THE SCHOOL FOR FIELD STUDIES

Wildlife Ecology
SFS 3720

Syllabus

The School for Field Studies (SFS)
Center for Wildlife, Water and Community Studies (CWWCS)
Kilimanjaro Bush Camp, Kimana, Kenya

This syllabus may develop or change over time based on local conditions, learning opportunities, and faculty expertise. Course content may vary from semester to semester.

COURSE CONTENT SUBJECT TO CHANGE

Please note that this is a copy of a recent syllabus. A final syllabus will be provided to students on the first day of academic programming.

SFS programs are different from other travel or study abroad programs. Each iteration of a program is unique and often cannot be implemented exactly as planned for a variety of reasons. There are factors which, although monitored closely, are beyond our control. For example:

- Changes in access to or expiration or change in terms of permits to the highly regulated and sensitive environments in which we work;

- Changes in social/political conditions or tenuous weather situations/natural disasters may require changes to sites or plans, often with little notice;

- Some aspects of programs depend on the current faculty team as well as the goodwill and generosity of individuals, communities, and institutions which lend support.

Please be advised that these or other variables may require changes before or during the program. Part of the SFS experience is adapting to changing conditions and overcoming the obstacles that may be present. In other words, the elephants are not always where we want them to be, so be flexible!

Course Overview

The Wildlife Ecology course will provide students with in-depth understanding on the climate, ecology and dynamics of East Africa Savanna Ecosystems and their linkage to wildlife and natural resources conservation in the predominantly Maasai inhabited Kenya-Tanzania borderland of the Amboseli Ecosystem. Students will learn and apply in the field multiple approaches and techniques to studying wildlife and ecological sampling techniques They will also explore application of ecological concepts and principles in sustainable management of wildlife, water and other natural resources through lectures, field exercises and experiential hands-on learning. Aspects learned will be applied in the Faculty guided Directed Research (DR) at the end of the semester.

The course will be done in the rapidly changing Maasai landscape of the Amboseli Ecosystem situated in the South eastern sector of Kenya, along the Kenya-Tanzania border. Field lectures, exercises and DR will be done in the Maasai Group Ranches, private and community owned conservancies including private land in the former Kimana Group Ranch. Field trips to protected areas mainly; Amboseli, Chyulu Hills, Tsavo West, Lake Manyara, Tarangire and Serengeti National Parks will be used to further student's field experiential learning. Data collected by students in field exercises and DR will be synthesized and analyzed for acquisition of multiple skills such as; field sampling techniques, data management and synthesis, report writing and application of research in promoting sustainable management of wildlife and natural resources in general. At the end of the semester, students will present their DR work and findings to multiple stakeholders. Overall, the course aims at equipping students with ecological knowledge of nature, imparting problem-solving and scientific skills that are needed to understand the ecological interactions affecting wildlife and natural resources. It offers practical, hands-on experiences inside and outside the classroom.

Learning Objectives

Through lectures, experiential and interactive learning, this course exposes students to the following aspects: -

1) Climate, ecology and dynamics of East Africa Savanna Ecosystems with emphasis on the Amboseli Ecosystem
2) Climate change science and its effects on wildlife, natural resources (with emphasis on water) and local livelihoods
3) Techniques and approaches to studying wildlife ecology, natural resources use and sustainable conservation
4) Human-environment interactions and their effects on sustainable utilization of natural resources and harmonious co-existence between humans and the environment
5) Effects of uncontrolled land use changes on the environment, protected areas, wildlife populations and natural resources
6) Effects of overexploitation and uncontrolled utilization of natural resources on their conservation and local community socio-economic well-being

Case Study

Overview

Globally, most natural resources face enormous pressure from multiple direct and indirect human activities, with delirious consequences for humans and natural life. Further, most of the resources are limited, and thus easily prone to any disturbance by humans. In this regard, a lot of effort has gone to

promote sustainable utilization of natural resources with emphasis on minimizing damaging human activities and overexploitation. Most parts of East Africa, Kenya included are dominated by Savanna or rangeland environments which are naturally dry for most of the year due to scanty annual rainfall. However, these are the same landscapes where diverse biota endowments are found but which are currently under siege and near extermination by rapid human population growth and unregulated land-use changes.

