Protected Areas Resilient to Climate Change, PARCC West Africa

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Using the systematic conservation planning approach for mitigating the impacts of climate change on protected areas

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The Durrell Institute of Conservation and Ecology is part of the School of Anthropology and Conservation at the University of Kent. It was found in 1989 and has a focus on building capacity in biodiversity rich countries and undertaking research with direct conservation relevance.

The UNEP World Conservation Monitoring Centre (UNEP-WCMC) was established in 2000 as the biodiversity assessment and policy implementation arm of United Nations Environment Programme (UNEP). The roots of the organisation go back to 1979, when it was founded as the IUCN Conservation Monitoring Centre. We are the custodians of the World Database on Protected Areas (WDPA), a joint project with IUCN – The World Conservation Union and their World Commission on Protected Areas. The WDPA is the only global database of marine and terrestrial protected areas, comprising GIS spatial data and spatial attribute data, in existence. It is used to report the progress towards targets such as United Nations (UN) Millennium Development Goal 7, the Convention on Biological Diversity (CBD), UN List of Protected Areas as well as providing support to policy and decision managers.

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Executive Summary

The PARCC West Africa project is a full-size GEF project focusing on the issues of climate change and protected areas. The Durrell Institute of Conservation and Ecology (DICE) at the University of Kent is one of the international partners on the PARCC project and is responsible for leading the conservation planning component. The aim of the work to be undertaken by DICE is: (i) to develop conservation planning systems for the West Africa region and five core countries that can be used to inform decisions about mitigating the impacts of climate change on protected area (PA) networks; (ii) to use these systems to help guide policy in the region; and (iii) to train conservation practitioners in the region so that they can continue to use these planning systems in the future.

The project will adopt a systematic conservation planning approach, which is the most widely used system for identifying priority areas for conservation. The first steps in this process involve developing a list of conservation features, such as important species and habitat types, and then setting targets for each feature. This information can then be used to (i) undertake a “gap analysis”, which measures the extent to which these targets have been met by existing PAs and (ii) run systematic conservation assessments, which use computer software to identify priority areas for achieving any unmet targets, whilst minimising costs and achieving connectivity. This project will undertake a gap analysis for the West Africa region and conservation assessments for the five PARCC focal countries (Chad, Gambia, Mali, Sierra Leone, and Togo).

The gap analysis and the conservation assessments will use data on the current distributions of bird, mammal, amphibian, freshwater fish, crab, dragonfly and mollusc species, Key Biodiversity Areas, geophysical types and vegetation types. They will also explicitly account for climate change impacts by using data on: (i) the predicted ranges of bird and mammal species under different climate change scenarios, based on bioclimatic and trait-based modelling; (ii) climate chance resilience areas, which will be based on identifying gorges, areas with high topographic variability and shaded slopes that are covered by natural vegetation. A data audit shows that much of the required information is already available, although more socio-economic data are required for the national conservation assessments to ensure that the identified priority areas have a minimal impact on the livelihoods of local people.

1. The PARCC project

PARCC West Africa, officially known as 'Evolution of Protected Area Systems with Regard to Climate Change in the West Africa Region' is a full-size GEF project focusing on the issues of climate change and protected areas. UNEP World Conservation Monitoring Centre (UNEP-WCMC) is the executing agency (Project Management Unit, PMU), and IUCN PAPACO is the main regional partner (Regional Management Unit, RMU).

The project will run from October 2010 to September 2015. The geographic scope of the project covers 5 core countries in West Africa: Chad, Gambia, Mali, Sierra Leone, and Togo. An additional 3 countries will participate in preparatory activities relating to transboundary conservation (Burkina Faso, Côte d'Ivoire and Ghana).

The project represents a significant body of work to be undertaken across a wide geographic area. There are potentially huge benefits to the whole West Africa region from using the tools developed to increase the resilience of protected areas to climate change. The project will also allow for additional transboundary conservation initiatives. To achieve these aims, the project will require significant support from all its local, regional, and international partners.

The Durrell Institute of Conservation and Ecology (DICE) at the University of Kent is one of the international partners on the PARCC project and is responsible for leading the conservation planning component. The aim of the work to be undertaken by DICE is: (i) to develop systematic conservation planning systems for the West Africa region and the five core countries that can be used to inform decisions about mitigating the impacts of climate change on protected area (PA) networks; (ii) to use these systems to help guide policy in the region; and (iii) to train conservation practitioners in the region so that they can continue to use these planning systems in the future.

