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Biodiversity for Life
South African National Biodiversity Institute

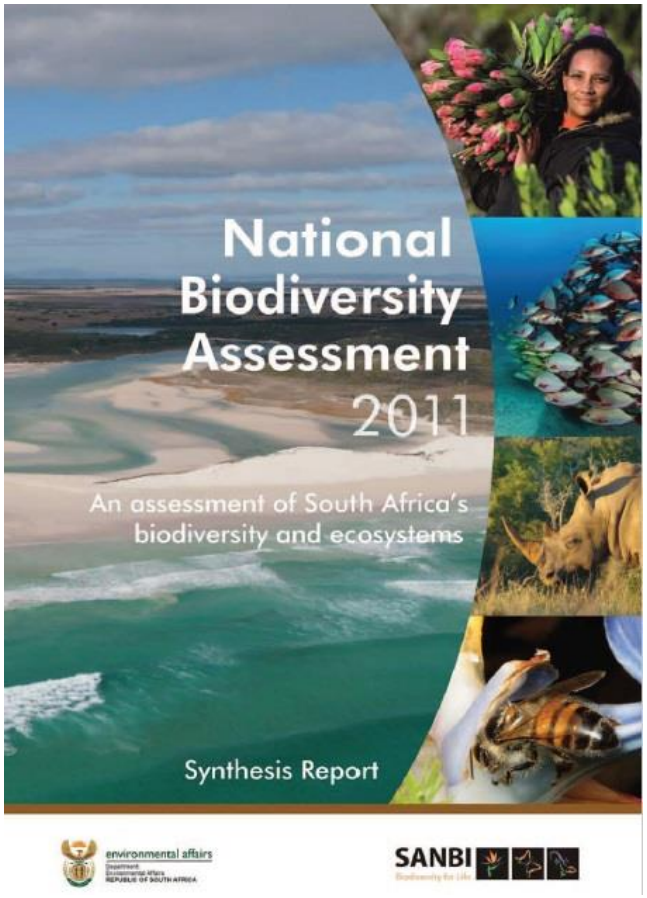
DEA GIS Day 2016

GIS in the National Biodiversity Assessment

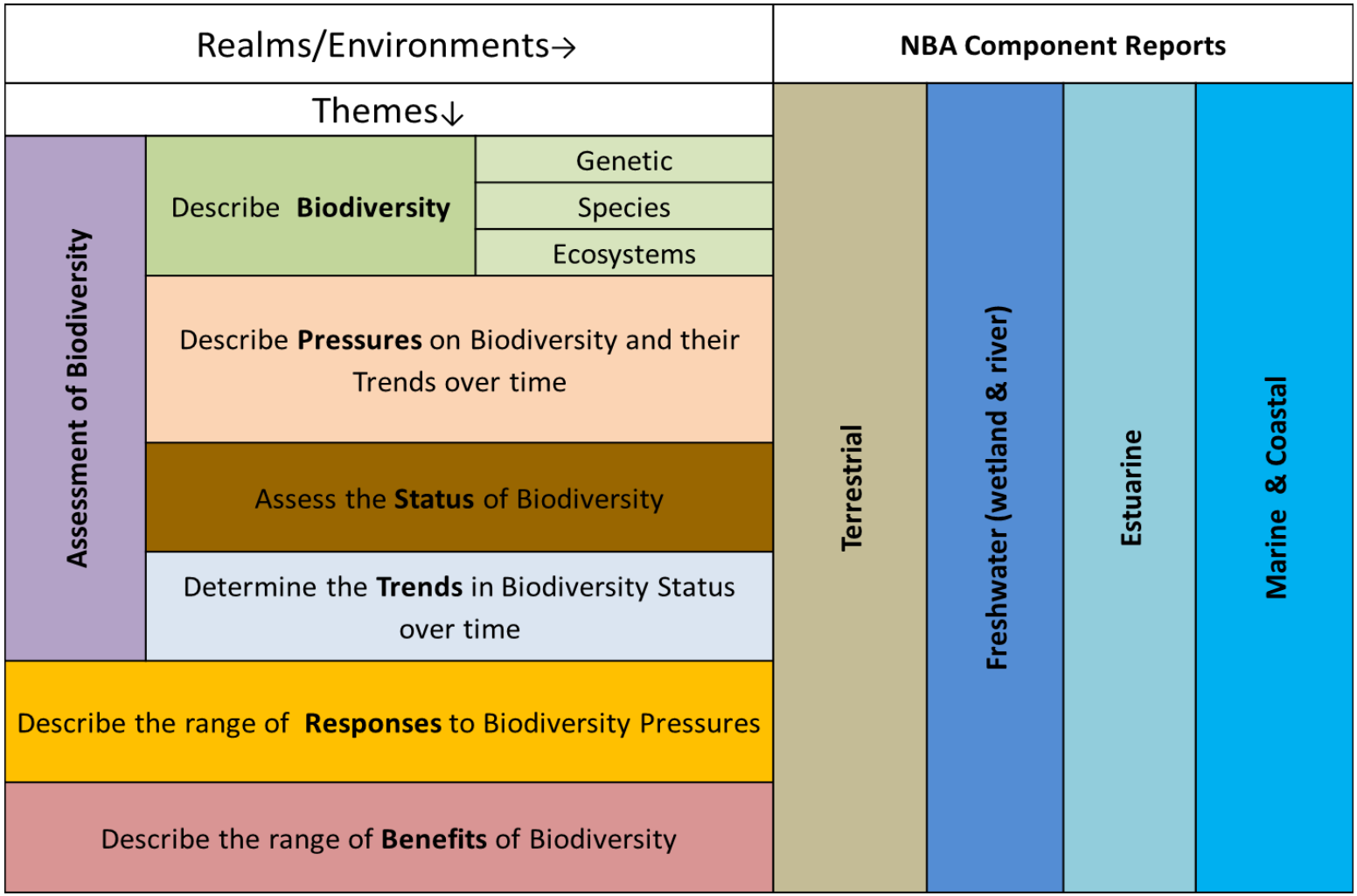
Presenter: Heather Terrapon (SANBI)

