Assessment of Landscape Change's Impact on Alpine Species Distribution Using a Multi-scale Approach

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Introduction: there is a strong relation between biodiversity and traditional land use in Mediterrean areas.
In these highly human dominated regions traditional activities profoundly shape landscape with strong consequences on biodiversity pattern.
In the last few decades the rapid socio-economic change lead to the abandonment of "marginal" land modifying the landscape structures.
Remote sensing data can provide information about environmental changes, but the occurence of temporal and spatial gaps can reduce the applicability of gained information.

The aim is to assess the recent land cover changes to evaluate their role in shaping Alpine species distribution. To explore the complexity of landscape structures, we propose a multi-temporal and scale approach integrating different kind of remote sensed and field data. This multi-scale analysis allows us to study how the environmental patterns affect the current animal distribution, using both a multi-taxa (carabids, butterflies, spiders, staphylinids, birds; sampled at community level in discrete fixed plots) and a single species approach (Alpine ibex, Capra ibex, monitored over continuous large spatial scale).

Keywords: land cover changes; species distribution; landscape ecology; mountain ecosystems; remote sensing.

Study area and sampling design: Gran Paradiso National Park (45°33' N, 7°12' E) was established in 1922 in north-western Italy, to protect the only surviving population of Alpine ibex. It is composed entirely of mountainous terrain and it is sparsely populated by humans and their activities in general are severely limited. We will focus on two spatial resolution:

- 5 altitudinal transects composed by 30 test areas (circular plot with r=100 m) representative of montane, subalpine and alpine belts (Viterbi et al. 2013);
- entire park area.

Analysis of land cover changes: using aerial photos and Landsat images to reconstruct the land cover changes occurred in the last decades (1970-2010).

1) Detection of land cover changes in the 5 altitudinal transects (Rocchini et al. 2006).
   - Pre-processing of aerial photos;
   - creation of land cover map legend;
   - supervised classification at highest possible resolution;
   - overlapping plots with a grid of cells equal to minimum mapping unit;
   - assignment of spatial unit to prevalent land cover class;
   - quantification of changes.

1) Landscape changes occurred in park territories (Fichera et al. 2012).
   - Pre-processing of aerial photos;
   - selection of areas to create training samples;
   - pre-processing of Landsat images;
   - supervised classification;
   - accuracy assessment;
   - landscape analysis.

Combining of aerial photos and satellite data to evaluate landscape changes at two different scales of analysis.

Monitoring of vegetation structure: integration of unmanned aerial vehicle (UAV) images and Landsat data to monitoring vegetation structure.

1) Monitoring of habitat structure along the altitudinal transects (Lobo et al.1998)
   - UAV survey during the vegetation growing season;
   - botanical sampling to constitute set for training phase and accuracy assessment;
   - image segmentation;
   - features extraction from segments;
   - per-segment classification using botanical sampling and segment feature;
   - accuracy assessment.

2) Park land cover types classification (Cingolani et al. 2004)
   - Pre-processing of Landsat images;
   - superimposition of a grid with cell size equal to Landsat pixel to UAV images;
   - extraction of structural, phisionomic and spectral feature of cells;
   - creation of spectral signature set;
   - classification using spectral signatures;
   - accuracy assessment.

Development of a monitoring program using high resolution classified images and satellite data to quantify vegetation structure changes.

The expected results of the project are the development of a method to evaluate the recent landscape changes occurred in the last decades and the creation of a protocol to monitor the rapid modification of vegetation structures. The integration between field and remote sensed data allows us to identify land cover types where occurred the major changes and the multi-scale analysis permits us to detailing the different effects of landscape patterns on Alpine species distribution ranging from fixed plots to entire park area.

In conclusions he under- standing of processes behind the species communities distribution have to consider the influence of landscape pattern on environmental processes. Only considering the species-landscape interactions it will be possible to carry out successful conservation initiatives, therefore management planning should be based on landscape management approach in order to preserve the high environmental heterogeneity of our regions.

