



THE SCHOOL FOR FIELD STUDIES
CENTER FOR WILDLIFE MANAGEMENT STUDIES
KILIMANJARO BUSH CAMP,
KIMANA, KENYA



EE 491 – DIRECTED RESEARCH
CWMS SYLLABUS, FALL 2007

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1. COURSE OVERVIEW

Directed research is based on a five year plan negotiated between the stakeholders and SFS. It is a critical tool used by SFS to train students on research and field methods, as well as achieve SFS research agenda in the Amboseli Ecosystem. The topics range from wildlife dispersal and management, community involvement in conservation and their relationships with natural resources, wildlife management practice and challenges in protected areas (Chyulu Hills National Park, Amboseli National Park and Tsavo West National Park), resource use conservation (wildlife, water and plant resources), range condition and habitat quality studies, socio – economic imperatives and how this affect conservation progress, threats to biodiversity and protected areas, ecology of a few keystone wildlife species, impacts of wildlife on critical resources for humans and associated human – wildlife conflicts, wildlife – habitat relationships and status of biodiversity.

2. LEARNING OBJECTIVES

The students get engaged in the research as a way of contributing information or contributing to a solution. In the process, they apply principles and techniques they have learned in class to addressing a real life challenge. They will be expected to follow closely supervision by faculty and learn how to plan, execute and collect data in teams. They will also be trained in aspects of data analysis using statistical packages and spatial tools such Geographic Information Systems in such away that meets research objectives and generates information critical for management of Amboseli Ecosystem. Another important skill expected is writing a scientific paper in standard accepted format. Data collection will involve biological measurements to PRA tools such as discussions and interviews with local communities. Animal and plant identification will be valuable tools, as well as appreciation and respect for local cultures in the process of research. This process provides the students with very unique opportunity that introduces them to the scientific research and its use to providing knowledge.

3. CASE STUDIES

Kuku, Mbirikani and to a lesser extent Kimana group ranches comprise extensive areas of land, which are legally registered with title deeds and owned by a known number of individuals mostly from the Maasai community. The area is characterized by a diversity of landscapes and habitats used by wildlife species from Amboseli and Chyulu hills/Tsavo West National parks, and it forms the corridor and dispersal zone between the protected areas. Apart from several permanent rivers fed by springs from Mt. Kilimanjaro and associated swamps, most of this region is largely arid or semi-arid with mean annual rainfall in the range of 300-500 mm. The area has been used traditionally by the Maasai pastoral community to graze their livestock on a communal basis. Because of the arid/semi-arid climate, the Chyulu Hills that mark the eastern boundary of the Kuku and Mbirikani group ranches provide an important dry season grazing area for domestic animals and wildlife species supplemented by swamps.

In recent years, there has been a steady shift in land use from purely pastoral to mixed agro-pastoral systems in the greater within group ranches in southern Kajiado district driven by a variety of socio-economic, cultural and geopolitical factors. There is demand for socio-economic development by the local communities on one hand, and conservation (especially of wildlife resources) on the other. Land use changes taking place in dispersal areas compromise their integrity and quality as habitats for a wide variety of wildlife species, generally posing a serious challenge to conservation of biodiversity in this region. Such hindrances are turning tiny protected areas like Amboseli National Park into ecological islands that cannot sustain natural ecological processes and maintain the high density and diversity of wildlife species using it for dry season grazing.

Since inception in 1968, group ranches have not realized the intended goals, and as a result the Kenya Government has encouraged an active policy towards group ranch subdivision. This notwithstanding the fact most of the group ranches in the country are on arid and semi-arid lands where the greater percentage of the country's livestock and wildlife species are found. Hence, subdivision of group ranches in this region will not only pose a greater threat to conservation of wildlife and other natural resources in the Amboseli-Tsavo region but also undermine pastoralism as a land use system. Partly because of diversity of community interests and socio-political forces, and partly as result of national and regional influences, most group members seem to think that privatization of land ownership guarantees them security of tenure and greater individual benefits from the land. The situation has been exacerbated by the fact that people incur considerable losses due to crop damage and domestic animals killed by wildlife and the current system of non-compensation.

In 1997, the KWS with funding from the European Union put up approximately 61 km-perimeter electric fence enclosing small-scale cultivators in two sites within Kimana group ranch and adjacent private farms as a contribution towards resolving the problem of human-wildlife conflicts in the area. Preliminary indications suggest that there is a new dynamic introduced by the fence in terms of shifting the conflicts to other areas. Within the same corridor, critical wetlands such as Kimana swamp (next to Kimana Wildlife Sanctuary) are also under considerable stress brought about by increase in cultivation. The net effect of these land use activities and possible group ranch subdivision is further fragmentation and could lead to eventual elimination of the wildlife corridor/dispersal zone. Preliminary work conducted by the School for Field Studies since 1999 shows that depressed economic livelihoods (decline in pastoralism among the Maasai) is the single most significant variable driving land use changes, especially the shift to cultivation. To address the

land use issues and promote sustainable use of natural resources, and incorporate wildlife as *a land use alternative*, integrated land use plans must be elaborated. The initial stage is to conduct research to obtain baseline information and gain a better understanding of the area using a holistic, system approach. Using the provisions of the Physical Planning Act (1996) and Environmental Management and Co-ordination Act (1999), and research data, land use zoning can be achieved through a participatory community based process.

The fall 2007 will continue to pursue the current **five-year research plan (2003-2007)**. Under the plan, carefully designed and sequenced research projects are implemented in a systematic fashion examining critical conservation issues within Amboseli-Chyulu hills /Tsavo West National parks system (with emphasis on group ranches in between). These projects focus on baseline assessments, critical analysis and investigation and monitoring aspects of land use changes and associated human-wildlife conflicts, wildlife-habitat requirements, and status of the dispersal area of the ecosystem between Amboseli Park and Tsavo / Chyulu Parks. Ecological aspects of relevance and protected area/human-interactions will be analyzed. The research plan will also address plant resources utilization and associated environmental impacts, resource (water) use competitions; ecotourism and wildlife based benefit systems will be examined; and the rate and factors causing contraction of the Tsavo – Amboseli wildlife dispersal area. Community perspectives on resource use and management, and evolving tenure arrangements (options after group ranch subdivision) will be investigated. Finally, definition of sustainable resource management criteria and indicators for the region will be attempted. Overall, the primary goal of the Center’s research in the **next five years** will be to provide information to guide sustainable natural resource management generally, and promote wildlife conservation specifically. This case study will be the basis upon which all the research projects are anchored. The strategic location of the Kilimanjaro Bush Camp (a campus of SFS-Kenya) allows various aspect of the system to be investigated in terms of cumulative research work both in three-months semester and one- month summer sessions; and collaborative research with other partners.

