SAVE

Save all Animals Vulnerable and Endangered

INTEGRATE FIELD AND REMOTE SENSING DATA WITH DEEPLEARNINGANDBEHAVIORMODELINGTOMONITOR VULNERABLE AND ENDANGERED ANIMALS IN AFRICA

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CONTEXT

Possible climate change, prolonged droughts, human population increase, settlement distribution, land fragmentation, poaching and conflict between people and wildlife have put excess pressure on Africa's wildlife in the recent times. In Kenya, with an additional one million people annually to the already high population densities, the demand for natural resources is rising. Modelling scenarios that anticipate the effects of these threats and provide containment options are essential in biodiversity conservation and environmental policy formulation. Despite rich long-term datasets collected during the last decades, most studies rely on cross-sectional and statistical analysis and thus do not target a predictive perspective, ignoring de facto the suitable scenario formulations for long term predictions.

STUDY AREA

The main study area is Amboseli National Park, Kenya. However, it is planned to extend our studies to other parks such as the Niokolo-Koba (Senegal) or Serengeti (Tanzania). The Amboseli ecosystem covers an area of 8,500 km^2 at an altitude of 1,200m and straddles the Kenya-Tanzania border. It receives an annual rainfall of 250 to 300 mm distributed in two seasons. It encompasses the region utilized by migratory large ungulates and pastoral livestock that concentrate each dry season around permanent swamps fed by Mt. Kilimanjaro. At the start of ecological studies in the 1960s, the ecosystem was dominated by dense woodlands and bush land interspersed with grasslands and swamps. By the 1990s woodlands had given way to open grassland and scrub land and the swamps had doubled in size. The dominant ungulate populations have fluctuated widely in response to the habitat changes, drought cycles and human impact.

This initial emblematic study area will be expanded as widely as possible across Western, Central, Eastern and Southern Africa, so as to make the most of the cross-cutting techniques developed and to improve their robustness. This expansion will also allow comparative studies and the sharing of best practices.

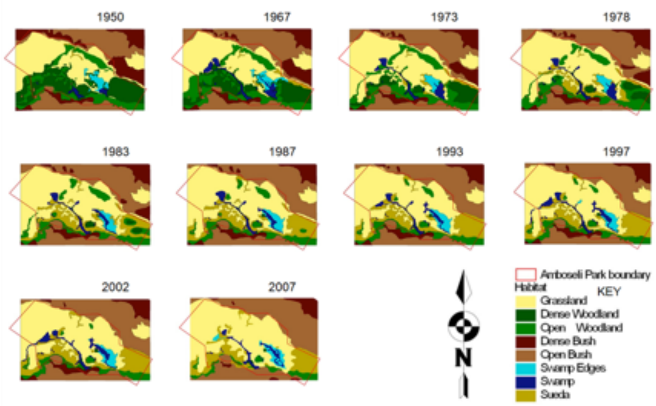

***Figure 1**: evolution of habitat since 1950 around Amboseli National Park*

OBJECTIVES

Formulation of biodiversity conservation policies requires an intimate understanding of the macro ecology of wildlife and livestock populations, land use and projected changes under a variety of development and climate change assumptions:

- Determine the effects of human activities on biodiversity and land health. This includes direct threats to species populations and diversity such as land subdivision and conversion and indirect effects such as human wildlife competition.
- Determine the effects of projected land-use and climate change on Africa's savannah ecosystems. In particular, determine the effects of recurrent and more severe droughts on animal species characteristics and survival at a local scale (within the parks) and at a meta-community scale (including seasonal migrations).
- Provide decision-making tools based on scenario modelling, taking into account individual county-level planning of infrastructure and land use.

The applied objective of the project is thus to develop modelling tools that allow the representation of demographic and dispersal/migration processes of ungulates on a savannah landscape based on a competition model and ungulates feeding selectivity.

DATA AND MODELS

The Amboseli area provides a large amount of data about animals and their habits, or geography. ACP has conducted aerial and ground surveys on large mammal censuses for over 45 years, based on two-dimensional grids (5km x 5km). The open terrain and regular counts of the populations and spatial distributions of all herbivores (ungulates) greater than 15 kg since 1967 (Western and Nightingale, 2004) make Amboseli an ideal field site for modelling studies.