National Biodiversity Assessment

- The National Biodiversity (NBA) assesses the state of South Africa's biodiversity, across terrestrial, freshwater, estuarine and marine environments, emphasising spatial (mapped) information for both ecosystems and species.



NBA 2018



Graphic courtesy of A. Skowno (SANBI)

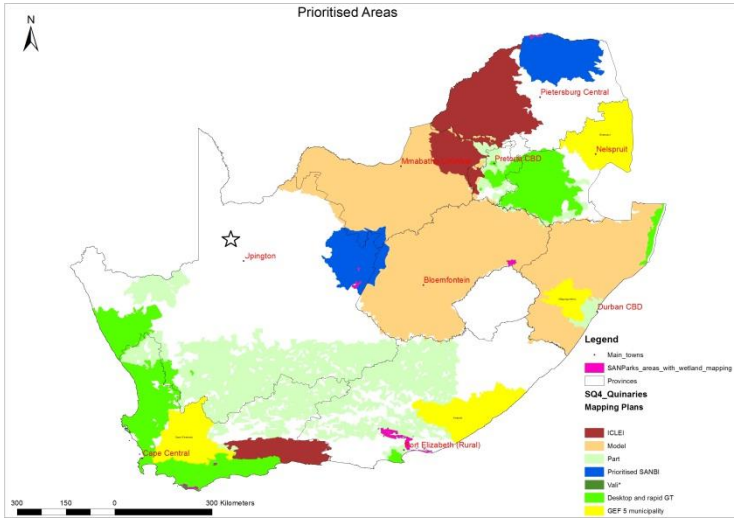
Data collection

- Certain datasets require data capture for the NBA
- Wetlands data
  - Integrate a previously modelled wetlands with more fine scale data
  - Undertake data capture & editing
  - Follow up with field work

Comparison of SPOT images from 2012 & 2014, data overlay undertaken by N. Biyela (SANBI)

Wetlands data capture

- Focal areas for data capture to prevent overlap
- Multiple teams (SANBI, CSIR & ICLEI) in multiple locations
- Geodatabase with behaviour to streamline data capture



Map of Focal areas,
courtesy of data capture partner ICLEI.