The Amboseli Ecosystem is characterized by a semi-arid environment, and rainfall is received twice a year but it's scarce, unpredictable and low (300-800mm per year). This creates a water deficient landscape, and most of the water is found in scattered rivers, streams, springs and wetlands like swamps, all linked to the hydrology of the neighboring Mt. Kilimanjaro. These conditions tend to favour wildlife conservation and pastoralism, the latter being the historical key land use by the local pastoral Maasai people. However, immigration into the region by agricultural communities in the 1970s and 1980s saw introduction of farming as a new land use along the wet and arable slopes of Mt. Kilimanjaro along the Kenya-Tanzania border. Thereafter, irrigated agriculture mostly for commercial purposes was introduced in the water systems of the Maasai Group Ranches where rain-fed farming is not possible. This lifestyle shift has seen pastoralism nearly replaced and dominated by agro-pastoralism among the Maasai.

Today, the dominant human activities, mostly irrigated farming and livestock keeping rely on the springs and rivers emanating from Mt. Kilimanjaro. The wildlife ecological dynamics in the ecosystem is also entirely dependent on these wetlands, which are the predominant dry season concentration areas as water and forage resources elsewhere diminish. Consequently, management of water resources is a major conservation and livelihood issue. Often there are conflicts associated with water use among humans and between humans and wildlife, which is attributed to diminished availability of this vital resource. Resolving these conflicts and promoting wise use of available water resources is a major preoccupation of wildlife and natural resources managers in the area, Water Resource Users Associations (WRUAs) and the Water Resources Authority (WRA), the lead Kenya Government agency on water management.

The Amboseli Ecosystem lies contiguous to the Tsavo West and Chyulu Hills National Parks which are part of the Tsavo Conservation Area, the largest wildlife conservation landscape in Kenya. Chyulu Hills was gazetted as a protected area in 1983 to enhance protection of its wildlife resources and watershed services. It's recognized as one of the important water catchment areas situated in the dry lands of the country and provides water to a vast landscape and diverse beneficiaries including Mombasa County. However, this service is threatened by destruction and general environmental degradation of the hills by livestock grazing, charcoal burning and accidental fires. Neighboring the Chyulu Hills N. Park is the expansive Tsavo West N. Park, which covers more than 9,000Km, and it's one of the important wildlife conservation areas in the country. Prior to its gazettement as a protected area in 1948, the area was used by pastoral communities like the Maasai. Over the years, human population and land use changes especially farming, adjust the park boundaries have increased significantly. This has led to escalation of human-wildlife conflicts and prevalence of illegal bush meat activities, which threatens the wildlife conservation agenda of the park.

SFS believes that the case study approach is a novel approach for studying such complex interrelated issues within landscapes. It presents students with an opportunity to analyze issues using a systematic, experiential and interactive approach. Thus, this case study will enable students to understand how development and natural resource conservation can be integrated for the overall well-being of humans

and the environment. It is a process that requires a defined focus, and in these two case studies, we have identified water as a most critical resource due to its paramount influence on humans, wildlife especially water dependent species and other natural resources. The learning approach involves learning the issues through class room lectures, field exercises, and interactive sessions with field experts and by analysis of some of the data collected. This information will be used to answer the following case study question: -

How can changes in land use, natural resources utilization and availability in the Amboseli Ecosystem be managed to promote socio-economic well-being of local communities whilst safeguarding and promoting natural resources conservation?

