Introduction to the
National Biodiversity Assessment 2011

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Freshwater Ecosystem Network: Introductory Workshop
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Overview

• What is the National Biodiversity Assessment?
• Selected highlights from the NBA 2011
• Relationship between NFEPA and NBA 2011
• Key concepts and foundations for the NBA
What is the National Biodiversity Assessment?

- Every 5 to 7 years
- Part of SANBI's mandate to monitor and report on the state of biodiversity

National Spatial Biodiversity Assessment 2004
→ 1st asmt of ecosystems across terrestrial, river, estuarine & marine environments

NBA 2011: Added wetlands & invasives, more focus on indigenous species & climate change

More than 200 scientists & practitioners from over 30 organisations contributed, 3 year process
Agricultural Research Council (ARC) • Anchor Environmental Consultants • BirdLife South Africa • CapeNature • CapFish • Diatom and Environmental Management (DEM) • Endangered Wildlife Trust (EWT) • International Ocean Institute (IOI) Southern Africa, University of the Western Cape (UWC) • African Rhino Specialist Group of the International Union for Conservation of Nature (IUCN) Species Survival Commission • iSimangaliso Wetland Park Authority • KwaZulu-Natal Sharks Board • Marine and Estuarine Research (MER) • Mpumalanga Tourism and Parks Authority (MTPA) • National Center for Ecological Analysis and Synthesis, University of California, USA • Oceanographic Research Institute (ORI) • South African Shark Conservancy (SASC) • Stellenbosch University • University of Cape Town (UCT) • University of Queensland, Australia • University of Zululand

Top highlights of NBA 2011…

- 12 highlights – top 3 are freshwater highlights
- For more: NBA 2011 Synthesis Report
- http://bgis.sanbi.org
1. Wetlands are the most threatened of all South Africa’s ecosystems

- 48% of wetland ecosystem types critically endangered
- Wetlands make up only 2.4% of the country’s area
- Wetlands crucial for purifying water and regulating flow – high value ecological infrastructure

2. High water yield areas* are SA’s water factories, and make up less than 4% of the country’s area

- Currently only 18% of high water yield areas have any form of formal protection
- Strategic importance for water security
- Explore options for extending and strengthening protection

* Now called Strategic Water Source Areas
3. Tributaries are generally in better condition and less threatened than main rivers

- Healthy tributaries play critical role in keeping hard working main rivers functioning, supporting water quality & quantity

![Graph showing comparison between main rivers and tributaries](image)

4. Coastal and inshore ecosystems are more threatened than offshore ecosystems

- 24% of coastal and inshore ecosystems are critically endangered, compared with 12% of offshore ecosystems
- 17% of SA’s coast has some form of development within 100m of the shoreline
- Nearly a quarter of South Africa’s population lives within 30km of the coast
- A national coastal biodiversity plan to identify coastal ecosystem priority areas is an urgent priority

![Graph showing habitat comparison](image)
5. St Lucia, SA’s flagship estuary, has been in a poor state – unable to fulfil its role as the most important nursery for marine fish on the south-east African coast

- St Lucia Lake system makes up more than half of SA’s estuarine area, and is part of a World Heritage Site
- Reduced freshwater flow to St Lucia, due to diversion of the uMfolozi River since 1950s and other factors → estuary closed to the sea for much of the last decade
- BUT link between uMfolozi and St Lucia restored in July 2012!
iSimangaliso Wetland Park Authority continues to prioritise restoration

6. Offshore marine ecosystems are the most poorly protected of all SA’s ecosystems, with only 4% of offshore ecosystem types well protected.

- Offshore Marine Protected Area project has identified focus areas for offshore protection
- Establishing offshore MPAs is a priority
10 focus areas for offshore protection

For protecting marine biodiversity, contributing to fisheries sustainability, and supporting management of by-catch

7. Biodiversity stewardship programmes are a major success story – making a significant contribution to meeting protected area targets, at low cost to the state

- Contracts with private or communal landowners to protect land of high biodiversity importance
- In 2004 biodiversity stewardship was a new and unfamiliar term, one pilot project underway
- Just 7 years later…
  - 6 provinces have biodiversity stewardship programmes
    - 24 contract nature reserves and protected environments declared
    - Over 100 more awaiting proclamation or in negotiation
  - If all of these are successfully proclaimed, around 430 000 ha will have been added to the protected area network – contributing 16% of the 2013 national protected area expansion target
7. Biodiversity stewardship programmes are a major success story – making a significant contribution to protecting ecosystems, at low cost to the state

