Project title

Coastal dunes Habitat fragmentation in time Exploring Italian EU-LTER sites

Promoter: Acosta Alicia (University of Molise, Italy) et al.

1. Aim (for the LTER)

a. Identify “landscape fragmentation indicators” in coastal dune ecosystems using land cover long time-series;
b. to evaluate the potential of landscape pattern parameters to describe the past and actual factors that menaces the natural coastal dune ecosystems.
c. to identify some “landscape pattern traits” able to describe LTER landscape sites that could be adapt to forecast future scenarios and to model other comparable coasts where long term data are not available.

2. Research questions and Hypothesis (500 words)

Coastal dune systems, characterized by outstanding biodiversity values, make up 20% of the area occupied by the world’s coastal landscapes. Human pressure on coastal zones around the world has increased dramatically in the last 50 years and this phenomenon is particularly striking in the Mediterranean (Curr et al., 2000). Coastal dune systems are also particularly fragile environments and several potential dangers threaten them. Human activities in littoral areas are widespread and have been intensifying in the course of the 20th century. Factors causing disturbance are of various nature. Cattle grazing, farming, reforestation and suburbanization have eliminated many stretches of internal vegetation zonation, while coast bound tourism and especially coastal erosion, endanger beach and embryo-dune communities (Taveira Pinto, 2004). It is therefore essential to monitor these environments closely in order to protect and manage their entire biodiversity adequately. Coastal dune ecosystem conservation and management plans cannot be implemented successfully without accurate ‘baseline’ land cover maps with exact information concerning habitat ditribution (Acosta et al., 2005). Correctly assessing coastal dune mosaic change in time is a priority in order to manage them adequately and to plan urban development in coastal regions. Furthermore, only long-term dataset could help in the exploration of possible effects of landscape dynamics on biodiversity.
In this project we propose to analyze coastal dune mosaic in time and to explore the relation between landscape change and other environmental determinants.
Furthermore we will compare coastal dune landscape mosaic in time inside and outside the EU-LTER sites. Thus we will investigate if the main trends of stability or change are similar inside and outside the EU-LTER sites. We will asses if the sites are representative of wide scale coastal dune landscape temporal trends and if EU-LTER sites conserve some relicts of natural habitats widely spread in the past.

3. Spatial and temporal coverage

At present we cover coastal dunes habitats of Italian LTER sites and contiguous comparable areas.

The present extent could be enlarged in the near future to include all the coastal dunes of central Italy. Temporal coverage: Land cover maps relative to the years: 2008, 2000, 1988. The time period could be increased adding the oldest data relative to the year 1954.

4. Parameters used/needed*

Parameter group (theme)	Selected parameter	Details about the parameter	Should be taken from existing data (yes/no)	Feasibility/constraints regarding existing data	Should be recorded in field (A5 work) (yes/no)	feasibility/ constraints regarding field sampling
1) Climate and physical variability					no	
2) Biogeochemistry data						
3) Structure and function of the ecosystems, communities and populations	Spatial composition and configuration of coastal dune landscapes.	Number of land cover categories and relative abundances (landscape richness and diversity). Natural and artificial cover types spatial pattern (e.g. NP, MPS, MSI, ENN)	Yes	The acquisition of 1988 data will be complete at December, 2011	No	none
4) Human population and economy						

5. METHODS USED

Data

Dune ecosystems are usually represented by long, narrow strips following the coastal line that need a fine scale mapping approach for identify single ecosystems. In this project we will use fine scale land cover maps (scale 1:5000) produced by photointerpreting geroferenced ortophotos available from the Italian National Geoportal ("portale cartografico nazionale" - http://www.pcn.minambiente.it/GN/) relative to the years 1988, 2000, 2008.

We choose to work at this scale because it is adequate for describing and monitoring coastal dune landscape mosaic (Acosta et al., 2005, Carboni et al 2008, Carranza et al 2011). Since the cartographic accuracy could not be assessed for maps derived from old ortophotos, we used a simplified CORINE land cover legend that include classes that are easily interpretable and at the same time have a strong ecological meaning.

Transition matrix and change detection analysis.
First, to summarize the temporal dynamics of the analyzed EU-LTER sites landscape over the period 1988-2008, a transition matrix will be computed separately for each time step (1988-2000; 1988-2011; 2000-2008) using transition matrix. In this way we will identify stable areas and changing areas and then we will discriminate different of changing patterns (e.g. transition to more natural or to more artificial land cover type)

Composition and pattern analysis in time.
In a second step we will analyze to composition and the structure of the analyzed EU-LTER sites landscape over the period 1988-2008.
The abundance of each land cover category will be calculated for the coasts to be evaluated, as well as the total richness of land cover categories. In particular these parameters are highlighted for natural areas and for natural coastal land cover categories. Attention will be paid to urban surface abundance as well, as an indicator of anthropization and of vulnerability to human disturbance of the natural landscape. Finally, richness and abundance parameters of the single categories will be utilized to express in a synthetic way the Diversity and Eveness of the analyzed landscapes (Carranza et al., 2007).
In order to analyse the spatial pattern of the coastal cover patches we propose to calculate the following classical landscape pattern statistics: the number of patches (NUMP) for all land cover categories, for natural areas and for coastal areas, their mean patch size in sq.m (MPS) and their Mean Shape Index (MSI). The way in which the surface of each category is arranged in number of patches (and therefore average patch size for each category) is related to habitat fragmentation or to heterogeneity of the spatial pattern. The Shape Index is a shape complexity indicator that usually assumes values greater than one. It equals one only for perfect isodiametric patches. In our case the MSI will be calculated as a sum of each patch's perimeter divided by the square root of patch area (hectares) for each class and adjusted for circular standard (polygons), divided by the number of patches (McGarigal and Marks, 1995). For coastal environments we hypothesize that natural formations would assume stretched out forms parallel to the coastline, therefore with high MSI values, while less natural typologies or fragmented patches would assume more isodiametric or round forms (Carboni et al 2008).

6. EXPECTED RESULTS

Trough the multitemporal description of LTER sites and the contiguous areas we will be able to depict the coastal dune landscape transformation in the last 20 years. We will identify the stable and the dynamic sectors of the analyzed landscape
The interpretation of the spatial pattern of the different coastal dune habitats in time will give a clear idea about the "fragmentation processes" in the area and could give useful information for modeling such scenarios in time or in other coastal areas.

Considering the Lter Sites are a sample of a wider landscape that include some relict of natural habitats, the obtained results will provide the basis for modelling coastal dune landscape change giving a sound frame to support the planning and management of coastal habitats.

7. REFERENCES

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