Case Study Background

The basis for this case study is the Ecosystem approach, which appreciates the spatial-temporal nature of natural resource interrelationships, and their linkage to human needs. Most of the learning will be largely done in the Amboseli Ecosystem in the South eastern sector of Kenya. The ecosystem comprises of expansive Maasai Group Ranches, privately owned land along the Kenya-Tanzania border, protected areas, mainly, Amboseli, N. Park and several private wildlife sanctuaries/conservancies. It also neighbours the Chyulu Hills, Tsavo West and Mt. Kilimanjaro N. Parks, and has a mixed community made up of different ethnic groups; the Maasai, Kikuyu and Kamba among others. Of importance are the Maasai people, whose pastoral lifestyle has remained highly tied to the environmental conditions of the landscape. Thus, these landscapes are still endowed with diverse and high wildlife abundance albeit in a rapidly human altered environment.

The biggest challenge in the Amboseli Ecosystem regarding sustainable natural resource conservation is how to best manage existing natural resources amidst increasing rural development, land use changes and unregulated use of the resources. Water, wildlife, plant and range resources are some of the vital resource endowments found in the region, and whose future is of great concern. While water is uniquely scarce due to the semi-arid nature of the region, it is arguably the most important resource as it supports most life systems including humans. As mentioned earlier, the major sources of water in ecosystem are perennial and semi-perennial wetlands, rivers and springs linked to Mt. Kilimanjaro hydrological system. Unfortunately, these water systems have undergone immense pressure with negative effects on water quality and quantity due to combined direct human use and Climate change. This has had delirious effects on wildlife in the area, particularly the migratory species and the species directly dependent on water such the African elephant, common zebra and wildebeest. The current scenario on the state of water resources in the region has created a lot of local and national concern. In particular, Amboseli National Park is a Biosphere reserve, whose future depends on balancing the needs of wildlife and neighboring communities. This is the case as only a small fraction of the wildlife range is supported by the park. Migratory species such as the African elephant, wildebeest and common zebra make seasonal movement into and out of the core protected areas and these movements are often dictated by water availability.

The major issue in Tsavo West and Chyulu Hills is how to balance local community natural resource needs and conservation of wildlife and watershed services. Chyulu Hills were historically owned and used by the Kamba and Maasai people as a dry season grazing area and for extraction of herbal medicine and contraction materials for their houses. However, this access and resource extraction is prohibited due to designation of the hills as a protected area, which has created a lot of conflict between the park management and these communities. Illegal livestock grazing by the communities is

rampant, and it's usually accompanied by burning the landscape to stimulate growth of rush and high nutritious forage for the livestock. Charcoal burning and illegal logging by the Kamba people are also prevalent and are very destructive to the native vegetation. Collectively, the inappropriate human activities in the hills are destructive to its environment and vegetation cover, thereby threatening the critical watershed services associated with the hills.

Tsavo West N. Park is an important elephant conservation area in the country, and it's endowed with many other wildlife species. Despite its vastness, human-wildlife interactions have increased to the detriment of their historical harmonious co-existence. Communities living around the park incur a lot of economic losses and destruction of their property due to wildlife. Human deaths, injury and livestock depredation are also prevalent, and present a big challenge for sustainable wildlife conservation and co-existence between humans and wildlife. Overall, the negative human-wildlife interactions in the region have created a negative attitude towards the park, wildlife and its conservation. In spite of the collective efforts by the park management and other stakeholders, illegal bush meat activities are still prevalent inside and outside the park and present a major threat to wildlife survival and its long-term conservation.

Assessment

No	Assessment Items	Value (%)
WE 04	Scientific field enquiry process: field observations & scientific write up	20
WE 06	Ecology and behavior of yellow baboons: field observations	15
WE 19	Cheetah ecology and conservation	15
	WE course participation grade	10
	Final exam	40
	TOTAL	**100**

Grading Scheme

A	95.00 – 100.00%	B+	86.00 – 89.99%	C+	76.00 – 79.99%	D	60.00 - 69.00%
A-	90.00 – 94.99%	B	83.00 – 85.99%	C	73.00 – 75.99%	F	59.99 - 0.00%
		B-	80.00 – 82.99%	C-	70.00 – 72.99%		

General Reminders

Readings: 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: 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% of the grade deducted.