SUBTYPE_L4A	Artificial	Channelled valley-bottom	Depression	Estuary	Wetland Flat	Floodplain	River	Seep	Unchannelled valley-bottom	Unspecified
OBJECTID										
FID_NVMM2_										
FID_NGI_20										
NGI0616_FT										
NGI0616_NA										
Peatlands										
NGIsprings										
WETLAND_NO										
W4W										
Estuaries_										
ESTUARIES										
Shape_Leng										
Shape_Area										
CS_L1	Default: Inland - Artificial Domain: -	Default: Inland - Natural Domain: -	Default: Inland - Natural Domain: -	Default: Estuarine Domain: -	Default: Inland - Natural Domain: -	Default: Inland - Natural Domain: -	Default: Inland - Natural Domain: -	Default: Inland - Natural Domain: -	Default: Inland - Natural Domain: -	Default: Unspecified Domain: -
CS_L2										
CS_L3	Default: Unspecified Domain: CS_L3	Default: Valley floor Domain:	Default: Unspecified Domain: CS_L3	Default: Unspecified Domain: CS_L3	Default: Plain Domain: CS_L3	Default: Plain Domain: CS_L3	Default: Unspecified Domain: CS_L3	Default: Slope Domain: CS_L3	Default: Valley floor Domain:	Default: Unspecified Domain: CS_L3
CS_L4A	Default: Artifical Domain: -	Default: Channelled valley-bottom Domain: -	Default: Depression Domain: -	Default: Estuary Domain: -	Default: Wetland Flat Domain: -	Default: Floodplain Domain: -	Default: River Domain: -	Default: Seep Domain: -	Default: Unchannelled valley-bottom Domain: -	Default: Unspecified Domain: -
CS_L4C	Default: Unspecified Domain: CS_L4C	Default: Throughput Domain: CS_L4C	Default: Unspecified Domain: CS_L4C	Default: Throughput Domain: CS_L4C	Default: Inflow Domain: CS_L4C	Default: Unspecified Domain: CS_L4C	Default: Throughput Domain: CS_L4C	Default: Outflow Domain: CS_L4C	Default: Throughput Domain: CS_L4C	Default: Unspecified Domain: CS_L4C
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CS_L5_hydr	Default: Unspecified Domain: CS_L5_Hydroperiod	Default: Unspecified Domain: CS_L5_Hydroperiod	Default: Unspecified Domain: CS_L5_Hydroperiod	Default: Unspecified Domain: CS_L5_Hydroperiod	Default: Unspecified Domain: CS_L5_Hydroperiod	Default: Unspecified Domain: CS_L5_Hydroperiod	Default: Unspecified Domain: CS_L5_Hydroperiod	Default: Unspecified Domain: CS_L5_Hydroperiod	Default: Unspecified Domain: CS_L5_Hydroperiod	Default: Unspecified Domain: CS_L5_Hy
CS_L6_arti	Default: Unspecified Domain: CS_L6_Artificial	Default: None Domain: -	Default: None Domain: -	Default: None Domain: -	Default: None Domain: -	Default: None Domain: -	Default: None Domain: -	Default: None Domain: -	Default: None Domain: -	Default: Unspecified Domain: CS_L6_Art
CS_L6_sali										
CS_L6_subs	Default: Unspecified Domain: CS_L6_Substratum	Default: Unspecified Domain: CS_L6_Substratum	Default: Unspecified Domain: CS_L6_Substratum	Default: Unspecified Domain: CS_L6_Substratum	Default: Unspecified Domain: CS_L6_Substratum	Default: Unspecified Domain: CS_L6_Substratum	Default: Unspecified Domain: CS_L6_Substratum	Default: Unspecified Domain: CS_L6_Substratum	Default: Unspecified Domain: CS_L6_Substratum	Default: Unspecified Domain: CS_L6_Su
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CS_NAME										
Image_date										
Data_edito										
Edit_date										
Val_type	Default: None Domain: Val_Type	Default: None Domain: Val_Type	Default: None Domain: Val_Type	Default: None Domain: Val_Type	Default: None Domain: Val_Type	Default: None Domain: Val_Type	Default: None Domain: Val_Type	Default: None Domain: Val_Type	Default: None Domain: Val_Type	Default: None Domain: Val_Type
Val_person										
Val_date										

