Darwin Initiative Annual Report

Important note:

To be completed with reference to the Reporting Guidance Notes for Project Leaders – it is expected that this report will be about 10 pages in length, excluding annexes

Submission deadline 30 April 2010.

Darwin Project Information

Project Ref Number	16-003
Project Title	Tools, training and research for managing eco-hydrology of Cape flora
Country(ies)	South Africa
UK Contract Holder Institution	Open University
Host country Partner Institution(s)	South African National Biodiversity Institute; Cape Nature
Other Partner Institution(s)	
Darwin Grant Value	£325,540.05
Start/End dates of Project	01.09.07 / 31.03.11
Reporting period (1 Apr 200x to 31 Mar 200y) and annual report number (1,2,3..)	1 April 2009 – 31 March 2010 Annual Report 3
Project Leader Name	Jonathan Silvertown
Project website	www.open.ac.uk/fynbos
Author(s) and main contributors, date	Jonathan Silvertown; Yoseph Araya 30 April 2010

1. Project Background

The Cape Floristic Region (CFR) of South Africa is an internationally recognised biodiversity hotspot, where 70% of the 9,000 plant species are endemic. The most important habitat of the CFR is the fynbos (a mixture of dwarf shrub and herbaceous species.) This diversity is protected by a network of nature reserves in the management or oversight of Cape Nature and South African National Parks, but rapid population growth and economic development in the Western Cape region are placing increasing demands upon water resources. To meet the urban demand for water, increased abstraction from the sandstone aquifers underlying important fynbos habitats is planned. Currently, very little is known about how such abstraction might affect the Cape flora and there is almost no information at all about the eco-hydrology of Cape plants. Our team has been studying the eco-hydrology of diverse plant communities in English meadows for many years and has devised methodologies that now successfully inform their management. With funding from the Leverhulme Trust we previously piloted a trial of the methods that have proved successful in English meadows in the fynbos habitats of the Cape. We discovered that fynbos species segregate along hydrological gradients, just as meadow species do in England. The significance of this is that the diversity of the community is dependent upon hydrological processes. In the present project we are quantifying precisely how species of the fynbos flora respond to fine-scale hydrological gradients. This information is being disseminated among nature-conservation managers and will be made available to other stakeholders involved in the management of the unique fynbos habitat. Cape Nature reserve managers have participated in our research to date and we have provided them with the opportunity to extend the scope of the research, to learn the methods of data collection, to implement the findings on the ground and to spread the knowledge they have gained through the conservation community.

2. Project Partnerships

One of our two main partners is the South African National Biodiversity Institute. Dr Guy Midgley, Chief Director of the Climate Change & Bio-adaptation Division (http://www.sanbi.org/index.php?option=com_content&view=article&id=199&Itemid=95) conducts world-class research on the impact of climate change on plant communities and has played a full part in the development of our pilot project and current project. He is supported by South Africa based Darwin Initiative PhD research employee (Mr. James Ayuk Ayuk). In addition, SANBI provides our project with office accommodation for the UK postdoc (Dr. Yoseph Araya) and laboratory facilities at its Kirstenbosch research facility in Cape Town. SANBI staff help in laboratory work and field monitoring and have already been trained by us in use of the equipment. The equipment and the technical skills required to use it and to interpret the data will become a permanent addition to SANBI's research capacities.

Our second project main partner is the Scientific Services Division (SSD) of Cape Nature (http://www.capenature.co.za/) headed by Dr Ernst Baard. The division makes an input into the evaluation of environmental impact assessments (EIAs) for new developments in the region. Cape Nature has been an active collaborator in terms of providing research sites (the exception is Cape Point which is managed by National Parks). Cape Nature also provide extensive help to the project in the form of staff time and logistical support. In response, field rangers of reserves have been trained by us in the methods of acquiring and interpreting ecohydrological data. This has enabled them to monitor sites for us. We also continue to get involved and extend our ranger training and monitoring collaboration with South African National Parks i.e. SANPARKS (http://www.sanparks.org/), another major conservation organization in South Africa.

