Adaptation of biodiversity to climate change

Presented by
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CSIR Environmentek
Introduction

- Adaptation
- Climate change and biodiversity research
- What has lead to current conservation
- Trends in conservation
- Adaptation options
Adaptation I

- What options do biological organisms have to adapt to changing climates
  - Persisters. The organism is pre-adapted to the new climate and will persist
  - Dispersers. The organism moves with the moving climatic envelope (autonomous) or is moved to a new suitable habitat (facilitated) dispersal
  - Expanders. The new envelope is a better habitat
  - Go extinct
  - Evolve. Not likely given the speed of change
Adaptation II

- Adaptation in global climate change is about how humans adapt to the impacts of climate change
- How can we as humans respond to the impacts that climate will have on biodiversity
  - Past trends in conservation / preservation
  - New trends – sustainable use and benefits
  - Adaptation options
Bringing together conservation planning and climate research

- Climatic predictions based on scenarios
- Climate change is a reality
- Strategic conservation planning – configuring reserves to best conserve biodiversity
- Species envelope mapping
- Dynamic species movement models
Formation of the current conservation network

- Pre-colonization resource management practices
  - Sacred forests
  - Hunting areas
  - Taboos
Colonial conservation

- Two paths of resource management
  - Game and nature reserves
    - Evolved from hunting
    - Main emphasis on the big and hairy
    - Largely based on ecotourism
    - Preservationist attitudes
  - Forest reserves
    - Sustainable wood extraction
    - Protection of indigenous forests
    - Catchment protection
Features of early conservation

- Trees and animals owned by the state
- Use – by the privileged and rich
- Forced removals of resident local people
- Poaching a crime
- Strong law enforcement
- Strong state backing
- Relatively good budgets for conservation
Where were reserves located

- Areas of poor agricultural potential
- Malaria and tsetse areas
- Areas of low human density
- Area with extreme climate
- Mountains
- Forests
- Biodiversity was not the consideration
In the SADC region, 17% of total area is conserved

However, South Africa has only conserved about 6%
What constitutes conservation

- Formally recognized
  - Formal reserves
- Less recognized
  - State forests
  - Wildlife management / hunting area
  - Private reserves
- Unrecognized in statistics used
  - Unused farmland
  - Low biodiversity impact farming practices
Mopane woodland

Typified by relatively low biodiversity in poor Kalahari sands
Mopane is more than adequately conserved

- 38% of Mopane Woodland in South Africa is conserved, mostly in Kruger National Park
Hotspots of biodiversity in South Africa

<table>
<thead>
<tr>
<th>Area</th>
<th>Area (km²)</th>
<th>Species</th>
<th>% Endemics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wolkberg</td>
<td>5 980</td>
<td>2700</td>
<td>4</td>
</tr>
<tr>
<td>Maputaland</td>
<td>26 734</td>
<td>1100</td>
<td>15</td>
</tr>
<tr>
<td>Pondoland</td>
<td>40 000</td>
<td>1750</td>
<td>30</td>
</tr>
<tr>
<td>Eastern Mountain</td>
<td>1 880</td>
<td>1500</td>
<td>8</td>
</tr>
<tr>
<td>Albany</td>
<td>22 500</td>
<td>2000</td>
<td>10</td>
</tr>
<tr>
<td>Succulent Karoo</td>
<td>111 212</td>
<td>4849</td>
<td>40</td>
</tr>
<tr>
<td>Cape</td>
<td>90 000</td>
<td>7000</td>
<td>80</td>
</tr>
<tr>
<td>Koakoveld</td>
<td>70 000</td>
<td>952</td>
<td>12</td>
</tr>
</tbody>
</table>
Ch 5: Biodiversity adaptation and conservation
Succulent Karoo

- Typified by small succulents and sparse individual plants.
- Occurs in the Karoo and up the west coast of South Africa, into Namibia.
- Less than 0.5% formally conserved
Fynbos

- Under extreme threat from urbanisation and agriculture.
- Reserves mostly limited to extreme slopes and mountain peaks.
Reserves in the fynbos region
### Extent of conservation versus “need” for conservation. Two extremes

<table>
<thead>
<tr>
<th>Vegetation type</th>
<th>Centre of endemism</th>
<th>Area in 1000 km²</th>
<th>% transformed</th>
<th>% conserved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mopane shrubveld</td>
<td>no</td>
<td>26</td>
<td>0%</td>
<td>99.8%</td>
</tr>
<tr>
<td>Mopane bushveld</td>
<td>no</td>
<td>209</td>
<td>8%</td>
<td>38%</td>
</tr>
<tr>
<td>West coast</td>
<td>yes</td>
<td>61</td>
<td>97%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Renoster mountain</td>
<td>yes</td>
<td>247</td>
<td>11%</td>
<td>26.2%</td>
</tr>
</tbody>
</table>