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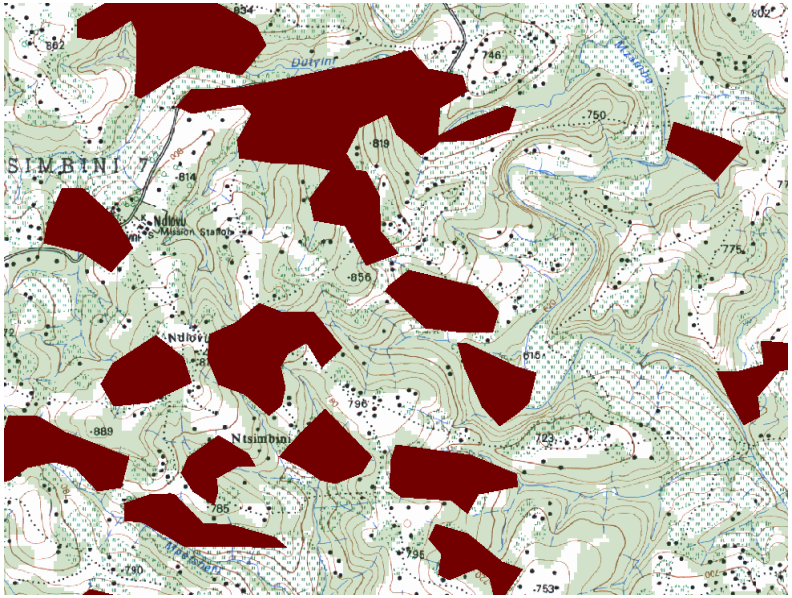
Field work

- Features are not always easy to classify
- Additional data from Goolge maps can present an alternative perspective

Screen shots from Google maps, Street view and SA 50cm imagery from ESRI online. Courtesy of Wetlands data capture team.

Data synthesis

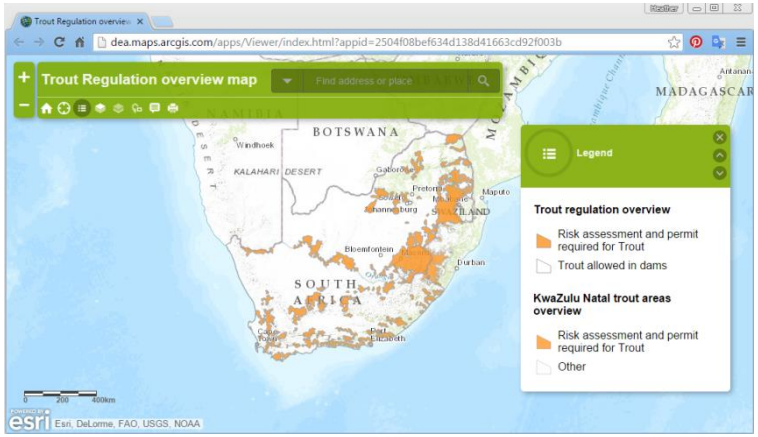
- Data from various partner organisations or government departments is collated into a single South African data layer
- Habitat modification
  - Old agricultural fields captured
  - Used to update Natural areas to in land cover

