Land cover change and morphological pattern analysis – a case study from the Alentejo, Portugal

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“Portugal has a complicated dynamic of forestry and forest loss due to fire; the resulting aggregate change dynamic is **fourth** in intensity globally” (Hansen et al., 2013, p 852).

- Portugal: the most dynamic land cover change of the 24 EU nations
- 1990-2000: highest percentage of land use changes (9%), and simultaneously, highest rates of afforestation (4%) and deforestation (3.5%)
- 2000-2012: Net forest loss of 5.6% of total land area; followed by Spain and France, each at 1.4%
- Mertola region, Alentejo (south of study area):
  - 1986-2000: more than 12% of land changed its use, with more than half of this as transfer from heterogeneous agriculture, shrub and arable to open forest
  - From 2000: overall decline in agricultural land and increase in forest area

Feranec et al. (2010); Jones et al. (2011; 2014)
Overall aim & context

- To develop new tools for biodiversity conservation in montado landscapes of southern Portugal
- Project builds on EU LIFE+ Iberian lynx and black vulture initiative, and the wider LPN/FFI Iberian lynx programme
- It seeks to evaluate/enhance the links between the landscape elements important for the Iberian lynx, and the other biodiversity values of these habitats
Changing lynx distribution

Approximate locations

- Pre-1900
- Early C21st

Objectives

1. Identify patterns of past and present land covers in a montado landscape
2. Investigate indicators of biodiversity values associated with different montado land covers
3. From (1) and (2) above, model effects of land cover patterns and changes on biodiversity and habitats
4. Develop a decision support tool to inform land use planning for biodiversity
5. Encourage new dialogue and action for montado biodiversity.
Study Area

Moura-Barrancos-Chança region, Alentejo
Land cover mapping and change analysis

Objectives

1. Identify patterns of past and present land covers in a montado landscapes
2. Provide information on land use/land cover (LULC) for modelling habitat and biodiversity change
3. Investigate whether Landsat can be used to track landscape changes at the spatially varied scale typical of many Mediterranean-type environments.
What is forest cover?

- Global Forest Watch: trees defined as >5m tall
- Continuous (closed canopy) cover vs. open tree’d landscape, e.g. montado
- What about transitional wood-scrub? Extent is greater in Portugal than any other EU country
Land Cover Land Use change detection

Correction of raw DN to Top of Atmosphere Reflectance

Normalise 1984 data to that of 2009

Mosaic northern and southern images for 1984 and 2009

Subset for the Moura-Chança region
Supervised LULC 2009 classification; accuracy assessment against a 2009 LC map, LULC surveys 2013/14; Google Earth

LULC Change: Tasseled-cap transformation & Change Vector Analysis

Potential historic LULC 1984: rule-based criteria
Tasseled-cap transformation

Weighted transformation of Landsat bands 1-5 & 7 into a new set of bands:

- **Brightness**
- **Greenness** – index of photosynthetically active vegetation
- **Wetness** – soils/surface moisture

Change Vector Analysis

Codes 1 and 2: biomass ‘loss’
Codes 3 and 4: biomass ‘gain’
Code 3 can also indicate change to standing water, e.g. reservoirs

Validated in a secondary exercise using Landsat Imagery from 2006 and 2014 and Google Earth imagery of the same dates
CVA: examples from SW Moura sub-region

Olive cultivation in 2009

Montado (>1.5m) in 2009

Abandoned olive in 2009

Agriculture in 2009

Biomass
- Gain since 1984
- Gain since 1984
- Loss since 1984
- Loss since 1984
Potential historic (1984) land cover

2009 Land Use Land Cover Classification + CVA biomass loss/gain for different LULC classes

Decision rules
• matagal and esteval (2009) + biomass gain = agroforestry (1984)

Output
• Extent of shrubland in 1984 and 2009
• Extent of Montado, olives and shrubland in 1984 and 2009
Morphological Spatial Pattern Analysis

**Objective:** Model the effects of land cover patterns and changes on biodiversity and habitats

- Describes the geometry and connectivity of habitat
- Simple mathematical operators, yet allows for user defined operations
  - edge-width of ecotone
  - connectivity search window
- Joint Research Centre (JRC) European Commission product
- Easy to use graphical interface, outputs files for GIS analysis
Create habitat layer
0 - no habitat
1 - habitat classes

3x3 filter passed over habitat layer
smooth shapes and remove small patches

Run MSPA
Define edge width
Define connectivity function

Two habitat iterations:
1. Shrubland = shrubby montado, esteval & Matagal
2. Open montado, olives and shrubland

Applying MSPA
### MSPA results shrubland: i.e. shrubby montado, esteval & matagal

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MSPA agroforestry results: i.e. shrubland plus open montado and olives

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MSPA example (SW Moura) – shrubland

1984

2009

- Core area
- Edge
- Bridge
Looking down over olive groves from area of matagal (abandoned olive)

Encroachment by shrubs and other taxa, e.g. Cistaceae, *Lavandula*, *Lonicera*, *Phillyrea*, *Pistacia*, *Rhamnus*
Mosaic of habitats to meet species needs

**Refuge**: closed biomes for species movement and resources

**Hunting**: open biomes for access to habitat with prey

**Ecotone**: transition between the open and closed biome. These areas are an important interface for species to access both biomes. Defined as 90m

**Pasture**: crop, fallow & pastureland
Primeiros linces vão ser libertados em Mértola na próxima semana

RICARDO GARCIA  09/12/2014 - 08:53

Programa de reintrodução do lince ibérico em Portugal entra em fase decisiva, com dois animais soltos numa grande área cercada, onde permanecerão durante algumas semanas.

Muito obrigada!

O lince ibérico está em “perigo crítico” de extinção

Headline from Público newspaper: 09/12/2014