ASSESSING WILDLIFE CONNECTIVITY IN ALQUEVA WATERSHED

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CLIENT: EU Taxpayers and EDIA

OBJECTIVE: To assess change in wildlife connectivity from the development of the Alqueva Reservoir in Southern Portugal and propose paths for conservation and restoration

METHODOLOGY:

1) Review literature on habitat requirements and previous studies
2) Perform McHargian suitability analyses on past and present land use to determine the change in suitable habitat for three species: European wildcat, European polecat and lesser kestrel
3) Determine least cost paths between most suitable habitat clusters to inform areas to conserve and restore
1. CORINE Land Use (*Source: European Environment Agency*)
   - Resolution: 100 meters
   - 1990 (raster)
   - 2006 (vector)
2. Roads (*Source: EDIA*)
   - Pre-dam (vector)
   - Post-dam (vector)
3. Topography (*Source: Shuttle Radar Topography Mission / Military Maps*)
   - Resampled: 10 meter resolution (raster)
4. Census (*Source: Instituto Nacional de Estatistica*)
   - 2011 (vector)
SCOPE: Boundaries of the study area are determined by the Alqueva watershed as well as a 2 mile buffer outside of the watershed boundary to account for ridgeline biodiversity.
European Wildcat 
(*Felis silvestris silvestris*)

**SUITABILITY ANALYSIS**

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1990 2006
European Wildcat (*Felis silvestris silvestris*)

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Map showing changes in habitat suitability from 1990 to 2006.
Change in Most Suitable **European Wildcat** Habitat: **16%**

Change in Average Cluster Size: 110 to 70 hectares **-38%**
SUITABILITY ANALYSIS

European Polecat
*(Mustela putorius)*

- **OPPORTUNITIES**
  - grasslands
  - forest
  - farms
  - stream banks

- **CONSTRAINTS**
  - population density
  - roads

1990

2006
European Polecat (Mustela putorius)

SUITABILITY ANALYSIS

1990

2006

OPPORTUNITIES

- forest
- grasslands
- farms
- stream banks

CONSTRAINTS

- population density
- roads
Change in Most Suitable **European Polecat** Habitat: -9%

**Change in Average Cluster Size:**
270 to 100 hectares -64%
SUITABILITY ANALYSIS

OPPORTUNITIES
- fallow land
- cereal
- holm oak
- pasture
- grasslands

CONSTRAINTS
- non-cereal crops
- irrigated crops
- roads

Lesser Kestrel (Falco naummani)

1990

2006
SUITABILITY ANALYSIS

**OPPORTUNITIES**
- fallow land
- cereal
- holm oak
- pasture
- grasslands

**CONSTRAINTS**
- non-cereal crops
- irrigated crops
- roads

** Lesser Kestrel (Falco naummani) **

1990 - 2006

Suitability analysis for grasslands, non-cereal crops, roads, and lesser kestrel habitats.
Change in Most Suitable **Lesser Kestrel** Habitat: **-19%**

Change in Average Cluster Size: 550 to 350 hectares **-37%**
Ecological Corridor
- connect isolated habitats
- mitigate fragmentation

- Mapped ecological corridors in the watershed area of Alqueva for year 1990 and 2006
- Mapping method: least-cost path (LCP) model
- Compared the results for changes

Method

1. Land cover → Cost surface → Least cost path (LCP)
2. Corridor by LCP
3. Corridor 1990 → Comparison for yearly changes → Composition with all corridors → Identify important corridor sections
4. Corridor 2006
The least-cost path (LCP) model generates a least-cost path, which costs the least to traverse between two locations. Cost is a function of time, distance, or some other criteria defined by the user (ESRI).

This LCP model has two inputs and one output:

1. Habitat data, which shows the distribution of most suitable habitat area for a certain species (based on previous suitability analysis).
2. Land cover surface raster, which describes the surface the organism moves through (created based on the table on the left).
3. The output corridors don’t have width, we buffered the corridors by 60 meters (30 meters from the center line).

