conducted during the long dry, short rain, short dry and long dry seasons. The presence of the species was confirmed in Rugezi, Kabatwa, Malalo and Ngezi swamps. In total 382 individuals were recorded and a population estimate of 166 (± 37 SE) individuals. The vegetation in swamps where the species was found to occur was dominated by *Mariscus sumatrensis*, *Cyperus denudatus*, *Schoenoplectus brachycerus*, *Juncus effuses*, *Philipia johnstoni* and *Hypericum revolutum* were also present. Whilst the heterogeneity of the vegetation was higher in swamps where GSW was not recorded, it influenced the vertical structure of the vegetation. Offspring of GSW were discovered but more details on the species breeding behavior are needed. Threats to GSW include illegal grass cutting and trampling by ungulates but VNP still crucial habitat for this species due to its protected status.

Keywords: Grauer's swamp, warbler, Volcanoes National Park, point count census, Albertine Rift, bird monitoring

Ecology and Phytogeography of the Orchids of Rwanda

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The orchid family is reputed for its unequalled beauty within the plant kingdom. In Rwanda, orchids are not as frequently studied as some of the other families, such as Poaceae, Asteraceae, Rubiaceae and Cyperaceae. However, Orchidaceae is a family which includes 221 known species in Rwanda. Until now, there has been few ecological and phytogeographical study on the diversity of Rwanda's plant species, particularly the Orchids. The objective of this study is to contribute to our knowledge. The method that was used for this study was a combination of a review of available literature and the use of GIS software ArcView 3.3. This study identified key factors which influenced orchid species distribution. The orchid species of Rwanda are mostly epiphytes. The analysis of distribution reveals their high degree of endemism and shows that they are primarily represented in the Afro-Montane regions, in the forests of high altitude (1600m to 2950m) with high moisture content, relatively low temperatures (10.9° C to 19.6° C) and a mean annual rainfall of 1744 mm. Distribution maps of each orchid species at the national and continental level have been created. This paper helps to define strategies to prioritize the in-situ and ex-situ conservation of the orchids of Rwanda.

Keywords: ecology, ex-situ, in-situ, orchids, phytogeography, Rwanda.

A Study of the Antibacterial and Antifungal Activity of Three Species of Aloe Native to Rwanda

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Traditional medicines are currently the basis for much of the primary health care delivered in tropical nations. Plant species endowed with therapeutic properties, useful against human ailments, represent one of the most powerful economic arguments in favor of maintaining the world's biological diversity. Aloe is well known for certain medicinal properties, and more than 420 species have been identified globally. There are 6 species native to Rwanda, and it is widely used for treatment of skin maladies and HIV/AIDS. In this study, we explored the antibacterial activity and fungicidal activity of three varieties of Aloe native to Rwanda, *Aloe dawii*, *Aloe volkensii* and *Aloe* sp. We compared proteins extracted from these three varieties and found significant differences in protein content and medicinal properties. We found that the Rwandan Aloe species studied possess antibacterial properties at extract concentrations varying from 10-12.5 µg/ml against the majority of Gram-positive and Gram-negative bacteria, and this efficacy is equivalent to that of antibiotics purchased at pharmacies. However, we did not identify any antifungal properties in these extracts. Our preliminary results suggest that Rwandan Aloe is an effective antibacterial plant. More detailed studies of the active properties of these species are needed in Rwanda, as well as the diversity, distribution and conservation status of this plant.

Keywords: medicinal plants, Rwandan Aloe, antibacterial and antifungal properties

Floristic Composition and Phenology of the Habitat of Golden Monkeys (*Cercopithecus mitis kandti*), Volcanoes National Park, Rwanda

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This study examines the difference in the floristic structure of the habitat of two groups (Kabatwa and Musonga) of golden monkeys in Volcanoes National Park. Forty vegetation plots, located along random transects within the home ranges of the two groups were surveyed. 82 plant species were identified within the Kabatwa group home range and 51 plant species in the Musonga group home range. These individuals were classified according to their life form (35.5% of phanerophytes), seed dispersal mechanism (28.6% of sclerochores), geographic distribution (17.2 % afro-montane species) and the leaf shape (25% of mesophylls). In addition, the phenology of 39 species in Kabatwa group home range and 32 species in Musonga group home range was studied during a 4 month period from January 2006 to May 2006. The appearance of the phenophases was correlated with rainfall. Leaf flushing peaked during the major wet season (March, April, May), whereas flowering peaked in the minor dry season (January, February). In contrast, fruiting phenologies, do not show any clear seasonal pattern. A comparison between the home ranges of the two golden monkey groups showed different flowering and fruiting patterns. The relationship between food availability of the seven primary plant species consumed by the golden monkeys and the percentage of the feeding time was evaluated.

Keywords: feeding preference, seasonality, phenology, golden monkey, vegetation.

Biodiversity under threat from climate change: Implications for tick-borne diseases in Sub-Saharan Africa

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Ticks depend on climate and vertebrate hosts for reproduction, survival and population establishment. Studies in Europe and Africa have recently reported that climate change may result in contractions, expansions or shifts in the geographical ranges of ticks and tick-borne disease. This paper discusses current and predicted future distribution of an economically important tick species, *Rhipicephalus appendiculatus* and ten vertebrate hosts. Current and future tick-host assemblage ranges are compared and the degree of tick-host assemblage change and/or shifts are analysed and provided. Predictive species model and 6 climate variables provided by a nested regional climate model DARLAM combined in a Geographic Information System medium were used. Results obtained show visual and statistical significant differences between the current and future tick-host assemblages indicating new geographic distribution of tick-borne diseases under climate change. Significant increases in tick-borne diseases were predicted in Tanzania, Rwanda, South Africa, Angola and Mozambique. The implication of these results on future tick abundance and tick-borne disease transmission were discussed using the “*dilution effect*” model. These results are particularly important in Countries like Rwanda that depend so heavily on the Livestock industry and are highly vulnerable to climate change.