This report provides an introduction to the topic of systematic conservation planning and an outline of the conservation planning work that will be done as part of the PARCC project. The first section describes the theory behind systematic conservation planning and techniques for incorporating climate change data. The second section describes the activities that DICE will lead on in the PARCC project.

2. Introduction to systematic conservation planning

Systematic conservation planning is an approach for designing PA systems and other conservation networks. One of its key strengths is that it avoids being overly prescriptive (Pressey et al. 2003), but the approach generally involves the following steps:

1) Identifying and involving key stakeholders
2) Identifying broad goals for conservation planning
3) Gathering and evaluating data
4) Formulating targets for conservation features
5) Conducting a gap analysis to review target achievement in existing PAs

6) Selecting additional conservation areas through a conservation assessment
7) Implementing conservation action in selected areas
8) Maintaining and monitoring established conservation areas

Systematic conservation planning is a long-term process and much of it involves working with stakeholders to collaboratively develop and deliver an implementation strategy (Knight et al. 2006a). However, there are two key short-term technical aspects to this process. The first is a gap analysis (step 5 listed above) which involves measuring the effectiveness of a current PA network to represent biodiversity. The second is a conservation assessment (step 6 listed above) which involves identifying new areas for conservation that address any representation gaps in the PA network (Knight et al. 2006a).

This project will develop a regional conservation planning system to conduct a gap analysis for the West Africa region to help guide and inform conservation activities and policies. In addition, it will produce a conservation planning system and undertake a conservation assessment for each of the five core countries, as well as build capacity to ensure that these systems can be used for long-term conservation planning and decision making. So, this section will contain a more detailed description of gap analysis and conservation assessment and discuss how this can incorporate data on climate change and climate change mitigation.

3. Gap analysis

A key part of any conservation planning process is to conduct a gap analysis, which measures the extent to which important species, habitats and ecological processes are represented in a PA system. Recent research has shown that many PA networks under-represent these important species and biomes (Rodrigues et al. 2004; Hoekstra et al. 2005), which is why the Conference of the Parties to the Convention on Biological Diversity have adopted a programme of work on PAs to support the establishment of ecologically-representative networks of PAs (Dudley and Parish 2006).

At its simplest, a gap analysis combines data on PA location with distribution maps of important conservation features, such as species and habitats, to measure the level of protection given to each feature (Scott et al. 1993). However, this simple analysis takes no account of the conservation value of the feature or how much of it needs to be protected to ensure long-term persistence. Thus, more sophisticated gap analyses set targets for how much of each feature should be conserved and measure target attainment rather than simple percentages of protection (Rodrigues et al. 2004). This type of target-based gap analysis is also an important first step in the systematic conservation planning approach to designing PA systems (Margules and Pressey 2000), which uses the same data to help identify priority areas for locating new PAs to meet all the targets.

4. Systematic conservation assessments

A conservation assessment is used to identify priority areas where new PAs or other types of conservation interventions should be focused. These assessments generally involve a large amount of data and so GIS and conservation planning software are commonly used to analyse this information, although the software outputs will only ever act as a support tool for decision makers. In general, this process involves:

i. Developing a list of conservation features, such as important species, habitats and ecological features.

ii. Setting representation targets for how much of each feature should be represented in the PA network (Carwardine et al. 2009).

iii. Sub-dividing the planning region into a number of planning unit polygons (Nhancale and Smith 2011).

iv. Determining the amount of each feature found in each planning unit.

v. Assigning a cost value to each planning unit, based on whichever constraint is relevant to the analysis, e.g. financial value or opportunity costs (Naidoo et al. 2006).

vi. Using computer software to identify portfolios of these units that meet the representation targets whilst minimising planning unit costs (Moilanen et al. 2009).

There is no specific method for conducting a conservation assessment, as they need to be tailored to local conditions (Knight et al. 2006b), but they all share the following four characteristics:

A. *Spatially explicit*

Conservation assessments identify priority areas and so are based on spatial data. This means that any relevant information that cannot be converted into a spatial format has to be excluded from the assessment process.

B. *Representation and persistence*

Conservation assessments aim to identify PA systems or other ecological networks that fully represent the planning region's biodiversity and ensure its long-term persistence (Knight et al. 2007). Mapping all of this biodiversity is beyond the scope of any assessment, so a set of biodiversity surrogates are used instead. These biodiversity elements, also known as conservation features, are selected based on local conditions and data availability, but they typically include broad environmental surrogates, such as habitat or landcover types, as well as key species and ecological processes (Cowling et al. 2004).