Based on Low and Rebelo 1996
Reserves in Madagascar
Reserves in other SADC countries
Conserved area in seven Southern Africa countries

Area (in 1000Km$^2$)

(based on Cumming 2004)
Number of parks in seven Southern Africa countries

(Only national parks and large game reserves for South Africa) (based on Cumming 2004)
Contribution of private land to conservation (estimates only - based on Cumming 2004)
Old trends

- Preservation
- Manage to pre-colonial (pre man) pristine state
- Exclude people
- Separate conservation from other land use
- Conservation the domain of the state
- State owned the wildlife and trees
Pressures on conventional conservation

- Population growth
- Inability to police
- Changed political priorities
- No more land available
- Cut in expenditure
New trends I

- Conservation rather than preservation
- Conservation may include sustainable use
- Allow for change
- Promote tourism and other value addition
- Conservation must pay its way
- Global contribution to third world conservation (e.g. GEF)
New trends II

- Transfrontier conservation areas TFCAs “peace parks”
  - Large areas across countries
  - Linked to development
  - Strong political backing
  - Strong international backing
Current trends I

- Devolution of resource ownership
  - Can own game
  - Local management
- Growth in tourism revenue as % of GDP
- Changes in agricultural subsidies
- Declining world food prices
- Globalization of markets
  - Cattle less profitable
Contribution of private land to conservation in South Africa

- Game Ranching
  - 5 million ha
  - 8.5% land area (vs 6% state reserves)
  - 5,000 – 8,000 ranchers
Current trends II

- Community conservation
  - Community based natural resource management (CBNRM)
  - Joint forest management
  - Community Public Private Partnerships
  - National CBNRM programmes eg CAMPFIRE
  - conservancies

- Strategic conservation planning
  - Computer assisted models e.g. C-plan
  - GEF funding
  - CAPE, SKEP, Wild Coast, STEP

- Habitat fragmentation
- Global warming becoming a reality
- Some species will lose their habitat
- Change in climate too fast for evolutionary adaptation
Adaptation responses

- Persists or expands
- Autonomous dispersal / migration
- Facilitated migration
  - New reserves
  - Management of corridors
  - Translocation
- Preservation
- Extinction
Providing the species is not already threatened, and is well conserved in current reserve networks, then no additional action need be taken.

If the species becomes ‘invasive’ it may need to be managed to prevent it having negative impacts on other species.

High probability of alien exotics invading new areas as a consequence of climate change.
Autonomous adaptation / migration

- Providing the species is not already threatened, and providing there are safe migration routes then no action will be needed
- May wish to conserve migratory pathways
- Manage the matrix in the migratory pathways
- Many species unlikely to migrate over different soils
- Land transformation likely to be a big barrier to migration
- Should be carefully monitored
- Strategic conservation needs to consider future habitats and species patterns
Facilitated migration

- Well established as a practice for mammals, but not common for other organisms
- Current paradigm of move species to where they occurred historically will have to change. We may need to move species to areas where they did not historically occur, but that are now suitable habitats
- New reserves may be needed
- Management of the matrix
  - Community based conservation
  - Contractual reserves
  - Incentives
  - Private reserves
  - Education
Preservation

- Gene banking
- Zoos
- Botanical gardens
**Conclusion**

- Current reserve patterns have historic rather than strategic conservation origins
- New strategic conservation tools being used to re-configure reserve layout
- Need to consider impacts of climate change in strategic conservation
- Manage for change
- Off reserve conservation is an critical component of strategy (manage the matrix)
- Devolution of ownership and use rights – make it worthwhile for farmers to conserve biodiversity
Conclusion

- Biological organisms have differing responses to climate change. Some may benefit but many are predicted to become extinct.
- A number of management options are available and these need to be specific to different organisms.
- Need to configure reserves for best conservation given climate change (e.g. protect environmental gradients).
- Need to intervene to help some species.
- Best option is to have off reserve areas (the matrix) as biodiversity friendly as possible.
Check your understanding of Chapter 5

PASS MARK 80%

Please do not proceed further until you have PASSED

Chapter 5: test yourself
I hope that found chapter 5 informative, and that you enjoy chapter 6.