Keywords: climate change, biodiversity, tick- host assemblages, tick borne diseases, *Rhipicephalus appendiculatus*, Sub-Saharan Africa, “*dilution effect*”.

Limitations of Community Forestry towards Sustainable Management of Medicinal Plants in Tanzania

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A study on traditional medicine was undertaken between 2002 and 2006, around community managed forests in Kilimanjaro, Arusha, Dodoma and Mara regions to determine capacity of community based forest management to control loss of plant resources and particularly some potential medicinal plants. Data collection involved open ended and semi-structured interviews, focus group discussions, cross sectional surveys and participant observations. Data were analyzed by SPSS and by “pair-wise ranking technique”. Continuous loss of plant resources in most forests demonstrated. Slight success of community forest management was attributed to; misconceptions in the structure and functions of local institutions to undertake coordinated collective action around common property management; exaggerated potential of indigenous management systems; less alternative revenue sources leading to resource vulnerability from forest dependency; insufficient integration of traditional values in economic development; failure to operationalize present policies, legal and regulatory basis of forest management; and inappropriate land tenure variables that constrain sense of ownership and effective enforcement. It is concluded that community forestry is a composite of biophysical, economic, and socio-cultural interdependencies requiring effective management of plant resources through modification of traditional governance. This strategy must be supplemented by urgent tenure reforms, transparent revenue sources and benefits sharing.

Keywords: community forestry, community consensus, local institutions, medicinal plants, plant resources, socio-economic variables, legal backed actor, Tanzania

Emerging Alternative Approach to Mosquito Biocontrol using Recombinant Bacteria Expressing Mosquitocidal δ -endotoxins from *Bacillus thuringiensis* subsp. *israelensis*

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Toxicity of lyophilized powder preparations of 16 combinations of four *Bacillus thuringiensis* subsp. *israelensis* (*Bti*) de Barjac genes (*cry4Aa*, *cry11Aa*, *cyt1Aa* and *p20*) products expressed by *Escherichia coli* were examined against three key mosquito vectors of disease, namely *Anopheles arabiensis* Patton, *Culex quinquefasciatus* Say and *Aedes aegypti* Linnaeus, followed by simulated studies using transgenic *Anabaena* PCC7120 expressing the same genes. A comparative analysis of response of the key mosquito species revealed a hierarchy of the toxins with synergistic interactions for at least 6 combinations against all the three mosquito species. Clones pVE4-ADRC and pVE4-ARC expressing *cry4Aa*, *cyt1Aa* and *p20* with and without *cry11Aa* respectively and pVE4-AD (expressing *cry4Aa* and *cry11Aa*) were the most toxic to all the three mosquito species tested. Our data relate stoichiometry (as determined by different promoter systems) to toxicity, even in clones with the same gene combinations. In simulated semi-field experiments, the transgenic *Anabaena* managed to protect the toxins from premature degradation and retained toxicity for up to 20 days, compared to commercial *Bti*, which lost toxicity within three days due to environmental factors. The role of the interaction of gene combinations in the transgenic bacteria and an improved delivery system for the insecticidal polypeptides, is discussed as an environmental healing process.

Key words: recombinant *E. coli* and *Anabaena* PCC7120, *Bti*, LC₅₀, semi-field simulation studies, *An. arabiensis*, *Ae. aegypti*, *C. quinquefasciatus*, δ -endotoxins, SDS-PAGE, western blot, environmental Healing

Contribution to the Study of Diet and Behavior of *Cercopithecus hamlyni* at Nyungwe National Park, Rwanda

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The owl-faced monkey, *Cercopithecus hamlyni* is an Albertine Rift endemic species which has not been well-studied to date. We studied the basic ecology of this species in the Nyungwe National Park, Rwanda over a 5 month period. We found that the owl-faced monkey eats more than 17 different plant species, insects, mushroom, and lichens. During the dry season, the terrestrial herb *Triumfetta cordifolia* and *Anisosparum humberti* were the most important plants in the diet, while bamboo shoots (*Sinarundinaria alpine*) dominated when they were available (rainy season). These monkeys devoted about 40% of their time feeding and 37% of their time moving. The opportunistic activities we observed were dominated by the “boom call” vocalization of the adult male, which is used to guide the group. The animals spent most of the time on the ground, and

frequented bamboo forest. *Cercopithecus hamlyni* is understudied and much more scientific studies are still necessary, including studies throughout the year to have a complete understanding of the diet and habitat use of this rare and endangered species.

Keywords: *Cercopithecus hamlyni*, Albertine Rift endemic, diet, behavioural ecology

Loss of Tropical Forest and Avian Extinction and Decline

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Human populations have increased dramatically over the past several decades, leading to pressure to develop or farm land and a concomitant acceleration of the rate of tropical deforestation. How native organisms respond to habitat loss and fragmentation has been the subject of intense study in temperate ecosystems and at various tropical sites in Latin America and southeastern Asia, but there has been little study of this phenomenon in Africa, a continent harboring a rich tropical avifauna. A survey of studies yields relatively consistent patterns of which types of birds are most vulnerable to local extinction in the face of shrinking habitat. In general, large-bodied species (regardless of guild), medium-sized frugivores, and small-bodied insectivores of forest interior are most prone to sharp population declines and extirpation. Whether these patterns hold true in tropical Africa requires study. Documenting the patterns in the Albertine Rift, for example, will require a two-pronged approach: (a) historical data will need to be collated in a manner that is comparable with (b) standardized and rigorous survey efforts to map current distributions and population sizes of birds. As a first step, compiling a year-to-year sighting record of species can provide a statistically sound means of determining probability of extinction or measuring population reduction. In the interim, as a first approximation, urgent conservation planning can take established patterns of forest bird vulnerability into account to begin the process of mitigating against further declines and extinctions.

