Rapid analysis of coastal landscapes for Mediterranean areas

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Objective:
improving base line studies

- Base line studies are extremely important in order to support screening and scoping

Problem:
how to make rapid assessment?

- As far as terrestrial ecology, geo-botany gives a good methodology (potential vs real vegetation); as far as river ecology the Extended Biotic Index and the river functional index are good integrated methodologies. The geomorphological measures (erosion, flood, loss of soil) complete the systemic vision.
- The integrated vision is provided by Landscape Ecology (1), (2).

Problem:
how to make rapid assessment?

- An environmental system is defined, from a hierarchial point of view, as follows:

- **Ecotope** is the little geographic unit characterised by the homogeneity of at least one geosphere attribute and by little variations of the biological components.
- **Land or Sea facet** or **Michrocore** is an horizontal combination of ecotopes that builds a pattern linked in the space of at least one common attribute of the constituent ecotopes.
- **Environmental system** or **Mesochore** is a combination of Michrocores that can be recognised at a determinate scale.
- An **environmental system mosaic** or **Macrochore** is the combination of different environmental systems (Farina, 1993).

Indicator set: 1

- An environmental system is complex, open, in non-equilibrium and is characterised by a feedback system. It can be defined by structure, function and evolutionary processes (Odum, 1983; Cini, 1994; Pignatti and Trezza, 2000); we can schematise an environmental system as follows (Pignatti and Trezza, 2000):

$$W = W(x, l, m)$$

- where W is an ecosystem or a system of ecosystems
- x is the internal diversity of the system and measures how it is structured;
- l is the set of constraints that preserves the system far from the equilibrium, generally the energetic flux;
- m is the set of boundary conditions, generally the physical and chemical conditions (the geosystem influence). State conditions evolve according to the condition of the parameters x, l, m.

Conceptual scheme

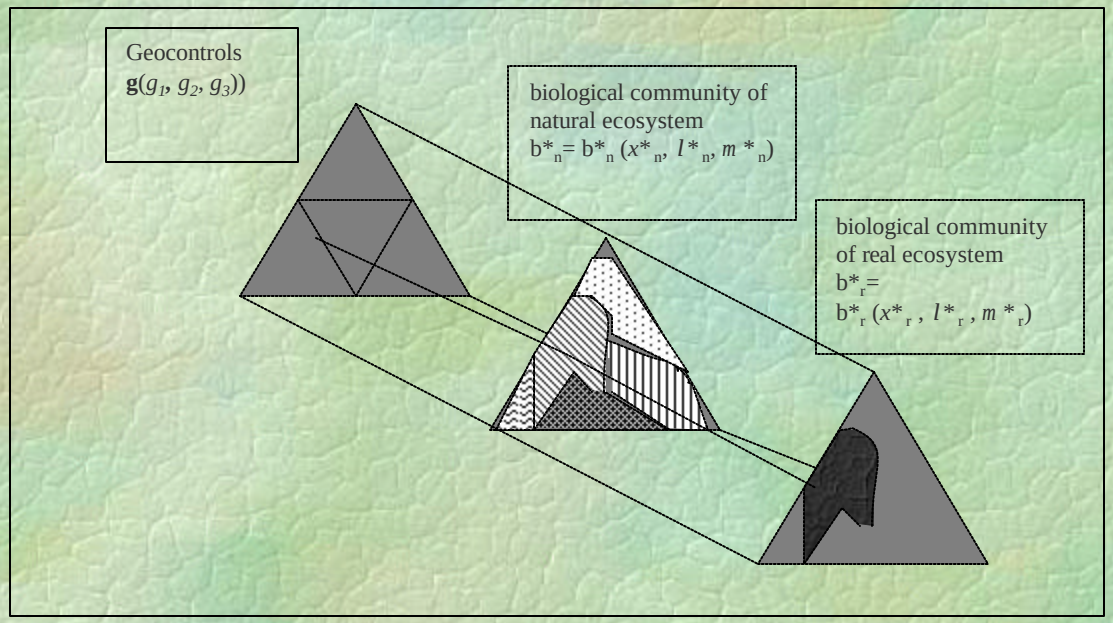

Figure 1. The real values took by biological communities corresponding to geocontrol values.