We continue to benefit from collaboration with Prof. Peter Linder, a South African botanist now based at University of Zurich, who is a world expert on Restionaceae and on fynbos ecology.

Overall, our good working relationship with the above nature conservation and research bodies in South Africa continues. At our last meeting in October 2009 and March 2010 we have discussed a follow-up Darwin Initiative project with them which they are very keen to support.

3. Project progress

3.1 Progress in carrying out project activities

Since our last report, we have completed full botanical and topographic surveys at the last 2 remaining sites (bringing our total surveyed sites to 10).

The sites chosen with brief locations are given in Table 1. Map of Site locations is also given in Figure 1.

Table 1. Location and details of study sites

No.	Site name	Location	Altitude /m a.s.l.	Quadrats recorded
1	Cape Point	S 34 º17'41.1" E 18 º 26'18.7"	120	225
2	Riverlands	S 33 º29'12.8" E 18 º 35'43.3"	120	305
3	New Years Peak	S 33 º41'19.7" E 19º 06'02.9"	1080	235
4	Steenbras	S 34 º 11'39.7" E 18 º 52'14.0"	350	172
5	Theewaterskloof	S 33 º 58.906', E 19 º 07.887'	347	200
6	Jonkershoek	S 33 º 59.600' E 18 º 57.174'	350	201
7	Kogelberg	S 34 º 16.745' E 19 º 00.508'	131	200
8	Cape Point 2	S 34 º 18.705' E 18 º 25.901'	112	201
9	Silvermine	S 34 º 06.555' E 18 26.901'	378	200
10	Bastiaanskloof	S 33 º 32.434' E 19 º 09.130'	358	200

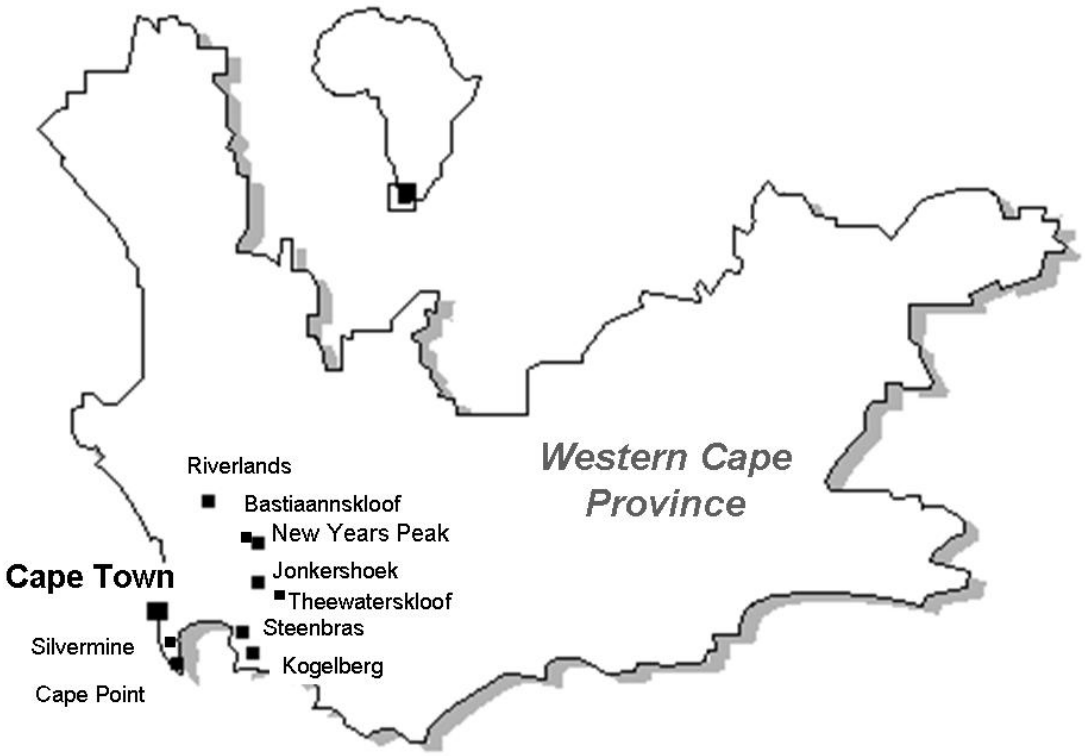

Figure 1. Location of the 10 sites established in the Western Cape Province, South Africa. Note that there are two sites at Cape Point.