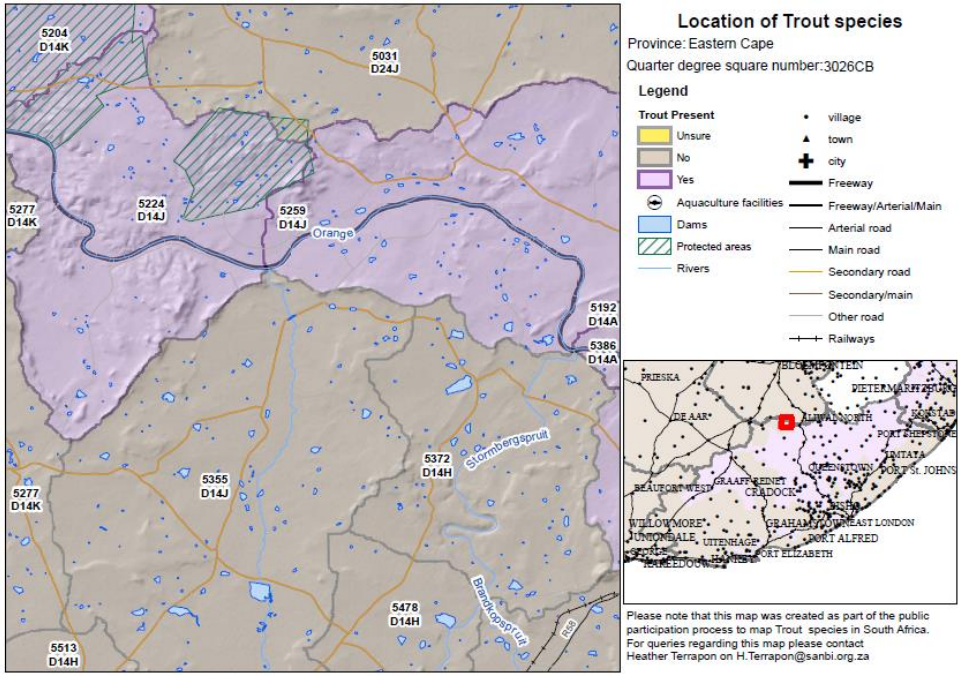


Comparison of agricultural fields in the Land cover vs. the fields shown on the 1:50 000 toposheets, image courtesy of S. Bhengu (SANBI)

Expert input

- Species occurrence often requires expert input
  - Trout species occurrence mapping was undertaken across SA, in partnership with DEA and driven by EPWP
    - 55 delegates
    - 7 provinces
    - 1900+ pdf maps





Online map of Trout Species served via DEA ArcGIS online facilities

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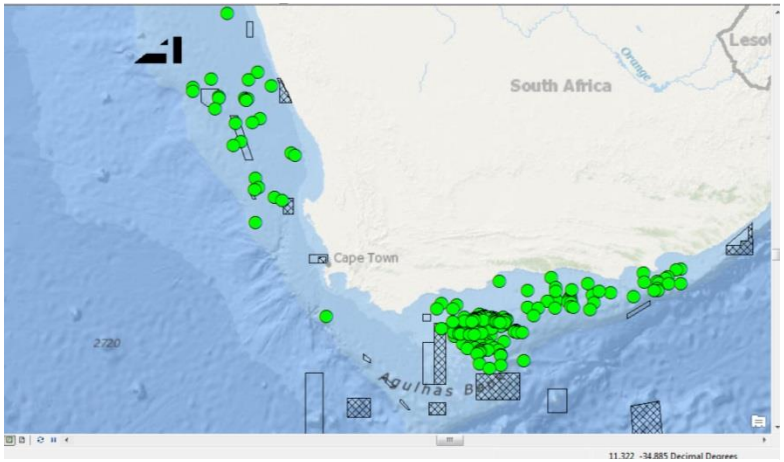
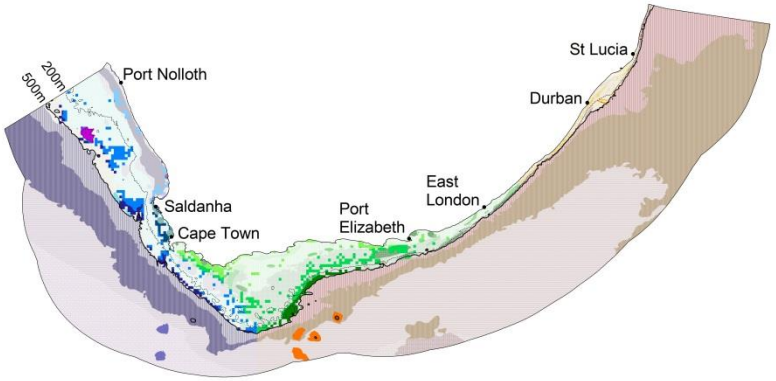
Key base data sets

- Base data to be updated
  - Wetlands
  - Vegetation
  - Estuaries
  - Marine ecosystems





Locations of abandoned well points will be used a pressure layer to update the Marine ecosystem pressures map.

An eye on assessment

Ecosystem Threat Status

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

Ecosystem Protection Level

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

↓

Evaluate the proportion protected against the biodiversity target for that ecosystem type