Geoindicators

- **g1) Geo-indices for near-shore environments**
  - g1A) Littoral environment
- We represent the *x* component of Eq. (1) for the geo-system with the grain size in f units (Wenthorth, 1922); the l value with the flux of energy of waves (Van Rijn, 1990; Dean R.G., R. A. Dalrymple R. A., 1992); the m value with the fractal dimension of the coastal line normalised by his maximum value of 3/2 (Mandelbrot, 1967; 1975).
  - g1B) Estuary and delta environments
- We represent the *x* component of the [1] for the geo-system with the total suspended matter (g/m^3) normalised by the maximum available value for the river; the l value with the river energy flux (Van Rijn, 1990); the m value of the [1] with the fractal dimension of the coastal line normalised by his maximum value of 3/2 (Mandelbrot, 1967; 1975).
- **g2) Geo-indices for Inner shelf environments**
  - g2A) Benthic environment
- We represent the *x* component of [1] for the geo-system with the grain size in f units (Wenthorth, 1922), the l value with the velocity of currents from the climatological data (Zavatarelli *et al.* 1998), the m value with the fractal dimension of the bottom contour line, normalised by his maximum value of 3/2 (Mandelbrot, 1967; 1975).
  - g2B) Pelagic environment
- We represent the *x* component of [1] for the geo-system with the suspended matter (g/m^3) normalised by the maximum available value for the river; the l value with velocity of currents from the climatological data,(Zavatarelli *et al.* 1998); the m value with the fractal dimension of the bottom contour line, normalised by his maximum value of 3/2 (Mandelbrot, 1967, 1975).

Bioindicators

- **b1) Bio-indicators for nearshore environment**
  - b1A) Littoral environment
- We represent the *x* value of [1] with the Shannon Weaver information diversity index (following the ecological literature, e.g. Margalef, 1993); the *l* value with the primary production (gC/m^3), normalised by the maximum production value in Mediterranean sea (following the ecological literature, e.g. Margalef, 1993); the *m* value with the total carbon (g/m^3) on the bottom sediment normalised by the maximum quantity measured in the region (for the particular grain size).
  - b1B) Estuary and delta environments
- We represent the *x* value of [1] with the Shannon Weaver information diversity index (following the ecological literature, e.g. Margalef, 1993); the *l* value with the primary production (gC/m^3) normalised by the maximum production value in Mediterranean sea (following the ecological literature, e.g. Margalef, 1993); the *m* value with the TRIX nutrient index (Montanari *et al.*, 2000; Vollenweider *et al.*, 1998)
- **b2) Bio-indicators for Inner shelf environment**
  - b2A) Benthic environment
- The indicators are the same of b1)
  - b2B) Pelagic environment
- We represent the *x* value of [1] with the Shannon Weaver information diversity index (following the ecological literature, e.g. Margalef, 1993); the *l* value with the primary production (gC/m^3) normalised by the maximum production value in Mediterranean sea (following the ecological literature, e.g. Margalef, 1998); the *m* value with the TRIX nutrient index (Montanari *et al.*, 2000; Vollenweider *et al.*, 1998).

Social perception: Methodology 1

- Calculation of non - use value
- Method: travel cost
- Example: Daily costs to reach and live the Conero Park have been estimated through the interview method: a meaningful sample of tourists (~1% of the average total daily tourist flux) during years 2000, 2001 and 2002 has been analysed.
- the nearest beach area outside the Park (Porto Recanati) has been chosen as the Control area

Social perception: Methodology 2

- State of the areas:

  Conero Park: urban land cover 0-10%; Urbanisation Index < 0.1

  Control (Porto Recanati): urban land cover > 50%; Urbanisation Index > 0.5
- Landscape Index:

  Percolation, land biopotentiality

Travel cost and touristic perception: Data Set

- 1000 Interviews (2000 - 2001)
- 200 Interviews (2002)

Data set

- Age groups: 15-20, 20-35, 35-50, over 50
- Distance groups from the beach: 0-20 km, 20-50 km, 50-100 km, 100 - 250 km.
- Environmental quality: Very High, High, Medium, Low, Very Low.
- Infrastructure and touristic services: Very High, High, Medium, Low, Very Low.
- Type of hotel /Restaurant: Very High cost, High cost, Medium cost, Low cost, very low cost.

