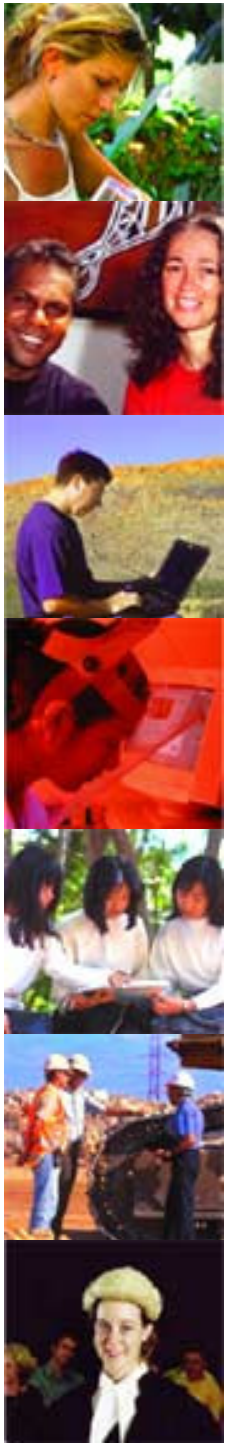
Object Based Image Analysis at CDU

Dr Guy Boggs
Senior Lecturer – Spatial Information Systems
School of Environmental and Life Sciences
guy.boggs@cdu.edu.au

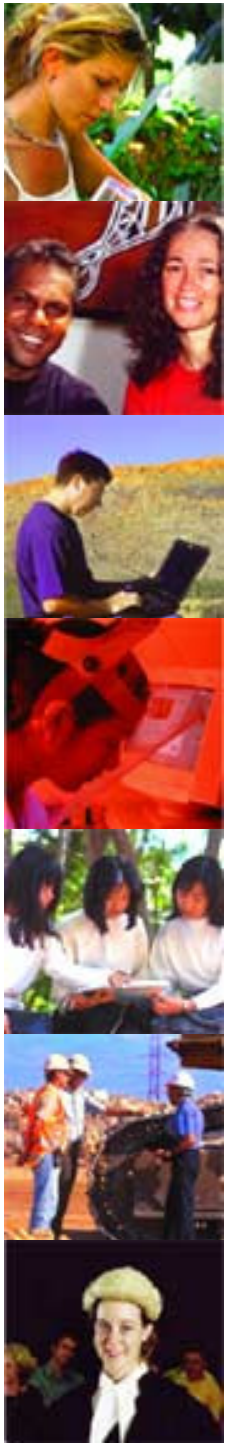
Charles Darwin UNIVERSITY Australia

TSSG Tropical Spatial Science Group



Outline

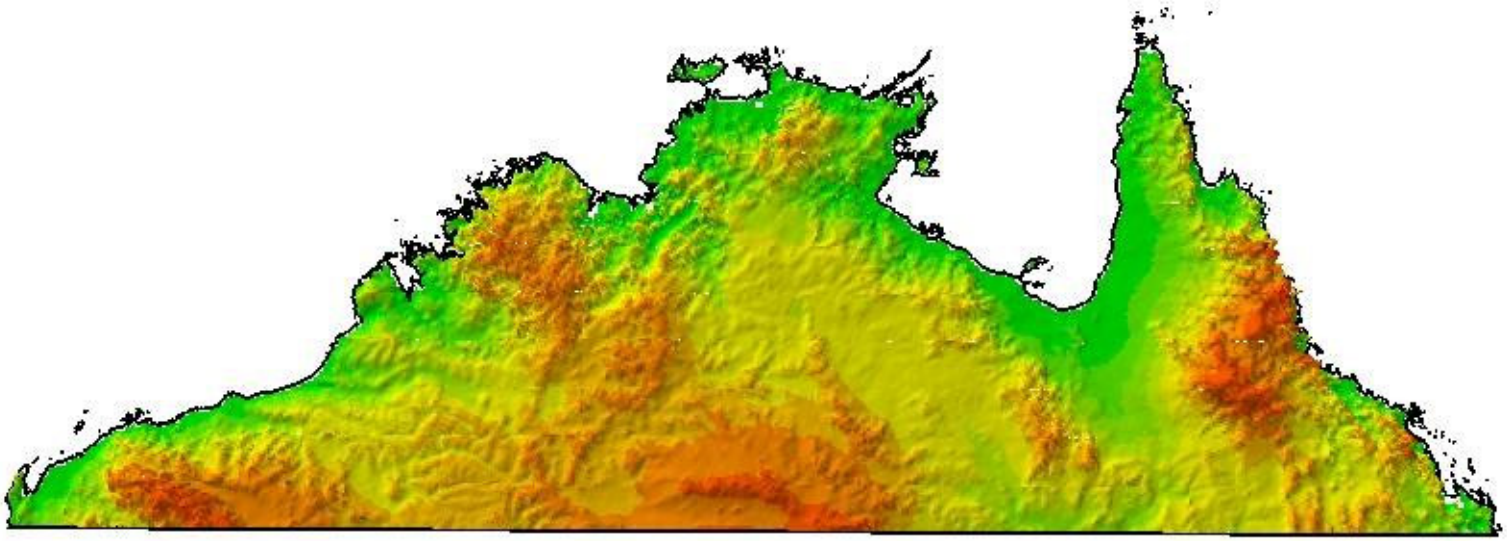
- Overview of OBIA at CDU
- Summary of existing OBIA projects at CDU (with partners)
- Detailed description of two projects using OBIA
  - Mulga/Spinifex boundary change
  - Fire impact on tree cover patterns in Kruger NP
- Summary

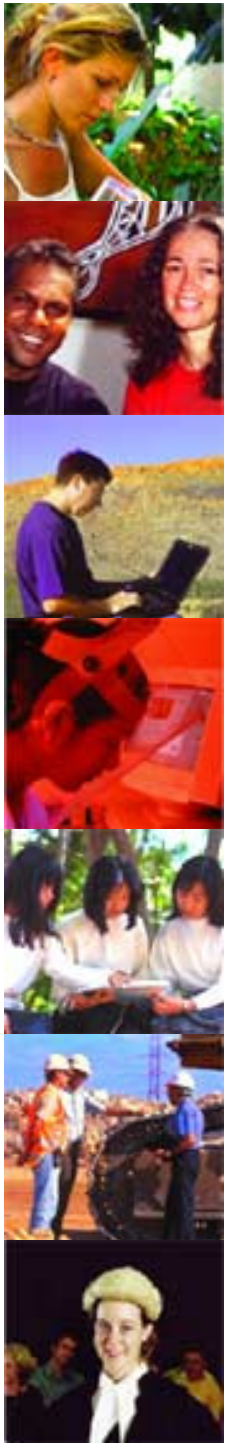


Charles Darwin UNIVERSITY Australia

Northern Australian Context

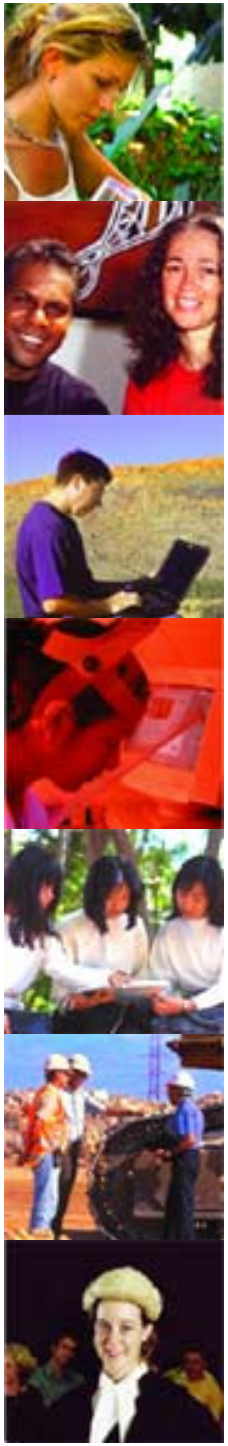
- Vast areas (NT ~ is 1,350,000 sq. km)
- Sparse population (~220,000)
- Large, 'natural' landscapes
- On-ground access difficult
- Few people, managing large areas!





TSSG

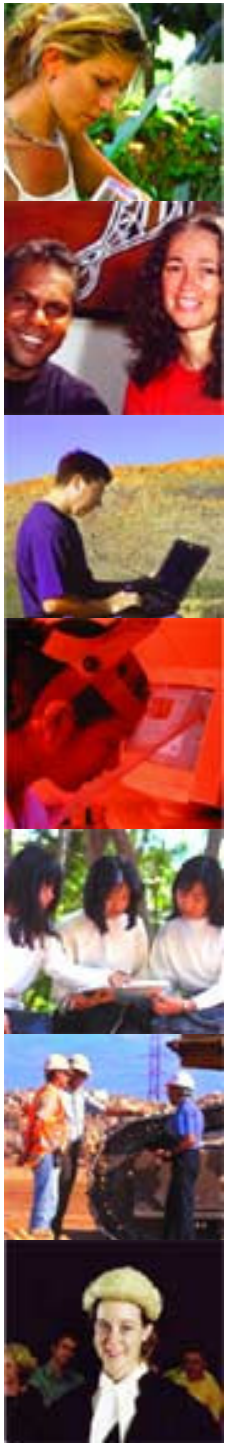
- **Tropical Spatial Science Group**
  - **Research and teaching in:**
    - **application of spatial analysis for cultural and natural resource management**
    - **investigation of spatial analysis techniques**
  - **Strong partnerships**



Charles Darwin UNIVERSITY Australia

TSSG CoE in OBIA

- **Centre of Excellence established in 2004**
- **Build on common interests of Definiens and CDU**
- **Joint initiatives in research, education and technology transfer**

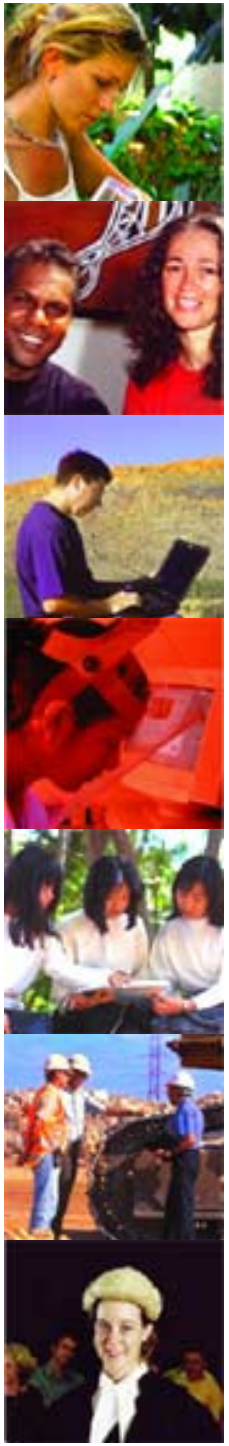


Charles Darwin UNIVERSITY Australia

TSSG Tropical Spatial Science Group

TSSG CoE in OBIA

- **ARC funded GIS/RS research lab**
- **11 licenses, 7 network and 4 for mobile use**
- **Definiens Professional 5, moving to Definiens Developer**

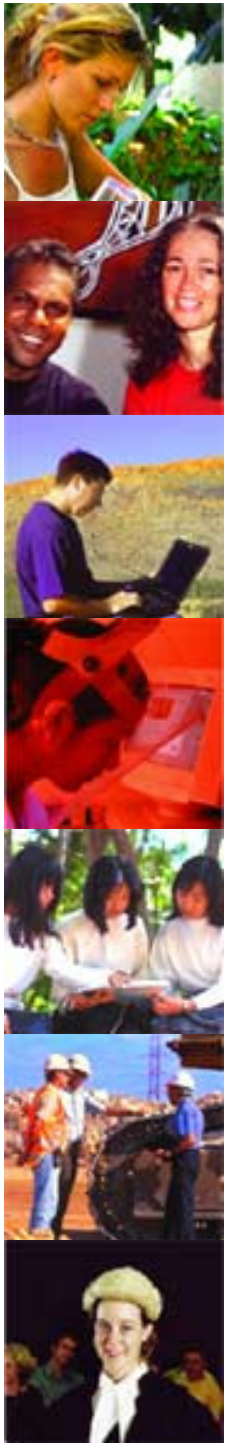


Charles Darwin UNIVERSITY Australia

TSSG Tropical Spatial Science Group

TSSG CoE in OBIA

- **Teaching:**
  - **Some application of OBIA in undergraduate studies**
  - **MSc and PhD OBIA projects focused on application of techniques in natural resource management**



Charles Darwin UNIVERSITY Australia

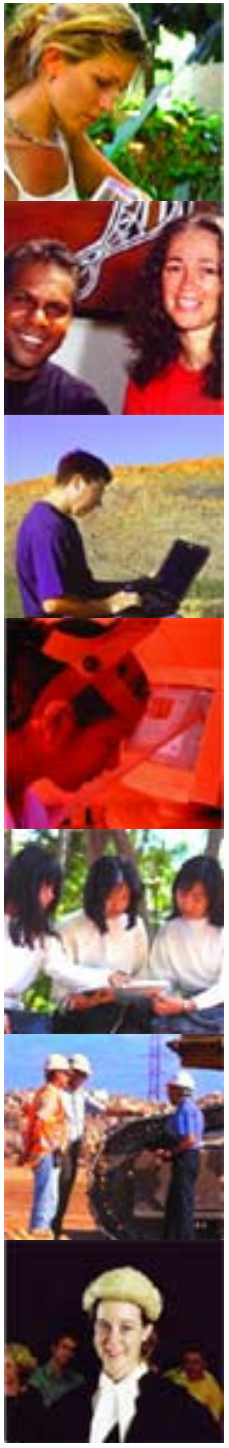
TSSG Tropical Spatial Science Group

TSSG CoE in OBIA

- **Research:**
  - **Application driven:**
    - **Vegetation mapping**
    - **Fire scar mapping**
    - **Marine habitat mapping**
    - **Change analysis**
    - **Wildlife Mapping**
  - **Image driven**
    - **Very high resolution imagery (eg Qbird)**
    - **Moderate resolution (eg Landsat)**
    - **Coarse resolution (eg MODIS)**