Keywords: Albertine Rift, deforestation, extinction, bird distribution, forest bird vulnerability

Rwanda's Forests Importance for the Conservation of Biodiversity in the Albertine Rift.

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The Albertine Rift contains more vertebrate species than any other part of the African continent. More than half of Africa's birds can be seen here and more than 40% of Africa's mammals. In addition there are more endemic vertebrate species confined to this region than any other ecoregion in Africa. As a result the Albertine Rift has been recognized globally as an Ecoregion, Endemic bird area and part of the Eastern Afrotropical Biodiversity hotspot. Data exist from at least 40 protected areas within the Albertine Rift region on the presence of various taxa and these were used to assess the relative importance of these protected areas for biodiversity conservation. The Virunga Volcanoes region and Nyungwe Forest are particularly important within the Albertine Rift region as a whole, with Nyungwe Forest having more known endemic species

than any other site, and the Virunga volcanoes ranking high for amphibian conservation. This ranking is in part because these forests have been better surveyed than some other sites but also because of their central position within the Albertine Rift. The results highlight the need for further survey work and also the need to monitor many of the endemic species, because many sites are under threat.

Keywords: Albertine Rift, birds, mammals, amphibians, plants, conservation, biodiversity, Nyungwe Forest, endemic species, survey

A Study of Natural Tree Regeneration in the Nyungwe Forest

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Nyungwe forest is recognized globally for its biodiversity. The present research deals with tree regeneration in gaps and in the understory. We sampled tree regeneration along a trail in the Nyungwe National Park, and collected data on environmental variables that may influence regeneration, including slope, aspect, altitude, herbaceous cover, dominant shrubs, and leaf litter density. Results revealed 19 plant species in the 12 gaps we inventoried along the trail, and 28 species in 117 plots in the understory. Certain plant species appear to regenerate well in gaps, sometimes better than in the understory. We found a diversity of 21 different plant species in the gaps, compared to 26 species in the understory, and a floristic diversity 19 times greater in the gaps than in the understory. Plant distribution was affected by environmental factors.

Keywords: tree regeneration, diversity, environment understory, floristic

Paternity and Relative Reproductive Success in Multimale Mountain Gorilla Groups: Using Genetic Analysis to Elucidate Reproductive Success of Male Mountain Gorillas

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One striking difference between gorilla populations is that while western gorilla groups almost always contain only one silverback male, a large proportion of mountain gorilla groups contain more than one silverback. Genetic analyses of multiple western gorilla groups suggest that the single resident male sires the offspring in his group. Elucidating the distribution of paternity in multimale groups is important for understanding the benefits and costs to males of residing together. In an ongoing study of paternity determination focusing on gorillas studied at the Karisoke Research Center, Rwanda, a total of 98 individuals were genotyped using DNA from noninvasively collected fecal samples. Results from 48 offspring born in four social groups between 1985 – 1999 revealed that subordinate males sired approximately 15% of the offspring. In combination with life history data, these results show that there is high variance in male reproductive success and that males that queue for dominance status in multimale groups gain substantial reproductive benefits. Ongoing analysis will determine paternity of approximately 35

offspring born between 1999 and 2005. These results help us understand the genetic diversity within and between social groups and can be compared to other gorilla populations across Africa.

Keywords: dominance DNA, offspring, reproductive success, paternity, genetic diversity

A Comparison of the Nutrition of Mountain Gorillas in Two Habitats: Implications for the Conservation of Biodiversity

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Maintaining high levels of biodiversity within animal habitats is important in ensuring adequate nutrition of endangered wildlife. Mountain gorillas (*Gorilla beringei beringei*) live in two geographically separated populations, Bwindi Impenetrable National Park, Uganda and in three national parks spanning the Virunga mountain region in Rwanda, Democratic Republic of Congo, and Uganda. The altitude, climate and plant composition of these habitats differ. Our goal was to compare the diets of mountain gorillas to determine if differences in dietary composition affected concentrations of nutrients in the diet. At both sites gorilla diets consisted of primarily herbaceous leaves, but the diet of Bwindi gorillas contained more tree leaves, fruit, pith and decaying wood, and fewer stems than those of the Virunga gorillas. Despite differences in habitat and dietary composition, the nutrient concentrations of both gorilla diets were remarkably similar. The diets and staple foods of Bwindi and Virunga gorillas contained similar concentrations of protein, fibre and non-structural carbohydrates. Small amounts of a diversity of plants were eaten daily, often contributing minerals that were deficient in common foods. Our results demonstrated that nutritional needs are by a mixture of foods, and that dietary diversity is important for gorilla nutrition and health.