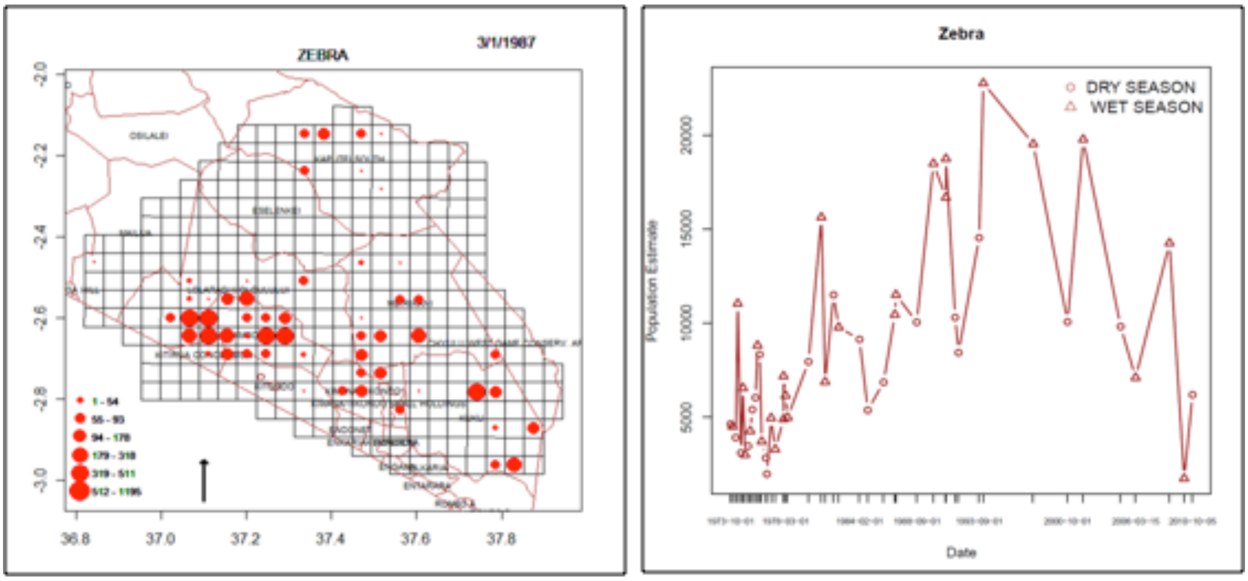

Figure 2: *Zebras distribution and population distribution*

The project adopts a multi-disciplinary approach using the expertise in mathematical modelling in ecology, computer simulations, data and statistical analysis together with a social economic approach. Modelling is based on dynamical systems and performed using a bottom-up approach, using a minimal set of factors in order to keep the model tractable. Such approach allows a better understanding of the influence of each factor and facilitates data analysis, each process being represented independently. Furthermore, it allows modularity in order to include additional processes in further developments of the models. Two versions of the models are being developed, using mathematical modelling and agent-based modelling (the later one being a hybrid model in GAMA platform, developed by IRD). The mathematical model is based on an energy-budget model that allows deriving animals demography from resource consumptions. In the mathematical model, populations are considered at the global level (population densities of meta-populations) while in the agent-based model, each individual is represented, which enables describing the dynamical processes with more details.

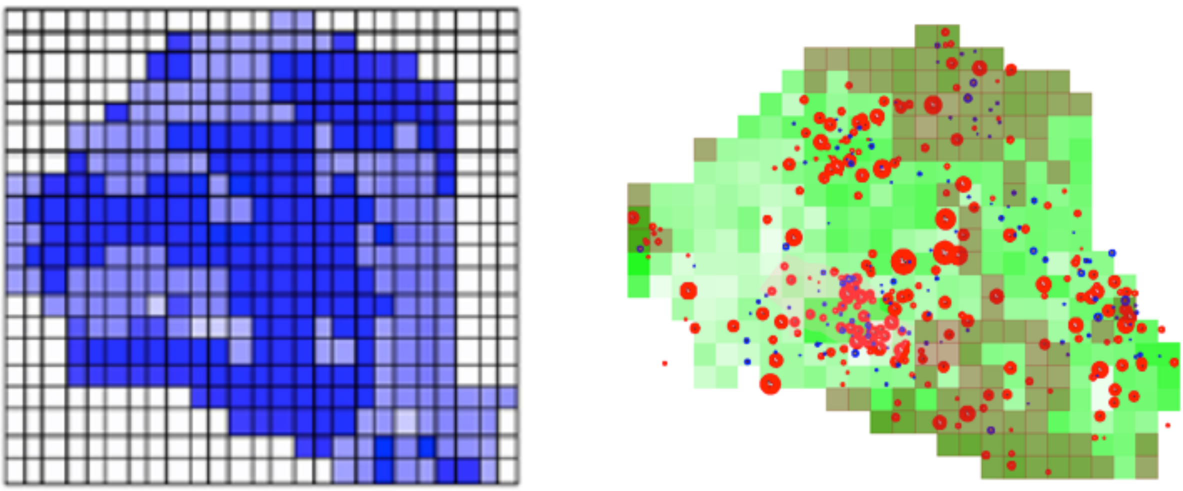

Figure 3: *Mathematical model (left) showing animal densities and mathematical model (right) showing individual behaviours and aggregation*