Presently all sites are being monitored by our collaborators at SANBI and the nature reserve rangers we trained as part of the project. Moreover, the monitoring tasks have already been incorporated into the routine conservation activities of Cape Nature personnel and we have been assured that this shall be maintained for at least the next 3 years at the end of this project.

We have employed a replacement for our South Africa-based research fellow. He is Mr. James Ayuk Ayuk, who is enrolled as a PhD student at the University of the Western Cape and is co-supervised by Dr Guy Midgley, our collaborator at SANBI (Kirstenbosch), Prof. Lincoln Raitt (University of Western Cape) and Dr. Yoseph Araya (Open University). This employment was in response to the hiatus created as a result of departure of our South Africa based Research Fellow and implemented after consultation with SANBI and DI secretariat. We had requested and been granted a no-cost extension of our project by 6 months so that the money allocated for this part of the work can be used to fund a full 2 years of Mr Ayuk's work. In this time he should be able to achieve the original objectives of this part of the project. (The remainder of his PhD will be funded by SANBI). We are glad to report that, the student (James Ayuk) has made a promising start.

Since his official start in October 2009, James Ayuk has collated and calculated historical and present meteorological information for the study sites for input in to our hydrological database. At the moment, the hydrological database is populated with meteorological, hydrological and botanical data and is ready for the next step of determining interrelationships between the different variables as well as modelling the expected future distribution of species in the light of the effect of projected climate change on soil hydrology. **Figure 2** presents the hydrological database components. **Figure 3** shows an example of data-set (water table depth and climate conditions) on which we are building physical/statistical relationships for use in the prediction of climate change scenarios.

Now that all 10 study sites have been surveyed, we aim to complete the eco-hydrological decision-making tools based on our field data in the next 6 months.

The full number of field rangers targeted for training has nearly been met (21 out of 24). There is additional demand that we have not been able to meet now and which we would hope to be able to satisfy in a follow-on project.