Keywords: nutrition, health, diet, mountain gorillas

Assessing Wetland Functions and Values in the Kigali City Area under Land Pressure and Climate Change

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Wetlands of Rwanda provide critical water source, water quality, hydrological and biodiversity habitat functions and values for the countries population. Rwanda is one of the most densely populated in the world. The country is predominantly characterized by steep rugged terrain. Land pressure and poverty conditions especially in the country's capital city area Kigali, have lead to dense settlements and intensive cultivation often with inappropriate or inadequate soil conservation measures. The Kigali city area also suffers from grossly inadequate sanitation infrastructure. The city and surrounding dense settlements rely on wetlands for stormwater

buffering, flood attenuation and downstream sedimentation. The sponge properties of the wetlands are able to slow down, absorb large stormwater, filtering out silt, industrial metals, excess organic and agricultural nutrients, pesticides and pathogens through natural oxidation and microbial activity. A slow and steady source of relatively cleaner water is thus assured. Moreover, the wetlands of the Kigali city area have shown a significant richness of biodiversity, especially in flora and avifauna. This paper discusses results of a study for the identification, function categorization and mapping of wetlands in the Kigali city area in the context of land pressure and changing climatic conditions. Although wetlands in Rwanda are protected by law against unsustainable use, the study reveals that the current critical functions and values remain under threat from industries and other structures the majority of which were installed before the legislation was instituted and from agricultural land use pressure. Moreover, erratically changing climatic conditions that have been associated with flooding and drought are anticipated to increase the threat. This paper hopes to augment the awareness efforts fostered by various agencies to sensitize all stakeholders to cooperate in land use management that conserves the critical wetland functions and values.

Key words: Kigali, Rwanda, wetlands, climate change, Assessing Wetland Functions and Values in the Kigali City Area under Land Pressure and Climate Change

Mountain Forest Dynamics in Rwanda, Effects on Bird Diversity

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Temporal and spatial patterns of mountain forest dynamics over the last century were determined by analysis of historical maps, aerial photographs and satellite imagery using GIS-based techniques. A total of 1018km² of forest area was lost between 1934 and 1998, representing a loss of 49.23%. The forest loss was mainly through felling for human resettlements and farming activities to accommodate the needs of a rapidly growing population as well as the country's economic development. The highest rate of forest loss (22.4 km² per year) occurred between 1993 and 1998, a period that was characterized by political instability, war and genocide. The lowest altitudinal levels were the most severely impacted (64.4% of forest lost between 1600 and 1800m). 12 forest bird species need particular conservation attention due to their restricted global range and their susceptibility to forest loss. Species were also ranked in broader conservation framework based on the estimated proportion of their total population found within Rwanda. The impacts of unimpeded forest loss on the environmental health and economic viability are discussed in the context of sustainable conservation strategy.

Keywords: bird diversity, deforestation, environment, conservation, economics, cartography, GIS

Gastrointestinal Bacterial Exchange Among People, Domestic Animals and Mountain Gorillas in Bwindi Impenetrable National Park, Uganda

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Infectious diseases pose a significant and growing threat to the health, well-being and long term viability of wild primate populations. This study was carried out in Bwindi Impenetrable National Park, Uganda. *Escherichia coli* was used as a model microbial system for studying disease transmission. Fecal samples were collected from gorillas, gorilla guides, field assistants employed in gorilla research and people from the local community and their domestic animals. *E. coli* bacteria were isolated from fecal samples, and Rep-PCR was used to generate unique fingerprints for bacterial isolates, from which epidemiological relationships were inferred. People, domestic animals, and gorillas tended to share similar *E. coli* genotypes with individuals from the same group or location. People working with gorillas tended to harbor *E. coli* bacteria genetically more similar to the bacteria of the gorillas with which they work than to the bacteria of gorillas with which they don't work. There was higher prevalence of antibiotic resistance in humans than in domestic animals and gorillas. Overall, these results suggest that spatial and behavioral overlap between people, domestic animals, and gorillas can lead to the exchange of gastrointestinal bacteria. Strategies to limit such exchange would benefit both gorilla conservation and human and animal health.

Keywords: gastro-intestinal bacteria, gorillas, domestic animals, humans, rep-PCR cross-species transmission

Ecotourism as a Potential Conservation Incentive for Local Communities Around Rwanda's Parc National des Volcans.

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Early approaches to wildlife management in Rwanda were based on protectionist policies that excluded local communities from wildlife resources after the creation of PNV, home to remaining populations of wild mountain gorillas (*Gorilla beringei beringei*), emphasizing on strict policing methods and ignored the interests of the local communities, and as a result, human-wildlife conflict intensified leading to successive encroachment and reduction of PNV from 340 km² to 160km², while illegal activities are still ongoing. This led ORTPN to establish a community conservation department within the national wildlife authority, to ensure the active and effective involvement of local communities neighboring protected areas in conservation activities and the implementation of concerted system whereby the tourism generated incomes are shared. This research therefore focused on the potential of gorilla-based tourism to act as an incentive towards conservation of PNV. The research findings established that there is little active involvement of local communities in PNV; lack of empowerment to participate in decision making especially of community conservation outreach and tourism revenue sharing projects; higher losses resulting from wildlife crop raiding as compared to benefits derived from tourism, and that tourism has not changed local community's negative attitude and behavior towards conservation of PNV.

Keywords: eco-tourism, revenue sharing, change of attitudes and behavior, wildlife cost and benefits, Rwanda.