4. ASSESSMENT

Assessment Item	Due date	Value (%)
Statistics exercise		5
DR proposal		5
DR Draft Written paper		23.5
DR Final Written paper		61.5
DR In-house Presentation		-
DR Community Presentation		5
TOTAL		100

5. GRADING SCHEME

A 92.50 - 100%	B +87.50 - 89.99%	C+ 77.50 - 79.99%	D 60.00 - 69.99%
A- 90.00 - 92.49%	B 82.50 - 87.49%	C 72.50 - 77.49%	F <60.00%
	B- 80.00 - 82.49%	C- 70.00 - 72.49%	

6. GENERAL REMINDERS

Readings and handouts: - Assigned readings and hand outs (exercises / assignments) will be available prior to the scheduled activities. Course readings must be read and clarification on issues sought where necessary since ideas and concepts contained in them will be expected to be used and cited appropriately in assigned course essays and research papers.

Plagiarism – using the ideas or material of others without giving due credit – is cheating and will not be tolerated. A grade of zero will be assigned for anyone caught cheating or aiding another person to cheat either actively or passively (e.g. allowing someone to look at your exam).

Deadlines and expectations - Deadlines for written field exercises and other assignments are posted to promote equity among students and to allow faculty ample time to review and return assignments in good time. As such, deadlines are firm and extensions will only be considered under the most extreme circumstances. Late assignments will incur a 10% penalty for each hour that they are late. This means an assignment that is five minutes late will have 10% removed, an assignment that is one hour and five minutes late will have 20% removed etc.

Class attendance and participation - Since we offer a program that is likely more intensive than you might be used to at your home institution, missing even one lecture can have a proportionally greater effect on your final grade simply because there is little room to make up for lost time. Participation in all components of the program is mandatory because your actions can significantly affect the experience you and your classmates have while at CWMS. Therefore, it is important that you are prompt for all course activities.

7. LECTURES

Code	Titles of Lectures /Field Exercises	Type	Time (Hrs)	Instructor
DR 01	DR introduction	L	2.0	JW / All
DR 02	How to write a proposal and a scientific paper	L	1.5	JW
DR 03	Introduction to Biometry: definitions, statistical, descriptive statistics, and statistics tools.	L	2.0	MO
DR 04	Statistical analytical tools and inferences: An overview of statistical tests and requirements	L	2.0	MO
DR 05	Statistical analysis computer lab	Lab	3.0	MO
DR 06	Sampling Methods	L	2.0	MO
DR 07	How to make a good presentation	L	1.5	JW / All
DR 08	Introduction to spatial analysis	L/Lab	4.0	Kioko/Tome
DR 09	DR field research		80.0	All faculty
DR 10	DR analysis and writing		72.0	All faculty
DR 11	DR presentation preparation (oral and poster)		8.0	All faculty
DR 12	In-house presentations		6.0	All faculty
DR 13	DR community presentation preparation		8.0	All faculty
DR 14	DR community presentations		2.0	All faculty
Total Hours			216 Hours	

Note: L, FL and FE represent a lecture, field lecture and field exercise respectively. L/FL, represents a lecture combined with field practice

8. LECTURE TOPICS, DESCRIPTIONS AND REQUIRED READINGS

Code	Title of Lectures and Description	Required Readings
DR 01	DR introduction <ul style="list-style-type: none"> ◆ To present the process and objectives of each DR topic by faculty for the purpose of student selection, and also expose research program of the centre 	None
DR 02	How to write a proposal and a scientific paper <ul style="list-style-type: none"> ◆ Give students appropriate guidelines on writing and presenting scientific data in standard scientific format 	Milewski, T. 1991. Scientific methods in ecology: evaluating scientific reports. Notes, SFS Kenya, Program. (Required)
DR 03	Introduction to Biometry: definitions, statistical, descriptive statistics, and statistics tools. <ul style="list-style-type: none"> ◆ Introduce students to various statistical terminologies, scales of data and how to properly distinguish data types for analysis 	Zar, J. H. 1999. Biostatistical Analysis. Fourth Edition. Prentice – Hall Publishers. New Jersey. 661 pp. (Suggested general reading)
DR 04	Statistical analytical tools and inferences: An overview of statistical tests and requirements <ul style="list-style-type: none"> ◆ To expose students to statistical inference, hypothesis testing, common analytical tools and when to use them 	Zar, J. H. 1999. Biostatistical Analysis. Fourth Edition. Prentice – Hall Publishers. New Jersey. 661 pp. (Suggested general reading) Freese, F. 1962. Elementary Forest Sampling. Agriculture Handbook 232. Forest Service, U.S. Department of Agriculture. O.S.U. Book Stores, Inc. Corvallis, Oregon, USA.
DR 05	Statistical analysis computer lab <ul style="list-style-type: none"> ◆ To train students on computer analytical tools and software, how to arrange data and how to interpret statistical computer outcomes 	None
DR 06	Sampling Methods <ul style="list-style-type: none"> ◆ Provide students with an overview of common field sampling methods and when to use them for reliable data collection and inference 	Zar, J. H. 1999. Biostatistical Analysis. Fourth Edition. Prentice – Hall Publishers. New Jersey. 661 pp. (Suggested general reading) Freese, F. 1962. Elementary Forest Sampling. Agriculture Handbook 232. Forest Service, U.S. Department of Agriculture. O.S.U. Book Stores, Inc. Corvallis, Oregon, USA.
DR 07	How to make a good presentation	

	<ul style="list-style-type: none"> ◆ Train students on various skills of research presentation and distinguish scientific vs community non – technical presentations 	Faculty to share their experiences
DR 08	<p>Introduction to spatial analysis</p> <ul style="list-style-type: none"> ◆ Expose students to Geographical Information System (GIS) spatial analysis for use in biological and social research 	None
DR 09	<p>DR field research</p> <ul style="list-style-type: none"> ◆ In the field for 10 days with their DR group conducting field research 	None
DR 10	<p>DR analysis and writing</p> <ul style="list-style-type: none"> ◆ Data analysis and interpretation ◆ Report writing 	None
DR 11	<p>DR presentation preparation (oral and poster)</p> <ul style="list-style-type: none"> ◆ Preparation for oral and poster presentations 	None
DR 12	<p>In-house presentations</p> <ul style="list-style-type: none"> ◆ Each student presents to the class 	None
DR 13	<p>DR community presentation preparation</p> <ul style="list-style-type: none"> ◆ Each DR group prepares a presentation for the community 	None
DR 14	DR community presentations	None

