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Adaptation of a crop composition and configuration analysis method to european agricultural landscapes

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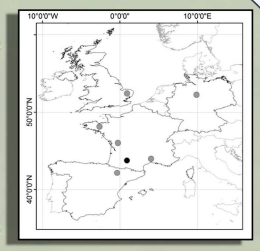
Introduction

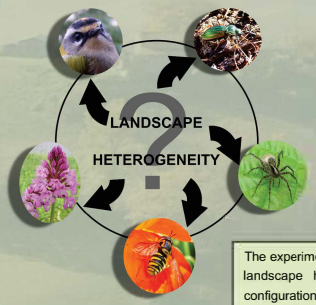
Agricultural landscapes approximately occupy a large part of available land surface and as such constitute a keystone in biodiversity conservation programs. In return, biodiversity contributes to production through ecosystem services as pollination or pest control. However, recent studies also suggested that new policies and modifications in agricultural practices in order to promote biodiversity must be accepted by the different actors of the rural space and incorporated in existing practices. In this perspective, deciphering the role of agricultural landscape heterogeneity in maintaining biodiversity may be a promising research direction. The FARMLAND project precisely aims at giving an answer to this questions combining tools from geomatics, remote sensing and geostatistics associated to ecological research on biodiversity. Based on spatial indexes from landscape metrics, this work proposes a mapping method for sampling quadrats and constituting an experiment design in order to dissociate the influence of composition (the number and probability of occurrence of the different cover types) and configuration landscape heterogeneity (the spatial display of cover types) on biodiversity. After the sampling of quadrats in each of the 7 European sites, multi-taxa biodiversity records and ecosystem services identification will be undertaken.

We present here the different steps (1 to 7) of the adaptation of the initial methodology from a previous study (Pasher *et al.*, 2011) to the French site "Vallées et Coteaux de Gascogne" that constituted a test zone for the other European sites.

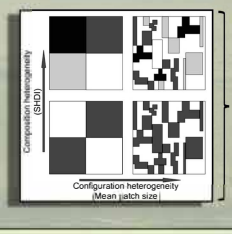
Context

The present work ascribes to the Farmland project (BiodivERsA2011-66) that aims at studying the relationships between agricultural landscape heterogeneity and biodiversity among seven study sites located in four different European countries.





EXPERIMENTAL DESIGN



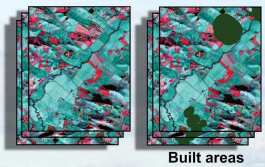
Determining sample quadrats for ecological survey.

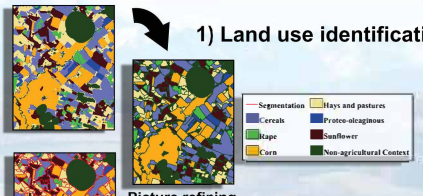
The experimental design has been set up in order to dissociate the influence of two components of landscape heterogeneity: composition heterogeneity (e.g. Shannon diversity index) and configuration heterogeneity (e.g. Mean patch size). In this purpose, the indexes have been discretized and four combinaisons of the higher and lower values have been sorted while maintaining their statistical independence (step 4).

1) Land use identification

Max. likelihood classification

SPOT multitemporal image stack



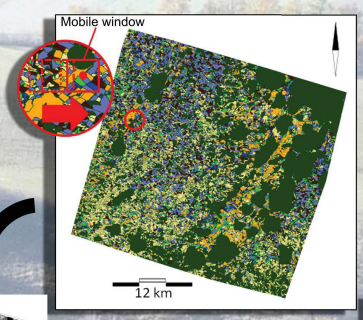


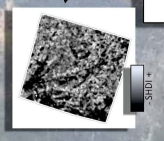
Built areas mask

Segmentation

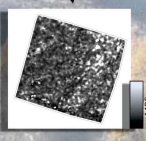
Picture refining

2) Determination of landscape metrics through mobile windows





Shannon Diversity Index (Composition heterogeneity)

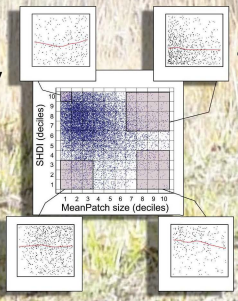


Mean patch size (Configuration heterogeneity)

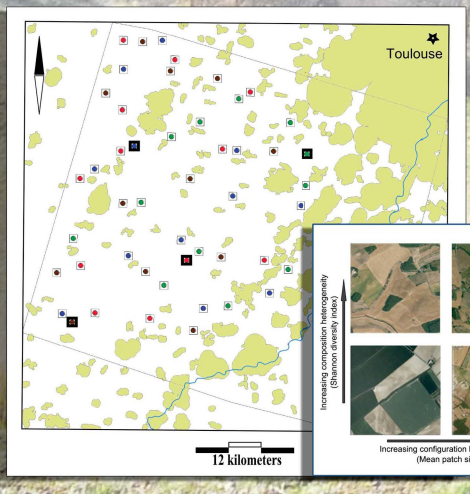
3) Masking of non-farming areas



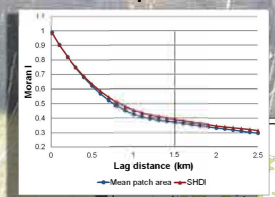
4) Crossing metrics and determination of sampling areas range

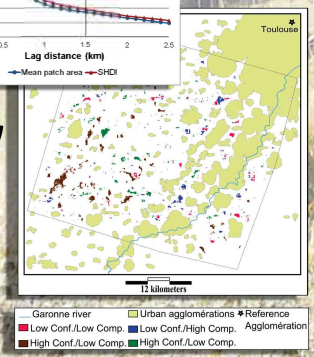


5) Cartography of sampling areas



6) Limiting autocorrelation. Minimum distance between the center of 2 quadrats: 1.5km.





Garonne river
Urban agglomérations
Reference Agglomération
Low Conf./Low Comp.
Low Conf./High Comp.
High Conf./Low Comp.
High Conf./Low Comp.

Garonne river
Urban agglomérations
Paragon points
Low Conf./Low Comp.
Low Conf./High Comp.
Reference Agglomération
High Conf./Low Comp.
High Conf./Low Comp.

7) Result: Sampling of 48 quadrats (1km²) corresponding to 4 combinations of composition and configuration heterogeneity modalities in landscapes accounting for 60 to 90% of farming surface.

Source: IGN, SPOT Image. Realisation: F. Calatayud.

Discussion

While landscape history and structure is radically different in the princeps and the present study, the process line has been adapted with success. The main innovations consists in taking into account most of land use and land cover classes to represent agricultural landscape complexity and masking urban agglomerations and small villages. Indeed, the classification process can easily confound hays and pastures with grass around habitations. The use of a buffer zone that takes into account the size of the agglomeration greatly improves the process line and prevented errors in the final sampling step (i.e. a quadrat in a urban agglomeration).

Though the original procedure has been adapted entirely to our site, the whole project will require the coordination of the different laboratories involved in the project in order to fit with the peculiarity of each study site. The kick-off meeting of the project that will take place in spring 2012 will be the opportunity of such a focus.