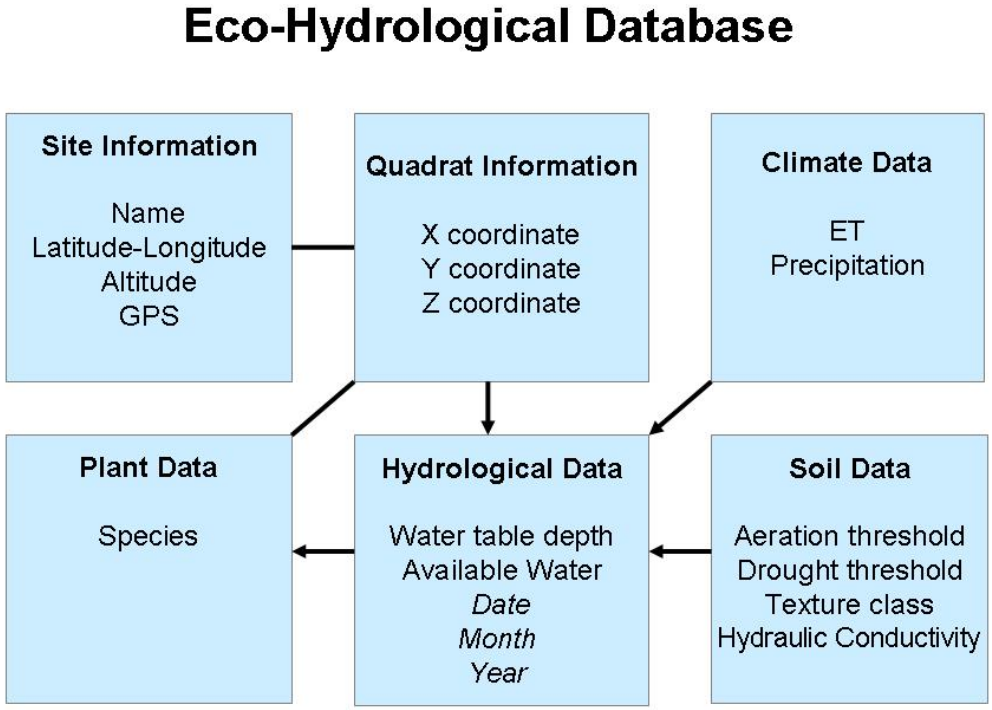

Figure 2. Ecohydrological database components. The connectors and arrows show database components which are linked to each other, while the arrows additionally show (when known) the direction of influence.

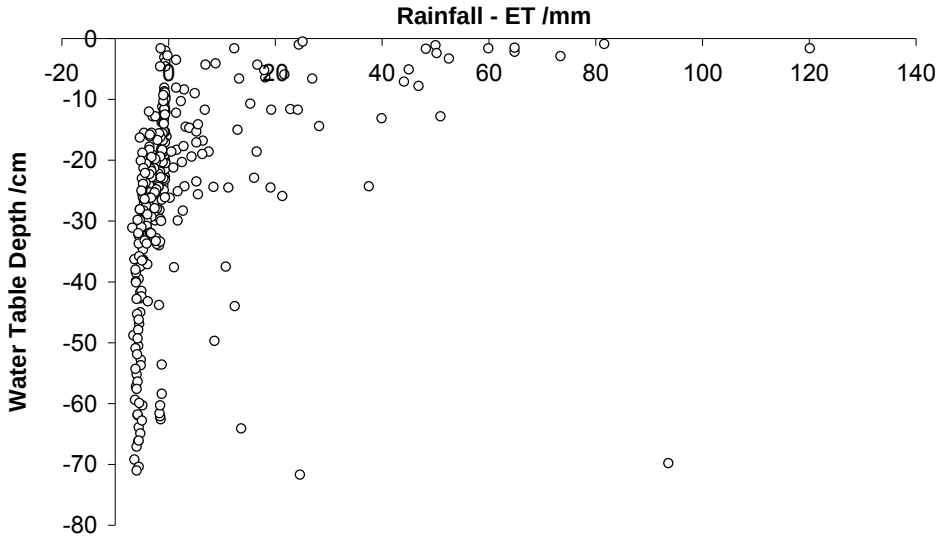

Figure 3. An example of the relationship between recorded meteorological data (i.e. Rainfall - Evapotranspiration) and observed hydrological data (soil water table depth). Developing an appropriate physical/statistical relationship will help us predict water table depths for future scenarios of changing climate (*work in progress*).

3.2 Progress towards Project Outputs

Two and a half years into the project, we have completed all our fieldwork. We have established and completed full botanical and topographical surveys of all 10 sites. We have calculated the mean water regime requirements (hydrological niches) of over 96 frequently occurring fynbos species (See **Figure 4**).