9. DIRECTED RESEARCH PROJECTS

Title of DR Project 1	Insights into community perceptions and expectations of national parks and community wildlife sanctuaries
Project Advisor:	Salaton Tome, M.Phil.
Research Assistant:	An intern
Project Partner(s):	The key partner is the local Maasai community-members of Kimana Olgulului, Kuku and Mbirikani Group Ranches. Other partners include relevant line departments, Kenya Wildlife Service (KWS), international and local NGOs working in the area.
Project Deliverables:	<ul style="list-style-type: none"> ◆ An up to date literature review of functioning community sanctuaries ◆ Documentation of dominant community views ◆ Documentation of net flow of benefits (to KWS, local tourism industry, local entrepreneurs and to communities) directly or indirectly ◆ An analysis of pertinent legislation and policies (or gaps) informing community participation in wildlife conservation /management.

Number of Students and Research Responsibilities	8-10 students: Students will be in smaller groups of 2-3 to ensure greater efficiency in data collection and sampling coverage.
Project Description	<p><i>Problem/Issues</i></p> <p>What are the community perceptions and expectations of national parks and wildlife sanctuaries?</p> <p><i>Background</i></p> <p>Conservation policies and agencies in Africa have come under heavy criticism especially in the '80s because of their exclusionist approach. Conceptual and empirical evidence from many countries indicate that the conservation goals have not been achieved. Consequently, new approaches which encourage the promotion of community participation, the concept of sustainable utilization and the centrality of markets in shaping the structure of conservation were introduced. These approaches have been concretized in different ways in different regions mostly paying special attention to the prevailing socio-politico and economic circumstances of the particular area. For example in Southern Africa the focus has largely been on enhancing community based conservation while in Eastern Africa the focus has been on community conservation initiatives that centre on protected areas or 'park outreach'.</p> <p>Community-based conservation in East Africa has evolved through complex interaction between factors operating at many levels and especially historical events before and after independence. The low agricultural potential and previously low human over much of the region have played a significant part in shaping the development of the conservation agenda. As such an extensive area of East Africa is legally conserved and is under the management of a large number of state and local-level agencies which in most part have failed to take into consideration the needs and interest of the local community. Though each country is still largely dependent on agriculture, each of the three East African countries of Kenya, Tanzania and Uganda have embraced different development agendas with Kenya concentrating on light industry and tourism. A substantial portion of the tourism industry is dependent on a network of protected which largely found in the marginal areas inhabited by pastoralist. Unfortunately the policies which are used to manage these areas have resulted in disenfranchisement of the local communities through alienation of resources they where hitherto using and destruction of local authority over the environment. With limited exceptions, few benefits accrue back to the local communities which have to bear the cost of conservation.</p> <p>However, starting from the '70s there has been concerted effort by the government and NGOs sector to develop policies and structure for community conservation in Kenya. This was based on the realization that the myriad initiatives premised on the 'park outreach' model were failing and becoming increasingly difficult to justify morally vis-à-vis human rights terms. Though the primary focus of projects targeting local communities around Amboseli and Tsavo national parks was towards the protected areas, they were important in informing the subsequent initiatives.</p>

These field based as well as lessons from other countries has been used as stepping stones for the ensuing community conservation initiatives some which include: benefit sharing with local communities; minimizing conflicts between conservation interests and local needs; and increasing co-operation with other sectors of relevance to conservation goals. In Kenya the Amboseli region can be duly considered the cradle of these community based conservation initiatives and as such the most appropriate place to launch an investigation on the same.

Amboseli National Park epitomizes problems facing conservation of biodiversity in many developing countries. With its small area most of the mammal congregations found within the PA seasonally migrate beyond its boundary to the surrounding group ranches. The owners of these ranches are the Maasai, traditionally nomadic pastoralists, who are fast changing in both their lifestyle and willingness to host wildlife on their land without any benefit. The scenario therefore begs the question of how wildlife can be conserved adequately under conditions of rapidly changing landuse. Fortunately, several measures such as the involvement of the local community in managing and benefiting from wildlife in their area of jurisdiction have been put in place to address the issue.

Objectives

The thrust of Fall 2007 directed research will be on reviewing the evolution and structure of the different permutation of community based conservation initiatives within the Amboseli system. Some of the fundamental issues which require investigation include: Who bears the cost of supporting wildlife in the system? Who benefits and under what arrangement? What types of initiatives abound in the area? What measures are needed to strengthen the initiatives? What are some the legal and policy issues which need addressing?

Specific objectives are to:

- Carry out a comprehensive economic and financial analyses of community conservation,
- Investigate benefit -incentive systems and sharing mechanisms among various partners in these protected areas / community sanctuaries
- Examine the institutional (legal and policy framework) governing the distribution of benefits.

Methods

Study will involve:

- ◆ Thorough literature search and an analysis of past and present community based conservation programs
- ◆ Conduct social surveys in representative sites using a combination of participatory techniques and semi-structured questionnaires. The focus is to

	<p>provide information on sources of economic livelihood, benefits accruing, relationship with conservation actors etc.</p> <ul style="list-style-type: none"> ◆ Key informants and focus group discussion ◆ Carry out exploratory benefit-cost analysis associated with community based conservation initiatives <p>Linkage to other five-year research plan</p> <p>This project is closely related to project 1:0 in aspects of natural resource management (influence of land tenure) – so can draw from it and also project 3:0 on population dynamics within group ranches.</p>
Permits/permissions required:	Permission to do research in Eselenkei, Kuku, Mbirikani, Kimana, and Olgulului will be sought from the group ranch officials. Additionally access to several tourist facilities will be sought.
Equipment/materials required:	Topographic maps of the area, GPS equipment,