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 attending the SFS program. Therefore, it is important that you are prompt for all course activities.

Course Contents

Type- **L**: Classroom lecture, **FL:** Field lecture, **FE:** Field Exercise, **D:** Class discussion

Type. & Time (hrs)	**Titles of Lectures & Field Exercises**	**Readings**
WE 01(L, 2Hrs)	**Overview of conservation issues in the Amboseli Ecosystem:** Lecture provides a broad scope of the human dimensions and natural resources conservation issues (threats, challenges and opportunities) in the Amboseli Ecosystem	None
WE 02(L, 2Hrs)	**The role of ecology in natural resource conservation**: The lecture demonstrates the linkage between the program's case study question and Wildlife Ecology	None
WE 03(L, 2Hrs)	**Scientific field enquiry process: Theory**: Lecture will provide insights on how to make observations on nature and note taking. Students will also learn the process of scientific paper writing	Remsen, J. V., Jr. (1977). On taking field notes. Amer. Birds 31: 946-953 (**Required**) Michael, D. (2011). Basics of research paper writing and publishing. RWTH Aachen University (**Required**)

WE 04(FE, 2 Hrs)	**Scientific field enquiry process: Field observations & scientific paper write up**: The aim or goal of this exercise is to assist students to develop skills on scientific and logical way to interpret nature through field observations and note taking. They will also learn how to apply a variety of techniques and approaches in conducting field observations on the environment, plants and wildlife. Each student will make four independent observations based on the guidelines provided by Faculty, and use 2 of them to write 2 comprehensive scientific papers for grading	Remsen, J. V., Jr. (1977). On taking field notes. Amer. Birds 31 : 946-953 (**Required**) Michael, D. (2011). Basics of research paper writing and publishing. RWTH Aachen University (**Required**)
WE 05(L, 2Hrs)	**Ecology and behavior of yellow baboons: Theory**: The lecture will examine the general ecology and behavior of yellow baboons, and provide insights on why studying primate behavior is critical to their conservation	Stacy, P. B. (1986). Group size and foraging efficiency in yellow baboons. Behavioral Ecology and Sociobiology, 18 (3: 175-187
WE 06(FE, 5Hrs)	**Ecology and behavior of yellow baboons: Field observations:** In this field exercise students will learn how to make observations on primate ecology and behavior focusing on yellow baboons. It will also introduce students on how to use ethograms for studying primate behavior	Altmann, J. (1974). Observational study of behavior: sampling methods. Behaviour, 49:227-267 (**Required**) Post, D.G. (1981). Activity pattern of yellow baboons (*Papio cynocephalus*) in the Amboseli National Park, Kenya. Animal Behaviour, 29, 357-374 (**Required**) Altmann, J. and Muruthi, P. (1988). Differences in daily life between semi-provisioned and wild-feeding baboons. American Journal of Primatology, 15:213–221 (**Suggested**)
WE 07(L, 2Hrs)	**Elephant movement pattern in the Amboseli region: insights from IFAW-KWS & SFS elephant research**: Lecture will focus on elephant movement pattern in Southern Kenya-Tanzania borderland based on collard elephants. It will also examine elephant meta-	Croze and Moss (2011). Patterns of occupancy in time and space; Chapter 7: pp89-105. In: The Amboseli elephants; a long-term