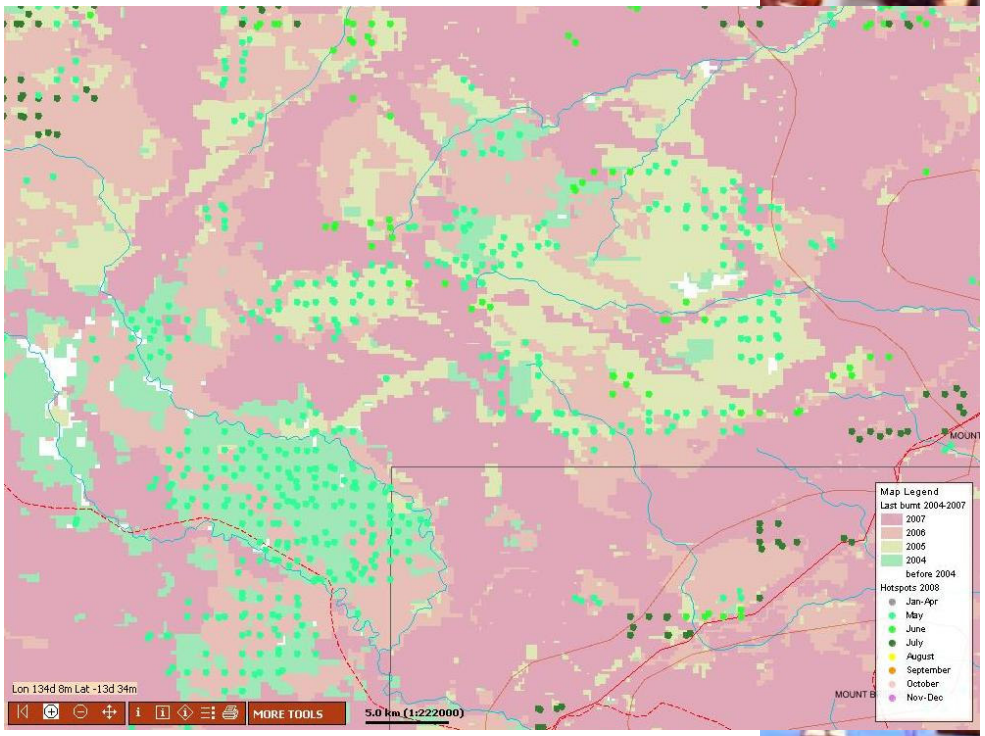
Charles Darwin UNIVERSITY Australia

TSSG Tropical Spatial Science Group



Fire Scar Mapping

- Fire history mapping based on *Definiens* software and MODIS imagery (West Arnhem Land Fire Abatement project)
- Difference images are segmented and classified in definiens, with manual editing to produce final product.
- Monthly fire scar maps are produced and uploaded to the NAFI website
- Mapping incorporated into fire management programs years.)
- TSCRC/CDU/NTG/Landgate/ CYPDA



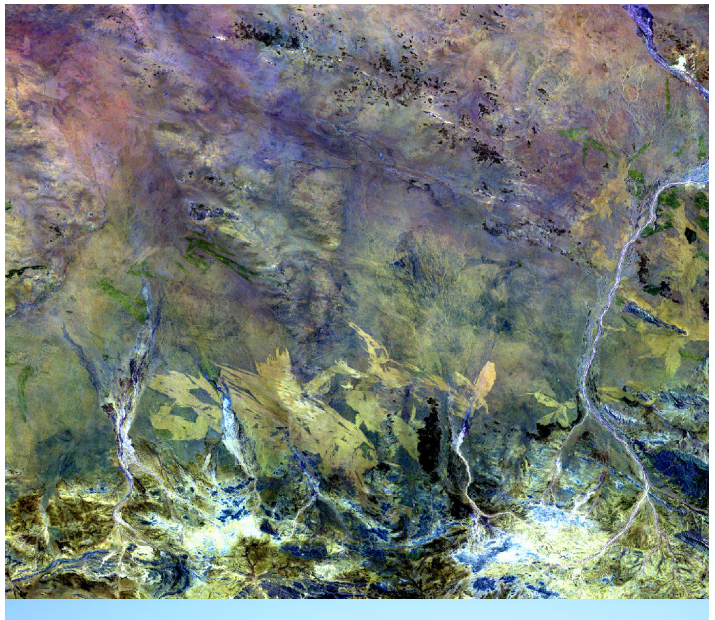
Charles Darwin University Australia

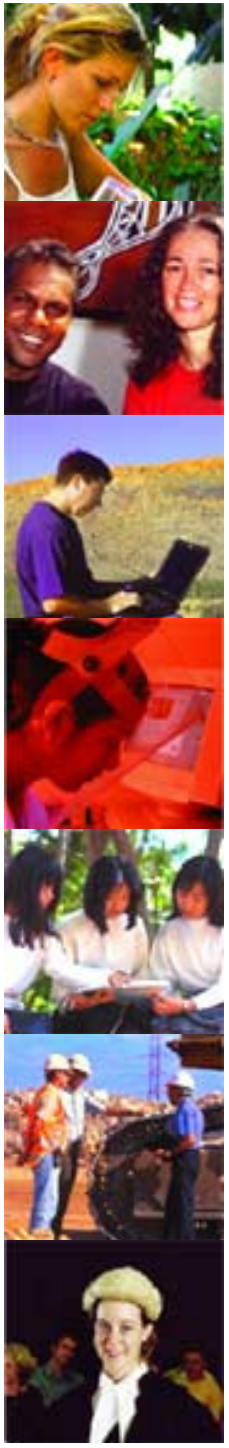
Northern Territory Government

TROPICAL SAVANNAS CRC

Arid Zone Veg. Mapping

- **Ben Sparrow (PhD student/NTG)**
- **Field driven image analysis using pixel and object based image analysis**
- **Uses extensive vegetation field data and Landsat imagery**



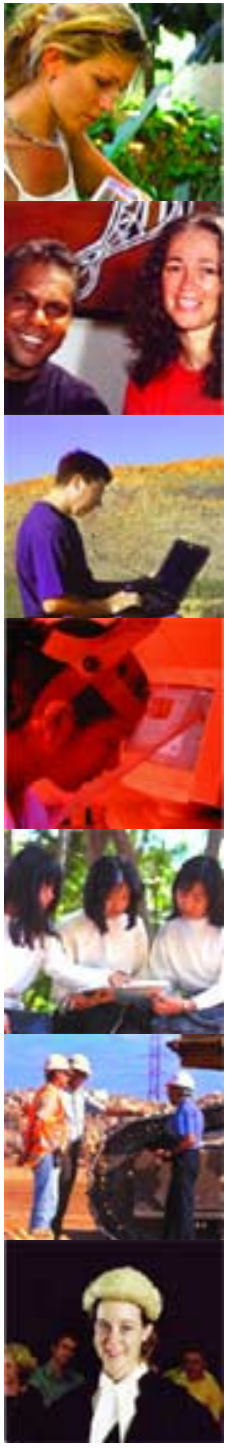


Charles Darwin UNIVERSITY Australia

Northern Territory Government

Floodplain Weed Mapping

- James Boyden (MSc/DEH)
- Map the distribution and abundance of para grass on the Magela Creek floodplain, Kakadu National Park;
  - Develop an image classification method to discriminate para grass across its environmental range
  - Assess the potential of VHR (QuickBird) for the detection and strategic management of para grass in expansive wetland landscapes;

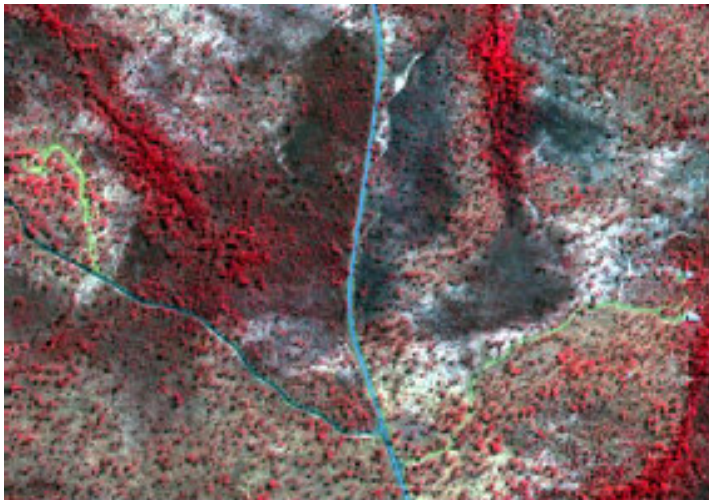


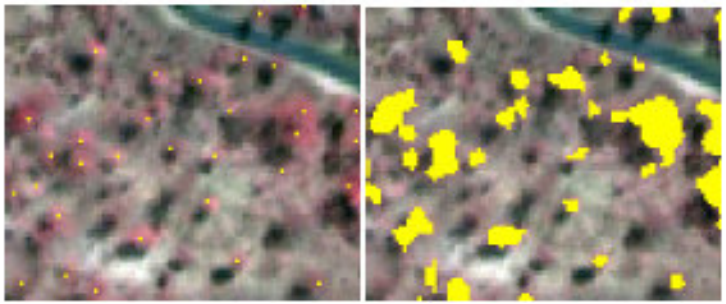
Charles Darwin UNIVERSITY Australia

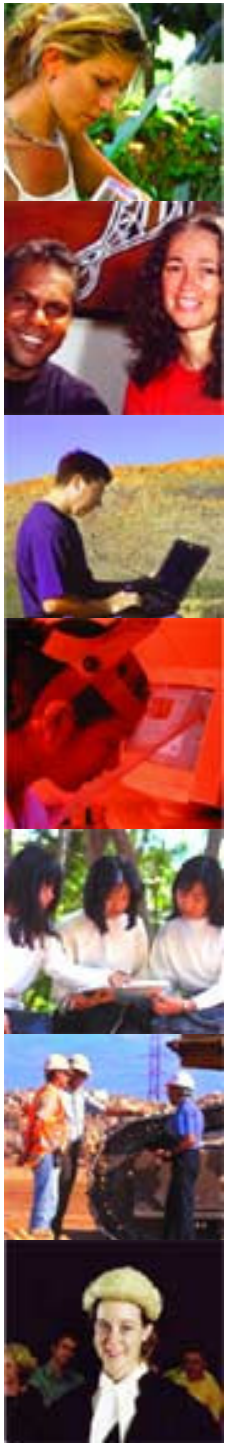
Australian Government
Department of the Environment and Heritage
Supervising Scientist

Landcover mapping

- Tim Whiteside (PhD/Batchelor Institute)
- Examining application of OBIA for veg mapping in savannas
- Very high resolution imagery application (QBird)
- Recent focus on tree cover mapping



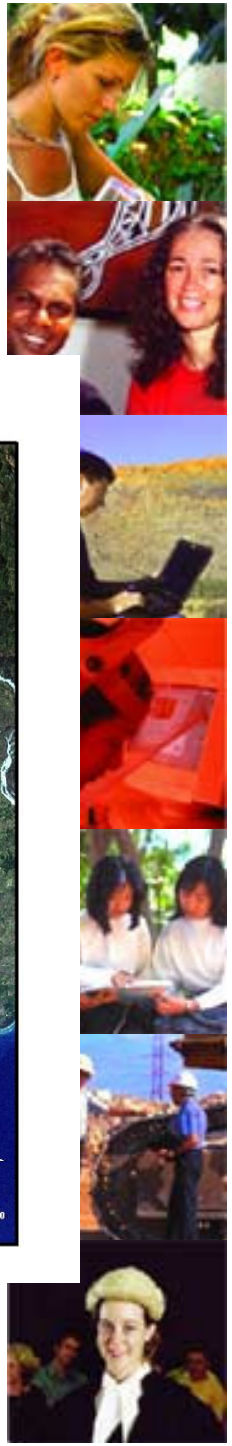




Charles Darwin UNIVERSITY Australia

Landcover change in Timor Leste

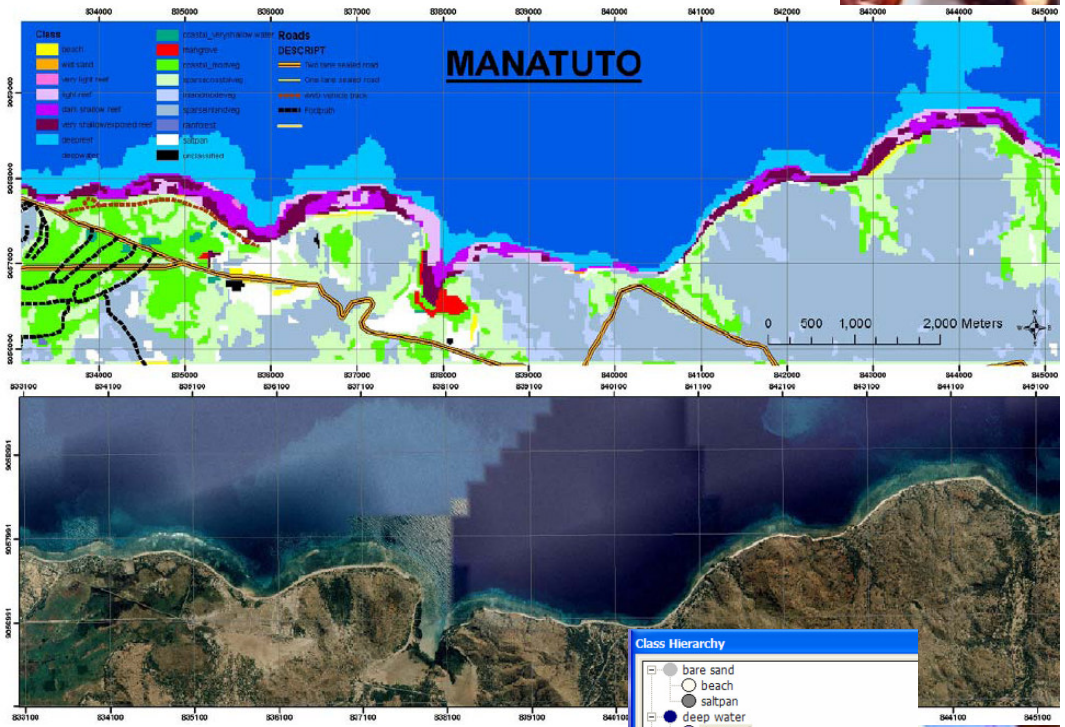
- **Juno Rouwenhorst (MSc)**
- **Investigate landcover and landuse change in Caraulun catchment, Timor Leste**
- **OBIA and Landsat for mapping channel, coastline and landcover change**

