BIOTA Southern Africa, phase III

PRE-PROPOSAL: Biomass research project

“Characterization of the carrying capacity of BIOTA observatories”

1. Project title

Characterization of the carrying capacity (for ungulate herbivores) of BIOTA observatories

2. Participants

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3. Key research objectives and activities

1. To determine the grass-based carrying capacity of all 23 Biota-observatories in Namibia, as well as 43 other sites selected to have both a good coverage of Namibia and to include many different land uses. The 66 sites have been arranged into six clusters to facilitate monitoring on a regular cycle of 10 days. A total of 12 trained para-ecologists are available to perform the field work for a period of one full year.

Carrying capacity will be determined by clipping standing herbaceous biomass along defined transects at 10-day intervals (Fig. 1) throughout the 2007/2007 growing season and at monthly intervals in the 2006 dormant season.

Standing biomass will be related to NDVI values obtained from SPOT/Vegetation satellite images and converted into biomass production estimates by the Monteith model. This process draws on existing knowledge and systems in the AEZ Laboratory. Since the available satellite images give an indication of total plant biomass production, they will have to be corrected for woody biomass production first. An archive of satellite-derived NDVI values stretching back 20 years is available and can be calibrated accurately, in retrospect.

2. Characterize the botanical composition, photosynthetic activity (greenness) as well as accessibility and palatability of the vegetation at the 66 sites at three crucial stages during the monitoring year. This will make it possible to correct satellite images for woody biomass which, when subtracted from total plant biomass, will yield satellite-derived grass biomass, which can then be related to field-derived grass biomass. Ground-truthing satellite-derived biomass production estimates in this manner will enable the calibration of all satellite images for the next 10 – 20 years without the necessity of field work, unless there are major changes in the structure of the vegetation.

3. Determine the nutritive value of clipped herbaceous samples to derive a seasonal nutritional profile of the herbaceous biomass on offer, thereby offering a quantitative as well as qualitative definition of “carrying capacity”.

4. The regional focus would be on Namibia, although the proposed project methodology is relevant to arid and semi-arid zones worldwide.
4. Key questions/applications

The following issues will be addressed by the proposed research project:

1. Being able to estimate grass-based carrying capacity from a satellite image will provide livestock and game ranchers in Namibia with baseline management information in real time that should enable ranchers to improve the sustainability of their rangeland-based enterprise. This application contributes to Project Theme 3: Understanding human use.

2. The last time Namibian ranchers had access to such baseline information was 30 years ago, and then for only 40% of the country. It was also a one-off determination (compared to the proposed, continuous process), which is no longer valid due to structural changes in the rangeland since then, e.g. bush-encroachment. This improvement contributes to Project Theme 1: Natural dynamics in space and time.

3. An archive of satellite-derived NDVI-values of 20 years is available, so that present carrying capacities can be compared with long-term (“average” or “usual”) carrying capacities and related to annual precipitation, advancing woody cover (derived from periodic aerial surveys), etc. This application contributes to Project Theme 2: Understanding natural processes of change.

4. The current within-season development of carrying capacity can be compared to the “average” within-season development of carrying capacity over the last 20 seasons. This will enable ranchers and decision makers to identify an approaching calamity such as a drought, damage due to insect “pests” (e.g. swarming locusts), uncontrolled fires etc. and to quantify its impact. This can lead to fact-based intervention in good time. This application contributes to Project Theme 4: Interventions for sustainable use.

5. Being able to accurately calibrate the existing satellite-image archive of 20 years will enable policy makers to determine the “average” or “usual” carrying capacity of any piece of land, thus attaching an objective ranching value to such land. This objective value can be converted into a fair purchase price in the case of farm sales on the free market or expropriation of white-owned farmland to satisfy land-hungry black Namibians, or to determine a fair, productivity-based tax on ranchland (implemented in Namibia in 2005), thus contributing to Project Theme 5: Informing policy.

5. Proposed co-operating partners

1. Within BIOTA, the mother project would be S1 (Remote sensing of vegetation structure parameters) with close ties to S11 (Socio-economic aspects) and S6 (Changes in botanical biodiversity due to changing land use and climate).

2. Co-operation with institutions outside BIOTA would be with the Faculty of Agriculture of the University of Namibia, the Polytechnic of Namibia and the Remote Sensing Centre of the Ministry of Agriculture for their technical expertise, as well as the Desert Research Foundation (DRFN) for their community contacts and capacity-building skills.

Full pre-proposal is available on request from:
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Figure 1: Proposed 10-day clipping routes for the Biomass Project of BIOTA phase III