MEDITERRANEAN COASTAL LANDSCAPE ECOLOGY

A HYPERTEXT

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I. THE CONTEXT

The Mediterranean sea is one of the world's largest semi-enclosed seas (2.542.000 km^2) with a coastline of more or less 46,000 km, and has been one of the busiest world area from the phylogenetic and human cultural point of view for several reasons (Diamond, 1997), among which the peculiar climate, characterised by warm dry summers and mild winters, and the strongly diverse evergreen sclerophyllous vegetation on predominantly limestone soils. It is one of the world's area with highest number of plant species and levels of endemism.

All these factors generated a wide diversity of cultural landscapes along the gradients of human impacts, related to the today high scenic diversity. Actually the Mediterranean has provided a base to some of the world's oldest human cultures that colonised various locations around the basin and exploited the available resources. Over the centuries, the region served indeed as a crossroads to various peoples and societies.

The coastal zone of the Mediterranean, densely populated along millennia, suffers from increasing pressure: the 50-70% of the population in Mediterranean countries live within 60 km of the coast. Other related pressures come from the recent intensification of agriculture, the pollution and the introduction of alien species.

I.1 Mediterranean Costal landscape

In the last decades there has been a paradigm shift from the single site conservation to the realisation that effective natural resource management needs to consider the landscape scale by means of a network approach, even from the scientific point of view or from the policy point of view. Landscape is in this way considered classically a mosaic of "interacting ecosystems" (Forman & Godron, 1986). This term has many components that including perceptive, socio-economic, cultural and cultural. The concept of 'landscape', encompasses both natural and cultural elements i.e. the natural landscape is the fabric that integrates settlement, agriculture and ecology.

Going on, the term *coastal* landscape implies a relationship between landscape and seascape, in a more (i. e. beaches) or less (i.e. mud flats) distinguishable linkage. For these reasons we need a peculiar definition, and a recent one (UNEP/MAP 2005) defines as coastal zone: *"……. the geomorphological area either side of the seashore in which the interaction between the maritime and land parts occurs in the form of complex ecological systems made up of biotic and abiotic components, living space for human communities and their socio-economic activities".*

Considering the coastal landscape mosaic, the 70 - 75 percent of the Mediterranean coastline is rocky (Dardis and Smith 1997), and for the remaining part it presents a high diversity of ecosystems (sandy beaches, sekhbas, salt marshes, coastal plains, deltas, lagoons, wetlands) heavily modelled by the civilisations' overlapping (UNEP/MAP/PAP 2001).

Coastal landscapes normally express a mix of high human exploitation driven by different economical sectors and interests that produce an intensive use of land and resources. Naturally, from a landscape ecology perspective, inland processes and functions, for example at the watershed scale, influence the coasts. Moreover these land management inputs affect directly or indirectly the marine ecosystems and their management.

I.2 The human pressures on the Mediterranean coastal landscape

In the centuries during which humans have lived in the Mediterranean coasts, and in particular in the past few decades of very fast development, societies has profoundly influenced the region's landscapes resources (consuming non urbanised land, freshwater, forests, marine fisheries): this is today a growing concern, as it is pollution.

As the population pressure increases, biodiversity within the Basin is increasingly at risk, but conversely some economic activities (like agriculture and tourism) will suffer if the region-wide development is not oriented to sustainability.

The pressure is expected to intensify because the coastal populations probably will double by the year 2025 (150 - 170 millions of people), and the number of tourists is expected to reach 260 million per annum. Today more or less the 19% coastline (9.000 km) is occupied by tourist systems (complexes, roads and infrastructure), and this kind of use is being planned faster and faster along the Mediterranean coast. This rapid growth of urban and tourism sprawl in the last decades is the main cause of loss of biodiversity and habitats.

The dramatic socio-economic transformations that took place during the last century have led to a quick demographic increase and a displacement of populations (rural - urban and south-north emigration), and as a consequence on one side the exacerbation of the landscape resources, on the other side the abandonment of productively marginal agricultural land. This combination of factors accelerated the unplanned and low sustainable land transformation for urbanisation, industrial development and tourism purposes, and in the same time the low quality sub-urban sprawl.

If the Mediterranean communities generally showed both prudence and foresight in the exploitation of landscape resources in order to ensure a steady yield, to day intensity and fast growing pressures have led to diminish the capacity of the Mediterranean ecosystems to close ecological cycles and absorb waste. As a consequence to human pressure entire ecosystems risk to be irreversibly damaged, with general and far reaching effects on the reduction of goods and services provided.

Agriculture activity was and is one of the most ancient and deeply changing factors in the Mediterranean coastal landscapes.

I.2.1 Agricultural impacts

Agriculture is the most significant and long-term factor that shaped land-cover within the Mediterranean coastal landscapes.

Wooded and wet areas were transformed into cultivated land, hills systems were terraced and major river systems were diverted and channelled, and huge quantities of groundwater were (and are) extracted. Last but not least has been the recent spread of greenhouses and poly-tunnels.