Insects Working for Conservation: a Case Study from Arabuko-Sokoke Forest, Kenya

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Insect-based enterprises are highly suitable as alternative income-generating activities for local communities living in or adjacent to buffer zones around Protected Areas. They give quick returns, are generally ecologically sustainable, require relatively low investment, are usually relatively low tech, are normally based on the biodiversity resource itself, and are often highly synergistic. Bee-keeping is the most familiar (usually restricted to honey bees) but there are other options. In this paper, honey bee-keeping and other insect enterprises are described from a case study at Arabuko-Sokoke Forest on the Kenya coast. The other enterprises involve wild stingless bees, butterflies, beetles and wild silkmths. Taken together these insects have generated almost a million dollars in revenues for Arabuko-Sokoke and its communities over the last 14 years. Synergies include pollination services, awareness creation and significant impacts on community attitudes towards forest conservation.

Keywords: insect-based enterprises, community attitudes, income generation, biodiversity, conservation

A Novel Method for Identification of Mosquitoes of the *Culex pipiens* Complex (Diptera: Culicidae): Important Vectors of Endemic and Emerging Diseases

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Mosquitoes belonging to the *Culex pipiens* complex are synanthropic bloodsucking pests that act as vectors of endemic and emerging diseases worldwide. The proximity to humans and livestock makes of these disease vectors a major threat to public health and the world economy. For example, human lymphatic filariasis, transmitted by *Culex quinquefasciatus* has infected more than 140 millions people in the tropics, and is reported as a major cause of disability in the Third World. *Culex pipiens* mosquitoes are also the vectors of emerging arboviruses such as West Nile virus and Rift Valley Fever that recently experienced significant expansion from their original natural transmission foci. Unfortunately, the biology of these mosquitoes remains little understood and their taxonomic status has not been fully resolved due to their ecological and behavioral plasticity. Here, we report the first real-time polymerase chain reaction assay that allows a reliable identification of members of the *Culex pipiens* complex. This essay will contribute to our understanding of the biology of the group as well as provide an ecological focus for vector abatement and host risk assessment. We discuss the implications of this finding for the improvement of global health and the conservation of the environment.

Keywords: taxonomy, mosquitoes, *Culex pipiens*, *Culex quinquefasciatus*, vector abatement, host risk assessment.

Local Stakeholder's Strategies in Sustaining Wetland Resources in Dryland Ecosystems: Lessons from Semiarid Ecosystems of Central Tanzania.

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This paper presents lessons learnt from the dryland areas of central Tanzania on the need to understand and integrate local stakeholder's strategies in the sustainable management of natural resources in the critical ecosystems. It is based on the experience from a research that assessed status of wetland resources existing in dryland ecosystems of Mpwapwa district central Tanzania. Local community as grassroots stakeholders, are aware of devastating effects their livelihood activities have caused on the wetland resources. As a result, they have proposed their own strategies discussed in this paper to ensure the health of the wetland resources is improved. As a basis to sustain these wetland resources in such a critical ecosystem, the proposed strategies should be communicated to the policy makers to ensure policy integration for sustainable management of these resources hence improved communities' livelihoods. The fundamental supposition in this paper is therefore that, negotiating proper utilization and management of natural resources such as wetland with different stakeholders through dialogues, is one of the best ways not only for conscientizing the stakeholders but also democratically engaging them to come up with useful integrated solutions that will have far reaching impacts towards sustaining wetland resources in such critical ecosystems.

Keywords: wetlands, critical ecosystem, sustainable management, dialogues, Central Tanzania.

Larval Control Of Anophles Mosquitoes In Eritrean Semi-Arid Ecosystems

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An. arabiensis production in the ephemeral natural aquatic habitats such the streambed pools was high throughout the year and negatively associated with rainfall ($r = -0.288$, $p = 0.047$). High densities of *An. arabiensis* larvae were also recorded from canals and drainage channels at wells and communal water supply points. There was a strong association between larval production and adult emergent densities ($r = 0.365$, $p = 0.011$). The results of this study further show that implementation of larval control strategies in the study villages significantly reduced vector productivity as measured by both larval ($F = 24.919$, $df = 1, 178$, $P < 0.001$) and adult *Anopheles arabiensis* densities ($F = 3.052$, $df = 1, 119$, $P =$

0.014) in the treated sites over the 24-month study period. The results of this semi-arid larval management model suggests that, 1) larval management backed by habitat identification, mapping and surveillance is a feasible tactic for managing malaria vectors, 2) a special focus in such semi arid ecosystems should be targeted to the highly productive larval habitats along stream beds and others of periodic importance derived from human activities, and 3) public information and sensitization of communities to participate in controlling the pre-adult stages of anopheline mosquitoes is central for success.

Keywords: *An. Arabiensis*, aquatic habitat, larval population, control strategies, arid ecosystems, community participation, Eritrea.

Variation in Feeding Behavior among Two Split Ring-tailed Lemur Troops Relative to Introduced, Exotic Plant Species at Berenty Reserve, Madagascar

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The ring-tailed lemur (*Lemur catta*) is an endemic species in the southwest of Madagascar. Berenty Reserve is a small private reserve that is fragmented by sisal plantations. The habitat of this lemur, gallery forest, contains some exotic plant species that were introduced here about 30 years ago. The feeding behavior among two troops of ring-tailed lemurs which split about 14 years ago was investigated. One troop is situated in natural plant habitat area and another troop lives in an open area designated for tourism and containing many of the introduced plant species. This paper will explore the influence of these invasive plant species on the ring-tailed lemur's ecology and feeding behavior and relate the findings to the ecology in Rwanda.