DIRECTED RESEARCH READINGS

- Adams, W.M., and D. Hulme, 2000. If Community Conservation is the Answer in Africa, What is the question? *Oryx* 35 (3): 193 – 200
- Bekure, S. (eds) 1987. Maasai Herding: Investigation of pastoral production on Group Ranches in Kenya
- Berger, D. 1993. Wildlife Extension: Participatory Conservation by the Maasai of Kenya. ACTS Environmental Policy Series No. 4. pp 5- 45.
- Campbell, D.J., H. Gichohi, A. Mwangi & L. Chege. 2000. Land Use Conflict in Kajiado District, Kenya. *Land Use Policy* 17: 337-348.
- Government of Kenya. 1989. Development Plan for Kuku Group Ranch. Ministry of Livestock Development and Department of Livestock Production. Government Printer, Nairobi.
- Ferraro P. J., and Kiss, A. 2002. Direct Payments to Conserve Biodiversity. *Science* 298: 1718 – 1719
- Hackel, J. D. 1998. Community conservation and the Future of Africa's Wildlife. *Conservation Biology* 13 (4) 726 - 734
- Katampoi, K., G. Genga, M. Mwangi, J. Kipkan, J. Seitan, M. Van Klinken, and MS Mwangi. 1990. Kajiado District Atlas. ASAL Programme Kajiado, Kajiado.
- Macnab, J. 1991. Does game cropping serve conservation? A re-examination of the African data. *Can. J. Zool.* 69: 2283-2290.

- Norton – Griffiths, M. 1996. Why Kenyan Conservation is failing. *Swara* (Special 40th anniversary edition), pages 6 – 8.
- Ogolla, B. D. & J. Mugabe. 1996. Land tenure systems and natural resource management. In: Juma, C. and J. B. Ojwang (eds.), *In land we trust: environment, private property and constitutional change*. ACTS Environmental Policy Series No. 7. Initiative Publishers. Nairobi. Pp. 85-116
- Ogutu Z. A. 2002. The Impact of ecotourism on livelihood and natural resource management in Eselenkei, Amboseli Kenya. *Land Degradation and Development* 13: 251 – 256
- Okello, M.M., Wishishitemi, B.E. & Mwinzi, A.M. 2001. Relative importance of conservation areas in Kenya based on diverse tourist attractions. *The Journal of Tourism Studies* 12(1): 39 – 49 (Required)
- Okello, M. M., B.E.L. Wishitemi, and B. Lagat. 2005. Tourism Potential and achievement of Protected Areas in Kenya: Criteria and Prioritization. *Tourism Analysis* 10 (2):151 – 164 (Suggested)
- Okello, M.M. & Manka, S.G. Tourism Satisfaction, The Role of Various Attractions And Implications for Tourism And Conservation In Amboseli National Park, Kenya. Submitted to *Tourism Analysis* (Suggested)
- Okello, M.M. & Manka, S.G. The Role and Relative Importance of Large Mammal Species In Tourism Viewing In Amboseli National Park, Kenya. Submitted to *Journal of Sustainable Tourism* (Suggested)
- Okello M.M. 2005. The Dilemma of Balancing Conservation and Tourism Interests in a Small National Park: The Case of Amboseli, Kenya. Submitted to *Tourism Management*
- Okello, M., Seno, S., and Wishitemi, B. 2003. Maasai community wildlife sanctuaries in Tsavo – Amboseli, Kenya. *Parks* 13(1): 62 - 75. Conservation Partnerships in Africa. IUCN, Gland, Switzerland
- Seno, S.K., W.W. Shaw. 2002. Land Tenure Policies, Maasai Traditions, and Wildlife Conservation in Kenya. *Society and Natural Resources*. 15: 79-88.
- Thresher, P. 1981. The present value of an Amboseli Lion. *World Animal Review* 40: 30 – 33
- Western D. Amboseli National Park: Enlisting landowners to conserve migratory wildlife. *AMBIO* 11(5): 302 - 308
- Wishitemi, B.E.L. and Okello, M. M. 2003. Application of the Protected Landscape Model in Southern Kenya. *Parks* 13(2): 12 - 21. Category V. IUCN, Gland, Switzerland
- Whyte, I. 1993. The movement patterns of elephants in the Kruger National Park in response to culling and environmental stimuli. *Pachyderm* 16: 72-80.

Title of DR Project II:	Contraction of Wildlife Dispersal space by Human Activities and Structures in Mbirikani Group Ranch near Amboseli, Kenya: A landscape level analysis
Project Advisor:	Moses Makonjio Okello, Ph.D.
Research Assistant:	An intern and research assistant
Project Partner(s):	Department of Resource Survey and Remote Sensing (DRSRS), KWS, Kenya Agricultural Research Institute (KARI), Group Ranches (Kuku, Kimana and Mbirikani) and conservation NGO's (African Wildlife Foundation (AWF), Africa Centre for Conservation (ACC) and private ecotourism enterprises in the ecosystem.
Project objectives and deliverables:	<ul style="list-style-type: none"> • To identify, establish prevalence and intensity of human activities and structures that contribute to the shrinking of the dispersal area, • Establish their location, and area of such human activities and structures and map them out for spatial analysis • To establish if the remaining dispersal area has sufficient resources (such as browse, grass forage, cover and water) necessary for wildlife and livestock • To examine potential options for the conservation of the dispersal area on a landscape level in view of the continuing group ranch subdivision and land use changes in the ecosystem. • Establish wildlife (large mammals) distribution and habitat associations of Kimana Group Ranch
Directed research progress and research responsibilities	<p>All students in this Directed Research will be encouraged to take part in all aspects of the work to harness all their competencies and skills. This work will be carried out on a landscape level in the entire dispersal area. Student groups will define the scope of their work, the study sites and contribution towards collective complete data / information for the dispersal area.</p> <p>This similar work has now been completed for Kuku and Kimana Group Ranches and now will be moving into Mbirikani Group Ranch. Results and manuscripts to this effect have been prepared and are in different stages of publication</p> <p>The Fall 2007 will mark the end of this work in Mbirikani. It will continue the landscape work in the remaining western part of Mbirikani Group Ranch to assess wildlife dispersal area and migration corridor contraction and factors contributing to that. Particularly, they will work on the mapping of <i>bomas</i> and other homesteads, area of agriculture and the key water points and rivers / streams, and locations of wildlife and livestock in the group ranch.</p>
Project Description	<p style="text-align: center;"><u>INTRODUCTION</u></p> <p>There are six group ranches between Tsavo west / Chyulu Hills national parks and Amboseli / Kilimanjaro conservation area. This area forms one of the key conservation blocks in Kenya. Local Maasai who are traditionally pastoralists inhabits this area. They have lived side by side with wildlife for many years. The pastoralism lifestyle though now declining has been compatible with the ecology of this area, which is characterized by low and erratic rainfall (200 – 500 mm per year). The soils are of recent volcanic activities and therefore there are many rock outcrops and shallow poorly developed soils. Most of the area is a rangeland only suitable for wildlife conservation and pastoralism. However, in the recent past, there are land use changes and other socio – economic developments that threaten this area as a</p>