As Mediterranean populations grew more and more land was reclaimed for cultivation and as a result, the combination of Mediterranean society and environment produced the Mediterranean cultural landscapes. The traditional agricultural systems was the result of "management practices optimising the typical annual fluctuations in productivity without causing ecological degradation" (Naveh & Lieberman 1994), but during recent decades these landscapes have been subject to dramatic changes through agriculture intensification and land abandonment.

Rural abandonment it is a widespread concern, for example in the case of the EU25 and not only along the Mediterranean coastal areas, and it is linked to the change of lifestyle and social models in the today society.

The effect of abandonment it is connected to the level of transformation that brought to the cultural landscapes, and to factors like topography, soil type and availability of water resources. When agriculture end as chronic disturbance regime, natural and semi-natural assemblages would form part of the secondary succession, and the rate at which the vegetation succession takes place also depends on the source of recolonization (floral resources from surrounding areas, existing plant cover, seed-bank soil). Re-naturalisation has not necessary a positive impact on biodiversity: actually losing the landscape heterogeneity related to cultivation can lead to a loss of biodiversity.

Abandonment poses even land management or ethical questions, due (i) to the need to manage the environmental risks (hydro geological risk, fires) once farmers or shepherds are no more managing them, and (ii) to the decision about what land use option should be considered by planners and land manager after the abandonment (urban development, natural park, secondary production, etc.). These decisions largely depend on site characteristics, geographical location and land-use priorities, but also on long-term sustainability policy and foresight.

Fires are induced for a variety of reasons in this region: land clearance, short term regeneration of pastures, hunting, land speculation, job demand creation by seasonal fires control workers, are among the reasons. Man-induced fires, mostly those not under control, can eliminate pristine natural vegetation, creating niche space for invasive species and accelerating erosion and/or landslides, especially on sloping areas, since weedy flora is seasonal.

Grazing pressures is a problem in numerous coastal areas especially where sheep flock and goat herd densities are too high and/or not controlled by predation mechanisms (human or not). Grazing and browsing activity influences significantly vegetation distribution patterns, and consequently on landscape characteristics and dynamics.

Another widespread pressure is represented by freshwater extraction, mostly the illegal one: technological advancement has lowered the cost of groundwater extraction bringing to an out of control exploitation of a finite resource. The combination of legal and illegal extraction leads to a faster and faster saline intrusion problem, and transforms otherwise arid landscapes into irrigated systems that have a short span of time, with immediate consequences on the long term destruction of precious resources (soil, water) and on the brief term economic collapse of agricultural unsustainable systems (with its social consequences).

Farmyard waste can have a detrimental effect on landscapes, altering the composition of ecological communities and trigging algal blooms and a suite of nitrophilous species, further harming associated ecosystems and, thus, altering the character of the landscape.

Another stress factor of the coastal Mediterranean landscapes is the invasion of alien species often favoured by agricultural practices (e.g. nursery), that is one of the principal causes of biodiversity loss, and, as a consequence, of landscape integrity. Alien species may replace native flora and fauna through predation or parasitism, and may alter the ecosystems, both from the point of view of water intake and displacement of indigenous species. Moreover, these species may alter and reduce the aesthetic value of Mediterranean landscapes for their atypical aspect where the landscape *genius loci* is concerned.

Last but not least the construction of dams for agricultural purposes in sandy substrate, like the constructions of tourist settlements in the same conditions, can have fast and deep effects on

coastal landscapes, leading to massive erosion of the beach and dune. This can have far-reaching consequences on the coastal system, including its ecological, geomorphological, landscape and socio-economic facets.

I.2.2 Other impacts

After the multitude of impacts that stem from agriculture and its ancillary activities, human impact that has most influenced Mediterranean coastal landscapes has been urban, infrastructure development and associated activity, particularly during the last four decades.

A general but surely partial list could include: infrastructures and industrial estates and related pollution; coastal urbanisation, road and car parks construction; unplanned urban sprawl; uncontrolled sewerage systems; fast tourism structures development and related pollution peaks; open-pit quarrying, domestic and building waste abandonment.

The real problem is that experience teaches that once there is an established local decision for urbanisation, then subtle and not desired consequence emerge, and coastal landscape tend to an incoherent urban sprawl: open-pit quarries, domestic waste and building debris land-fills, illegal dumping sites and uncontrolled sewer canals. All this has long terms negative consequence on landscape functioning and on economical activities (tourism).

The solutions are integrated planning at al landscape level resources management, clear and adaptive policies and long-term thought rules (the last Sardinian landscape law it is an excellent example).

Coastal landscapes resources should be analysed in an effectively holistic way, subjected to sufficient level evaluations (like Strategic Impact Assessment), and sustained by efficient planing tools.

Integrated coastal area management plans seek to address issues such as responsibility for management, maintenance and upkeep, interpretation facilities, organization of land-uses and identification of conflicts of use/incompatible uses, monitoring of assets for change and understanding pressures, risks and impacts.

II. THE LANDSCAPE ECOLOGY ROLE ON SUSTAINABLE DEVELOPMENT OF COASTAL AREAS

The landscape ecology approach for the analyses and the management of the landscape in sustainable way is consistent with recent changes in policy and legislation at the European level (e.g. the Landscape Diversity Strategy, European Landscape Convention, Rural Development polices).