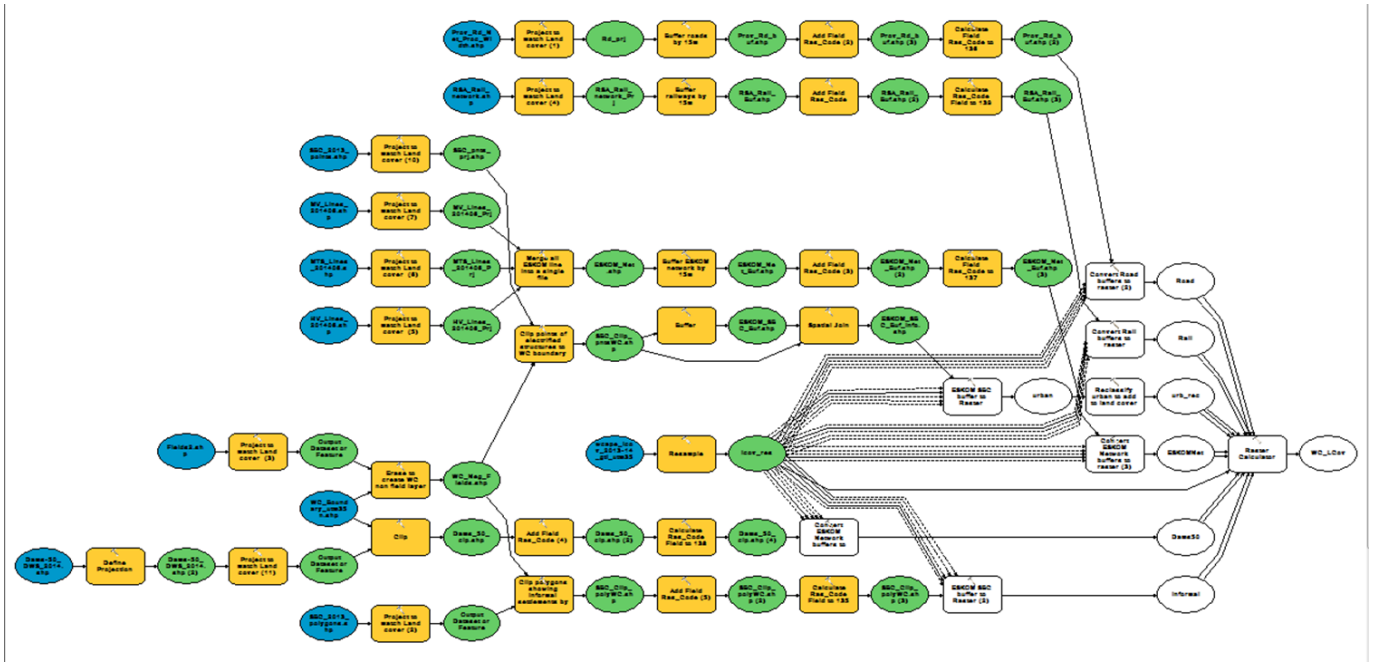
↓

Assign ecosystem protection level category

Graphics courtesy of NBA 2011 report

Doing the MATH

- Model Builder used to undertake analysis so that models can be published as part of the report



Data Standards

- All data needs metadata

- SANBI is the custodian of a number of the datasets and will be subject to the SDI Act
  - Collaborate with others when capturing data
  - Document methodology
  - Calculate data accuracy
  - Secure the data

Is it any good?

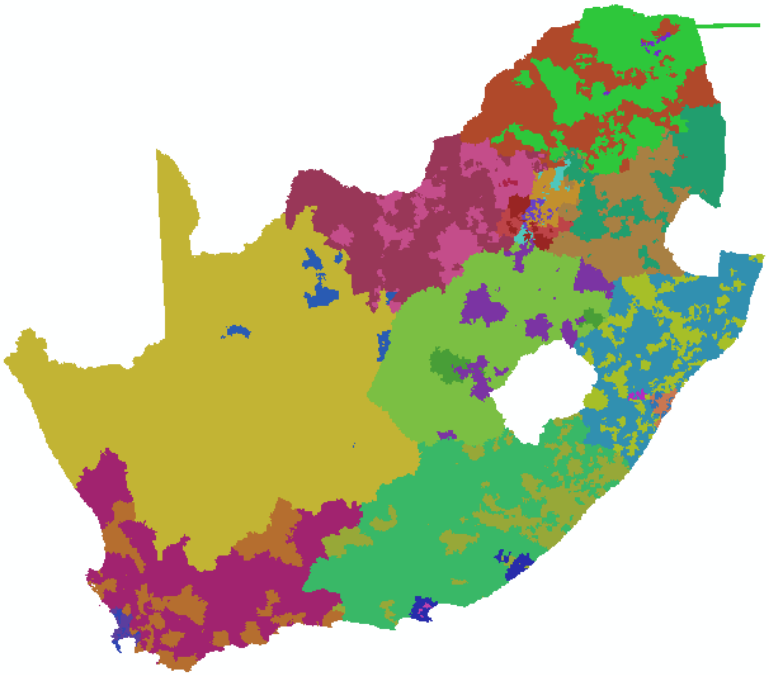
Does the layer accurately represent reality?