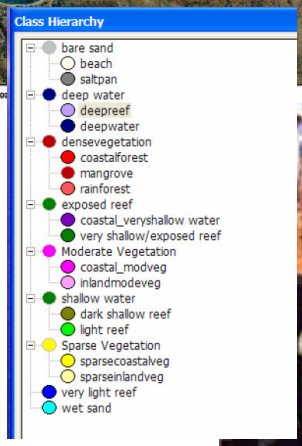


Charles Darwin UNIVERSITY Australia

Timor Leste Marine and Coastal Habitat Mapping

- **Timor-Leste Coastal/Marine Habitat Mapping for Tourism and Fisheries Development Project**
- **Landsat TM based mapping for entire Timor Leste coastline**
- **Collaborative project CDU/NTG/ANU and T-L Ministry of Agriculture, Forestry and Fisheries**



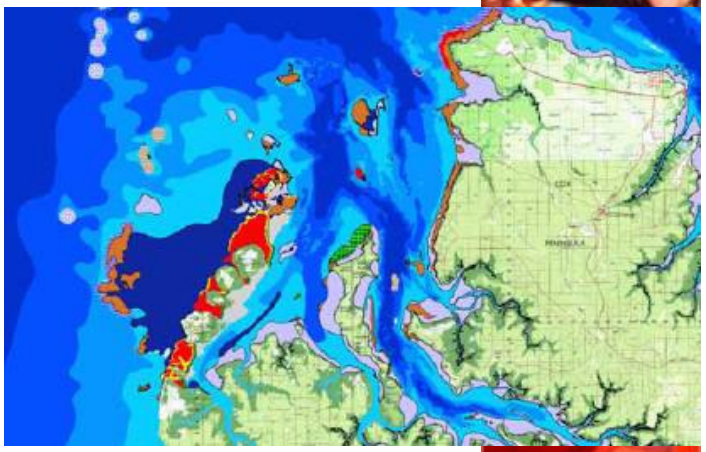


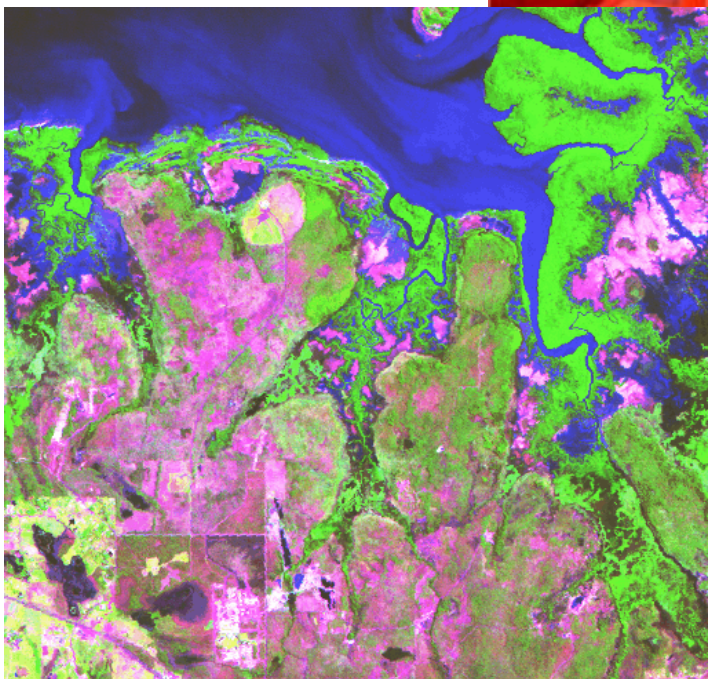
Charles Darwin UNIVERSITY Australia

Northern Territory Government

NT Marine/Coast Habitat Mapping

- NTG/CDU
- Develop protocols for broadscale marine/coast habitat mapping
- Trialling medium resolution imagery (Alos, Landsat), pixel vs OB image analysis and field protocols
- Map marine/coast habitats of Anson Beagle bioregion



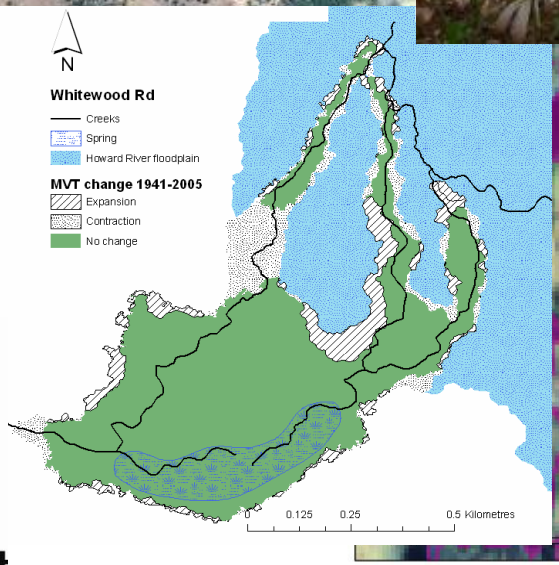


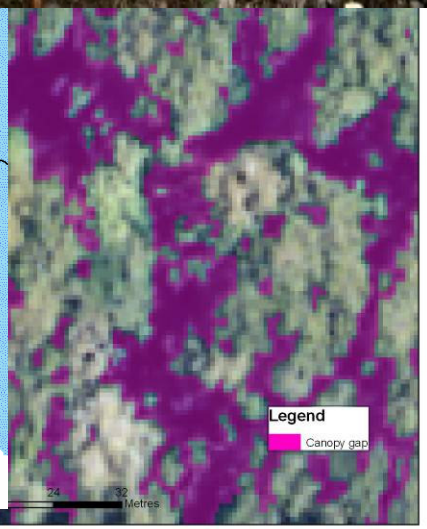
Charles Darwin UNIVERSITY Australia

Northern Territory Government

Rainforests and Groundwater Use

- CDU/NTG/CSIRO
- Rainforests around Darwin are spring fed
- OBIA and manual interpretion being used to map changes in rainforests and possible links to over extraction of groundwater
- Aerial Photographs and QuickBird imagery



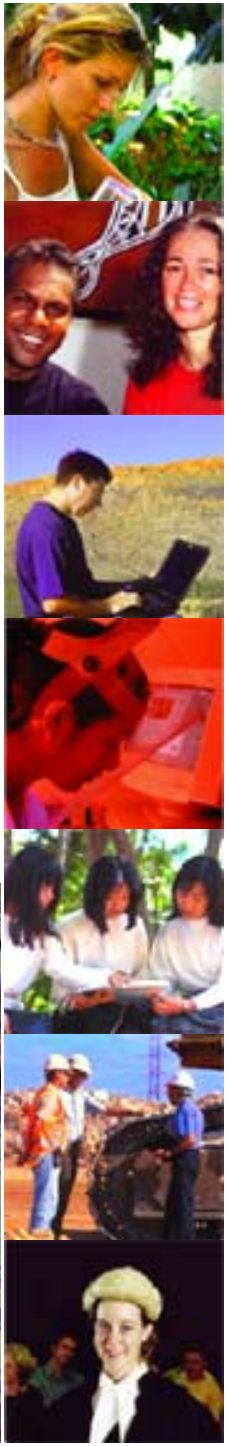


Charles Darwin UNIVERSITY Australia

Northern Territory Government

Mapping Houses

- **CDU/NTG**
- **Very High Resolution Imagery and advanced object oriented mapping investigated as a method for quickly mapping housing and related infrastucture in remote communities**



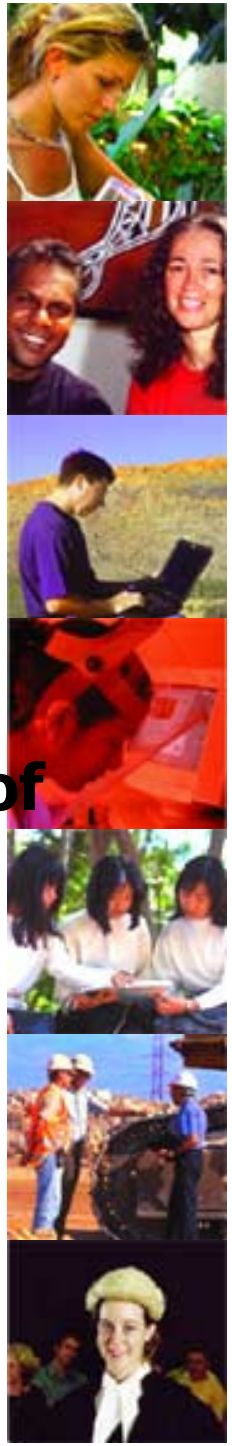
Charles Darwin UNIVERSITY Australia

Northern Territory Government

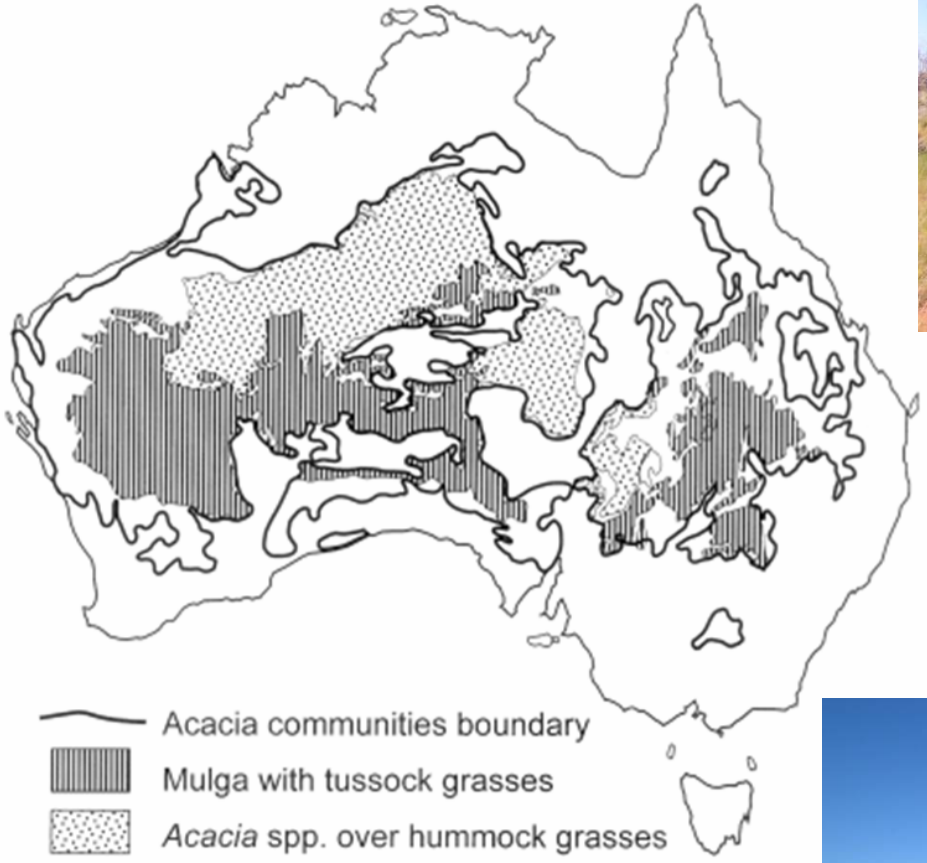
Mulga/Spinifex Change

Guy Boggs, David Bowman, Lynda Prior

- **Mulga (*Acacia aneura*) and spinifex (*Triodia*) communities are believed to have been in dynamic equilibrium**
- **How long has this equilibrium existed?**
- **Has the established equilibrium altered post European settlement because of introduction of livestock and altered fire regime?**