C. *Target driven*

Conservation assessments are based on explicit numerical representation targets, so that priority areas are designed to conserve the specified amount of each conservation feature (Carwardine et al. 2009). This helps ensure that the conservation planning process is not derailed by implicit or explicit political pressures (Cowling et al. 2003). Each target should be developed to ensure the long-term persistence of its associated conservation feature (Pressey et al. 2003).

D. *Complementarity*

Conservation assessments recognise that conservation is only one of a number of competing land-uses and that any priority area system should minimise its impacts on other sectors. The most efficient methods for meeting the conservation targets are based on the concept of complementarity. These methods aim to identify the most cost-effective group of areas that, when combined, meet all of the representation targets (Csuti et al. 1997).

5. Incorporating economic and threat data

Conservation planning software can incorporate a range of other relevant spatial data, thereby increasing the real-world relevance of the assessment. This involves assigning a cost to each planning unit and then using software packages, such as Marxan, to identify portfolios of these planning units to minimise the costs of meeting the representation targets (Ball and Possingham 2000). Thus, using a planning unit cost metric that represents the financial value of the land (Pence et al. 2003), the opportunity costs of using the land for conservation (Smith et al. 2008) or land-owner willingness to engage in conservation (Knight et al. 2011) can identify PA systems with more political relevance.

Producing a PA system that meets all of the representation targets is usually a long-term process, with projects often assuming a 20 to 50 year implementation time period. This makes it highly likely that conservation assessments will identify some priority areas that will be transformed before they can be protected. Conservation planners can address this problem in two ways. First, it is important to continuously update the planning system data and repeat the assessment process at regular intervals (Meir et al. 2004). This will ensure that the assessment identifies priority areas based on the actual distribution of the conservation features. Second, assessments can include data on risk of habitat transformation. These data can be used both to avoid high risk areas wherever possible and prioritise conservation interventions (Wilson et al. 2005).

6. Incorporating climate change into conservation planning

When producing long-term plans to develop robust and representative PA networks, it is also important to incorporate data on climate change into the conservation assessment. There are two broad approaches to mitigate the impacts of climate change. The first is to establish new PAs to ensure that the future range of important conservation features are adequately protected. Such an approach may also involve considering whether any current PAs should be degazetted in the future because they no longer contain important conservation features (Fuller et al. 2010). The second is to increase landscape connectivity by creating or maintaining linkages so that species can move between existing PAs.

The first approach involves predicting how species ranges will change in response to climate change and these models are affected by uncertainty in how the climate will change at a particular location and how the species will respond. The second approach is less dependent on these models, as it makes the general assumption that increasing connectivity will help mitigate impacts without specifying which particular species will benefit. This is why conservation planners have developed a range of techniques to incorporate climate change into the analysis (Game et al. 2011), which vary in terms of their reliance on high quality data and the accuracy of the model predictions. These techniques include:

i. Using current and future species range maps to identify where new PAs should be located to help meet conservation targets at the present time, as well as in the future based on bioclimatic models (Hole et al. 2009).

ii. Using current and future species range maps to identify where new PAs should be located, based on trait-based models that predict how each species will respond to climate change.

iii. Using data on geophysical characteristics to ensure that the full range of physical factors that influence species distributions are represented in a PA network (Beier and Brost 2010). This approach is fairly conservative, as it makes no predictions about how species will respond to climate change, but setting targets for the relative importance of each geophysical type is also strongly affected by uncertainty.

iv. Mapping areas where climate change resilience is likely to be highest, either because models predict relatively small changes in temperature and/or rainfall or because the physical characteristics of the landscape mean that any broad changes will be less severe (CEPF 2010).

v. Designing corridors or maintaining connectivity to ensure that species can disperse along climate gradients and so move between PAs and other patches of natural vegetation in response to changes in climatic conditions (Hodgson et al. 2009).

In this project we will use a number of these different techniques to ensure our analyses are robust to issues of data uncertainty.

7. Conservation planning projects in PARCC

A. West Africa regional projects

a. Mapping climate change resilience areas

There are a number of geographical features that mitigate the impacts of climate change, either because they are naturally cooler than the surrounding landscape or because they provide connectivity that increases the likelihood that species can disperse and so modify their ranges. Fortunately, these features are relatively easy to map using digital elevation model (DEM) and landcover data, so this project will adopt an existing approach (CEPF 2010) to map gorges, intact landscapes and areas with high topographic variability and north facing slopes. We will use the Shuttle Radar Topography Mission (SRTM) DEM dataset, which has a global coverage and a 30m resolution and for the intact landscapes, will combine this with the GLOBCOVER landcover data, which has a 300m resolution and is based on satellite images from 2004 and 2006. These data will be used as part of the regional PA gap analysis and we will also calculate the area of gorges, areas with high topographic variability and shaded slopes that are covered by natural vegetation.