Are some classes more accurate than others?

Does the accuracy of a class vary in different geographical areas?

Structuring the sample

- Stratifying samples
  - Cannot use data that is being analyzed
  - Need ensure geographic distribution and coverage of many classes
  - Used census population density data for stratification
  - Habitat modification had 45 strata

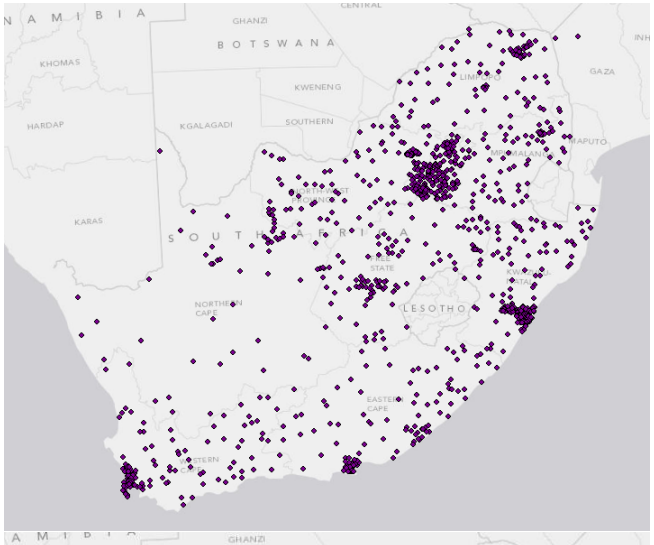


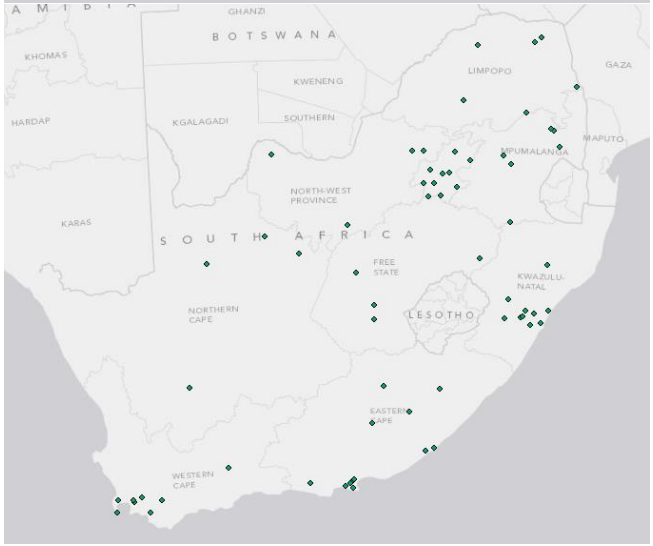
Number of sample points

- Difficult to calculate due to the nature of the data (Qualitative)
- How much error do you suspect
- Remember that if you have 100 sample points then each mis-classification equals one 1% of your accuracy

An example

- Habitat modification used 1024 points – approximately 20 per stratum
- Initial tests were run on 64 points
- Note the clustering around densely populated areas, more validation in areas with more diverse cover