- Low cost to the state – biodiversity stewardship contracts cost a fraction (less than one tenth) of land acquisition
- Modest extra resources for provincial conservation authorities → could expand contribution of biodiversity stewardship, including to river & wetland ecosystems

8. The NBA 2011 provides a new national map of areas that are important for climate change resilience

- Areas of natural habitat that support functional, stable landscapes in the long term, supporting continued provision of ecosystem services
- Further analysis needed to determine which of the areas are most important for ecosystem-based adaptation
9. Rates of loss of natural habitat are high in parts of the country

- Loss of natural habitat (e.g. cultivation, plantations, mining, urban sprawl) = biggest pressure on terrestrial ecosystems
- In North West, KZN and Gauteng: if current rates of conversion of natural vegetation to other land uses continue → almost no natural habitat left outside protected areas by about 2050

→ Use maps of Critical Biodiversity Areas to guide decisions about where best to locate development
10. SA has over 2000 medicinal plant species. 656 are traded, and of those, 56 are threatened.

- Urgent action required for threatened medicinal plants
- Research and monitoring required to ensure that harvesting patterns are sustainable for those currently not threatened

Distribution of medicinal plant species

- Highest concentrations in grassland, savanna & forest biomes
- 2062 plant species used in traditional medicine
- 656 (a third) traded in medicinal markets
- 56 threatened, including 7 Critically Endangered
Traditional medicine trade is a large industry – worth nearly R3 billion a year (2007), employs over 130 000 people (Mander et al 2007).

11. Total area infested by invasive alien plants increased dramatically between mid-1990s & 2007 (approx 10 million to 20 million ha)

- At least R6.5 billion worth of ecosystem services (e.g. water, grazing) lost every year as a result of invasive plants
- Huge scope to scale up natural resource management programmes such as Working for Water, with coupled job creation and ecosystem service benefits

National Invasive Alien Plant Survey
12. Huge progress in mapping and classifying ecosystems

- Provides the foundation for ecosystem-level assessment, monitoring, planning and management
  - The ecosystem equivalent of taxonomy
- Long history of mapping vegetation types in SA – terrestrial environment
- Now we also have:
  - Marine and coastal habitat types
  - River ecosystem types
  - Wetland ecosystem types
  - Estuary ecosystem types
New: 136 coastal, inshore & offshore habitat types

- 58 coastal & inshore habitat types
- 62 offshore benthic (seabed) habitat types
- 16 offshore pelagic habitat types (water column)

223 river ecosystem types

based on
- 31 ecoregions
- 2 flow regime categories
- 4 longitudinal zones
New: wetlands (~300 000) \(\rightarrow\) 792 types

Based on hydro-geomorphic classes & wetland vegetation groups

46 estuary ecosystem types (not easy to show on a national map)

New: 1st ever map of estuarine functional zone for all 291 estuaries

Previously: dots along the coastline

Now: actual mapping of open water area and floodplain

Estuaries
Rivers
Coastline
Amatole District
Floodplain
Open water
Relationship between NFEPA and NBA 2011

**Good timing**
- NFEPA: 2008-2011
- NBA: 2009-2012

→ NFEPA underpinned freshwater component of NBA 2011
Input data

Nel et al. 2009 Biological Conservation

Co-production of knowledge

Collective experience of almost 1000 years!
Collaboration between scientists & managers
Criteria for FEPAs

- Represent river, wetland and estuary ecosystem types
- Represent free-flowing rivers
- Identify connected systems
- Represent NB migration routes
  - Wetland clusters
  - Fish corridors
- Maintain water supply areas
  - High water yield areas
  - High groundwater recharge areas
- Represent threatened fish
- Represent estuary species

A FEPA map for every catchment

- Which rivers, wetlands and estuaries should remain in good ecological condition
- A nationally consistent information source
Widespread dissemination, training and ongoing support for users

- FEPA maps and underpinning data
- Implementation Manual
- Ecosystem management guidelines

http://bgis.sanbi.org  Data DVD

Diversity of uses: national & local
Key concepts and foundations for the NBA

- National ecosystem indicators
- Foundational data sets

National ecosystem indicators

**Ecosystem threat status**
- Four categories:
  - Critically endangered (CR)
  - Endangered (EN)
  - Vulnerable (VU)
  - Least threatened (LT)

**Ecosystem protection level**
- Four categories:
  - Unprotected
  - Poorly protected
  - Moderately protected
  - Well protected

→ Both indicators can be assessed in terrestrial and aquatic environments
• How threatened are our ecosystems?

