(a) Name of proposing person(s):
Dr Richard Knight, BCB, UWC, Dr Charles Musil, SANBI.

(b) Title of project:
Developing validation methodologies for assessing the impacts of climate-induced change in arid rangelands and the implications for rehabilitation projects

(c) Regional focus and limits:
Knnersvlakte and Richtersveld BIOTA sites. Where the existing network of Climate Change Experimental sites have been established by Dr Charles Musil under phase 2 of the BIOTA project

(d) Please explain how your proposal would contribute to our 5 overarching themes of BIOTA:

Natural Dynamics in space and time
This will contribute to our understanding of how environmental stress induced by predicted climate change scenarios, is likely to impact on the biodiversity hotspots of the Knnersvlakte and Richtersveld regions of the Succulent Karoo biome.

Understanding natural processes of change
Climate change induced by anthropogenic factors is a reality that will cause temporal changes in biodiversity that are independent of other landscape transformations. This project will develop new experimental designs and maintain the existing field experiments for assessing the influence of climate change and will examine additional climatic parameters (most notably wind) that could cause temporal changes of biodiversity.

Understanding human use, value and impact in space and time
Many arid ecosystems are being rehabilitated through direct interventions (passive methods are stock reduction and active methods include soil tilling, reseeding and brush packing etc). These measures are being undertaken during period of increasingly varying climatic conditions. Consequently we need to recognise that rehabilitation might not be possible to states that previous existed since the controlling climatic variables are now different to those that operated even a few years ago. Consequently the process of rehabilitation cannot be undertaken in isolation of climate change and this project will provide the platform to assess how changing climatic factors might influence efforts to rehabilitate degraded arid landscapes.

Interventions (strategies, tools, techniques) for sustainable use of biodiversity and biodiversity management
Through an understanding of the stresses that climate changes might impose on keystone plant species we hope to develop ameliorating conditions that might offset climate change when undertaking rehabilitation projects.

(e) Proposed co-operating partners:
Persons will be identified – especially from SANBI (e.g. Dr Phobe Barnard)

(f) Key questions:
Which of temperature, moisture or wind factors contributes most to causing physiological stress on selected keystone species of the Knnersvlakte and the Richtersveld?
Can we isolate the interactions of temperature, moisture or wind factors so as to determine how these variables in combination influence the stress on keystone species of the Knetsvlakte and the Richtersveld?

Can we use data from these experimental design and the existing experimental set up to develop models that explore the relationship between temperature, moisture or wind factors in more detail and apply these to the design of rehabilitation projects?

**Key activities:**

This project will follow up on the network of climatic change experimental sites established by Dr Charles Musil and Prof Norbert Juergens along the BIOTA transect. The heating chambers combined with the fog exclusion chambers and fog harvesters provide the first insights on how heating and desiccation might impose stress on plant species. Additional experiments will include solar-panel heating of the soil which will have the effect of increasing soil surface night temperatures (with implications of reducing dew-induced moisture at the soil surface).

A second experimental design will involve reciprocal replacing of naturally occurring white and black quartz pebbles that are the matrix in which these succulents grow in. The exchanging of white for black quartz pebbles which will change thermal properties that will increase ranges in daily temperatures (postulated higher diurnal and lower nocturnal temperatures).

A third experimental design will involve reciprocal replacing of the white quartz pebbles with the fine aeolian clay that is trapped around the base of non-succulent shrubs and the removal of these fine aeolian deposit at the base of the non-succulent shrubs with quartz pebbles. This will also change the thermal properties and probable moisture regimes at the immediate soil surface.

A fourth experiment will assess the role of wind, a parameter that has largely been ignored in climate change experiments. Using screens that selectively reduce higher velocity wind speeds but allow breezes and fog to pass through will assess how higher wind speeds (a likely result of increasing temperatures causing increasingly differential heating over land and sea and stronger land sea breeze regimes). Surface soil particle-transport will be tested using submerged “clay tile” particle traps and these will be used to calibrate the impacts of the screens for reducing surface wind velocities.

Existing heating chambers, fog exclusion chambers and fog harvesters will be maintained and a combination of existing data loggers, inexpensive temperature loggers will be used to quantify environmental parameters operating under the various experimental conditions.

Monitoring will be maintained using repeated high resolution digital photographs that was developed during the second-phase of BIOTA (S06.5).

Using the results of all of these experiments we will develop models that more explicitly explore the relationships between temperature, moisture and wind and use these models to better plan rehabilitation projects so that they may more successfully restore keystone species to degraded landscapes.