It is at the *landscape scale* that analyses and foreseen are significant enough for a sustainable development policy making: *the path towards sustainable development should generate policies and strategies where the quality of life results from a balance between the pursuit of responsible economic aspirations, and the long term conservation of the region's natural resources and cultural heritage*.

Sustainability effort acts nevertheless at space and time scales wide enough to encompass the interrelation of socio economic, cultural and ecological factors. For this reasons sustainability addresses to issues like is the impacts of Land Use and Cover Change (LUCC) on ecosystems processes, goods and services, understanding LUCC biophysical and socio economic mechanisms.

Landscape Ecology contributes to sustainability efforts (scientific analyses, policy making) on several grounds (Wu, 2006).

- Landscape ecology can contribute to define cultural landscape, which represent the lower scale at which nature and society interact, as operative units for studying and applying sustainability.
- Landscape ecology focuses on hierarchical ecosystems mosaic functioning at multiple scales, giving an ecologically integrated approach to biodiversity and landscape processes management.
- Landscape ecology comprehends cultural factors in its analyses, relevant for the nature society interaction of sustainability effort.
- One of the core elements of Landscape ecology is the study of the effects of spatial landscape configurations on landscape processes and functions, to detect path of sustainable landscape transformations.
- Landscape ecology quantitative methods and indices can offer supports to the critical issues of measuring what sustainability is.

II.1 Landscape ecology and landscape management

In this section some deeper analyses are presented about the use of the landscape ecology approach on the sustainable landscape resource management.

Water quality is a main issue in coastal landscape management, and scientific evidences suggest that the management of water quality at local scale is not sufficient to get a sustainable use of this resource in the long term, and a landscape approach is needed.

Not only landscape water fluxes can be analysed by means of a landscape ecology approach to get a sustainable development of landscape resource, but also socio-cultural processes can

be treated as ecological processes. An example of this kind of approach developed in a coastal zone is analysed, and the implication on landscape management are discussed.

Treating socio- economic processes is another issues of interest of the holistic nature of landscape ecology. An environmental economy method can be applied to analyse and verify the effects of landscape pattern on economic behaviours.

Land use transformation and evolution, and the use of spatial planning as a management tool for land use sustainable evolution, are core issues of landscape ecology.

Considering the landscape transformation memories is necessary to pursue a sustainable evolution of the same landscape, and landscape ecology principles and methods allow considering these factors in estimating landscape conditions and evolving scenarios. An example in a lagoon landscape is discussed.

The same principles and methods can be useful to detect strength and weakness of actual planning tools and to evaluate best choices to adapt them, and/or to develop specific Decision Support Systems for sound ecological based plans.

II.1.1 Assessment

1. What is connectivity from a landscape ecology perspective?
2. What is the role of the structure - function concepts in landscape ecology?
3. Outline an example of space explicit model.
4. What is heterogeneity from a landscape ecology perspective?
5. Outline the relations among landscape pattern and water quality.
6. What are the effects of fragmentation from a landscape ecology perspective?
7. What do we mean for scale? What are the implications of scale?
8. Can we compare landscape cultural processes to landscape ecological functions?
9. What do we mean for “memory of transformations”?
10. Outline a definition of landscape ecology and its role in the scientific and application fields.

III. THE SUSTAINABILITY OF LANDSCAPE DEVELOPMENT AND HER SONS: THE BEST KNOWLEDGE, POLICY AND MANAGEMENT FEEDBACK

The social welfare it is linked to several socio economic factors and to the preservation of several landscape "qualities", that on the whole define a "social" need satisfaction.

Polices represent the answer that the society tries to give, reaching the best trade off among the different needs, and they should be based on a best knowledge awareness. Policies act as Programs and Regulations that are concretely realized by Plans - Designs.

Landscape pattern (of land use) spatial transformation is the end of pipe effect of this process (at the landscape scale), that should give the best effects the more feedback presents between knowledge, policy, planing and transformation.

These aspects are complex but have to be holistically accounted for in a sustainable development perspective, and landscape ecology can be a useful approach in this context.

A first deepening about these issues comes form the analyses of the state of the art of the ecological network perspective in the European context, which represent a clear example of ecological, socio- economic, land use and planning weave. The deepening is referred to the general issue, but can be simply translated in the Mediterranean coastal areas context.

Other particular aspects regarding the needing of spatial planning to pursue coastal rural landscape sustainable development can be deepened (e.g. Franco, 2002).

A more general and intrusive discussion regarding the relationships of the different factor linked to sustainable development, strategies - knowledge - policies - resource management, is discussed considering the rural landscape effect.

These analyses are completed with an overview of the aims of Rural Development EU policies, a dominant factor of coastal landscape evolution in a considerable part of Mediterranean coast, and its inter-relations with landscape transformation and planning.

III.1.1 Assessment

1. Select three policies and three plans which can have a direct landscape effects in your region.
2. Describe these effects from a landscape ecology perspective.
3. Provide a comparison of the polices/plans aims and effects from a landscape ecology perspective.

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