Skukuza Science Leadership Initiative Major Research Themes

Following 12 years of research experience, we have focused our research themes along with the long term research goals of the KNP researchers. These Kruger Long-Term Research Initiative projects include the following:

The demography, dynamics and consequence of the loss of big trees. At a global scale, we are losing large trees at an unprecedented rate. In KNP, the combined effects of the feeding of elephants and frequent, intense fires exacerbate this loss. Research foci include the population biology of the species in questions (are they at risk of extirpation?), plant life history traits (which traits make species more resilient?) and what are the consequences of the loss of overstorey structure.

Essential to our understanding of the risk to large trees is developing an understanding of demographic bottlenecks i.e. at which stages are species most vulnerable and how are they adapted to coping with these ecosystem drivers. We are focusing on the importance of mutualisms (pollination and dispersal), germination dynamics, how plants establish in the landscape in the face of competition with grasses, intense herbivory and frequent fires and, lastly, how adult trees are affected by browsing by large herbivores.

In contrast of other biomes, savanna woody plants possess a range of unique traits in order to cope with regular, at times, catastrophic

disturbance. As part of a larger working group, we are identifying the traits that make savanna trees and grasses unique and how these would vary across the globe as the key ecosystem determinants (edaphic factors, climate and disturbance) vary.

We are also particularly concerned about the impact that the change in vegetation structure has on faunal and floral communities. In partnership with the University of Florida, we conduct extensive biodiversity surveys in sites comprising a range of vegetation densities to understand how this change might influence small and mesomammals, birds, bats and selected invertebrates.

The ecological role of megaherbivores: Africa is the last remaining continent which supports extant megafauna (defined as animals that are larger than a ton); keystone species which are considered to be prodigious ecosystem engineers. From elephants, with their large body size and huge appetites, can substantially change vegetation structure through to rhinos and hippos which create substantial “grazing lawns” in the landscape.

There is considerable debate in the literature about the management of elephants which revolves around their effect on local faunal and floral diversity, which is mediated by change in vegetation structure. Conversely, they are also considered to be critical in the dispersal and establishment of a range of tree/shrub species. We have focused a great deal of effort on the ecological role that elephants have in influencing savanna dynamics. Allied to this work is the use of alternative means to manage elephants to mitigate these negative impacts. We are currently exploring the use of honey bees and chili to control elephant movements, as an alternative to current methods.

Grazing lawns are caused by the intense grazing in selected patches in the landscape (for reasons largely unknown) resulting in the change in grass sward and an increase in local productivity. The switch from taller bunch grasses to more productive lawn grasses has important trickle down effects on the ecology of these systems. These grazing lawns attract a range of other grazers that are drawn to the elevated nutrient status of the forage, as well as the relative safety of the open areas where predators can be seen from a distance. We have found that invertebrates and smaller vertebrates also respond strongly to change in grass composition and structure. Aside from the switch in grass species and effects on fauna, the presence and abundance of lawns may also affect fire regimes (there is less biomass available to carry fires on the lawns) and hence could influence the establishment of woody plants in the absence of fire.

With the ongoing poaching of rhino in the KNP, a key aim of the research then is to assess the effect of losing the rhinos would have on the ecology of savannas.

The use of bioacoustics in biodiversity monitoring. The development of new and existing biodiversity technologies over the last decade has presented a number of exciting opportunities in the realm of biodiversity science. One of the fasted growing disciplines is that of bioacoustics, which boasts a multitude of techniques and applications in evolutionary and behavioural ecology, and more recently as a non-invasive method for collecting species inventories and even estimating biodiversity.

Bioacoustic monitoring is widely applied in terrestrial environments for well-known taxonomic groups such as birds, bats, and amphibians. The technique capitalizes on the fact that these animals use vocalizations for communication and orientation. Fortunately for us, most vocalisations exhibit distinctive features, and can therefore be used in biodiversity research and monitoring programmes. Until recently, the application of automated recording units has been limited due to high purchase cost and the technical knowhow required to use such devices. However, recent improvements have allowed for the more widespread implementation of recording devices, and the approach is gaining popularity in biodiversity monitoring. Since 2012, OTS has been testing and developing methods for bioacoustic recording and analysis in savanna and fynbos settings. We formally train OTS and South African students in the configuration and deployment of modern acoustic recording devices and the use of analysis software for compiling species inventories using bioacoustic data. We encourage students to develop projects that match their individual interests within the fields of bioacoustics.