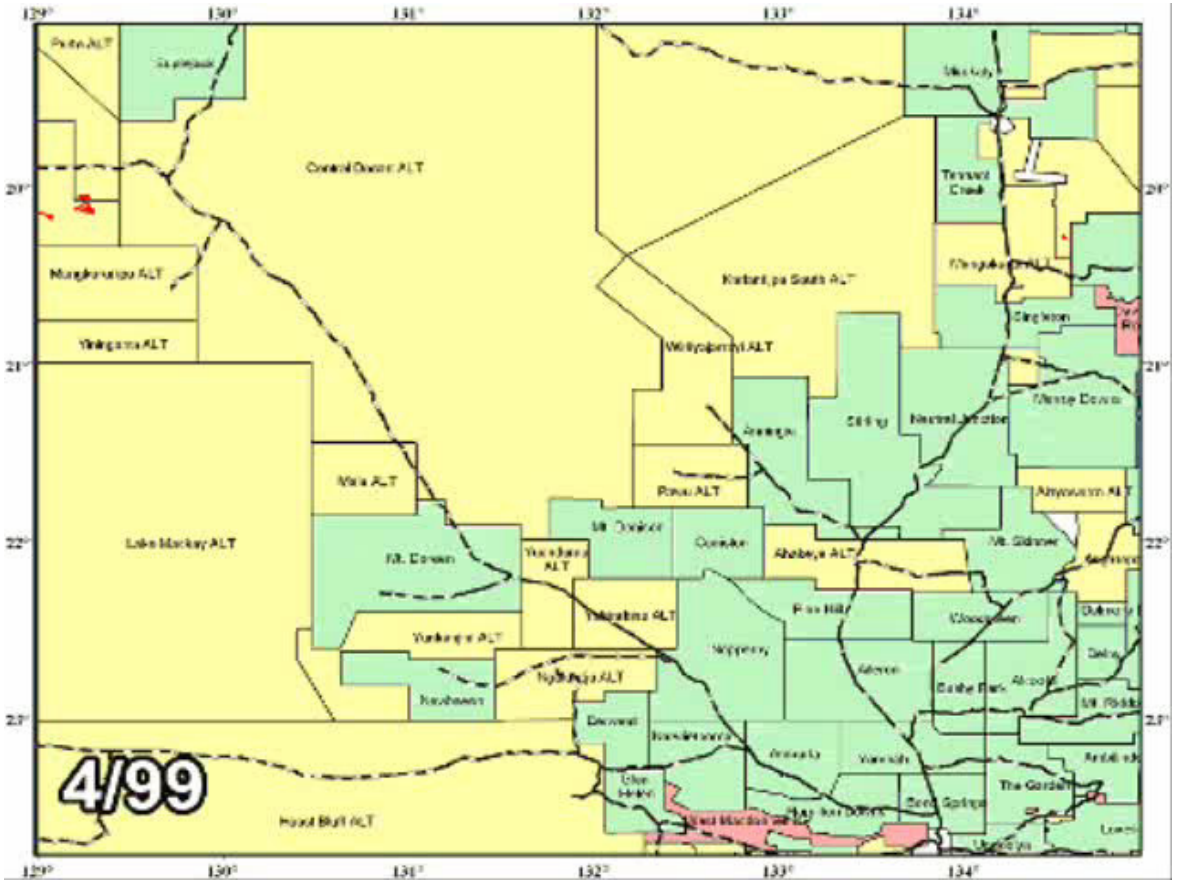


Charles Darwin UNIVERSITY Australia



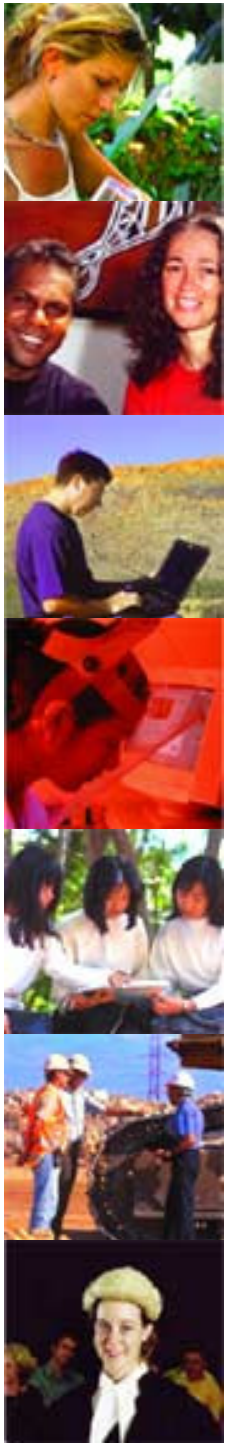
Charles Darwin
UNIVERSITY
Australia

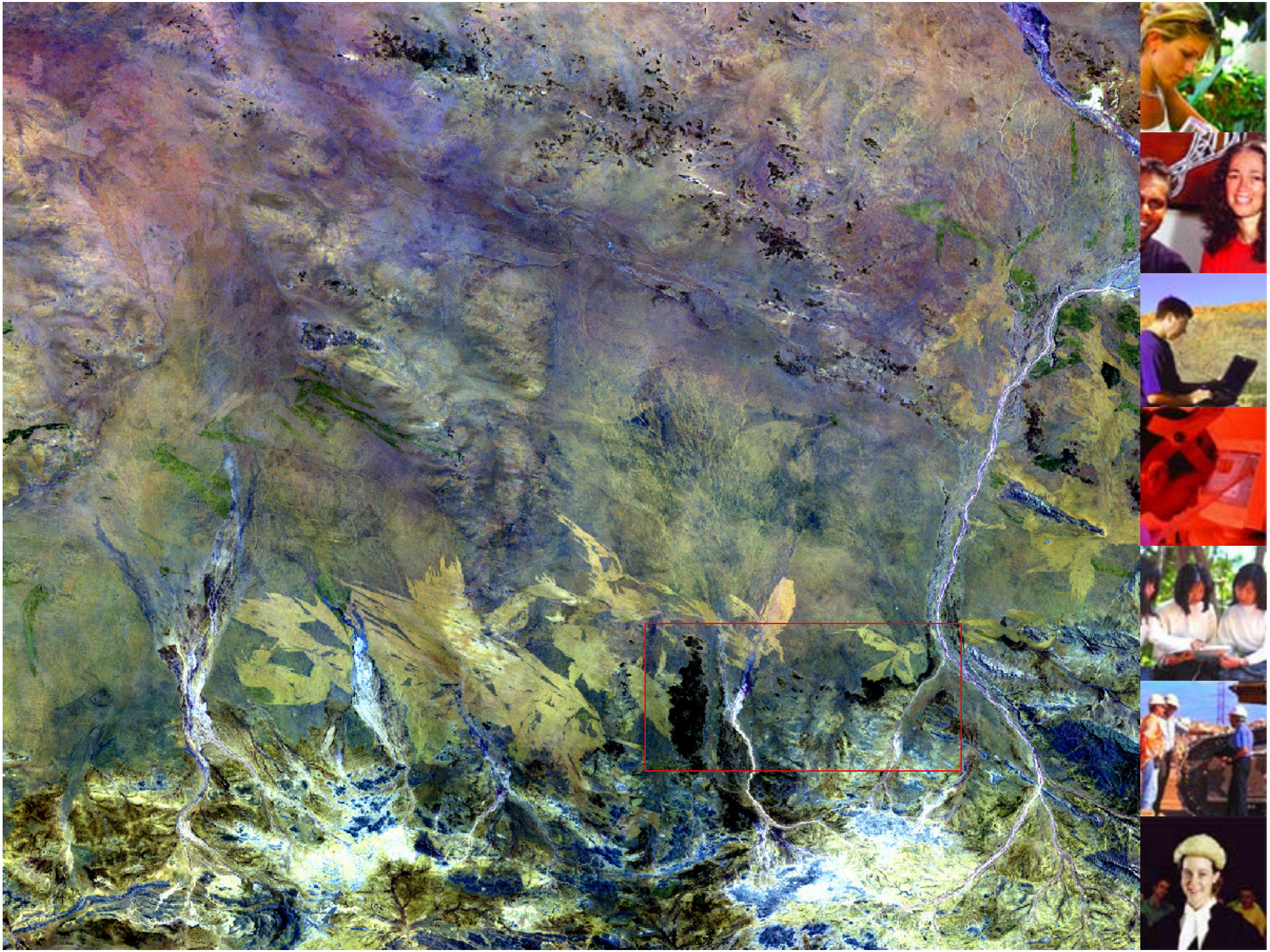
Fire Regime



http://www.nt.gov.au/nreta/natres/bushfires/research/index.html

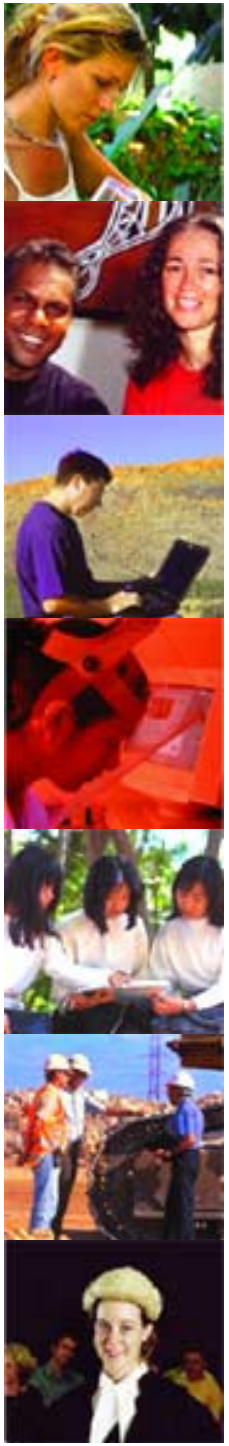
Charles Darwin
UNIVERSITY
Australia



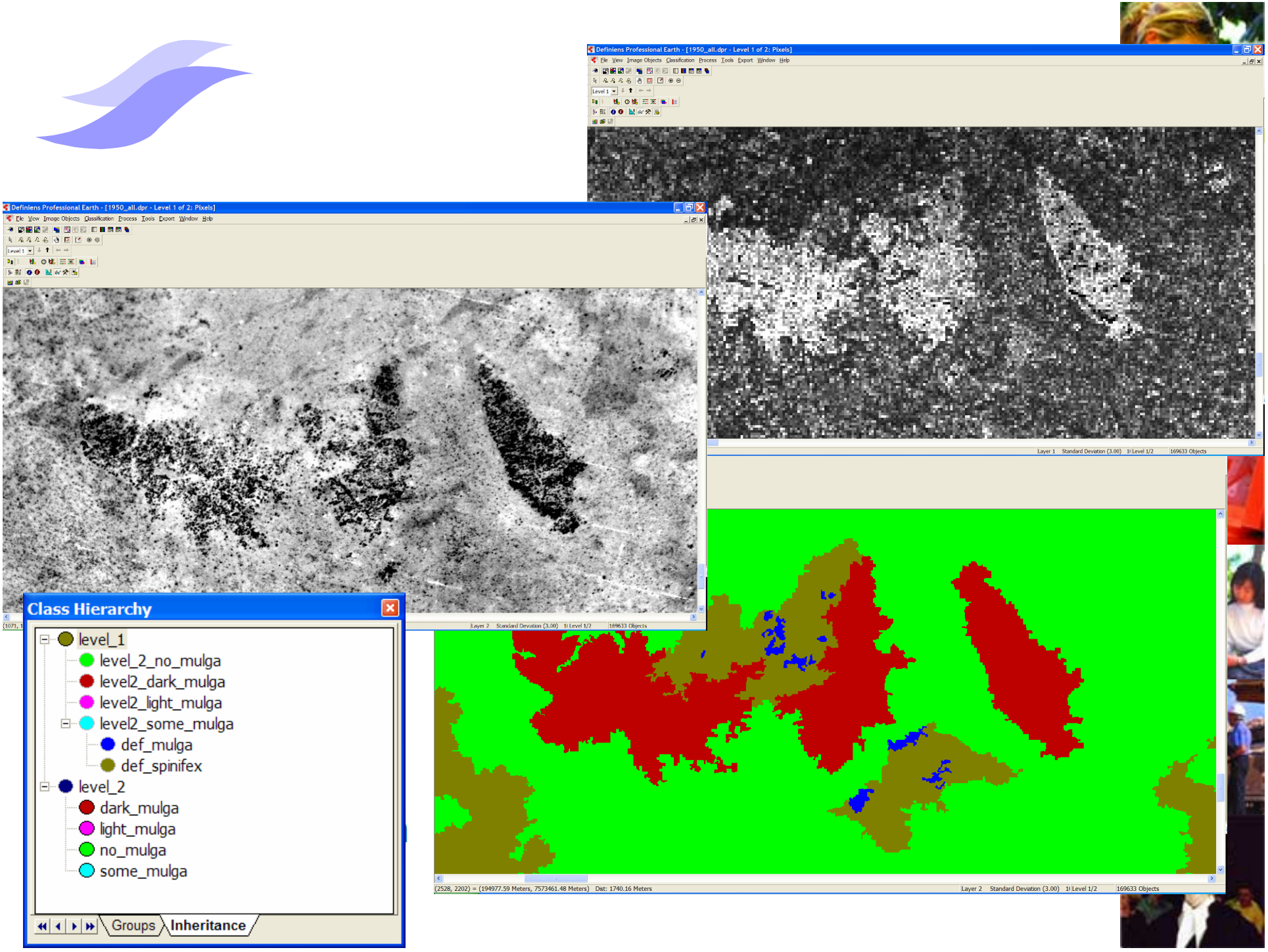


Methods – Medium Term

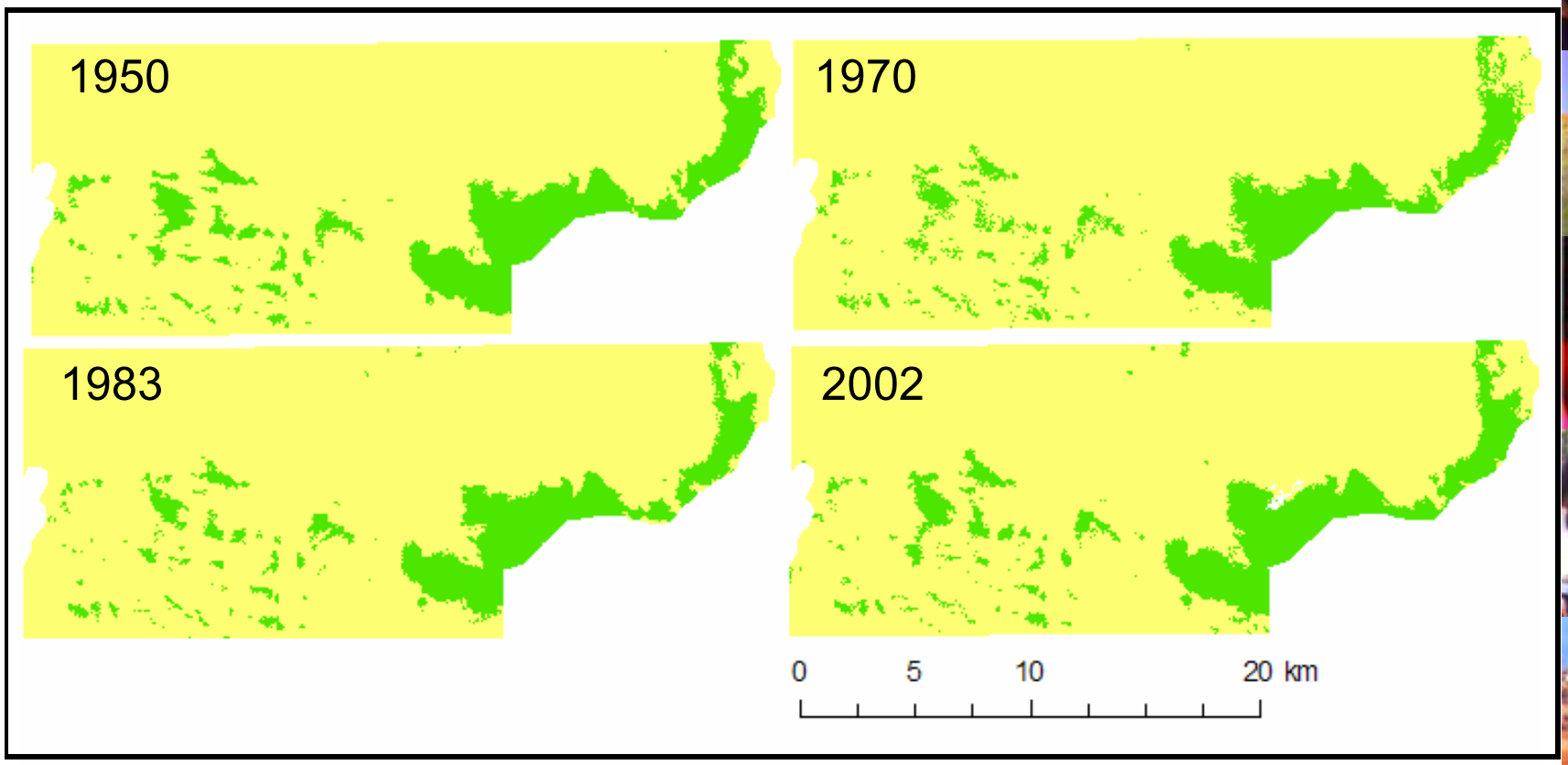
- **Aerial photography from 1950 (1:50,000), 1970 (1:80,200), 1983 (1:81,000) and 2002 IKONOS satellite imagery**
- **Object based classification with subsequent manual classification used to identify mulga (< 1 ha)**
- **176 field points and 1000 manually classified points used for validation**

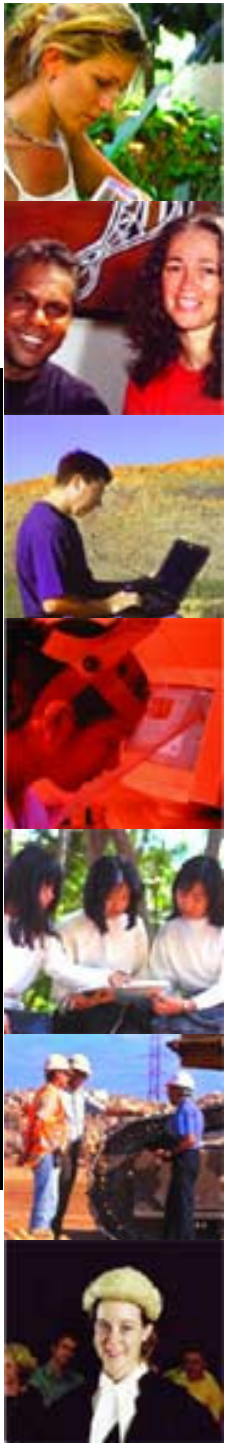


Charles Darwin UNIVERSITY Australia


Definiens Professional Earth - [1950_all.dpr - Level 1 of 2: Pixels]