	populations in the borderland, their genetic connectivity and key elephant movement corridors	perspective on a long-lived mammal (Edited by; Cynthia J. Moss, Harvey Croze and Phyllis C. Lee) (**Required**)
WE 08(L, 2Hrs)	**Ecology of the Amboseli Ecosystem and its influence on water resources, land-use and wildlife movement**: Lecture will examine the ecological characteristics of the ecosystem and their linkage to land use, water resources availability, wildlife movement and dispersal pattern	Croze and Lindsay (2011). Amboseli Ecosystem context: past and present; Chapter 2: pp11-28. In: The Amboseli elephants; a long-term perspective on a long-lived mammal (Edited by; Cynthia J. Moss, Harvey Croze and Phyllis C. Lee) (**Required**) Western et al. (2009). The impact of subdivision and sedentarization of pastoral lands on wildlife in an African Savanna ecosystem. Biological Conservation, 142:2538-2546 (**Required**)
WE 09(L, 2Hrs)	**Climate change and impacts on water resources, pastoralism and food security: the case for the Amboseli region**: Lecture will introduce students to the science of Climate change, concerns associated with this phenomenon and how it impacts natural resources, food security and livelihoods in the Amboseli Ecosystem	Campbell et al. (2016). Reducing risks to food security from climate change Global Food Security, 11:34–43 (**Required**) Taruvinga et al. (2013). Climate change impacts and adaptations on small-scale livestock production. International Journal of Development and Sustainability, 2 (2): 664-685 (**Required**) Kimaro, E.G and Chibinga, O.C (2013). Potential impact of climate change on livestock production and health in East Africa: a review. Livestock Research

		for Rural Development, 25 (7) (**Suggested**)
WE 10(L, 2Hrs)	**Vegetation sampling techniques: Theory**: The lecture will provide students with an overview on different vegetation sampling methods/techniques and how the data collected can be used for wildlife management purposes. It will also familiarize students with some commonly assessed vegetation parameters and their relevance in wildlife ecology and wildlife management	Kenneth F. Higgins et al. (1994). Vegetation sampling and measurement. In: Theodore, A. Bookhout (ed), Research and management techniques for wildlife and habitats. The Wildlife Society, Inc., Allen Press, Inc. Lawrence, Kansas. Pp567-591 (**Required**)
WE11(FE,4Hrs)	**Vegetation sampling techniques: Practice**: This exercise will provide students with an opportunity to use how to collect vegetation data using some of the commonly used sampling methods. In this process, they will; learn and develop skills on how to design and conduct vegetation surveys, develop ability to synthesis and interpret vegetation data as well as acquire knowledge on use and application of vegetation sampling methods and techniques. The exercise will not be graded	Kenneth F. Higgins et al. (1994). Vegetation sampling and measurement. In: Theodore, A. Bookhout (ed), Research and management techniques for wildlife and habitats. The Wildlife Society, Inc., Allen Press, Inc. Lawrence, Kansas. Pp567-591 (**Required**)
WE 12(FE, 5Hrs)	**Range condition in the Amboseli region wildlife sanctuaries.** This field exercise will be done in Kimana Wildlife Sanctuary and will provide students with techniques on how to evaluate range condition. Students will also learn the implications of range condition on wildlife conservation	Lynn et al. (2018). Habitat conditions in a continuously grazed wildlife sanctuary in Kenya. Journal of Environment and Earth Science, 8 (8): 131-139 (**Required)**
WE 13 (L, 2Hrs)	**Ecology of grey crowned cranes:** In this lecture students will learn about the ecology of grey crowned cranes and their use as bio-indicators. It will also explore their population status and trend, threats to their conservation including the impact of Climate change, and conservation action	Fakarayi et al. (2016). Varying Land-Use Has an influence on Wattled and Grey Crowned Cranes' abundance and distribution in Driefontein Grasslands Important Bird Area, Zimbabwe. PLoS ONE 11(11): 1-14 (**Required**) Nsengimana, O. and Becker, M. (2017). Minimum population size and distribution of Grey Crowned Cranes in Rwanda. Aerial and