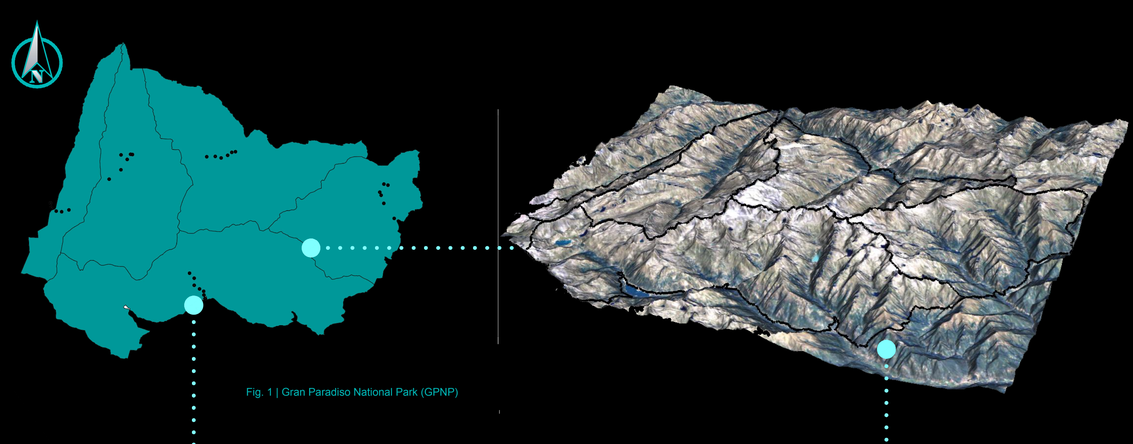

Fig. 1 | Gran Paradiso National Park (GPNP)

Fig. 2 | Landsat image of GPNP

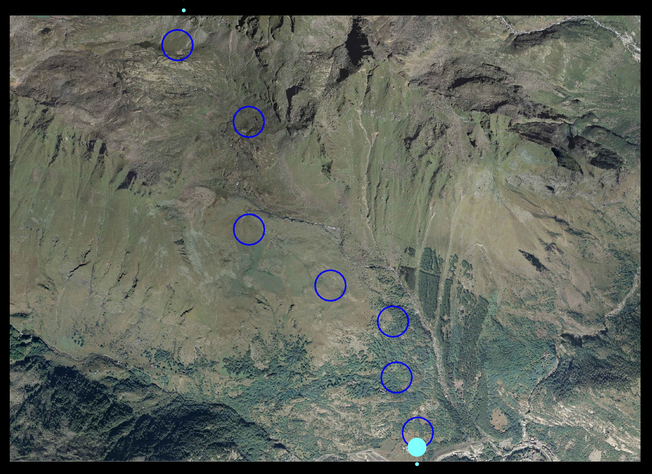

Fig. 3 | Orthophoto of an altitudinal transect

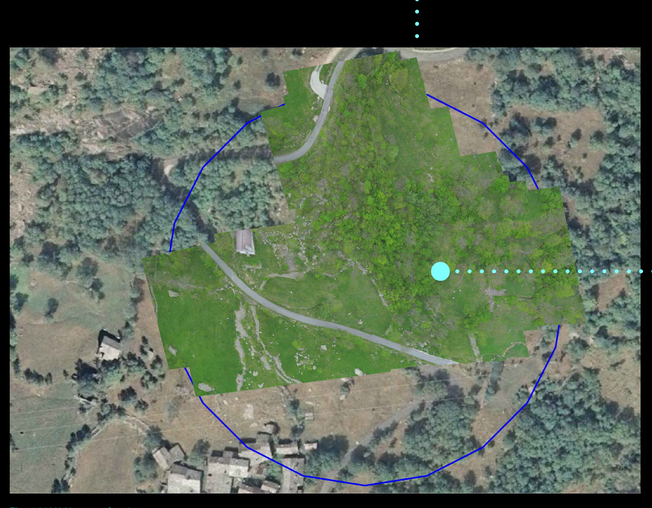

Fig. 4 | UAV image of a plot

Fig. 5 | Male Ibex. Source: GPNP archive

Fig. 6 | Lanius collurio

Fig. 7 | Parnassius apollo

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