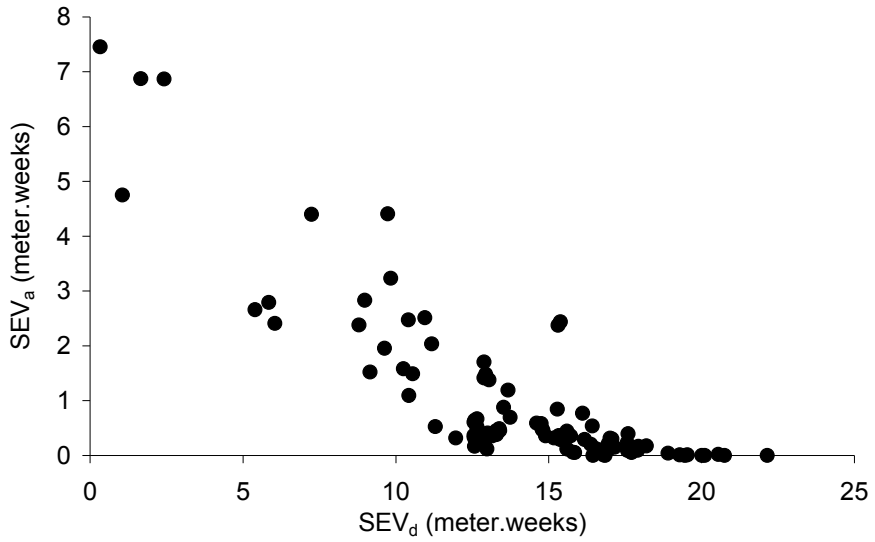

Figure 4. Mean hydrological niche parameters of 96 fynbos species (●), as assessed by Sum Exceedance Values: SEV_d for drying and SEV_a for aeration stress. (from Araya *et al*. submitted)

Hydrological monitoring is being continued by our South African partners including 21 of the rangers trained by our project. A SANBI technician is collating the data.

Our eco-hydrological database is being populated with hydrological, botanical and meteorological data. These data are being prepared for further analysis by our South Africa based researcher (Mr. Ayuk) who will analyse relationships between those data with the aim vegetation distribution modelling. We aim to use the outputs from these analyses to develop the conservation management decision-making tools.

In all this we have fully involved our project partners and their relevant personnel in establishing sites, collecting data and disseminating results.

3.3 Standard Measures

Table 1 Project Standard Output Measures

Code No.	Description	Year 1 Total	Year 2 Total	Year 3 Total	Year 4 Total	Total to date	Number planned for this period	Total planned from application
6A, 6B	Field rangers trained	14	10			24		24
15b	Local press release in SA	1	1	1		1	1	3
New - Project specific measures	n/a							

Table 2 Publications

Type	Detail (title, author, year)	Publishers (name, city)	Available from	Cost £
Journal article	Variation in $\delta^{13}C$ among species and sexes in the family Restionaceae along a fine-scale hydrological gradient, Araya et al., 2010	Wiley-Blackwell, Ecological Society of Australia	http://www.wiley.com/bw/journal.asp?ref=1442-9985	

Our paper entitled: A fundamental, eco-hydrological basis for niche segregation in plant communities, Araya et al. is currently in review with a leading ecology journal.

We had two invitations to speak at two international conferences on which the following two talks were presented.

Silvertown, Araya, Linder, Gowing, McConway and Midgley; *Evolution of hydrological niches*. Ecological Society of America Annual Meeting, Aug 2-7, 2009; Albuquerque, NM

Silvertown, Araya, Gowing, McConway, Linder and Midgley. *Hydrological niches in the Cape flora.* British Ecological Society; Sept. 8-10, 2009; Hatfield, UK

In October 2009 we briefed a features writer for the daily Afrikaans national broadsheet newspaper, *Die Burger* (www.dieburger.com) who was very excited about our work and said that she will be reporting on it in one or more articles over the next 12 months.

Prof. Silvertown also gave project update presentations to the Scientific Services Section of Cape Nature in October 2009 and at Kirstenbosch Research Centre, South African National Biodiversity Institute in April 2010.

3.4 Progress towards the project purpose and outcomes

At this stage of the project we have completed the collection of data to enable the provision of sufficient quantitative data for fynbos management (output i).

Our recently appointed South Africa based researcher (Mr. Ayuk) has taken over from our previous employee and is on track to produce output on species distribution modelling (output ii) according to the revised schedule.

Ranger training has been completed with two rounds of training undertaken (output iii).

Progress towards output (iv), is expected in the next 6 -12 months, using inputs of (i) and (ii).