		ground Survey, pp 1-25 (**Required**)
WE 14(L, 2Hrs)	**Lion ecology, conservation and human-lion interactions in the Amboseli region**: Lecture will examine lion ecology and human-lion interactions in the Maasai group ranches, their impacts on lion ecology and conservation. The lecture will also explore the influence of Climate change in the ecosystem on lion ranging behavior	Abell et al. (2013). The long-term viability of current lion conservation strategies: a role for ex-situ reintroduction. Open Science Repository Natural Resources and Conservation. Online (open access), e70081975. doi:10.7392/open access.70081975 (**Required**) Tuqaa et al. (2014). Impact of severe climate variability on lion home range and movement patterns in the Amboseli Ecosystem, Kenya. Global Ecology and Conservation, 2: 1–10 (**Required**) Blackburn et al. (2016). Human–wildlife conflict, benefit sharing and the survival of lions in pastoralist community-based conservancies. Journal of Applied Ecology, 53, 1195–1205(**Required**)
WE 15(L, 2Hrs)	**Plant-herbivore interactions: impact of large mammals on vegetation: theory**: Lecture will examine how large herbivores like elephants interact and affect vegetation and the physical environment, and why large herbivores have negative impacts on the vegetation and the physical environment. It will also examaine determinants of the magnitude and impacts by large herbivores, and, application of plant-herbivore interactions in wildlife conservation	Antoni and Derek (2006). Interactions between large African browsers and thorny Acacia on a wildlife ranch in Kenya. Afr. J. Ecol., 44: 515–522 (**Required**) Western and Maitumo (2004) Woodland loss and restoration in a savanna park: a 20-year experiment. Afr. J. Ecol., 42: 111–121 (**Required**)
WE 16(D, 3hrs)	**Plant-herbivore interactions: impact of large mammals on vegetation: students symposium**: Students will evaluate journal articles on plant-herbivore interactions and do a 20mins presentation	Faculty will provide readings prior to the symposium

	on the findings of the papers	
WE 17(L, 2Hrs)	**Ecological separation of African wildlife ungulates and its application in wildlife management.** Lecture will explore how assemblages of African wildlife ungulates are able to co-exist through resource partitioning, and how this knowledge can be used to enhance their management and conservation	Hanley, T.A. (1982). The nutritional basis for food selection by ungulates. Journal of Range Management, 35(2): 146-151 (**Required**) Nichols, R. (2012). Coexistence in ungulate communities: niches, resource partitioning, competition & facilitation. Introductory Research Essay No. 17, Department of Wildlife, Fish, and Environmental Studies Swedish University of Agricultural Sciences 901 83 Umeå, Sweden (**Required**)
WE 18(FL, 2Hrs)	**Chyulu Hills watershed ecosystem services**: This lecture will introduce students to services and goods provided by watershed ecosystems including the Chyulu Hills. It will also examine the types and status of water sources associated with the hills, typology of watershed beneficiaries (water users), water economy, water discharge and abstraction, and threats to the hill's hydrological services	Kiringe et al. (2015). Water management tools in the Chyulu Hills Watershed. Report prepared for the African Wildlife Foundation (AWF) by Habitat Planners, Nairobi, Kenya (**Required**) de Groot et al. (2002). A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological Economics 41, 393–408 (**Required**) Constanza et al. (1997). The value of the world's ecosystem services and natural capital. Nature, 387: 253-259 (**Suggested**)
WE 19(FE, 3Hrs)	**Species-habitat relationships in Tsavo West National Park**: The field exercise will expose students to techniques on how to assess wildlife-habitat	Mwangi and Western (1998). Habitat selection by large herbivores in Lake Nakuru