Class Hierarchy
level_1
level_2_no_mulga
level2_dark_mulga
level2_light_mulga
level2_some_mulga
def_mulga
def_spinifex
level_2
dark_mulga
light_mulga
no_mulga
some_mulga
Groups
Inheritance

Results – Medium Term

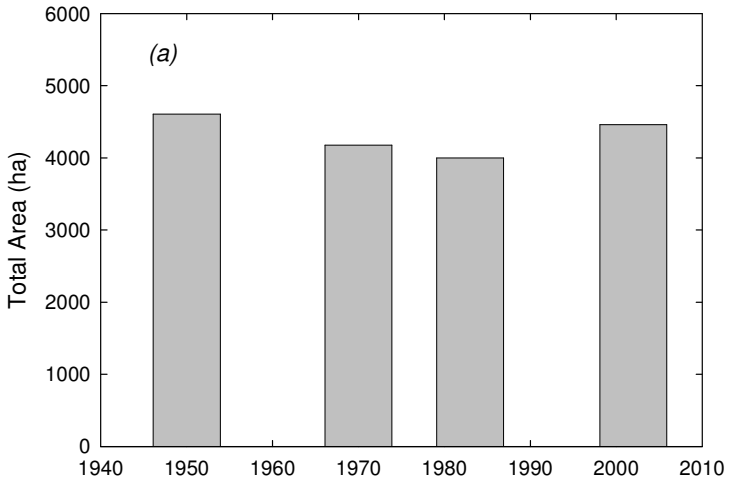


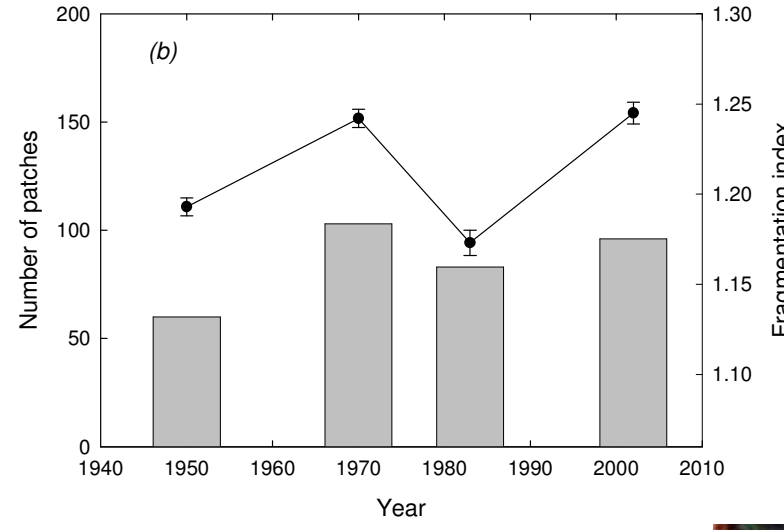


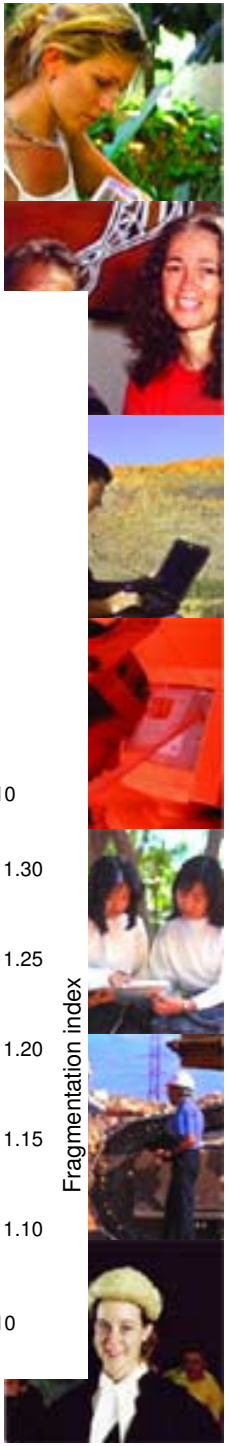
Charles Darwin UNIVERSITY Australia

Results – Medium Term

- Few, large mulga patches in east, many small patches in west
- Decrease in mulga 1950 – 1983, increase 1983-2002
- Small changes in fragmentation index, with peaks in 1970 and 2002



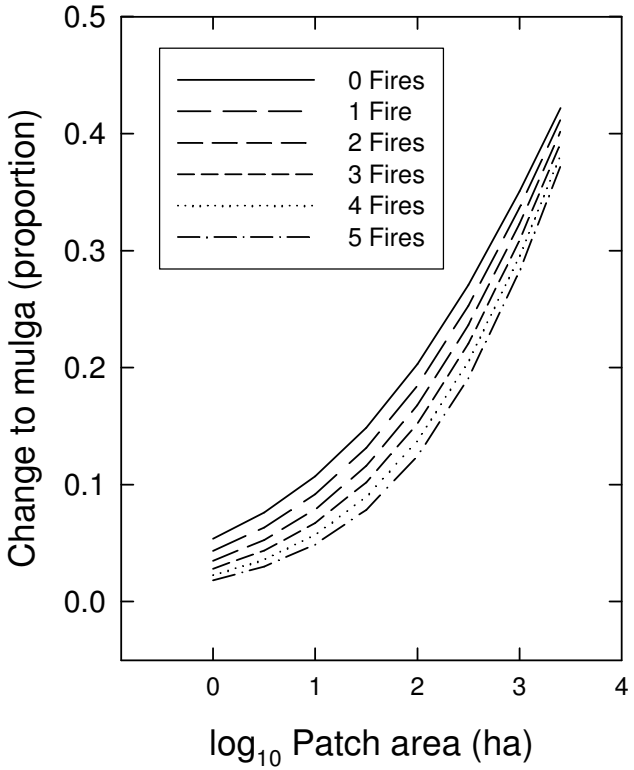


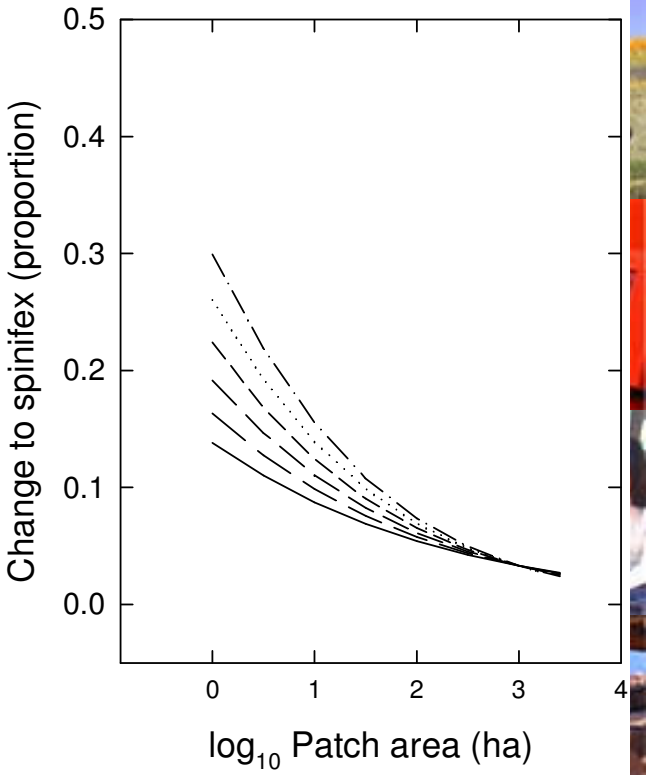


Charles Darwin UNIVERSITY Australia

Results – Medium Term

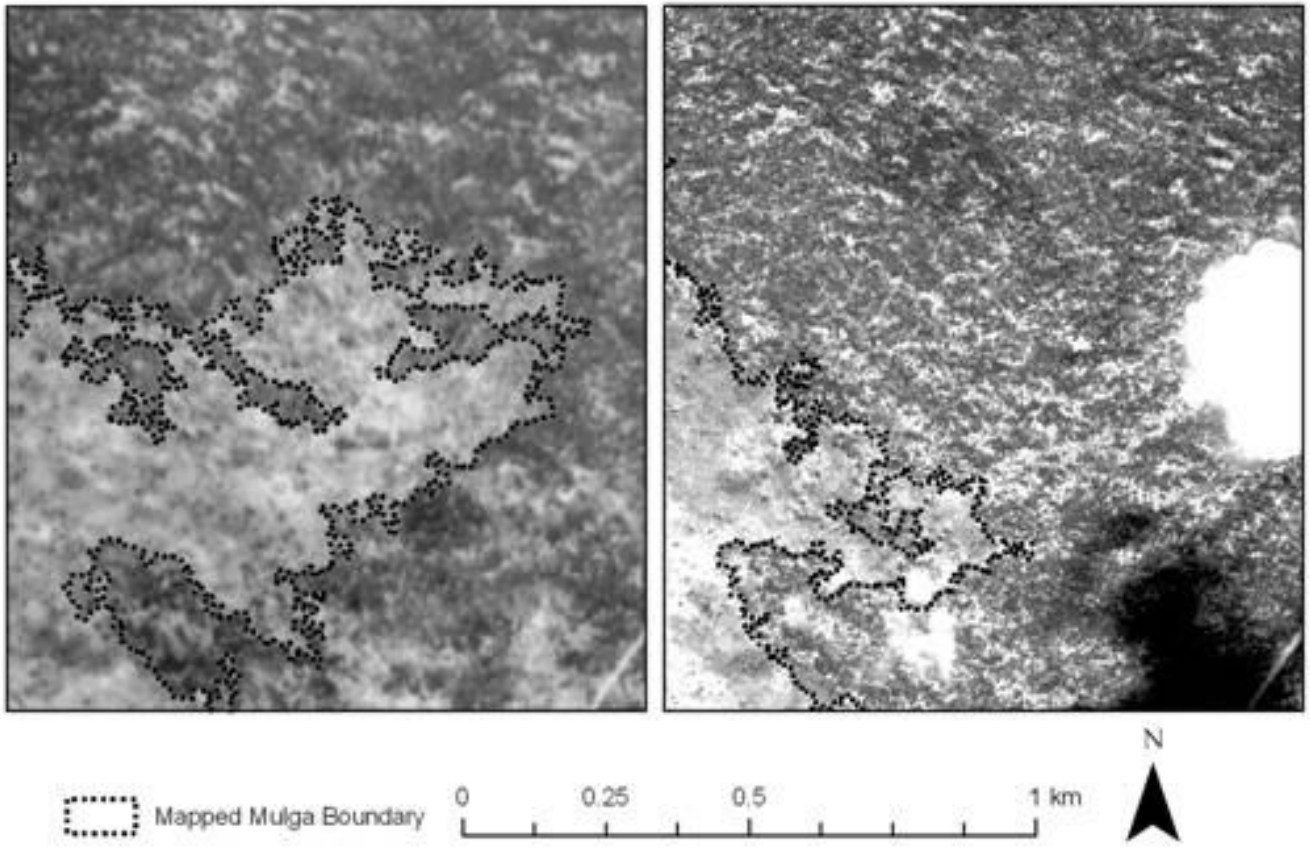
- **Boundary change only (< 50 m)**
- **Large patch boundary more likely to convert to A. aneura, but reduced by fire**