dispersal area for wildlife in Tsavo – Amboseli ecosystem. The ecological integrity and cultural lifestyle of the ecosystem is being destabilized by the following processes: increase in human population; agricultural establishment and expansion especially along riverine areas, swamps and in open rangelands for horticultural production; impending and continuing group ranch sub – division; persecution of wildlife through illegal poaching and bush meat trade; the high intensity of human – wildlife conflicts; the expansion of market centers that displace wildlife; general environmental degradation from overstocking of livestock; and excessive depletion of tree and shrub plant cover resources by local communities for various uses. With these changes, the crucial data urgently needed for conservation of wildlife resources in the dispersal area (that will influence the viability of the neighboring parks dependent on it) are: the status of the dispersal area in Kimana Group Ranch; the factors responsible for the decline of this dispersal space; the effective remaining wildlife dispersal size; factors that will promote the continuity and integrity of the remaining dispersal area and associated intervention measures; resource sufficiency and endowment in the dispersal area that will provide for wildlife presence, needs and survival; and compatible land use practices that can be promoted alongside wildlife conservation in the remaining dispersal spaces, and the models and mechanisms that will promote local community socio – economic welfare and support for conservation. This directed research seeks to address these crucial areas and provide data and information based on a landscape level approach. The project will be done in four phases that will coincide with study sites, with each study site taking about two directed research student groups. The project is expected to last for five years in order to cover the entire dispersal area between Tsavo West / Chyulu system and Amboseli / Kilimanjaro conservation system.

DATA COLLECTION AND ANALYSIS

Using two main ecological indicators of **wildlife presence** (large mammal density and diversity) and **aspects of range condition** (such as soil erosion and tree and shrub percent cover) **indicators**, the following area will be mapped and estimated in size

- **Different dispersal area - shrinking uses: location and area taken in the ecosystem:** These areas will include market areas and extended areas of wildlife exclusion, Maasai homesteads and immediate area of degradation that excludes wildlife, clusters of Maasai settlements (e.g. markets, electric fences and agricultural concentration areas) and areas of public utilities (such as cattle dips, schools, health centers, administration centers) where wildlife has been excluded.
- **Status, location and size of natural and artificial water resources:** Water is a limiting factor in this ecosystem and presence of water, the size and seasonality is an important factor in determining presence of suitable dispersal and resident area for wildlife. Therefore current location of rivers, swamps, springs and artificial watering spots will be located. Further, the current status in terms availability as a water source, size and level of access to these sources by wildlife and livestock in the dry season will be assessed
- **Location of wildlife and livestock concentration sites in the dispersal areas:** Areas of wildlife concentration in the group ranches (watering points, community sanctuaries, relatively unsettled, undegraded wildlife inhabited locations) in the dry season will be identified and broad habitat associations with wildlife density will be established

Constraints:	<ul style="list-style-type: none"> • The main constraint to producing excellent information is limited facilities and software for GIS that can allow overlaying of information to show relationships. Some good investment in more powerful GIS equipment and basic faculty training may greatly assist the quality of work produced. • Some other constraints may be road network or access to more remote areas of the group ranches for sampling and wildlife counts.
Equipment/materials required:	GIS maps of group ranches, topographic maps of group ranches, Scoping scopes, Binoculars, Rangefinders, Mammal Field Guides, Tally counters, any previous aerial photographs, GIS equipment, software and computers.
Other issue(s):	For this information to be useful for the ecosystem, it will have to extend to at least Kuku and Kimana Group ranches, and part of Mbirikani Group Ranch.

DIRECTED RESEARCH READINGS

- Campbell, D.J., H. Gichohi, A. Mwangi & L. Chege. 2000. Land Use Conflict in Kajaido District, Kenya. *Land Use Policy* 17: 337-348.
- Fahrig, L. 1997. Relative Effects of Habitat Loss and Fragmentation on the Population Extinction. *Journal of Wildlife Management*. 61(3): 603-607.
- Lindenmayer, D. A. & H. A. Nix. 1993. Ecological Principles for the Design of Wildlife Corridors. *Conservation Biology*, 7(3): 627-630.
- Milton, S.J. 2000. Biodiversity and Conservation in the Real World. Inaugural Address. June 2000. University of Stellenbosch. South Africa. pp. 1-8.
- Mwale, S. 2000. Changing Relationships: The history and future of wildlife conservation in Kenya. *Svara* 22(4):11-17.
- Mwalyosi, R. 1992. Influence of livestock grazing on range condition in south-west Maasailand, Northern Tanzania. *Journal of Applied Ecology*. 29: 581-588.
- Newmark, W.D. 1993. The Role and Design of Wildlife Corridors with Examples from Tanzania. *Ambio*. 22(8): 500-504.
- Newmark, W.D. 1996. Insularization of Tanzanian Parks and the Local Extinction of Large Mammals. *Conservation Biology*. 10(6): 1549-1556.
- Norton-Griffiths, N. 1997. Why Kenyan Conservation is failing. *Svara* November 1996 / February 1997: 6-8. Special *Svara* 40th anniversary edition
- Ogolla, B. D. & J. Mugabe. 1996. Land tenure systems and natural resource management. **In:** Juma, C. and J. B. Ojwang (eds.), *In land we trust: environment, private property and constitutional change*. ACTS Environmental Policy Series No. 7. Initiative Publishers. Nairobi. Pp. 85-116
- Okello, M.M. & J.W. Kiringe. 2004. Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya. *Journal of Sustainable Tourism*. 12(1): 55-69.