	relationships for effective management purposes. In the process, they will learn and develop skills on how to; conduct road transects surveys and classify wildlife habitats using vegetation structural appearance. Students will learn how to analyze the collected data using SPSS and interpret the results	National Park, Kenya. Biodiversity and Conservation, 7:1-8 (**Required**) Francis Lemckert (2010). Habitat relationships and presence of the threatened heath frog *Litoria littlejohni* (Anura: Hylidae) in central New South Wales, Australia. Endangered Species Research, 11: 271–278 (**Required**) Sutton et al. (2010). Habitat relationships of reptiles in pine beetle disturbed forests of Alabama, U.S.A. with guidelines for a modified drift-fence sampling method. Current Zoology, 56 (4): 411−420 (**Required**)
WE 20 (FL, 2Hrs)	**Cheetah ecology and conservation:** This lecture provides background to life history traits and conservation challenges of this wide-ranging hunter. Historical and recent events in population decline and current conservation efforts are the basis for discussions about potential conservation approaches in future	Dobrynin et al. (2015). Genomic legacy of the African cheetah, *Acinonyx jubatus*. Gen Biol 16:277 (**Required**)
WE 21 (L/Demo, 3Hrs)	**Wildlife monitoring tool:** This tutorial lecture introduces the use of multipurpose monitoring software (CyberTracker) for a variety of data collections. Students will learn to modify the software and to create their own monitoring database	None
WE 22 (FE, 4Hrs)	**Reptile identification and sampling methods: Practice:** This lecture introduces different sampling techniques for reptile assessments. The most common species will be presented, and students will learn methods for monitoring different groups of reptiles (1hr). After the lecture, students will practice finding, capturing and identify reptiles in the field (3hrs)	Spawls et al. (2006). Pocket guide to reptiles and amphibians of East Africa (**Required**) Spawls et al. (2018). Field guide to East African reptiles (**Required**)

WE 23(L, 1.5Hrs)	**Elephant ecology and social system: Theory:** Students gain insight in the behavioral ecology of the largest and most prominent African mammals. Learning how to identify individuals, aging and sexing in a group of elephants is the basis for own observations on group demography	Owen-Smith N (2006). A scientific perspective on the management of elephants in the Kruger National Park and elsewhere. SA J Sci 102: 389–394 (**Required**)
58.5	**Total Hours**	

Reading List

*Readings in Bold are required. Readings are listed in the order in which they appear in the above table.

Chris and Tilde Stuart (1994). A field guide to the tracks and signs of Southern and East African Wildlife

Michael Dernt. (2011). Basics of Research Paper Writing and Publishing? RWTH Aachen University

Remsen, J. V., Jr. (1977). On taking field notes. Amer. Birds 31: 946-953

Croze and Lindsay (2011). Amboseli Ecosystem context: past and present; Chapter 2: pp11-28 and Chapter 7: pp89-105. In: The Amboseli elephants; a long-term perspective on a long-lived mammal

Western et al. (2009). The impact of subdivision and sedentarization of pastoral lands on wildlife in an African Savanna ecosystem. Biological Conservation, 142:2538-2546

Okello, M.M. and D'Amour, D.E. (2008). Agricultural expansion within Kimana electric fences and their implications to natural resources conservation around Amboseli. N. Park. Journal of Arid Environments. 72: 2179-2192

Australian Academy of Sciences (2015). The science of climate change; questions and answers

Arab Water Council (No date). Perspectives on water and climate change adaptation; Vulnerability of arid and semi-arid regions to climate change and adaptive strategies

Mogaka et al. (2006) Climate variability and water resources degradation in Kenya: improving water resources development and management. The World Bank Working Paper, 69

Campbell et al. (2016). Reducing risks to food security from climate change Global Food Security, 11:34–43

Taruvinga et al. (2013). Climate change impacts and adaptations on small-scale livestock production. International Journal of Development and Sustainability, 2 (2): 664-685

Kimaro, E.G and Chibinga, O.C (2013). Potential impact of climate change on livestock production and health in East Africa: a review. Livestock Research for Rural Development, 25 (7)