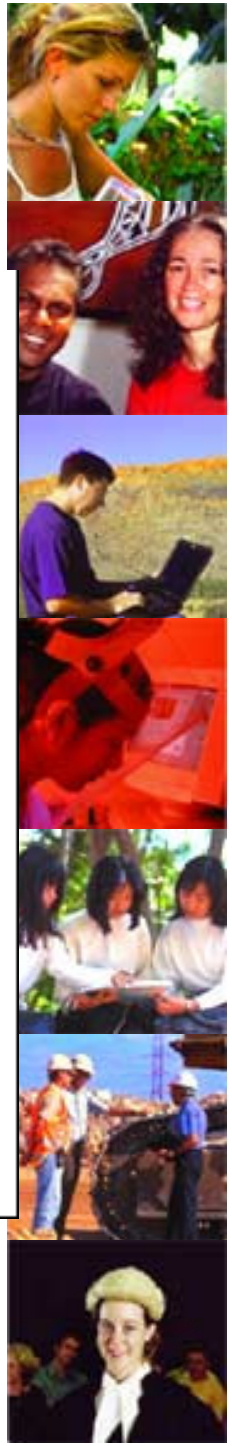


Charles Darwin UNIVERSITY Australia

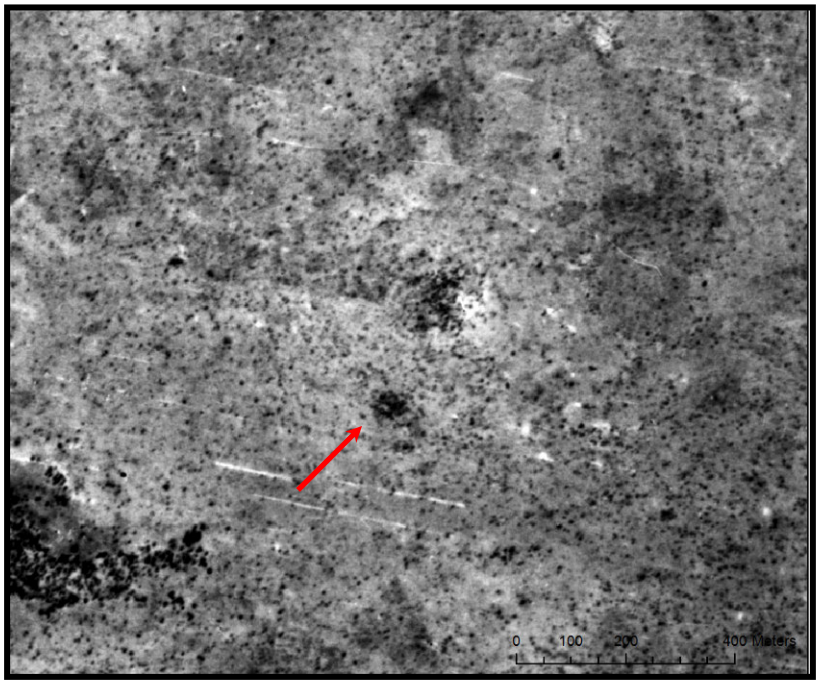
Results – Medium Term

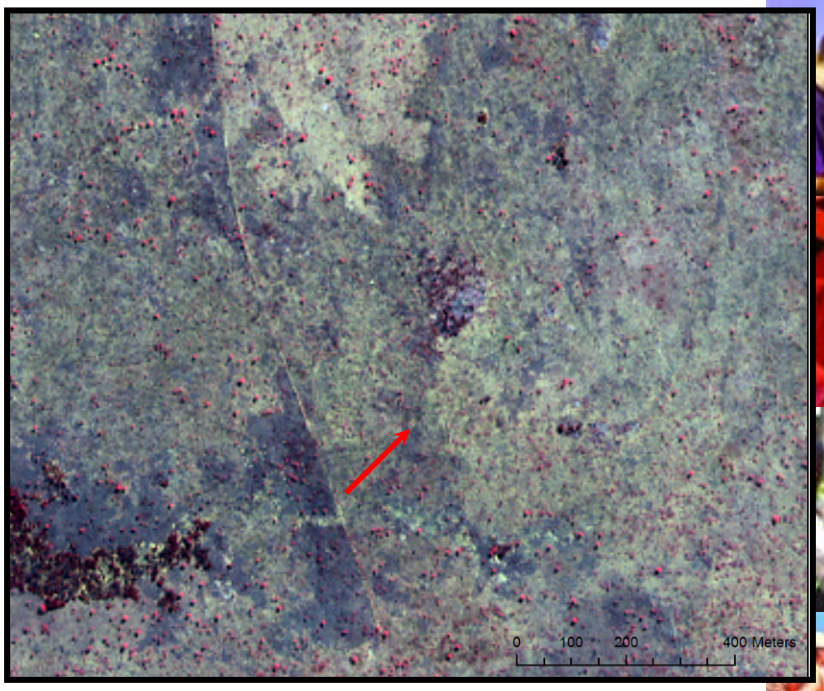


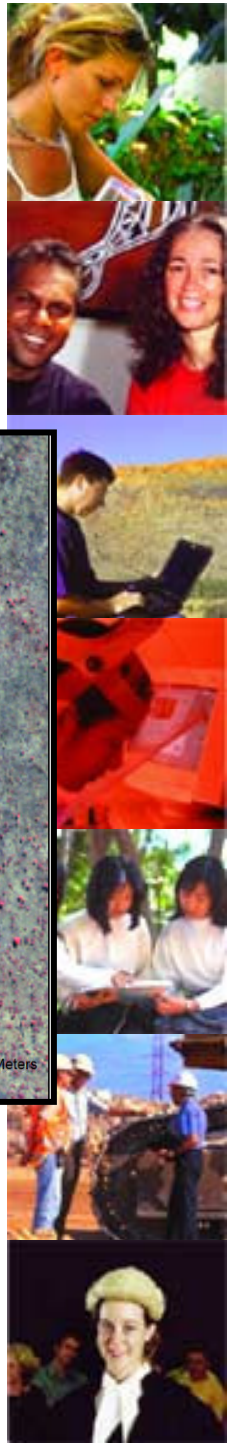
Charles Darwin UNIVERSITY Australia



Results – Medium Term

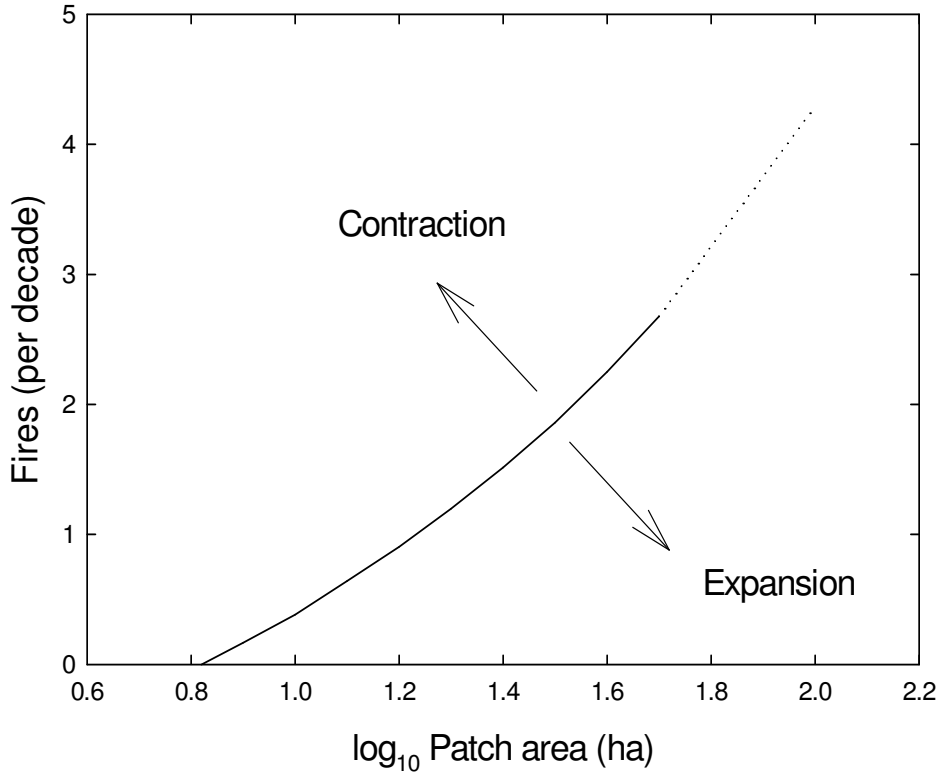


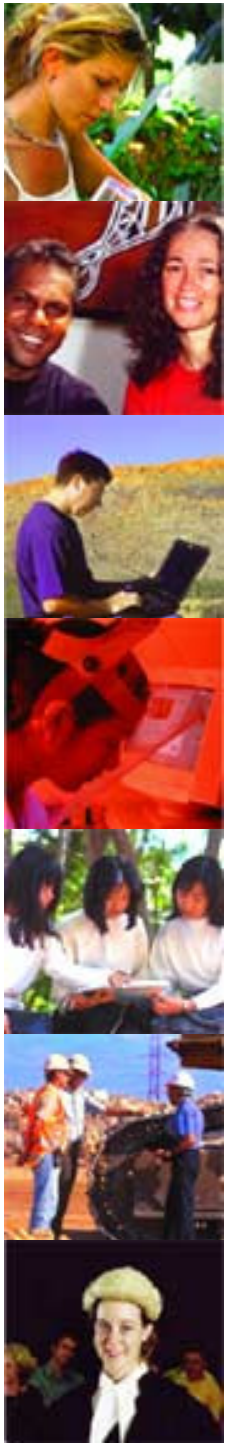




Charles Darwin UNIVERSITY Australia

Results – Medium Term



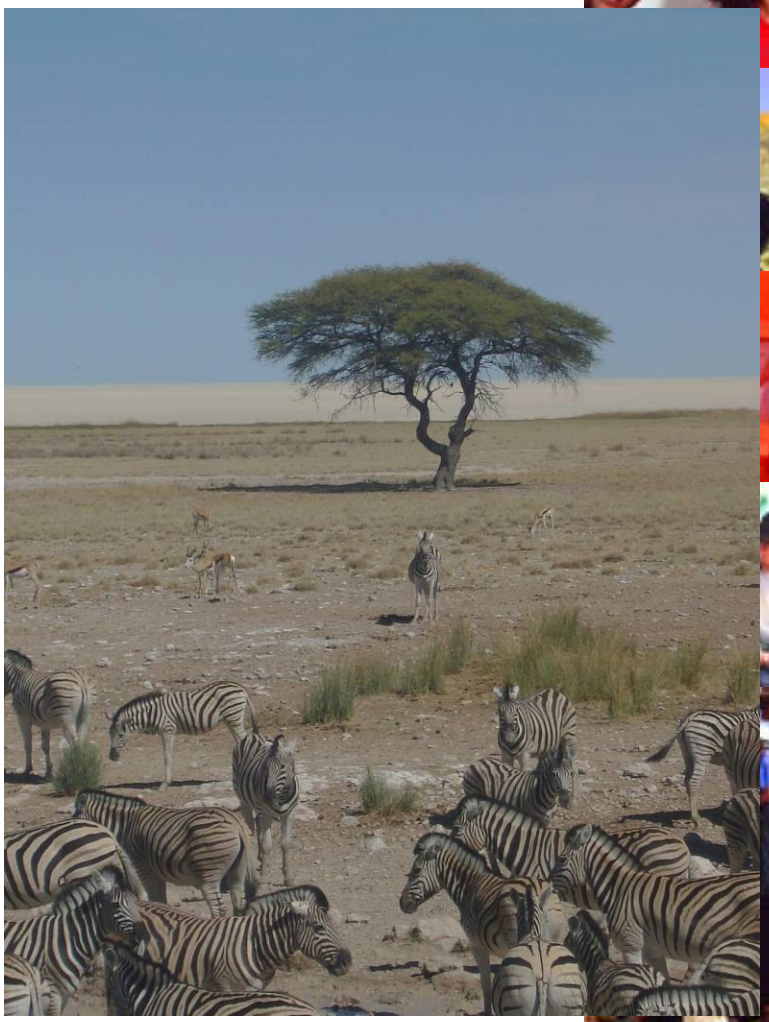


Charles Darwin UNIVERSITY Australia

Tree Cover Mapping

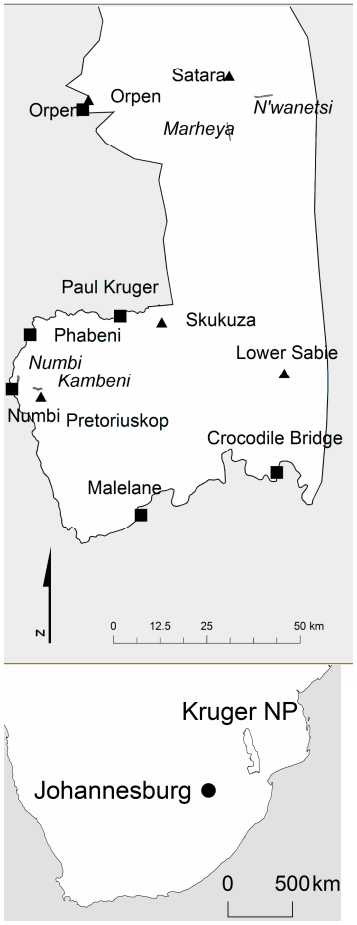
Guy Boggs, Kate Parr, Izak Smit

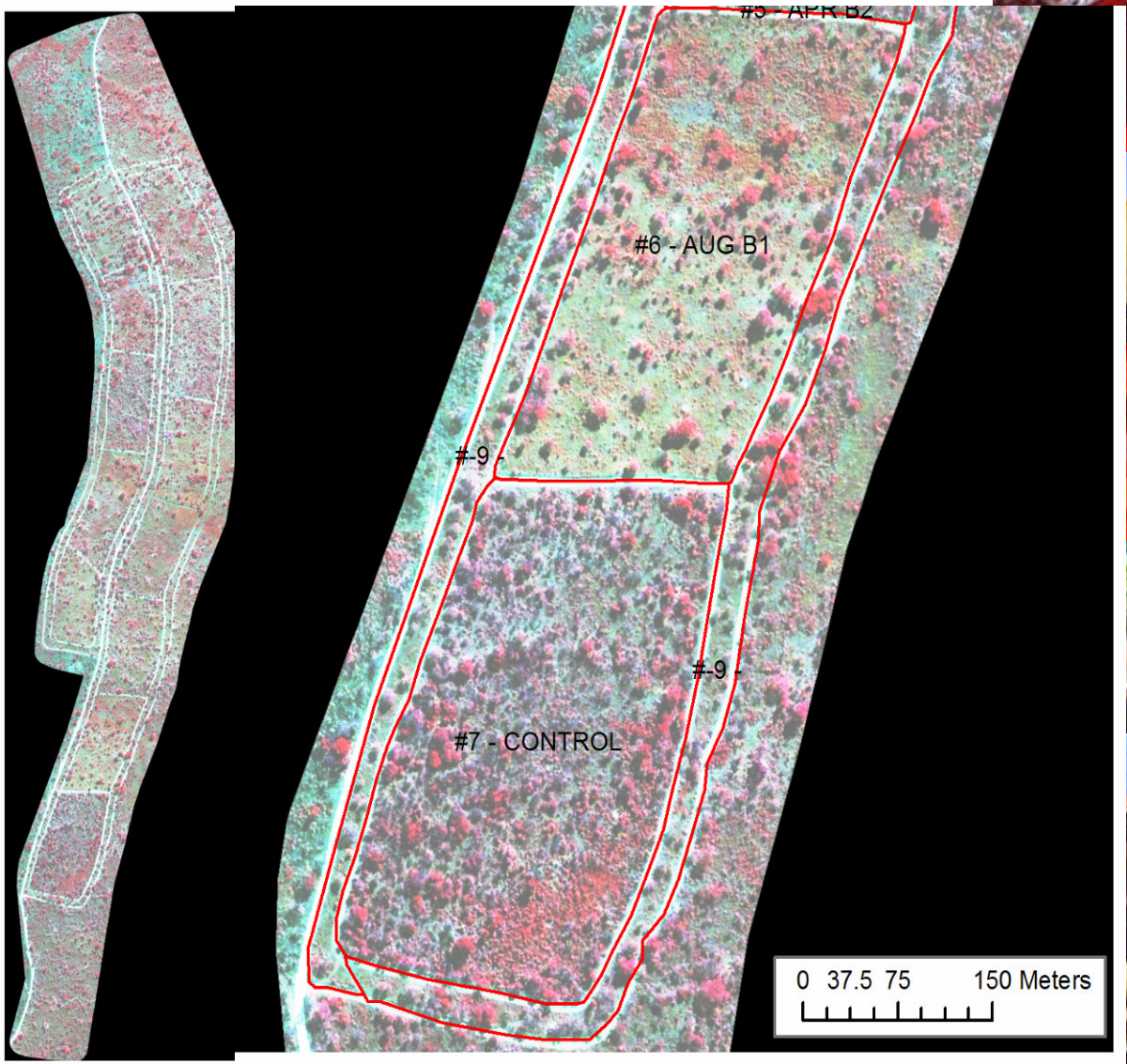
- Tree cluster patterns shown to follow power law distrbution
- Disturbance likely to alter relationship