- Okello, M. M. 2005. Land Use Changes and Human - Wildlife Conflicts in the Amboseli Area, Kenya. *Human Dimensions of Wildlife* 10(1): 19 – 28
- Okello, M.M., Seno, S.K., & Wishitemi, B. L. 2003. Maasai community wildlife sanctuaries in Tsavo – Amboseli Ecosystem, Kenya: management partnerships and their conditions for success. *Parks* 13(1): 7 - 15. IUCN Gland, Switzerland.
- Seno, S.K. & W.W. Shaw. 2002. Land Tenure Policies, Maasai Traditions, and wildlife conservation in Kenya. *Society and Natural Resources*. 15:79-88.
- Thouless, C.R. & J. Sakwa. Shocking elephants: Fences and crop raiders in Laikipia District, Kenya. *Biological Conservation*. 72:99-107.
- Waithaka, J. M. 1996. Elephants: A keystone species. pp. 284-285 **In:** McClanahan, T.R. and T.P. Young (eds.), *The East-African Ecosystems and their Conservation*. Oxford University Press (OUP), New York.
- Western, D. 1975. Water availability and its influence on the structure and dynamics of a savannah large mammal community. *East African Wildlife Journal*. 13: 265-286.
- Western, D. 1989. The ecological role of elephants in Africa. *Pachyderm*. 12:42-45.
- Western, D. 1994. *Ecosystem Conservation and Rural Development: The case of Amboseli*. Island Press, Washington D.C. 15-52 pp.
- Wishitemi & Okello. 2003. Application of the Protected Landscape Model in Southern Kenya. *Parks*. 13 (2): 12-21.
- Young, T. P. & T. R. McClanahan. 1996. Island Biogeography and Species Extinctions. Pp. 292-293. **In:** McClanahan, T. R. and T. P. Young (eds), *The East-African Ecosystems and their Conservation*. Oxford University Press, New York.

Title of DR Project III	Range condition, trend and productivity in the Maasai group ranches of the Amboseli region of Kenya
Project Advisor(s)	John W. Kiringe
Research Assistant (s)	An intern or research assistant
Project Partner(s)	The Maasai people who live in communal group ranches (i.e. Kuku, Kimana and Mbirikani Group Ranches) that straddle between the Amboseli, Chyulu and Tsavo West National Parks, Ministry of Fisheries and Livestock Development and local NGOs working in the area such as African Centre for Conservation (ACC), African Wildlife Foundation(AWF) among others.
Project Objectives and Deliverables	<ul style="list-style-type: none"> • Assess range condition, trend and productivity within the group ranches • Assess the carrying capacity of the rangelands within the group ranches • Establish factors influencing the status and rangeland condition within the group ranches • Establish the impacts and implications of rangeland changes on the Maasai community, pastoralism, land use, wildlife conservation and other biodiversity resources within the group ranches • Develop a holistic ecological monitoring protocol and indicators that will help elucidate changes in range condition and trend <p>Use the research findings to make recommendations on the best strategies that will enable the group ranches (i) enhance sustainable utilization of rangeland resources and promote the socio-economic welfare of the Maasai community (ii) mitigate rangeland degradation (iii) maintain their ecological integrity and (iv) promote conservation of wildlife and other biodiversity resources</p>
Number of Students and Research Responsibilities	A group of about nine or ten students will be involved in this project, and whenever necessary work in the same or different study site(s). This way, a rapid collection of the required data and information will be achieved. Faculty will guide students on how to (i) develop their directed research proposal (ii) share out various responsibilities in the field and during data analysis and (iii) write their directed research papers
Project Description	<p style="text-align: center;">INTRODUCTION</p> <p>Rangelands cover about 4.5 billion hectares of the world's dry lands or one fifth of the earth's land surface, which is more than double the area that is under cultivation and represent the most valuable yet neglected and abused biome. They support approximately 135 million people or nearly one fifth (20%) of the world's population and are confined to the tropic and sub-tropic regions. Compared to the high potential lands, their climatic conditions and soil types are such that potential for crop production under natural conditions is extremely low. Until recently, the predominant inhabitants of these vast lands were pastoralists such as the Maasai, Samburu, Rendille, Boran of Kenya. However, in the last few decades, large populations of non-pastoral communities have migrated and settled in rangelands, and are an integral component of these regions. In spite of their dry nature, soils and vegetation of rangelands are fundamental natural resources upon which their</p>

inhabitants depend on. One of the fundamental concerns of these lands is that degradation and subsequent loss of soils and vegetation will precipitate a cascade of ecological, environmental as well as socio-economic and political problems some of which can spill over and even be felt beyond the locality or region where such degradation has occurred.

Usually, rangelands are regarded as wastelands with very little economic value. However, if managed appropriately taking into account their ecological limitations, they are a valuable biome with considerable economic returns. They are an important source of livelihoods for local communities especially pastoralists who have practiced traditional pastoralism for thousands of years. Indigenous pastoral production is an important and ecologically sound form of land use in rangelands since they are too dry to support crop production. For millennia, tapping the productivity of this vast land has depended mostly on wildlife and domestic animals especially cattle, sheep, goats, camels and donkeys. Within Africa, 230 million cattle, 246 million sheep, and 175 million goats are supported almost entirely by rangeland ecosystems. In 1987, the International Institute for Environment and Development and the World Resources Institute estimated that wildlife and livestock in pastoral areas support nearly 30-40 million pastoralists and millions of other settled non-pastoral communities outside rangelands. About four fifths of the world beef and mutton production (which is roughly 52 million tons), comes from animals that forage on rangelands. The value of livestock among pastoral communities is way beyond producing vital resources like hides and skins, milk, blood and meat. Livestock is regarded as a capital investment and in some communities like the Maasai, they are associated with social status. They represent an important asset that can be converted or liquidated to cash whenever a need arises.

Rangelands in arid and semi-arid regions are fragile and easily get degraded. Land degradation in dry lands can be defined as, “the reduction of biological productivity of dry land ecosystems including rangeland’s pasture, rain fed and irrigated croplands as a result of an acceleration of natural physical, chemical and hydrological processes.” These processes may include; erosion and deposition by wind or water, salt accumulation in soils, ground or surface water run-off, a reduction in amount of diversity of natural vegetation and decline in ability of the soil to transmit or store water for plant growth. By the end of the 20th century, rangelands of Africa and other parts of the world were subjected to a lot of pressure with nearly 70% of these lands getting degraded resulting in severe degradation in certain regions like the Sahel in Africa. In Africa, the annual loss of rangeland productivity is estimated at \$7 billion, more than the gross domestic product of Ethiopia, with both Africa and Asia accounting for two thirds of this loss at the global level. Arresting the deterioration of the world’s rangeland environment presents a difficult challenge. Mitigating this kind of degradation and subsequent deterioration requires regular assessment and monitoring to keep abreast with changes in the state of the environments. With better animal husbandry and ecologically sound range management practices, rangelands can attain even higher economic returns than is currently realized. Another equally important livestock production system is ranching either by individual landowners or communally owned ranches. For instance, the Maasai group ranches of the

Amboseli region and the Maasai-Mara ecosystem are examples of huge tracks of rangeland landscapes that were set aside by the Kenya Government with an objective of boosting livestock production among the Maasai.