Keywords: ring-tailed lemur, splitting, ecology, feeding behavior, Madagascar

The Role of Zoos in Biodiversity Conservation

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Like other fields of science, wildlife conservation is a changing field. Threats facing wild populations of apes and other species two decades ago are often not the same ones most pressing today, and, even where threats have remained unchanged, more effective means of addressing them may be available now. Conservation scientists have learned from many years of experience, and both theoretical and technological advances today provide conservation tools not available in the past. In particular, zoological gardens and societies have come to play an ever more active role in wildlife conservation, although there is still much room for increased involvement. This talk will illustrate the ways North American zoos currently contribute to *in situ* conservation (with a specific focus on *in situ* conservation of great apes) and suggest models for increasing collaborations between these institutions and habitat countries. Specific examples of zoo-field partnerships will be presented, and the benefits and limitations of zoo-supported programs will be discussed.

Keywords: zoos, biodiversity, conservation, habitats, partnerships, solutions

Seasonal Variation of Leaf Litter Fauna around the Grey-necked Picathartes Site in the Yaoundé Massif Forest

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Almost all soil/leaf-litter fauna and understory insects are critically important to the effective functioning of ecosystems on which other components of biodiversity, including humans depend. They also form a major part of food chains. Most conservation research programs and initiatives are targeted toward charismatic mega fauna such as mammals and birds, excluding or marginalizing soil/leaf-litter fauna and understory insects which are non negligible important components of ecosystems functioning. This research seeks to employ several complementary sampling techniques to investigate the availability of food supply for the globally threatened Grey-neck Picathartes (classified as Vulnerable according to the IUCN red list). Techniques would involve the use of pitfall traps, malaise traps, census walk and quadrat sampling. 4 months of field expeditions would be carried out corresponding to the four field seasons of the Yaoundé climate. The result would enable us to establish a species list of soil/leaf-litter fauna and understory insects compatible with the goals of comparing species richness between breeding, potential breeding and random sites of Grey-necked Picathartes. It also investigates seasonal variations and correlations with the breeding period of the bird.

Keywords: soil/leaf-litter fauna, Grey-neck Picathartes, food supply, Yaoundé, understory insects, breeding patterns

Enhancing Participatory Protected Area Management Effectiveness in the Albertine Rift: the case of Rwanda.

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The Albertine Rift is one of Africa's most important sites for the conservation of biodiversity. It holds 39%, 52% and 14% of all the mammals, birds and plant species that occur on the African continent. Of these, 35 mammal species, 25 birds and 40 plant species are considered to be highly threatened by extinction. Over 42 Protected Areas have been identified in the Albertine Rift as the main strategy for the conservation of this rich heritage. Most protected Areas in Rwanda are in areas of high human population density and good agricultural potential. Consequently, there is huge enticement for local people to encroach on these areas in order to enhance their livelihoods. Local communities surrounding some of these Protected Areas are not motivated to participate in reducing threats, because they do not receive tangible benefits from the biodiversity. In such situations, conservation goals are very difficult to achieve, and particularly in 'small sites', which do not generate much revenue from tourism and are hence often overlooked in terms of allocation of the limited resources for conservation. Over the past seven years, BirdLife has been applying a partnership approach between state agencies and local communities to improve conservation of key sites. In the process, BirdLife has acquired knowledge and experience in motivating and empowering local communities to participate in the management of natural

resources at key sites for biodiversity conservation (Important Bird Areas), particularly, those that are not protected.

Keywords: Albertine Rift, birds, monitoring, local communities, biodiversity conservation

Valorization of Aromatic Plants of Rwanda

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The flora of Rwanda includes a diverse range of plants among which are those that can be used for the production of essential oils. Elsewhere in the world these plants are used to generate incomes. Through this study, we wish to increase public interest of these medicinal plants. For that, we collected plants from which we extracted essential oils which were then analyzed by Gas Chromatography and Mass Spectrometry for the determination of the chemical composition. The tests of antimicrobial activity were then carried out on different micro-organisms in order to confirm the medicinal virtues. Besides these analytical methods, we made a literature review for economic values of essential oils. The results obtained showed that many plants have activity on various used micro-organisms, and this confirms some uses of those plants in traditional medicine. Some abundant autochtones or adapted plants produce required essential oils. As an example, we can mention *Lantana camara* of which one litter of essential oil is sold between 300 and 333 Euros, *Pelargonium graveolens* whose 15ml are sold between 90 and 150 US \$ and *Aloysia citriodora* that brings one million of Euros/year for Morocco.

Keywords: Rwanda, aromatic plants, essential oils, chemical composition, antibacterial activity.

The Diversity of Plants Used to Treat Snake Bites in Rwanda

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Until now there is has been no detailed study of medicinal plant usage for the treatment of snake bites. Thus, the purpose of this study is to contribute to the improvement of knowledge on the virtues of the plants used against the bites of snakes. To arrive at the results, we interviewed various tradipraticians and to supplement the results obtained, we carried out a library search relating to the subject. The results obtained showed that in one formulation several plants were used, resulting from various families of which the most represented was Asteraceae, Fabaceae and Mimosaceae. Among the plants used against the most poisonous snakes are: Elapidae, *Girardinia condensata*, *Fagara chalybea*, *Phytolacca will dodecandra*, *Indigofera arrecta*, *Acalypha villicaulis*, *Thunbergia alata*, *Chenopodium opulifolium* and, for Vipéridés, *Chenopodium opulifolium*, *Lantana Camara*, *Indigofera arrecta*, *Acalypha villicaulis*. Considering the notable importance of these plants species in the fight against the bites of snakes, this work makes it possible to distinguish the priorities of the conservation of these species.

Keywords: biological activities, snake bites, diversity of the plants, Rwanda.

Feeding Ecology of Golden Monkey (*Cercopithecus mitis kandti*) in the Volcanoes National Park, Rwanda.