Travel cost method

(Pearce and Turner, 1990; Turner et al, 1998)

- Average travel cost using
- Average cost = Fuel+Highway+Restaurant/Hotel
- Control cost = Fuel+Highway+Restaurant/Hotel

Ecological quality: emerged areas

- Two Landscape quality indices
- Biopotentiality (Ingegnoli, 1993)
- Percolation (Farina, 1993)

Human pressure

- Urbanisation:

Land cover by buildings, roads, parkings, touristic facilities %.

- Beach density: people/day
- Coastal protection structures
- Marinas

Conclusion

- The global approach and the set of all data cover a wide part of the system;
- The different point of view fit with the traditional data sets;
- A general methodology supports the decision on monitoring strategy and gives a cost assessment for all the base line studies.

References

- Dean R.G., R. A. Dalrymple R. A., 1992. *Water wave mechanics for Engineers and scientist*. World Scientific Publ., Singapore-New Jersey, 355 p.
- Farina A., 1993. *L'ecologia dei sistemi ambientali*, CLEUP, Padova, X-200 p.
- Farina A., A.R. Johnson, S.J Turner, A. Belgrano, 2003. *" 'Full world versus 'empty' world paradigm at the time of globalisation"*, Ecological Economics, 45, pp. 11-18.
- Ingegnoli V., 1993. *Introduzione all'ecologia del paesaggio*, Città Studi, Milano.
- Mandelbrot B. B., 1967. *"How long is the coast of Britain? Statistical similarity and fractal dimension"*, Science, 155, pp. 636-638.
- Mandelbrot B. B., 1975. *"Stochastic models of the Earth's relief, the shape and the fractal dimension of the coastal lines, and the number area rule for the isalnds"*, Pr. Of the National Academy of Sciences, USA, 72 pp. 3825,-3828.
- Margalef R., 1993. *Teoria de los sistemas ecologicos*, Universitat de Barcelona Publicacions, Barcelona, p. 290.
- Montanari G., F.Giovanardi, A Melley, 2000. *Gli Indici trofici per le acque marine costiere,* Agenzia Nazionale per la protezione Ambientale, Roma, 60 p.
- Naveh Z., A. Lieberman, 1994. *Landscape Ecology. Theory and application* (second ed.) Springer, New York - Berlin.
- Odum H. T., 1983. *System Ecology, Wiley Interscience,* New York, 644 p.

References

- Pignatti S., and B. Trezza, 2000. *Assalto al pianeta - Attività produttiva e crollo della biosfera,* Bollati Boringhieri, Torino, 301 p.
- Peirce D.W., R.K. Turner, 1990. *Economics of Natural Resources and Environment*, Harvest Wheatsheaf, Hertfordshire 320 p.
- Turner R. K., W., N. Adger and I. Lorenzoni, 1998. *Towards an integrated modelling and analysis in coastal zones: principles and practices*. LOICZ Report Studies n. 11. LOICZ IPO , Texel, Netherlands, iv+122 p.
- Vollenwaider R.A., F. Giovanardi, G. Montanari, A. Rinaldi, 1998. *"Characterisation of the trophic conditions of marine coastal waters, with special reference to the NW Adriatic Sea: proposal for a trophic scale, turbidity and generalized water quality index"*, Environmetrics, 9, pp. 329-357.
- Van Rijn L. C., 1990. *Principles of Fluid Flow and Surface Waves in Rivers, Estuaries, Seas and Oceans*. Aqua Publications, Amsterdam 400 p.
- Wenthorth C. K., 1922. *"A scale of grade and class terms for clastic sediments"* Journal of Geology, 30, pp. 377-392.
- Zavatarelli M;, F. Reichich, D. Bregant, A. Russo, A. Artegiani, 1998. *"Climatological biogeochemical characteristics of the Adriatic Sea"*, Journal of Marine Systems, 18, pp.227-263.