Kiringe et al. (2009). The water situation analysis in Kimana area: causes and consequences of water quality, quantity, and distribution dynamics. Final water situation analysis report: prepared for project implementation committee (PIC) Kimana water resources conservation project

Blackburn et al. (2016). Human–wildlife conflict, benefit sharing and the survival of lions in pastoralist community-based conservancies. Journal of Applied Ecology, 53, 1195–1205

Tuqaa et al. (2014). Impact of severe climate variability on lion home range and movement patterns in the Amboseli Ecosystem, Kenya. Global Ecology and Conservation, 2: 1–10

Abell et al. (2013). The long-term viability of current lion conservation strategies: a role for ex-situ reintroduction. Open Science Repository Natural Resources and Conservation. Online (open access), e70081975.

Githaiga et al. (2003). Survey of water quality changes with land use types in the Loitokitok area, Kajiado District, Kenya. LUCID Working Paper Series, 35, Pp1-28

Howard and Bartram (2003). Domestic water quantity, service level and health

Okello, M.M. and D'Amour, D.E. 2008. Agricultural expansion within Kimana electric fences and their implications to natural resources conservation around Amboseli. N. Park. Journal of Arid Environments. 72: 2179-2192

Kenneth F. Higgins et al. 1994. Vegetation sampling and measurement. In: Theodore, A. Bookhout (ed), Research and management techniques for wildlife and habitats. The Wildlife Society, Inc., Allen Press, Inc. Lawrence, Kansas. Pp567-591

Kenneth F. Higgins et al. (1994). Vegetation sampling and measurement. In: Theodore, A. Bookhout (ed), Research and management techniques for wildlife and habitats. The Wildlife Society, Inc., Allen Press, Inc. Lawrence, Kansas. Pp567-591

Milton et al. (1994). A conceptual model of arid rangeland degradation. Biosience, 44(2): 70-77

Macharia, P.M. and Ekaya, W.M. (2005). The impact of ranage condition and trend to the grazing resources of a semi-arid environment in Kenya. Journal of Human Ecology, 17(2): 143-147

Antoni and Derek (2006). Interactions between large African browsers and thorny Acacia on a wildlife ranch in Kenya. Afr. J. Ecol., 44: 515–522

Western and Maitumo (2004) Woodland loss and restoration in a savanna park: a 20-year experiment. Afr. J. Ecol., 42: 111–121

Kiringe et al. (2015). Water management tools in the Chyulu Hills Watershed. Report prepared for the African Wildlife Foundation (AWF) by Habitat Planners, Nairobi, Kenya

de Groot et al. (2002). A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological Economics 41, 393–408

Constanza et al. (1997). The value of the world's ecosystem services and natural capital. Nature, 387: 253-259

Richard Forman (1995). Some general principles of landscape and regional ecology. Landscape Ecology, 10(3): 133-142

Almo Farina (No year). Landscapes and their ecological components (pp 435-448)

Kevin McGarigal (No year). Introduction to landscape ecology

Mwangi and Western (1998). Habitat selection by large herbivores in Lake Nakuru National Park, Kenya. Biodiversity and Conservation, 7:1-8

Francis Lemckert (2010).Habitat relationships and presence of the threatened heath frog *Litoria littlejohni* (Anura: Hylidae) in central New South Wales, Australia. Endangered Species Research, 11: 271–278

Sutton et al. (2010).Habitat relationships of reptiles in pine beetle disturbed forests of Alabama, U.S.A. with guidelines for a modified drift-fence sampling method. Current Zoology,, 56 (4): 411−420

Dobrynin et al. (2015).Genomic legacy of the African cheetah, *Acinonyx jubatus*. Gen Biol 16:277

Spawls S et al. (2006). Pocket guide to reptiles and amphibians of East Africa

Spawls S et al. (2018). Field guide to East African reptiles

Owen-Smith N (2006). A scientific Perspective on the management of elephants in the Kruger National Park and elsewhere. SA J Sci 102: 389–394