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The Albertine Rift is the only confirmed location for this endangered subspecies of *Cercopithecus mitis* (IUCN Red List). The study was conducted on feeding ecology of two golden monkey groups (K and M) in the Volcanoes National Park. The influence of seasonality on diet and feeding behavior was determined. Opportunistic and scan sampling methods were employed to collect data during a twenty-one month period in 2004-2005. Groups studied are estimated between 54-74 individuals that live in small home ranges of 0.74 km² and 0.60 km² respectively in group M and K. Golden monkeys are folivorous; they were observed to eat 56 different plant species, belonging to 30 families and 40 genera. Bamboo was the predominant vegetation and the golden monkey's key food species (74.91%), with a feeding reliance on seven top food plants species, which counted for 85% of total feeding records. Six plant parts that were observed to be eaten by the golden monkey, were flowers, fruits, leaves, bamboo shoots, stems and tubers. Leaves made up of the bulk of the diet (67.03%) followed by seasonal consumption of bamboo shoots (28.08%). Golden monkeys spend approximately 53.76% of the time feeding. The phenology findings demonstrate habitats exhibited different flowering and fruiting patterns and the leaf flushing peaked seasonally.

Keywords: *Cercopithecus mitis kandti*, diet, Albertine Rift, feeding ecology, Volcanoes National Park, bamboo

Golden Monkeys Decline in Mgahinga Gorilla National Park Despite Increased Protection

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We sought to establish the current population status and distribution of the golden monkey (*Cercopithecus mitis kandti*) in Mgahinga Gorilla national Park. Comparing census results from this study and past studies we detected a gradual decline of golden monkeys over a 14-year period. Given the decline of an endangered subspecies in an increasingly protected area, this study underscores the value of long-term monitoring, which can detect conservation problems for timely action. We found bamboo to be the primary source of proteins and may play a role in reproduction within golden monkey populations. We speculate on factors causing the observed decline to be related to the fact that the monkey inhabits an environment in which it is stressed and therefore there may be low recruitment through births. We argue that reliance on a very narrow dietary range, may lead to nutritional stress, but it is possible that there are other factors at play and are yet to be established. We recommend for a restoration program in the previously degraded part of the park to increase suitable habitat by 75%.

Keywords: golden monkey, bamboo, recruitment, restoration, human activity, population decline

Food and Bioproducts: Vehicles of Sustainability in Africa

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There is currently a good opportunity and global responsibility to assist Africa in harnessing its vast bio-resources to build healthy, prosperous, diversified and sustainable economies. Although agriculture is the leading economic activity on the continent, there has not been an effective and sustainable diversification to enable the sector to shift from subsistence to competitive industrial growth. Resource management for food and bioproducts production is key to biodiversity preservation as well as sustainable livelihood for the continent. Food security is a critical millennium development goal in Africa. Bioenergy and bioproducts are vital in ensuring energy security and sustainability in environmentally responsive ways. Germplasm conservation and breeding programs to meet sustainable agricultural practices, processing of biomass into value added products as well as proper post-harvest management can work together to achieve these goals. Capacity building, dialogue with policy makers and innovation can pave the way towards commercial bioproducts and increased revenue from food production while invigorating rural economies. Understanding of capacity building needs, gaps and priorities and how these can be addressed in a sustainable way will be important steps in building strong bio-based economies while promoting biodiversity management.

Keywords: bioprocessing, economic development, food security, capacity building, biodiversity

Tree Species Composition for Biodiversity Conservation in Gishwati, Rwanda

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Supervised classification and expert knowledge of the study area was used to classify Landsat-TM 1986 image and ASTER 2006 image. The classified images were later used to detect changes in land cover in 1986 and 2006. The natural forest cover was reduced from 60% to 8% between 1986 and 2006 due to forest clearing for pasture land, pine plantation, cropland and settlement. The differences in mean tree densities, tree height, tree canopy density and tree diversity are highly significant in land use types. Analysis of data collected from the 125 sample plots in the study area, revealed that 4359 individuals trees were in existence: 56 species, 53 genera and 34 families. DCA analysis of 49 native species extracted from the total number of species identified revealed that the variation between species explained by the first axis was 12%. The research reveals that while some indigenous species are abundant others are rare or disappeared completely in the study area. CCA result showed that dominant species has unimodal response to environmental factors in Generalized Additive Models (GAM) analysis. It is concluded that anthropogenic disturbances have an impact on forest structure and diversity and these disturbances were predominant in high elevation.

Keywords: land use change, biodiversity, conservation, Gishwati

Algae and human health: important antibacterial and antifungal properties of *Spirulina platensis*, an algal species found in Congo

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The blue-green microalga (cyanobacteria) *Spirulina* is found naturally in saline lakes in tropical regions, and has been found to be effective in boosting the immune system and is rich in proteins (60-70% dry weight). *Spirulina platensis* is found in regions of east Africa and the Congo Basin in rivers of appropriate conditions for algal growth. We studied a sample of *Spirulina platensis* originally obtained in the wild from a river in Congo, and cultivated in Goma, DRC. We studied the antibacterial and antifungal activity of this algal species. We found high concentrations of total proteins from all fractions sampled. The protein extract of this alga was effective in inhibiting *Shigella flexneri*, *Salmonella typhi*, and *Salmonella B*, *E. coli*, and *Candida albicans*. The hydroethanolic extract was also effective in inhibiting *E. coli*, *Salmollea typhi*, *Salmonella B*, and *Shigella flexneri*, although not *Staphilococci*. This algal species is an important resource for fighting bacterial infections in humans, as well as a potentially important source of nutrition for humans, highlighting the importance of biodiversity to human health. The culture of *Spirulina* represents a potentially important economic and public health resource for Rwanda and the region.