3.5 Progress towards impact on biodiversity, sustainable use or equitable sharing of biodiversity benefits

We are on schedule to deliver our knowledge, research and training objectives. Cooperation from South African partners has been excellent and they already appreciate the benefits of this project to their organizations. One example of this is, Cape Nature have declared their intention to maintain hydrological monitoring of the 5 of our field sites that are on their land for at least 3 years after our project ends. We have also discussed a follow-up DI project with them which they are very keen to support.

We are compiling the eco-hydrological database of fynbos species which will form an important part of the project's legacy.

4. Monitoring, evaluation and lessons

We have conducted 3 fieldwork visits in the last year, both as part of DI project and the associated NERC funded post-fire project (See Section 6 of this report), to monitor progress. We maintain regular phone and e-mail communication with partners in South Africa. Data collection by local partners are regularly monitored by the PIs and the UK-based postdoc.

5. Actions taken in response to previous reviews (if applicable)

Query 1. Can more use be made of the full species diversity data in terms of modelling future changes, or is the full focus of the project on Restionaceae?

In our monitoring protocol we have made sure to record all species found in our quadrats. Although our project mandate will focus on Restionaceae, the data collected could potentially be used for other species, although many such as Proteaceae have sample sizes that will be too small.

6. Other comments on progress not covered elsewhere

In response to the fires that occurred at two of our study sites last year, we obtained an urgency grant from NERC (£45,000) to study post-fire regeneration of fynbos species on those sites. This grant has enabled us to extend the scope of our research into the origin of the patterns that we have discovered in fynbos vegetation.

This year, we have resurveyed our two burnt sites. The results are not yet finalized, awaiting DNA identification (barcoding) of germinated Restionaceae seedlings. Nevertheless, the results look promising and we believe not only will this research complement our current work but it should also lead to other opportunities. Meanwhile, hydrological monitoring of the sites still continues.

7. Sustainability

Local partners and staff will ensure the project carries on beyond UK partner's project involvement. To date we have received enthusiastic support and involvement from all partners involved (Cape Nature, SANBI and SANPARKS) as well as from the three main HEIs in the W.Cape: University of Cape Town, Stellenbosch University and more recently University of the Western Cape.

8. Dissemination

Our dissemination has involved communicating with nature reserve managers; scientific personnel at conservation organizations (Cape Nature, South African National Parks) and academic/research institutions (CSIR, SANBI, University of Cape Town, Stellenbosch University and University of the Western Cape).

Another way of dissemination we are considering, In collaboration with our project partner Cape Nature is to produce flyers about our research for the use of rangers and the general public.

We have briefed a features writer for the daily Afrikaans national broadsheet newspaper, *Die Burger* (www.dieburger.com) who will be reporting our work. We aim to build on this in the up-coming period.

Prof. Silvertown plans to attend the Fynbos Forum in August 2010 to report on the results of the project and to talk to existing and potential new project partners about a post-project application that we expect to submit later this year. Fynbos Forum is a three-day meeting attended by about 300 conservation professionals, land managers and scientists who work on fynbos.

9. Project Expenditure

Table 3 Project expenditure during the reporting period (Defra Financial Year 1 April 2009 to 31 March 2010)

Item	**Budget** (please indicate which document you refer to if other than your project application or annual grant offer letter)*	Expenditure	Variance
Rent, rates, heating, overheads etc			
Office costs (e.g. postage, telephone, stationery)			
Travel and subsistence			
Printing			
Conferences, seminars, etc			
Capital items/equipment (specify)			
Others (specify)			
Salaries (specify by individual)			
TOTAL			

*NB This refers to the modified budget that was approved when a no-cost extension of the grant was agreed in early 2010.

10. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum). This section may be used for publicity purposes

I agree for LTS and the Darwin Secretariat to publish the content of this section

Annex 1 Report of progress and achievements against Logical Framework for Financial Year: 2008/09

Project summary	Measurable Indicators	Progress and Achievements April 2008 - March 2009	Actions required/planned for next period
Goal: *To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but constrained in resources to achieve* *The conservation of biological diversity,* *The sustainable use of its components, and* *The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources*			*(do not fill not applicable)*
Purpose: To provide a quantitative, scientific basis for the incorporation of eco-hydrology in the management of fynbos habitats in the Cape Floristic Region potentially threatened by water abstraction.	Inclusion of eco-hydrological data in impact assessments and conservation management plans for fynbos habitats.	It is early in the project for this to have been achieved, but the enthusiastic cooperation we have received from Cape Nature, SANBI, SANPARKS and CSIR in South Africa indicates that our results are eagerly awaited and will be used when available.	We will continue with the planned programme of research and when possible training.
Output 1. A database of eco-hydrological requirements of endemic species	Number of species and sites for which eco-hydrological parameters have been entered in the database.		
Activity 1		Good progress has been made. We have data on more than 60 species of Restionaceae at 10 sites. Restionaceae are keystone species in fynbos and are the focus of our work.	
Output 2. Enhanced models of the distribution of species in the	Comparison of the performance of models with and without eco-		

Project summary	Measurable Indicators	Progress and Achievements April 2008 - March 2009	Actions required/planned for next period
Proteaceae and Restionaceae.	hydrological parameters.		
Activity 2		We have scoped the problem and decided how the models will be built. We are currently tackling the issue of how we connect the local scale at which we are making hydrological measurements with the geographical scale appropriate for the modelling of species' distributions. This is being done by looking at the empirical correlation between rainfall and soil water availability. In addition to the work we are doing ourselves, more data on actual geographical distributions of Restionaceae will be collected by our collaborator in Zurich (Peter Linder) and climate envelopes will be computed for his data.	
Output 3. Trained staff.	Number of trained staff.		
Activity 3		We have designed the training course, written course materials and undertaken training twice (July 2008 and October 2008). 21 rangers from Cape Nature and SANPARKS have successfully completed. They are already helping in monitoring.	
Output 4. Improved decision-making tools.	Comparison of new decision-making tools with previous practice.		
Activity 4.		This activity is planned for later in the project.	

Annex 2 Project's full current logframe

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Goal: To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilisation of genetic resources			
Purpose To provide a quantitative, scientific basis for the incorporation of eco-hydrology in the management of fynbos habitats in the Cape Floristic Region potentially threatened by water abstraction.	Inclusion of eco-hydrological data in impact assessments and conservation management plans for fynbos habitats.	Impact assessments and management plans for fynbos habitats	Impact assessments and management use an evidence-based approach.
Outputs (i) A database of eco-hydrological requirements of endemic species (ii) Enhanced models of the distribution of species in the Proteaceae and Restionaceae. (iii) Trained staff. (iv) Improved decision-making tools.	(i) Number of species and sites for which eco-hydrological parameters have been entered in the database. (ii) Comparison of the performance of models with and without eco-hydrological parameters. (iii) Number of trained staff. (iv) Comparison of new decision-making tools with previous practice.	(i) Reports and publication of peer-reviewed papers. (ii) Test models against observed distributions of species with and without inclusion of eco-hydrological parameters. (iii) Independent verification by Cape Nature &/or allied bodies. (iv) Testing and use of decision-making tools.	Sufficient staff of the right grades obtain training, so as to permanently enhance the capacity of conservation managers in eco-hydrology,

Checklist for submission

	Check
Is the report less than 5MB? If so, please email to Darwin-Projects@ltsi.co.uk putting the project number in the Subject line.	Y
Is your report more than 5MB? If so, please advise Darwin-Projects@ltsi.co.uk that the report will be send by post on CD, putting the project number in the Subject line.	N
Have you included means of verification? You need not submit every project document, but the main outputs and a selection of the others would strengthen the report.	Y
Do you have hard copies of material you want to submit with the report? If so, please make this clear in the covering email and ensure all material is marked with the project number.	N
Have you involved your partners in preparation of the report and named the main contributors	Y
Have you completed the Project Expenditure table fully?	Y
Do not include claim forms or other communications with this report.	