(Spencer et al., 2010)
Most of the ecological corridors were concentrated in the middle of the watershed, but expanded to larger areas after the reservoir was constructed.

Some corridors in 2006 are surrounded by the reservoir which means the polecat needs to come across the water in order to get to suitable habitat.
IMPORTANT CORRIDOR
FOR EUROPEAN POLECAT
The ecological corridors for European wildcat also expanded to larger areas after the reservoir was constructed.
IMPORTANT CORRIDOR FOR WILDCAT
LESSER KESTREL CORRIDOR

Area comparison

1990: 15.003302
2006: 16.151567

+7.7%

Pattern Distribution comparison

- The ecological corridors did not change very much.
- A high frequency of the corridors were constructed across the water in 2006.

Legend
- Biological Corridor
- Habitat Opportunity

VALUE
- 0
- 5
- 10
- 15
- 20

Legend
- Ecological Corridor
- Habitat Opportunity

Landcover Resistance
Value
- 0
- 2
- 4
- 6
- 8
- 10
- 12
- 14
- 16

Sources: Esri, HERE, DeLorme, TomTom, Intermap, ENTELS, GOOG, NASA, USGS, USGS, AEROS map data, USDA, NRCAN, Geobase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Shanghai), Xian VastGIS, Geoamérica, MapmyIndia, OpenStreetMap contributors, World Imagery  © 2018 Esri,deLorme

Map of lesser kestrel corridor area and distribution comparison between 1990 and 2006.
IMPORTANT CORRIDOR
FOR LESSER KESTREL
CORRIDOR CONSTRUCTION: European Wildcat

BROAD-LEAVED FOREST
- Kermes oak
- Holm oak

HERBACEOUS COVER
- Edge grasses

SCRUBLAND
- C. ladanifer
- Pistacia lentiscus

CEREAL CROPS
- Barley
- Wheat
FINDINGS

Changes in Most Suitable Habitat:

• 16% increase for european wildcat, which could reflect increased land abandonment and resultant conversion to scrubland

• 19% decrease for lesser kestrel, likely from conversion of non-irrigated cereal crops to irrigated crops from increased availability of water

Fragmentation:

• Fragmentation greatly increased for all species which reflects the addition of Alequeva Reservoir as a barrier between ecoregions

• The european polecat experienced the greatest fragmentation, about 33% more than that of the other species. This could be a result of grassland and forest conversion to farmland from increased availability of irrigation water from Alqueva dam.
FINDINGS

LCP Model Deficiencies:

• LCP assumes that a traveler has complete knowledge of the landscape it travels, which might not be the case for every species.
• Did not take elevation and slope information into cost surface construction due to a lack of complete elevation data.

Corridor Connections:

• There are no significant area changes between 1990 and 2006.
• However, the pattern of ecological corridors has changed since the dam was built. Most of the corridors expanded to larger areas, and more corridors came across the water body.
These exists a lack of data for habitat cover specific to the Alentejo region so increased biological surveys of each species is neccessary. Furthermore, sampling of vegetation within frequented habitat patches of each species could inform affective corridor planting designs.

Enhanced resolution of CORINE land-use data from 100m to 30m would greatly improve the accuracy of future habitat suitability analyses. Up to date CORINE land-use covers would decrease error and enhance understanding of long-term impacts of Alqueva Reservoir.

Consideration of each species’ food sources could inform valuable parameters for corridor connections. For example, the European Wildcat in the Alentejo region relies heavily on wild rabbit as a main food source. When the distance between the edge of scrubland and cereal crops is under 50 meters, rabbit abundance was found to greatly increase (Calvete et al., 2004).

Special attention should be taken in conserving the ecological corridors that are unchanged (which exist both before and after the Alqueva Dam was built).

Next priorities should examine heavily fragmented areas to establish vegetative connections.
QUESTIONS / COMMENTS?

THANKS!