- Aim: map tree cluster patterns across variable fire regimes

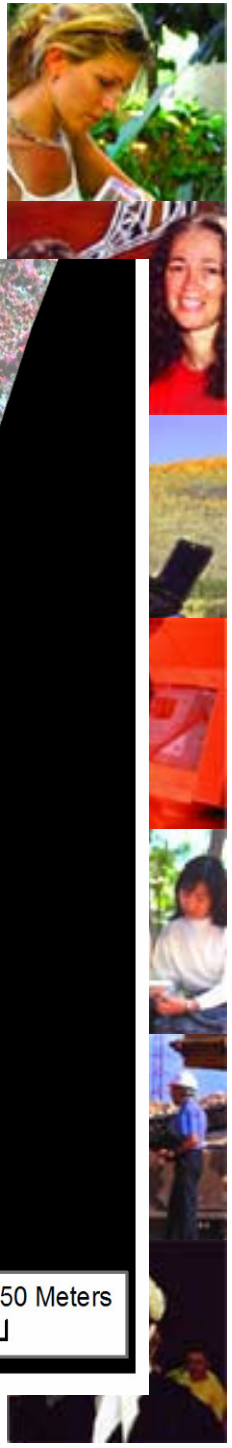


Charles Darwin UNIVERSITY Australia

Tree Cover Mapping





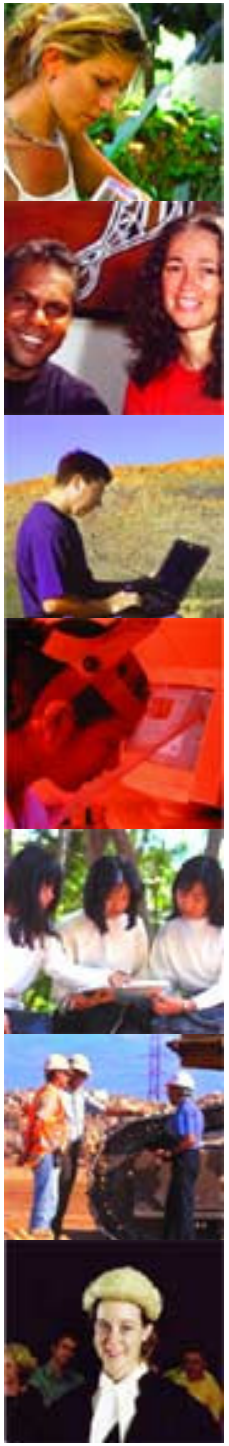


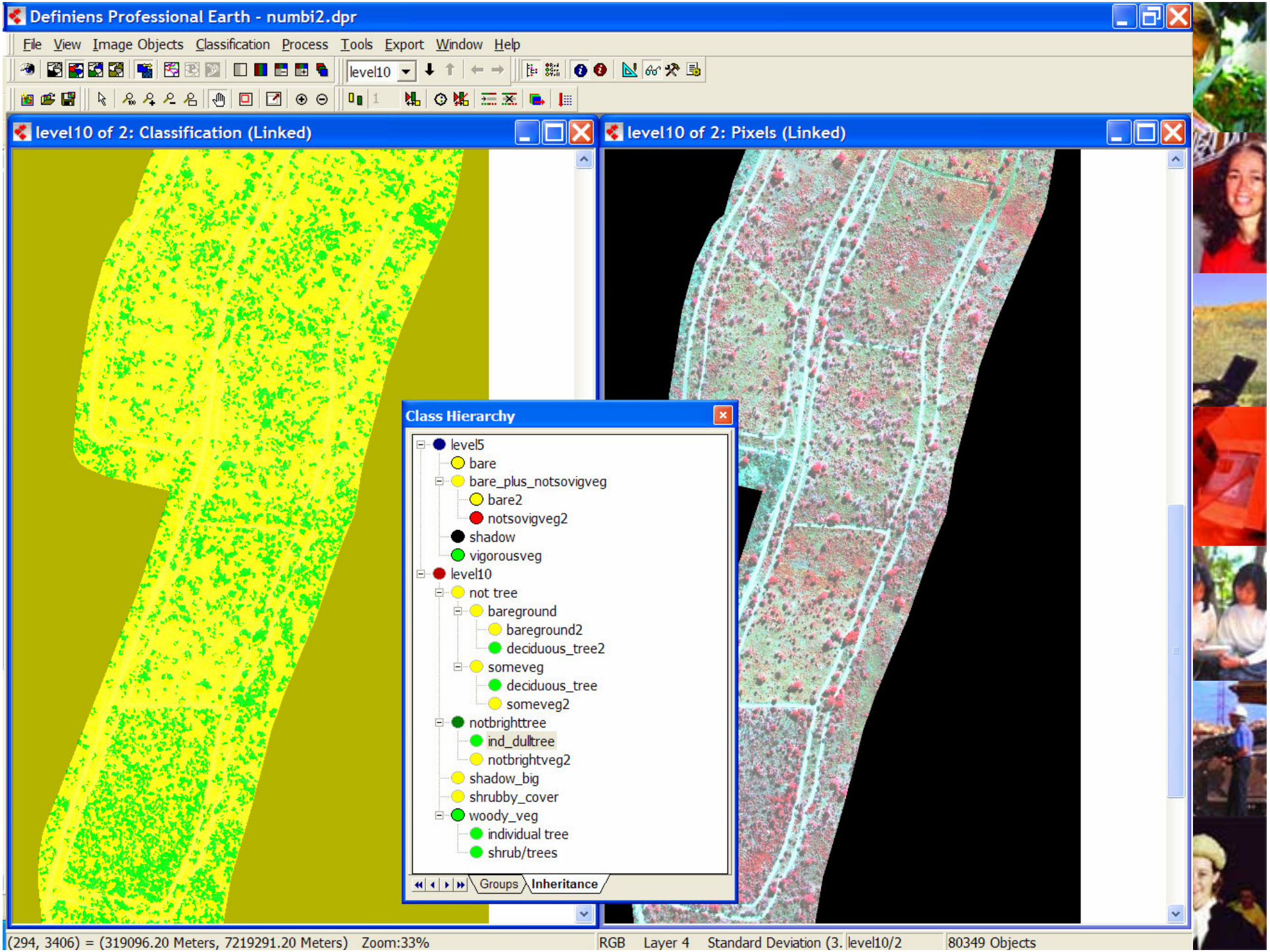
Charles Darwin UNIVERSITY Australia

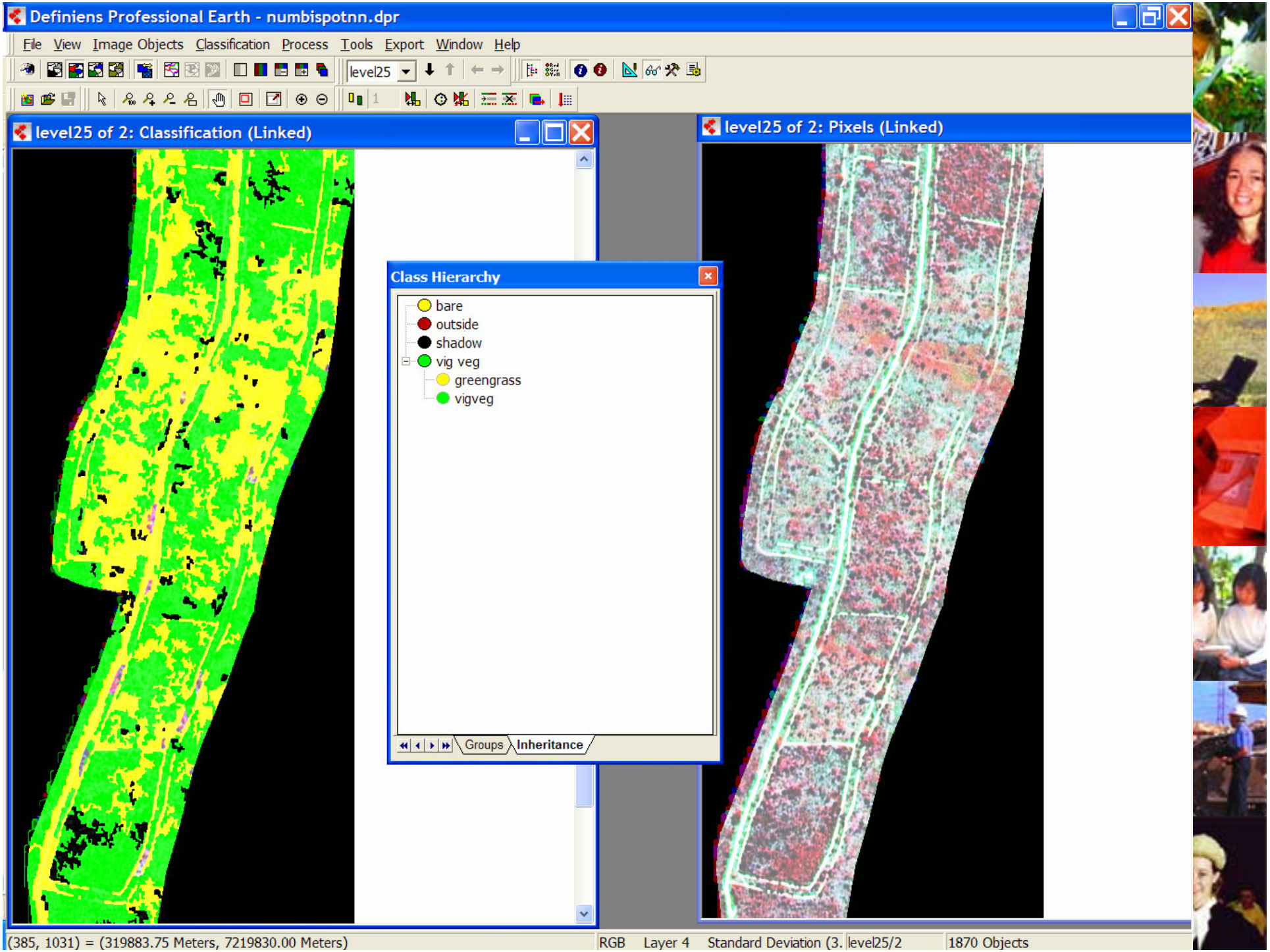
Methods

- SPOT (2.5m) and QuickBird (0.6m) pan sharpened imagery
- OBIA and NDVI threshold methods evaluated
- Two segmentation levels created (smaller objects and mapping scale)
- Class hierarchy complex for high rainfall QuickBird imagery
  - NN and membership functions used
  - Spectral and relational features used (eg border to shadow)
- SPOT imagery classification generally simpler