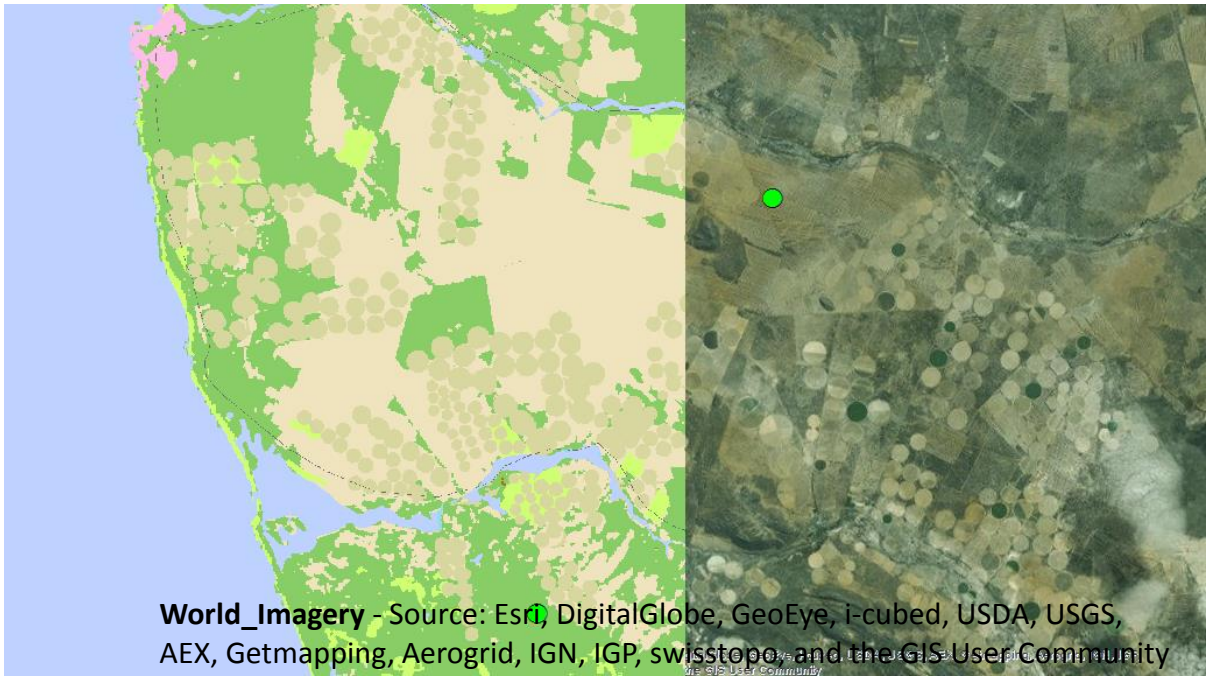




Map background courtesy of ESRI

Validation

- Generating random sample points per census class using ArcGIS
- Compare value in the habitat modification layer to imagery



Things to think about

- Imagery should be of the same time frame as the data
- Consider the entire cell and report on the majority value (if that is how the raster was created)
- Create a fishnet or wire frame (Spatial Ecology GME tools) to view grid cell boundaries

Confusion matrix (simplified)

		Habitat Mod					
		Dryland Cultivation	Natural Waterbodies	Primary Natural Areas	Secondary Natural Areas	Urban Built Up	
LandSat	Dryland Cultivation	3	0	1	0	0	4
	Natural Waterbodies	0	1	1	0	0	2
	Primary Natural Areas	0	0	33	0	1	34
	Secondary Natural Areas	1	0	1	7	0	9
	Urban Built Up	0	0	0	0	7	7
		4	1	36	7	8	56

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Calculations

Accuracy (ACC)

$$x = \frac{\sum True\ Positive (+\ \sum True\ negative)}{\sum Total\ population}$$

$$= \frac{3+1+33+7+7}{56}$$

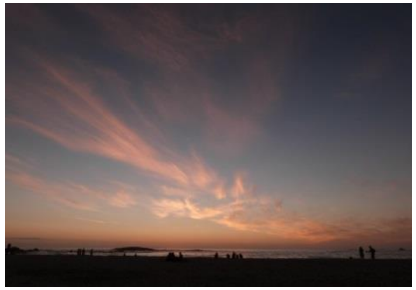
$$= \frac{51}{56}$$

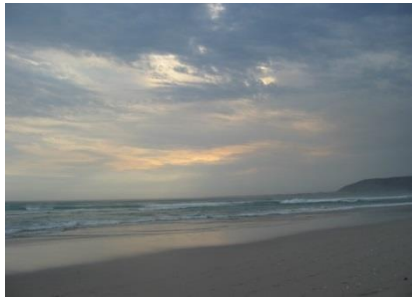
$$= 0.91\ (91\%)$$

The next step

- Identify distinct geographical areas where there is a high true positive or false positive or false negative values
- For example the prediction of Primary natural areas might be accurate in the Fynbos Biome, but less so in the Grasslands Biome because of the difficulty differentiating between intact grasslands and fallow fields.

Thank you

Special thank you to DEA for the opportunity to present and to organisations working in partnership with SANBI on the NBA.





All images/graphics not cited were authored by H.Terrapon

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