• Are our ecosystems well represented in protected areas?

Ecosystem threat status for rivers  Ecosystem protection level for rivers

- Critically endangered
- Endangered
- Vulnerable
- Least threatened
- Not protected
- Poorly protected
- Moderately protected
- Well protected
Threat status & protection level are assessed independently of each other

- **Ecological condition**
  - Natural through to irreversibly modified

- **Ecosystem threat status**
  - For each ecosystem type
  - Based on series of thresholds
  - E.g. if <20% of ecosystem type is in natural/near-natural condition ➞ critically endangered

- **Location of protected areas**

- **Ecosystem protection level**
  - For each ecosystem type
  - Based on series of thresholds
  - E.g. if biodiversity target has been met in PA ➞ well protected
Steps in assessing threat status and protection level

- Map and classify ecosystem types
- Map ecological condition
- Evaluate proportion of each ecosystem type in good ecological condition relative to a series of thresholds
- Assign ecosystem threat status category
- Map and classify ecosystem types
- Map existing protected areas
- Calculate the proportion of each ecosystem type protected, i.e. included in one or more protected areas and in good ecological condition
- Evaluate the proportion protected against the biodiversity target for that ecosystem type
- Assign ecosystem protection level category

Evaluate proportion in good condition against thresholds

<table>
<thead>
<tr>
<th>An ecosystem, e.g. vegetation type, river type, estuary type, marine habitat</th>
<th>CR</th>
<th>EN</th>
<th>VU</th>
<th>LT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Representation threshold: Biodiversity target</td>
<td>Very little original extent left in natural or near-natural condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Likely to have lost most of their natural structure &amp; functioning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Associated species may have been lost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>In danger of losing the last remaining natural examples of these ecosystem types</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Narrow window of warning: Biodiversity target + 15%</td>
<td>Majority original extent still in natural or near-natural or moderately modified condition, with some loss of habitat or deterioration in condition</td>
<td></td>
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<tr>
<td></td>
<td>Likely to have lost some structure &amp; functioning, and this will be further compromised if loss of natural habitat or deterioration in condition continues</td>
<td></td>
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</tr>
<tr>
<td>Ecological functioning threshold: usually 60%</td>
<td>Have experienced little or no loss of natural habitat or deterioration in condition</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Maps of biodiversity priority areas should guide planning, resource management and decision-making in these ecosystems types</td>
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</tr>
</tbody>
</table>

WARNING BELL!!
How do threat status and protection level relate to FEPAs?

National ecosystem indicators → snapshot of the state of ecosystems

Ecosystem threat status
• Four categories:
  – Critically endangered (CR)
  – Endangered (EN)
  – Vulnerable (VU)
  – Least threatened (LT)

Ecosystem protection level
• Four categories:
  – Unprotected
  – Poorly protected
  – Moderately protected
  – Well protected

Threatened ecosystems

Ecosystem priority areas
→ what to do, where to prioritise action

Under-protected ecosystems
Ecosystem priority areas

• Uses systematic biodiversity planning approach to identify priority areas
• Based on biodiversity target
  – Ecosystem threat status and ecosystem protection levels therefore integrated into identification of priority areas

Same foundations needed for both

1. Ecosystem types
2. Biodiversity targets
3. Ecological condition
4. Protected areas
Essential data inputs

→ Classification & mapping of ecosystem types
  e.g. vegetation types

→ Map of protected areas – land-based & marine

→ Maps of ecological condition
  e.g. marine & coastal habitat types

→ Biodiversity targets for ecosystem types

1. Mapping ecosystem types
River ecosystem types

- 223 ecosystem types
  - 31 level 1 ecoregions
  - 2 flow variability categories
  - 4 geomorphic zones

