Conservation planning: climate change implications

Presented by
Belinda Reyers

CSIR Environmentek
Conservation planning

- Use of systematic procedures to identify priority geographic areas for conservation attention
The process of conservation planning

- Biodiversity data
- Transformation
  - Targets
  - Protected areas
- Software and GIS

Cape Action Plan for the Environment Biodiversity Irreplaceability Map

Core sites of the proposed 20-year Conservation Vision for SWARTLAND/BOLAND Bioregion
Conservation planning

- Static vs. dynamic focus
- Biodiversity data
  - Species distributions
  - Habitat extent
  - Ecological and evolutionary processes
Climate change affects future species distributions
Future conservation planning

- Conservation strategies as we know them – soon obsolete
- Formal flagship protected areas predicted to lose many of their species (Rutherford et al. 1999; Erasmus et al. 2002)
- Need to include implications of climate change into conservation planning
- Dynamic conservation planning
- Future climate change constrained
- Climate change-integrated conservation strategies (CCS)
Needs

- Regional modeling of biodiversity response
- Selection of protected areas with climate change as an integral factor
- Landscape level management of biodiversity
- Regional coordination of management
- Polluter pays
- (Hannah et al, 2002)
Currently

- **Range of methods available**
  - Biome movement
  - Mapping gradients
  - Detailed climate change studies on particular species of conservation concern

- **Theoretical**

- **Practical framework**
  - Data, infrastructure and expertise
  - Type of CCS
Framework for climate change-integrated conservation strategies (CCS)

- CCS1: Tier 1
- CCS2: Tier 2
- CCS3: Tier 3

Increasing complexity of strategy

Data & expertise available
# TIER 1

## CCS 1 – Areas of stability/resilience

<table>
<thead>
<tr>
<th>Data available</th>
<th>broad ecosystem map</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>topographical information</td>
</tr>
<tr>
<td>Expertise</td>
<td>model future distribution of</td>
</tr>
<tr>
<td></td>
<td>ecosystems/biomes</td>
</tr>
<tr>
<td>Method</td>
<td>Identify areas of greatest stability under 1+ scenarios</td>
</tr>
<tr>
<td>Refinements</td>
<td>Refine those using areas of high topographic diversity</td>
</tr>
</tbody>
</table>
Projected future change in biomes
Ch 8: Implications for conservation planning

CCS 1 – Areas of stability/resilience
<table>
<thead>
<tr>
<th><strong>TIER 2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CCS 2 – Areas of current &amp; future conservation value</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Data available</strong></th>
<th>broad scale species distributions (Presence/absence; interpolated; grid cell)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expertise</strong></td>
<td>model species distributions conservation planning</td>
</tr>
<tr>
<td><strong>Method</strong></td>
<td>Identify areas of high conservation value based on <em>current</em> &amp; <em>future</em> species distributions</td>
</tr>
<tr>
<td><strong>Refinements</strong></td>
<td>Assess overlap</td>
</tr>
</tbody>
</table>
Ch 8: Implications for conservation planning

Conservation value

Conservation value map with different tiers indicating conservation value ranges.

Tier 2

Irreplaceability

0 - 0.1
0.1 - 0.36
0.36 - 0.65
0.65 - 0.89
0.89 - 1

Kilometers

0 - 4
5 - 12
13 - 20
21 - 29
30 - 41
CCS 2 – Areas of conservation value

Irreplaceability
- 0.1
0.1 - 0.36
0.36 - 0.65
0.65 - 0.89
0.89 - 1

Kilometers

Current

Future
CCS 3 – Species dispersal

- Data available: Expertise: Complex climate time step modeling

- Identify areas required by each species to track climate change
Tier 3

**CCS3 – Bioclimatic & Dispersal Time Slice modelling**

- **Data available**: species localities (fine scale), life history information
- **Expertise**: complex climate time slice modeling
- **Method**: Identify areas/corridors required by species to track climate change
Tier 3

**CCS3 – Bioclimatic & Dispersal Time Slice modelling**

- Midgley, Hughes *et al.* (In Press)
- Uncertainties in projecting the impacts of climate change on biodiversity
  - Assumptions of niche based modeling
  - GCM projections
  - Migration rate & dispersal abilities
    - 2 extreme assumptions: full (instantaneous & unlimited) or null migration
    - Species specific parameterization
Tier 3

**CCS3 – Bioclimatic & Dispersal Time Slice modelling**

- 336 Protea species (Protea Atlas)
- 60,000 georeferenced sites
- Presence-absence - 250,000 records
- GCM HAD2
- 5 bioclimatic variables: Soil fertility and texture
- 1 minute grid
- Modeled 10 year time intervals = decadal time slices
- Migration rate determined per time slice based on dispersal agent
  - 1 cell per time slice for ant and rodents dispersed spp.
  - 3 cells per time slice for wind dispersed spp.
Tier 3

CCS3 – Bioclimatic & Dispersal Time Slice modelling
Tier 3

CCS3 – Bioclimatic & Dispersal Time Slice modelling

- Method was applied to the problem of conservation planning in Williams et al. In Press
- Method for identifying multiple corridors of connectivity through shifting habitat suitabilities that seeks to minimise
  - dispersal demands and then
  - the amount of land area required
- Goal is to represent each species where possible in at least 35 grid cells (approximately 100 km²) at all times between 2000 and 2050 despite climate change.
- Identify dispersal chains backwards
  - Heuristic algorithm in WORLDMAP
  - Suitable habitat within specified distance
Tier 3

CCS3 – Bioclimatic & Dispersal Time

Slice modelling

- Maximum dispersal step permitted per time slice = 1 cell
- Search backwards from 2050
- Minimum dispersal steps

Click to enlarge
CCS 3 – Species dispersal

- (light grey) cells with 66% or more transformation of habitat
- (green) cells with existing protection
- (red) cells chosen to represent goal-essential chains
- (blue) cells chosen to complete chains for species part-represented within existing protected cells and goal-essential cells
- (orange) cells chosen using an iterative complementarity algorithm based on greedy richness.
Check your understanding of Chapter 8

PASS MARK 80%

Please do not proceed further until you have PASSED

Chapter 8: test yourself
I hope that found chapter 8 informative, and that you enjoy chapter 9.