Connecting society and conservation: Communities abutting the park, from wildlife ranchers to rural communities, play a critical role in conservation in South Africa, and the rest of the continent. This work evaluates the factors that influence the perceptions of communities surrounding the Kruger National Park. The objectives for this study are to determine whether: (1) The socioeconomic status of an individual; (2) Being employed or having a family member employed in tourism; and (3) Having access to ecosystem services from the park influences an individual's perception about the Kruger National Park. The presence of a protected area may improve the economic development of the region and result in job creation for local communities. However, if local communities are excluded in the decision-making process, conflict may arise between park management and local communities. This can create difficulties in managing a protected area. Improving relationships with local communities can provide a means of education and participation in conservation and anti poaching efforts.

Disease ecology in vertebrates. Interest in animal diseases has increased following the outbreak of several devastating emerging infectious diseases such as Ebola and Influenza type A. The outbreaks of such diseases quickly spread to several countries in the world and proved highly pathogenic, leaving epidemiologists and the public fearful of further disease transmission (World Health Organization 2006). The possibility for animal disease spillover to humans and the domestic livestock is thus of great concern. Most animal diseases, especially those with a zoonosis potential, represent a significant threat to health, fitness, biodiversity and ecosystem function.

OTS students can contribute to the research efforts of the Skukuza Disease Ecology Working Group, a partnership between the Organization for Tropical Studies (OTS), South African National Parks (SANParks), University of the Witwatersrand, Oregon State University (OSU), run with the support of the Skukuza Science and Leadership Initiative (SSLI). We aim to not only focus research on much needed themes, but also train the next generation of research leaders in disease ecology. The primary outputs of the proposed initiative would be both cutting edge disease research but also knowledge transfer and skills development. On the one hand, the initiative is a platform to conduct research on topics of concern disease ecology, ranging from the prevalence of Avian Haemo- and Ectoparasites in several biomes in South Africa and Schistosome (Bilharzia) infection along the Crocodile and Lower Sabie Rivers in the Kruger National Park, to the role of anthropogenic land use change in vector-borne disease risk of Rift Valley fever, Sindbis, Chikungunya and West Nile. However, research is not complete without knowledge transfer and human capital development. Therefore, we will formally train OTS students as well as both South African and international pre-Vet and graduate students on emerging research topics and techniques in the field of disease ecology.

As a key top-down control of faunal communities, one of the key foci of the program is to assess the prevalence and drivers of parasitic (haemo- and ectoparasites) disease load in KNP. We trap a range of small vertebrates (birds and rodents, to name a few) and assess prevalence at different land use change gradients.

Invasion dynamics of freshwater fauna. Alien invasive species continue to be the focus of growing research across the globe, often threatening the biodiversity and functioning of the ecosystems that they invade. Freshwater ecosystems are particularly susceptible to the establishment of invasive species, but often receive less attention than their terrestrial counterparts. Direct impacts of aquatic invasive species include the alteration of species assemblages through competition and predation, the disruption of biochemical fluxes and the introduction and spread of diseases. It is therefore important to establish ecosystem or taxon-specific monitoring projects that closely monitor the distribution, population dynamics, and environmental consequences of invasive aquatic species in protected areas.

OTS collaborates with scientists from local conservation authorities (SANParks and CapeNature) in research focused on alien invasive species in and along rivers flowing through protected areas. We exposed students to the techniques involved in conducting habitat assessments, collecting aquatic species inventories and compiling ecological datasets. The use of aquatic species inventories is not limited to the field of invasion biology, and we also use these inventories for bioassessments of water quality in these ecologically important rivers. OTS has established and contributed to long-term river monitoring projects along the Sabie and Crocodile rivers in the Kruger National Park.

Light pollution impacts. Light pollution is the excessive, misdirected, or obtrusive artificial light from anthropogenic sources, mainly from electrical grid infrastructure. The scope and number of papers documenting the impacts of light pollution on biodiversity are increasing globally and it may impact the environment by altering ecosystem function via changes to local assemblage structure. Using local scale observational and manipulative studies, we aim to assess the impacts of local light pollution on birds, bats and insects.

Functional Trait Ecology. “We will never understand the unravelling of ecosystems if we do not first understand how they are built” said Ricklefs. Functional ecology is interested not so much what species are, but rather what they do in ecosystems, and how that influences community composition. We use observational and manipulative studies, usually using a species trait based approach, to study fundamental questions in community assembly patterns, and what happens when such traits are removed from ecosystems, and why that occur.