Kleynhans et al. 2005

Surveys and Mapping
DWA 1:500K rivers

Rowntree & Wadeson 1999; Moolman et al. 2002

Mapping wetland locations

INPUT DATA

<table>
<thead>
<tr>
<th>National Land Cover 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterbody</td>
</tr>
<tr>
<td>Wetland</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DWAF 2004 Farmlands &amp; rivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dam</td>
</tr>
<tr>
<td>Lake</td>
</tr>
<tr>
<td>River</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Waterbody</td>
</tr>
<tr>
<td>--------------------</td>
</tr>
<tr>
<td>Dry pan</td>
</tr>
<tr>
<td>Lake</td>
</tr>
<tr>
<td>Mfutha</td>
</tr>
<tr>
<td>Non-perennial pan</td>
</tr>
<tr>
<td>Pernickai pan</td>
</tr>
<tr>
<td>Pool</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fine-scale sub-national data</th>
</tr>
</thead>
<tbody>
<tr>
<td>KZN</td>
</tr>
<tr>
<td>CAPE fine-scale plans</td>
</tr>
<tr>
<td>Kamieskroon</td>
</tr>
<tr>
<td>Niewoudville</td>
</tr>
<tr>
<td>Overberg</td>
</tr>
</tbody>
</table>

NATIONAL WETLAND MAP 1
(“Beta version”)
- Waterbody
- Wetland

NATIONAL WETLAND MAP 2
- Artificial waterbody
- Wetland
- Natural waterbody
- Unclassified waterbody (20%)

NATIONAL WETLAND MAP 3

NFEPA DRAFT: WETLAND MAP 3
- Natural
- Artificial

“Artificial” = artificial and/or transformed
Combining these data results in sliver polygons which were not cleaned

- Fringe vegetation or natural?
- Left as is, but calculated whether “majority natural” or “majority artificial”

Accuracy assessment of wetland map

- 22% delineation accuracy
- 75% wetlands not captured
- 11% incorrectly classified as wetland
Wetland ecosystem types: Level 4 of SANBI framework

NATIONAL WETLAND TYPING FRAMEWORK (SANBI 2010)

- 6 hierarchical levels
  1. Systems: Marine, Estuarine, Inland
  2. Regional context: Bioregions, Biogeographic Zones and Ecoregions
  3. [grouping of landscape settings]
  4. Landform, hydrological characteristics
  5. Hydroperiod
  6. Site characteristics: geology, veg, substratum, salinity, pH, naturalness

1. Seep
2. Valley-head seep
3. Channelled valley-bottom
4. Unchannelled valley-bottom
5. Floodplain
6. Depression
7. Flat

43% classification accuracy
Van Deventer et al. 2014. SA Journal Geography

Wetland types: regional context

- Used national vegetation map
- Grouped into 133 “wetland vegetation groups”
- Each wetland assigned its majority “wetland vegetation group”
- 792 wetland types

National vegetation types
(Mucina & Rutherford 2006)

Resulting “wetland vegetation groups”
2. Biodiversity targets

• For ecosystem types
• The proportion of each ecosystem type that should:
  – Be maintained in good ecological condition
  – Ideally be protected in the long term
• Based on species area curves if suitable data available
  – Higher target for ecosystem types that are more species rich
• Otherwise flat 20% target per ecosystem type
3. Ecological condition

- At the broadest level
  - Good
  - Fair
  - Poor
- For freshwater ecosystems, more detail is possible

<table>
<thead>
<tr>
<th>Ecological condition</th>
<th>≥91%</th>
<th>90-75</th>
<th>75-61</th>
<th>60-41</th>
<th>40-21</th>
<th>≤20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>State</td>
<td>Excellent</td>
<td>Good</td>
<td>Fair</td>
<td>Poor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition, structure, function</td>
<td>Retain composition, structure and function</td>
<td>Some loss of composition and structure, function still intact</td>
<td>Loss of composition and structure; function compromised</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DWS’s Present Ecological Status

Level of modification to 6 indicators:
• Instream habitat continuity
• Riparian/wetland zone continuity
• Potential instream habitat
• Riparian-wetland zone
• Potential flow
• Potential physico-chemical