Charles Darwin UNIVERSITY Australia




Definiens Professional Earth - numbi2.dpr
File View Image Objects Classification Process Tools Export Window Help
level10
level10 of 2: Classification (Linked)
level10 of 2: Pixels (Linked)
Class Hierarchy
level5
bare
bare_plus_notsovigveg
bare2
notsovigveg2
shadow
vigorousveg
level10
not tree
bareground
bareground2
deciduous_tree2
someveg
deciduous_tree
someveg2
notbrighttree
ind_dulltree
notbrightveg2
shadow_big
shrubby_cover
woody_veg
individual tree
shrub/trees
Groups
Inheritance
(294, 3406) = (319096.20 Meters, 7219291.20 Meters) Zoom:33%
RGB Layer 4 Standard Deviation (3. level10/2 80349 Objects

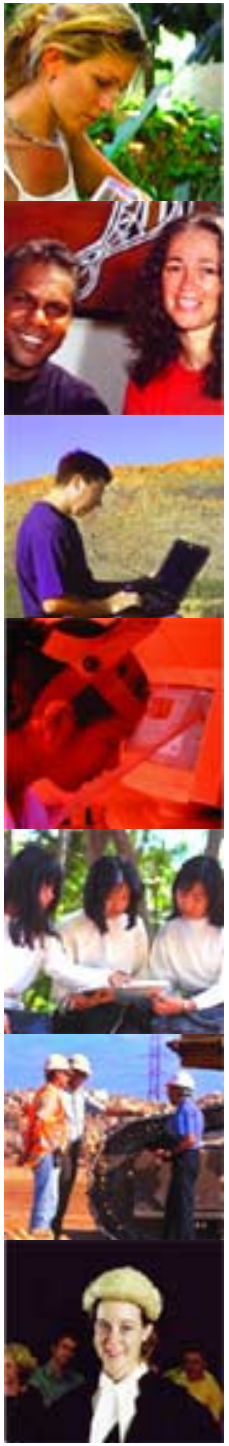

Definiens Professional Earth - numbispotnn.dpr
File View Image Objects Classification Process Tools Export Window Help
level25
level25 of 2: Classification (Linked)
level25 of 2: Pixels (Linked)
Class Hierarchy
bare
outside
shadow
vig veg
greengrass
vigveg
Groups
Inheritance
(385, 1031) = (319883.75 Meters, 7219830.00 Meters)
RGB
Layer 4
Standard Deviation (3.
level25/2
1870 Objects

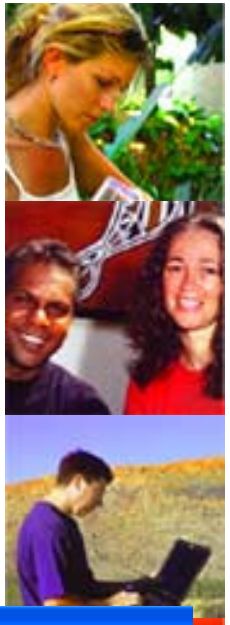
Results

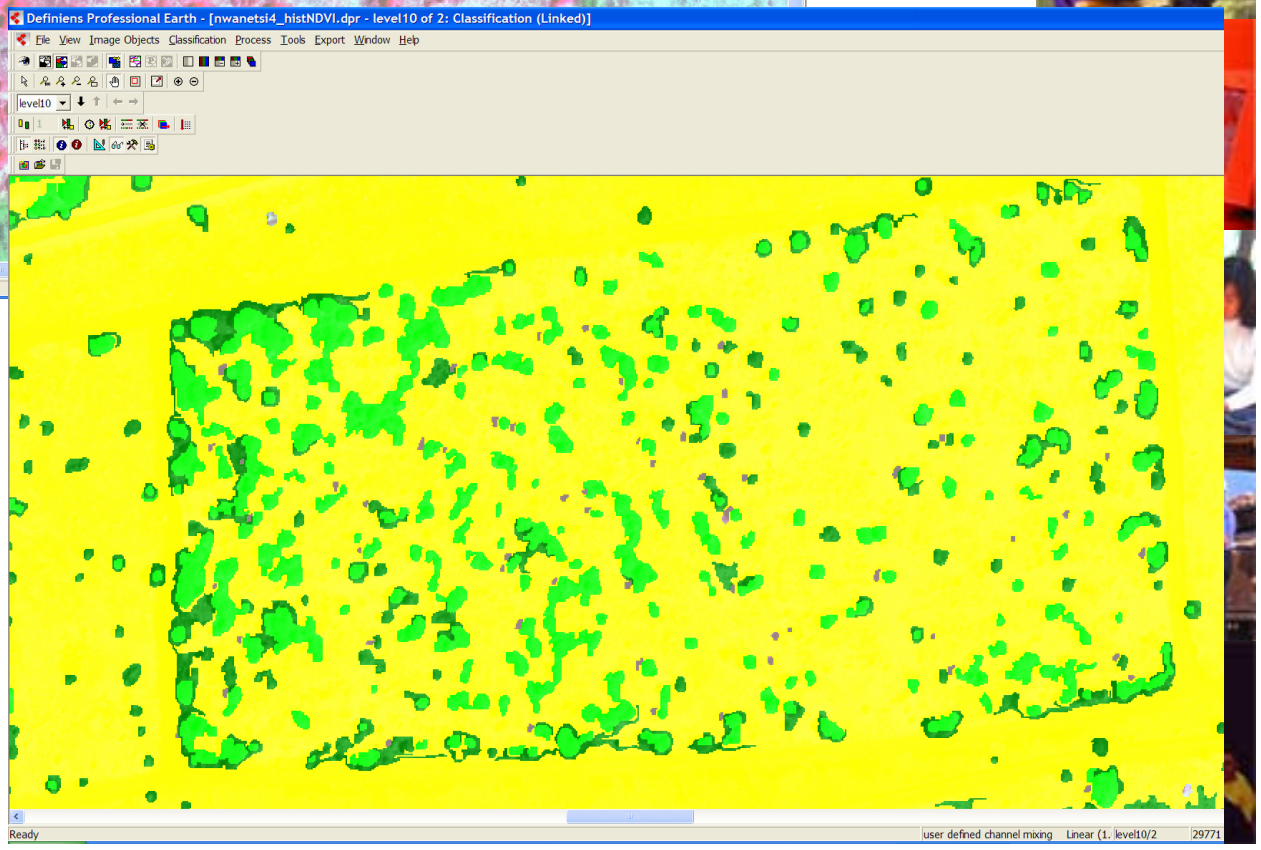
- **QuickBird performed well using OBIA and image threshold**
- **SPOT produced acceptable results using OBIA only**

	QuickBird		SPOT	
	NDVI	OB	NDVI	OB
Numbi	89 (0.79)	87 (0.74)	69 (0.40)	81 (0.60)
Kambeni	85 (0.69)	85 (0.69)	71 (0.41)	75 (0.49)
Nwanetsi	95 (0.91)	97 (0.93)	59 (0.19)	79 (0.59)
Marheya	93 (0.87)	95 (0.89)	53 (0.07)	72 (0.45)

Charles Darwin UNIVERSITY Australia



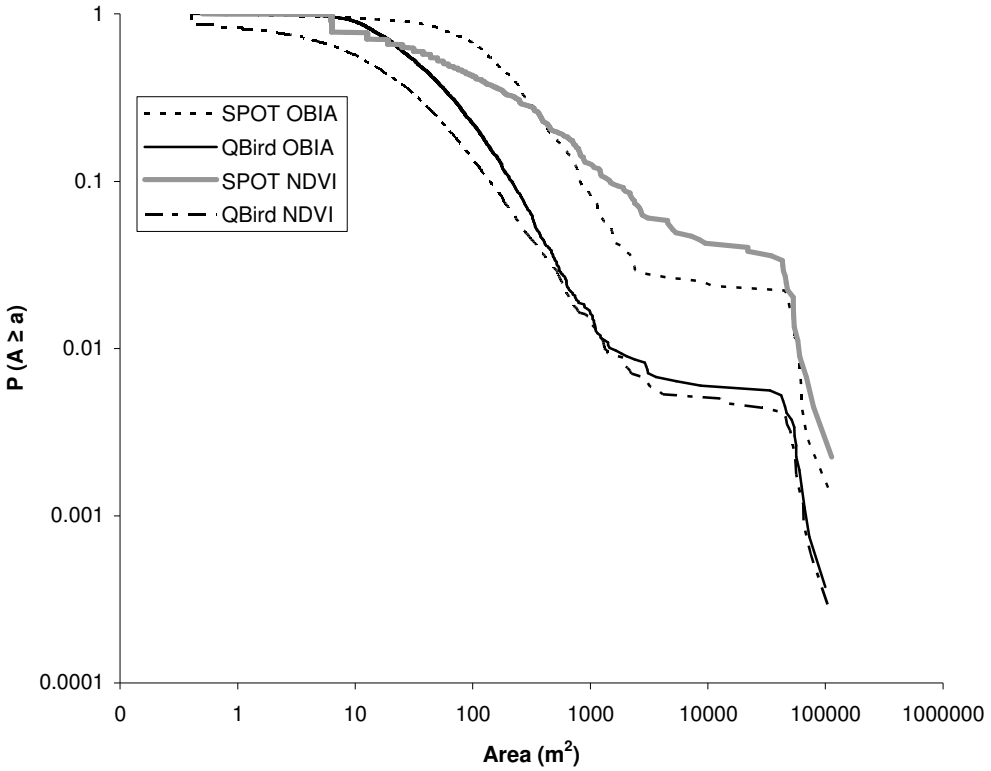


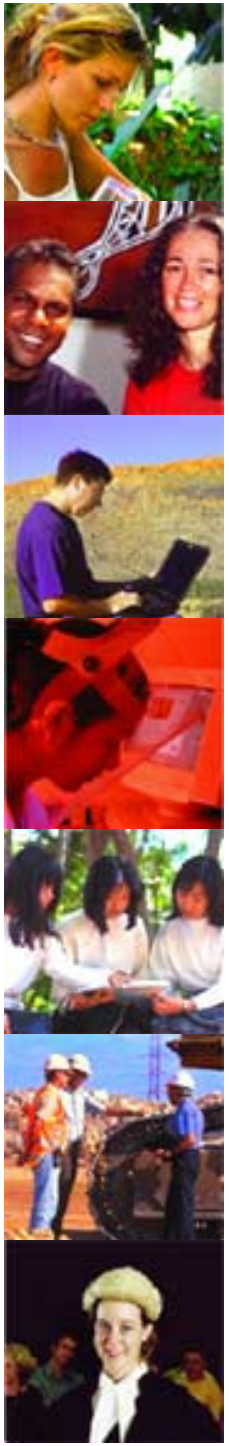


Charles Darwin
UNIVERSITY
Australia

Results

- **Tree Cluster Patterns show similar power law distributions for QBird NDVI, OBIA and SPOT OBIA**

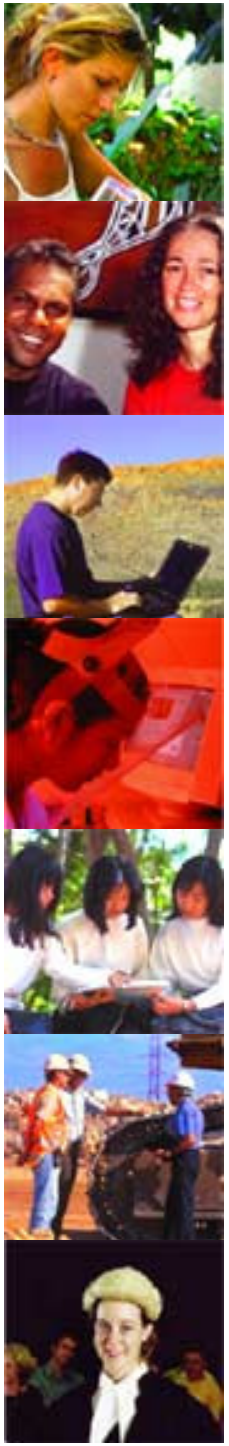




Charles Darwin UNIVERSITY Australia

Summary

- OBIA applied research well developed in NT
- OBIA advantages of;
  - Cartographically acceptable mapping
  - Incorporation of relational, textural and spectral information
  - Application with high resolution imagery
- Attention on developing semi automated techniques for adoption in mapping programs



Charles Darwin UNIVERSITY Australia

Questions?

Charles Darwin UNIVERSITY Australia

Contact:
guy.boggs@cdu.edu.au


29/06/2006


05/07/2006