b. West Africa regional PA gap analysis

The regional PA gap analysis will use the latest available data on PA distributions for the West Africa region and measure the extent to which each of the following features are represented in the PA system at both a regional level and for the 15 member states:

i. Current distributions of bird, mammal, amphibian, freshwater fish, crab, dragonfly and mollusc species
ii. Predicted distributions of bird and mammal species (+ ideally amphibians) based on bioclimatic and trait-based modelling
iii. Important Bird Areas
iv. Current distribution of vegetation types (based on combining landcover, elevation and ecoregion data).
v. Future distribution of vegetation types (based on combining landcover, elevation and ecoregion data)
vi. Climate change resilience areas
vii. Geophysical types

This gap analysis will also use PA management effectiveness data, where known, to measure the area of each conservation feature found in PAs with each of the management effectiveness scores. This analysis will provide extremely important information on how well each feature is protected and will flag up any conservation features that are particularly under-represented in the PA system. Maps of these features will then be produced to highlight where new conservation interventions are needed and combined with maps of socio-economic data to show where these interventions are most likely to succeed.

B. National analyses and projects

a. Produce the five national conservation planning systems

The five national conservation planning systems will be based on the Marxan and Zonae Cogito software packages, which are both freely available for download. Developing these planning systems will involve collating all the available GIS data and running expert workshops to determine how these data should be supplemented, combined and analysed. This will broadly involve the following steps:

i. Importing all the available species, vegetation, ecological process and climate change resilience area distribution maps into the conservation planning system.
ii. Deciding which available social and socio-economic data (e.g. human population density data) should be used as the basis of the planning unit cost metric and deciding how these data should be combined and included in the planning system.
iii. Producing implementation data maps that show where plans to set up new PAs or corridors are likely to be supported (e.g. where this overlaps with existing government plans or where local communities support is high) and where conservation is not likely to be supported (e.g. where land has already been set aside for mining or agricultural expansion).
iv. Setting targets for each of the conservation features based on the best available scientific research, comparisons with previous studies and expert opinion.

b. Provide training in using the national planning systems

As part of the workshops to develop the conservation planning systems we will provide training in using the Marxan and Zonae Cogito software packages. We will also produce guides to using the software so that participants and their colleagues can refresh their knowledge when they need to use their planning system. Finally, we will provide their national planning systems in the correct format within Marxan and Zonae Cogito so that they can be used as a decision support tool by government and other groups.

c. Undertake conservation assessments to identify priority areas in each country

We will use the conservation planning systems to identify priority areas for conservation in each of the five core countries of the project, based on the current distribution of the conservation features and predicted changes under climate change. These priority areas will account for existing PAs and show areas that are most important for meeting the conservation targets, whilst maintaining connectivity, minimising socio-economic costs and accounting for local implementation factors.

d. Socio-economic MSc project

This project will involve reviewing the broad conservation and climate change mitigation policy documents for West Africa, collating the available socio-economic data and conducting a needs assessment to determine how relevant these datasets are for informing policy and what datasets are needed to address any information gaps.

8. Proposed timetable

Year 1

- Produce inception report

Year 2

- Produce the climate change resilience areas map for the West Africa region
- MSc project – preliminary gap analysis for the West Africa region
- MSc project – socio-economic gap analysis

Year 3

- Produce the initial versions of the five national planning systems based on available data

Year 4

- Produce conservation planning training materials
- Training workshop for partners from the five pilot countries

- Workshop with partners to develop the national systematic conservation planning systems

Year 5

- Produce reports presenting conservation assessments for the five pilot countries
- Produce report presenting the results from the West Africa region gap analysis
- Submit manuscript describing the gap analysis results

9. Data audit

	PA boundaries	PA management effectiveness	Species	Species under climate change*	Vegetation	Elevation	Socio-economic data
Regional	I	I	✓	✓	✓	✓	✓[1]
Chad	I	I	✓	✓	✗	✓	✗
Gambia	✓	✓	✓	✓	⌛	✓	✓
Mali	I	I	✓	✓	✓[2]	✓	✗
Sierra Leone	⌛	I	✓	✓	✗	✓	⌛
Togo	⌛	I	✓	✓	✗	✓	✗

✓ = complete; I = incomplete; ⌛ = in preparation ✗ = not available

* Bird, mammal and amphibian data [1] Human population density data [2] Maps showing ecoregions

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