In spite of their harsh conditions, rangelands are important biodiversity depository sites, and in countries like Kenya, Botswana, Uganda, Tanzania and Sudan they support a variety of wildlife species where a protected areas network in form of reserves and national parks have been established. Wildlife based tourism in such countries generates significant revenue in form of foreign currency and contributes to the overall national economy. In addition to livestock production, rangelands supply a variety of other resources and products which are important to local economies including bush meat, tubers medicinal plants, building, fencing and thatching materials, tannins, gums, fruits, berries and incense. The value of rangelands in supplying bush meat and vegetable food staffs to local communities cannot be overestimated. These are derived from species that are well adapted to the ecological limitations of such areas and therefore available in the event of substantial crop failure or loss of livestock due to prolonged drought. Other uses of rangelands include mining for example Rubies and Tanzanite in Kenya and Tanzania respectively, quarrying, bio-prospecting (e.g. for important genetic resources, herbal medicines and other biological materials), rural based economies (e.g. game ranching, eco-tourism and livestock sales).

In Kenya, rangelands cover about 80% of the total land and include; the Coast region, North Eastern, Rift Valley and Eastern parts of the country. These are both arid and semi-arid zones but support a large proportion of the country's livestock population (about 70% of sheep and goats, >50% of cattle, all the camel population) as well as nearly 35% of the country's population majority of whom are pastoralists. The population of livestock, which is an important backbone of many African economies often, exceeds the carrying capacity of the land by half or more. A study that looked at the increasing grazing and browsing pressure on rangeland grasslands in nine southern African countries showed that the capacity of the land to support local communities and sustain livestock production is diminishing. It's imperative that the on-going rangelands degradation in Kenya and other parts of Africa be addressed and appropriately mitigated.

RESEARCH RATIONALE

The Masaai Group Ranches adjacent Amboseli, Chuylu and Tsavo West National Parks, are important wildlife dispersal areas without which the parks would be degraded and become ecologically unviable since they are too small to support large and viable wildlife populations. This landscape is also home to the Maasai community who have used it for traditional nomadic pastoralism for hundreds of years. However, in the last couple of years, the rangelands in the ranches have undergone significant changes in their condition and if this is not addressed, it's likely to trigger a cascade of ecological changes thereby undermining the ability of the land to support wildlife, livestock production as well as compromise the livelihood of the Maasai people. It is probable that these changes especially on the vegetation is related to considerable changes that have occurred in the last couple of year especially land use practices, which have seen agriculture become prevalent.

Apart from increased human population and related activities, livestock numbers appear to have been on the increase and this has added a new dimension with regard to utilization of the vegetation especially the herb layer. Further, due to the introduction of the group ranch system and the underlying restrictions in resource use by the community, livestock appears to be restricted in its overall coverage through which grazing takes place on a yearly basis thus putting a lot of pressure on the rangeland's vegetation. Traditional nomadic pastoral lifestyle, a sound ecological practice that helps rangelands to maintain their integrity and ability to support livestock, wildlife and people, has also dramatically changed in the recent past. It has now been replaced by a more or less sedentary lifestyle that is characterized by almost permanent Maasai homesteads (bomas) which compounds the total amount of pressure exerted on the rangelands. Collectively these changes in conjunction with prevalent drought conditions are potential threats to the ecological and environmental integrity of the ranches.

Recent observations in Kuku, Kimana and Mbirikani Group Ranches indicate that there has been significant changes and modifications of the woody species and the herb layer which have raised a lot of concern among the members as well as the officials. They have also noted a decline in pasture quality and plant species composition, which they feel, will in the long run undermine livestock production. Whereas the community and their leaders are concerned on the ability of the ranches to support livestock production, our concern includes the implications of such changes to wildlife and the livelihoods of the local community, which is heavily dependent on this land and its natural resources. An understanding of the dynamics and changes of the herb layer, trees and shrubs in the ranches and intervention strategy is urgently needed. This can partly be addressed by undertaking short and long term studies on the factors that influence and drive the structure, dynamics and productivity of the herb layer. This information will be useful in establishing biomass levels in the rangelands throughout the year, as well as estimating forage utilization/off-take by livestock and wildlife species. Biomass level and productivity dynamics, together with off - take rates of large herbivores will be useful in establishing stocking rates and stability of the grazing system in the group ranches of Amboseli region. Assessment and monitoring of the range condition and trend is equally important. Overall, the findings of this study are a critical step towards effective and sustainable management of the range forage resources and its associated faunal populations.

DATA COLLECTION PROCEDURE

This research will focus on Kuku, Kimana and Mbirikani Group Ranches and its envisaged that data from these ranches will give a clear picture on rangeland condition and trends within the Amboseli region, their productivity and carrying capacity especially for livestock production. It will also shed light on the causal factors for rangeland condition changes and trends, and their impacts and implications on: the socio-economic status of the Maasai community, pastoralism, land use, conservation of wildlife other biodiversity types across the region. Overall, the findings will be useful in sustainable utilization of the rangelands and associated resources. Data collection will begin in Spring 2007 and focus on Kuku Group Ranch and later shift to Kimana and Mbirikani. A variety of techniques and

	<p>approaches will be employed to help obtain the desired data and information. These will involve:-</p> <ul style="list-style-type: none"> • Comprehensive literature review of various aspects of rangelands • Comprehensive review on past and present rangeland utilization in Maasai land, changes in the Amboseli region and impacts and implications on rangeland resources • Conduct social surveys in representative areas using a combination of participatory techniques and semi-structured questionnaires. This approach will be used to elucidate various aspects of rangelands within the Amboseli region. Key informants and focus group discussion will also be employed to complement the household social surveys. • Rangeland condition and trends will be discerned by conducting vegetation and soil components within representative sites of the group ranches. These will employ a variety of existing techniques and approaches. Other aspects of the rangelands which will also be investigated include: <ul style="list-style-type: none"> (a) Monitoring changes in the species composition of the herb layer (b) The structure and dynamics of the herb layer (c) Biomass production and levels of primary productivity. This will focus more on the herb layer and will employ the destructive (harvest) and non-destructive methods. (d) Plant biomass utilization/off-take (mostly the herb layer) by wildlife and livestock (e) Livestock stocking rates and carrying capacity of the group ranches. This will also involve conducting livestock counts within the ranches (f) Monitoring seasonal variation in rainfall. If this is monitored over the years, it will help to establish how rainfall availability influences rangeland condition and trend, the herb layer biomass production and productivity levels, ecological resilience of the rangelands especially during drier seasons or drought conditions. (g) Depending on the study site characteristics, agricultural fields, Maasai bomas and other human structures will be noted and mapped out using GPS and GIS software. Any soil erosion gullies will be noted and mapped out and an overall assessment on the degree or severity and prevalence of soil erosion determined.
Constraints (include any actions that the Support Center can perform to help)	None
Permits/permissions needed	See DR01
Equipment/materials needed	General topographic and grid maps of the Maasai group ranches in the Amboseli region, compasses, assorted tape measures, GPS equipment, GIS software, plant identification and vegetation field guides, other sampling tools such as ranging