Assessed for two time periods:
• 1999
• 2011

<table>
<thead>
<tr>
<th>Ecological category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Unmodified, natural</td>
</tr>
<tr>
<td>B</td>
<td>Largely natural, few modifications</td>
</tr>
<tr>
<td>C</td>
<td>Moderately-modified</td>
</tr>
<tr>
<td>D</td>
<td>Largely-modified</td>
</tr>
<tr>
<td>E</td>
<td>Seriously-modified</td>
</tr>
<tr>
<td>F</td>
<td>Critically/Extremely-modified</td>
</tr>
</tbody>
</table>

Descriptions of ecological condition categories

<table>
<thead>
<tr>
<th>Ecol condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td><strong>Unmodified, natural</strong></td>
</tr>
<tr>
<td>B</td>
<td><strong>Largely natural</strong>, with few modifications. A small change in natural habitats &amp; biota may have taken place but the ecosystems functions are essentially unchanged</td>
</tr>
<tr>
<td>C</td>
<td><strong>Moderately modified</strong>. A loss and change of natural habitat &amp; biota have occurred but the basic ecosystem functions are still predominantly unchanged</td>
</tr>
<tr>
<td>D</td>
<td><strong>Largely modified</strong>. A large loss of natural habitat, biota &amp; basic ecosystems functions has occurred</td>
</tr>
<tr>
<td>E</td>
<td><strong>Seriously modified</strong>. The loss of natural habitat, biota &amp; basic ecosystems functions is extensive</td>
</tr>
<tr>
<td>F</td>
<td><strong>Extremely modified</strong>. Modifications have reached a critical level &amp; the system has been modified completely with an almost complete loss of natural habitat &amp; biota. Worst instances: the basic ecosystem functions have been destroyed &amp; the changes are irreversible</td>
</tr>
</tbody>
</table>
Based on 6 attributes / drivers of condition

- Attributes:
  - Flow (e.g. quantity, timing, velocity)
  - Inundation (dams, weirs, other obstructions in the channel)
  - Water quality
  - Stream bed condition
  - Introduced instream biota
  - Riparian or stream bank condition

- For each attribute:
  - Extent of modification from natural is assessed
  - Based on data and expert input, with a confidence rating

Mapping ecological condition
River condition assessed for mainstems & tributaries

- **Quaternaries:** ~1900 in SA
  - Average size ~650 km²
- **Sub-quaternaries:** ~9 400 in SA
  - Average size ~135 km²

1999 Present Ecological State assessed for quaternary mainstems

Tributary condition modelled based on national land cover

River condition

COMBINED:
- DWA Present Ecological State data (1999)
- DWA PES updates in certain regions
- River Health Programme data
- Reserve data
- Modelled land cover data
- Expert opinion
Trends in ecological condition for rivers

1999 PES + modelled AB tribs

2011

% river length

%AB
%C
%DEF

0 10 20 30 40 50 60

1999 2011

Wetland condition

CONDITION OF NON-RIVERINE WETLANDS
• Based on the minimum % natural land cover in and around the wetland:
  – Wetland
  – 50 m area around a wetland
  – 100 m area around wetland
  – 500 m area around wetland

CONDITION OF RIVERINE WETLANDS
• The condition of the river is also considered
  – If river condition is D, E or F
    ⇒ wetland condition is D, E or F
  – If river condition is A, B, C or unknown
    ⇒ wetland condition is based on minimum
    % natural landcover in and around the wetland
Wetland condition

- **AB** – intact wetland
- **C** – riverine wetland with associated C river
- **DEF** – riverine wetland with associated D, E or F river
- **Z1** – not intact and based on % natural land cover
- **Z2** – majority of wetland unit “Artificial”
- **Z3** - “Artificial” from CDSM

Maps of ecological condition

Terrestrial (based on land cover)

Rivers

Wetlands

Marine & coastal
4. Protected areas

- Declared in terms of Protected Areas Act
  - Special Nature Reserves
  - National Parks
  - Nature Reserves
  - Protected Environments
- Recognised in terms of Protected Areas Act
  - Mountain Catchment Areas
  - Marine Protected Areas
  - World Heritage Sites
  - Specially Protected Forest Areas

Map of protected areas – land-based & marine

- 7% land area
- 22% coastline
- < 1% offshore marine