Keywords: Algae, human health, *Spirulina spp.*, anti-bacterial, anti-fungal

Application of GIS as a Tool for Determination of Ecological Preferences and Prediction of the Distribution of Wild Noctuid Stem Borer Genera in Africa.

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Lepidopteran stemborers are the major biotic constraints to cereal production in sub-Saharan Africa. Among them, the most destructive pests belong to the family of Noctuidae, For along time have been considered to be polyphagous. However, recent studies indicate that that the borer

species diversity in this family is much richer than reported with many species and crop pests being new to science. We report data from a study carried in 600 localities across 15 African countries between 2003 and 2007 to evaluate stem borer species diversity. Special emphasis was given to the ecological conditions (climate and vegetation structure) suitable to genera such as *Acrapex*, *Busseola*, *Carelis*, *Manga*, *Poenomona*, *Sciomesa*, *Sesamia*, *Speia*. Using a canonical discriminant analysis, it was shown that temperature was the most important climatic parameter in describing the distribution of different genera. Analysis of the vegetation mosaics showed that forest transitions mosaics had the highest diversity. Hence, the distribution of these genera in Africa was predicted based on the average climatic data, using GIS and the Maximum Entropy model (MAXENT). This model showed that the areas of high biodiversity were in mid altitude areas of East Africa.

Key Words: GIS, biodiversity, ecology, Stem-Borer Spp, distribution, prediction, Africa

The Science and Management of Water as a Means for Integrating Ecologic, Economic and Human Health Priorities: Possible Strategies for Rwanda

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The integrity of freshwater ecosystems in the Great Lakes region of Africa is rapidly declining. In Rwanda, water related issues, with burgeoning human population pressures, threaten the economic, social, and environmental security of society. The purposes of this presentation are to (1) examine unique and common water issues in Rwanda from regional and global perspectives; (2) describe the expanding focus by scientists on complex environmental systems as a framework for generating useful and reliable knowledge pertaining to water issues; and (3) outline and describe the elements needed for sustainable integrated water resource management in the region. The future well-being of Rwanda can be greatly enhanced by the effective deployment of science, technology and policy pertaining to water. Further, water is a particularly useful theme for integrating natural resource management needs in many countries, including Rwanda, with priority economic and human health issues. Experience gained in the Great Lakes region in the Midwestern United States supports this perspective, and lessons learned from the United States will be discussed relative to possible strategic scenarios applicable to Rwanda. Implications for the health and management of forest, river, lake, and wetland ecosystems will also be discussed.

Keywords: water, ecosystem health, economics, natural resources management

Putting People in the Conservation Equation: Rwanda in a Global Context

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Thirty years ago, the dominant model in conservation saw parks as fortresses and people as the enemy. Conservation science had no human component. Today, a new paradigm calls for the integration of parks and people and the reconciliation of wildlife and human interests. Conservation science strives to be multidisciplinary. Yet despite much progress and considerable

advocacy for human needs, there is still far too little applied social science research being conducted in the cause of conservation. This paper assesses the current state of applied social science in conservation planning, implementation and evaluation, with a focus on Rwanda within an international context. Rwanda was one of the first sites in the world where socioeconomic data were used to design its pioneering gorilla conservation and ecotourism programs. Periodic studies continue to monitor the state of local human relationships with its parks. Yet Rwanda also continues to attract attention as a country where some believe that “conservation shouldn’t be able to succeed” because of its many daunting challenges, from post-genocide recovery and reconciliation to poverty and HIV/AIDS. Conservation is in fact succeeding very well in Rwanda. As conservation scientists work to understand and monitor Rwanda’s charismatic wildlife, however, greater effort is still needed to address a set of critical issues of equal importance. Rwanda is especially well-positioned for studies of the relationship between rural poverty and conservation, the role of ecotourism in rural development, decentralized buffer zone management practices, ecosystem valuation, and long-term monitoring of socioeconomic conditions in communities bordering protected areas. The results of such work would benefit not only decision-makers and managers in Rwanda, but also those working in the conservation and sustainable development communities around the world.

Keywords: social sciences, conservation, planning, ecotourism, disease, genocide, rural Poverty, Rwanda

The Ecology of Black and White Angolan Colobus (*Colobus angolensis ruwenzorii*) Isolated in Montane Forest

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Over a 4 month period, we used scan sampling to collect data on activity budgets, and transects and plots to measure abundance of food plant species. Food plant species richness and activity budgets of colobus monkeys from intact forest (Nyungwe National Park) with those in the fragment were studied. The diet of the colobus in the fragment included only 26 plant species whereas that of the intact forest included more than 59 plant species. These results are consistent with the idea that small fragments offer lower plant species diversity. Occasionally the group crossed the surrounding tea plantation to the neighboring *Eucalyptus* sp. stand to feed on bark and fruit of *Eucalyptus* and other species not found in the fragment. The fragment group spent 32% of their time resting, while moving and feeding accounted for 62% of the activity budget. In contrast, colobus in intact forest spent 54% of the time resting, and 39% moving and feeding. This fragment could become an important tourism destination due to ease of access and primate viewing. Our study highlights the importance of creating a corridor that would link the fragment to the intact forest avoiding future carrying capacity crisis.

Keywords: white angolan colobus, activity budgets, transects, abundance, fragmentation, diversity, corridor, carrying-capacity crisis

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