	poles, quadrats, pin-frames, clip boards and data entry sheets etc
Other considerations	In order to have a clear picture and understanding on rangeland condition and trends in the larger Amboseli Ecosystem, this study needs to cover other group ranches as well. Thus, it is imperative that once Kuku Group Ranch is adequately covered, the focus will shift to Kimana and Mbirikani Group Ranches respectively.

DIRECTED RESEARCH READINGS

Note:-

Faculty will also provide other readings to supplement this list but students are **STRONGLY** advised to also search for relevant literature in the library and using the internet.

- Awere-Gyekye K. 1996. Land use planning and coordination study: national land use patterns and trends. Final report to the Kenya Wildlife Service. Kenya Wildlife Service.
- Berger, D.J. 1993. Wildlife Extension: Participatory Conservation by the Maasai of Kenya. African Centre for Technology Studies (ACTS), Nairobi, Kenya.
- Campbell, D.J, Gichohi H, Mwangi A, Chege L. 2000. Land use conflict in Kajiado District, Kenya. Land Use Policy 17:337-348.
- Cheeseman. T. 2001. Conservation and the Maasai in Kenya. Tradeoff or lost mutualism? Pp 1-23. http://www.environmentalaction.net/kenya/kenya_policy_failure.html
- Gichohi H., Gakahu C., Mwangi E. 1996. Savanah Ecosystems. In: MaClanahan, T.R. and Young, T.P. (Eds). East African Ecosystems and Their Conservation pp. 284-285 Oxford University Press, Oxford.
- Gooch, M. 2003. A landscape level analysis of wildlife dispersal by human activities in Kuku Group Ranch, Kenya. Unpublished directed research project. Center for Wildlife Management Studies. Nairobi, Kenya.
- Dregne, H.E. 1986. Desertification of arid lands. In: Pysics of desertification, ed. F. El-Baz and M.H.A. Hassan. Dordrecht, The Netherlands: Martinus, Nijhoff. Pp 1-16. <http://www.ciesin.org/docs/002-193/002-1193.html>
- Dregne, H.E. 2002. Land degradation in the drylands. *Arid Research and Management*, 16:99-132.
- Haley, B.J. 2004. Displacement effects and dispersal area contraction by human activities on wildlife in Kuku Group Ranch, Kenya. Unpublished directed research project. Center for Wildlife Management Studies. Nairobi, Kenya.
- Homewood, K.M. 2004. Policy, environment and development in African rangelands. Pp 1-35. <http://ez.hamilton.edu>
- Katampoi, K., G. Genga, M. Mwangi, J. Kipkan, J. Seitan, M. Van Klinken, and MS Mwangi. 1990. Kajiado District Atlas. ASAL Programme Kajiado, Kajiado.
- Kiringe, J.W. and M.M. Okello. 2005. Use and availability of tree and shrub resources on Maasai communal rangelands near Amboseli, Kenya. *African Journal of Range and Forage Science* 22: 37-45.

- LaGrandeur, R.W. 2004. A survey on the impacts of humans and elephants (*Loxodonta africana*) on an *Acacia tortilis* woodland in Kuku Group Ranch, Kenya. Unpublished Directed Research Project, Center for Wildlife Management Studies. Nairobi, Kenya.
- Livestock Production Department Range Planning Unit. 1989. Group Ranch Planning Project, Kuku Group Ranch. A.S.A.L Programme: Kajiado District.
- McNaught, M. 2004. Wildlife displacement and dispersal area reduction by human activities within Kimana Group Ranch corridor near Amboseli, Kenya. Unpublished Directed Research Project. Center for Wildlife Management Studies, Nairobi, Kenya.
- Munei, K. 1998. Study on Subdivision of Group Ranches in Kajiado District. Ministry of Department of Livestock Production. Kajiado District
- Oba, G. N. Steinseth, and W. Lusigi. 2000. New Perspectives on Sustainable Grazing Management in Arid Zone of Sub-Saharan Africa. *Bioscience*. 50(1):35-50.
- Ogolla, B.D. and J. Mugabe 1996. Land tenure systems and natural resource management. In: Land We Trust: Environment, Private Property and Constitutional Change. ACTS Environmental Policy Series No 7. Initiative Publishers. Nairobi.
- Okello, M.M. 2005. Land use changes and human-wildlife conflicts in the Amboseli area, Kenya. *Human Dimensions of Wildlife* 10(1):19-28.
- Republic of Kenya. 1997. Kajiado district development plan. Office of the Vice President and Ministry of Planning and National Development, Nairobi, Kenya.
- Roddy, A.B. 2004. Impacts of humans and elephants (*Loxodonta Africana*) on woody species in Kuku Group Ranch, Kajiado District, Kenya. Unpublished Directed Research Project. Center for Wildlife Management Studies, Nairobi, Kenya. 42pp.
- Seno, SK and Shaw WW. 2002. Land tenure policies, Maasai traditions and wildlife conservation in Kenya. *Society and Natural Resources*. 15:79-88.
- Touber, L. 1983. Soils and vegetation of the Amboseli-Kibwezi area. Ministry of Agriculture – National Agricultural Laboratories, Republic of Kenya. Reconnaissance soil survey report No R6, 1983. 270pp.
- Western, D. 1982. The Environment and Ecology of Pastoralists in Arid Savannas. *Development and Change*. Vol. 13: 183-211.
- Zar, J. 1999. Biostatistical Analysis: Fourth Edition. Prentice-Hall, Inc. Englewood Cliffs, New Jersey.