Quanta energia possiamo sottrarre dalle foreste italiane senza ferirle? Il caso Lazio.

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proforbiomed
Promotion of residual forestry biomass in the Mediterranean basin

Prelievi legnosi e impatti sugli ecosistemi forestali: indicatori vegetali e del suolo

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con il patrocinio della
Regione Lazio

Projet cofinancé par le Fonds Européen de Développement Régional (FEDER)
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Aim of our work is to detect the effects of the forest management on the functional diversity in deciduous oak forest in Central Italy subjected to different tree cutting management.

In order to curry out the study we used plant ecoindicators and soil/humus measured parameters.

The study area is subdivided in:
Latium 4 macroareas
Tuscany 2 macroareas
Campania 2 macroareas

total 48 sites

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Humus and Vegetation Survey: pioneer study in the Mediterranean environments

48 phytosociological relevès for the vegetation surveys and 48 soil/humus profiles in the same sampling sites.
Humus forms were sampled and classified in the field according to *European Humus Forms Reference Base 2011*, recently slightly modified and proposed for the classification of humus forms. The process of classification is realised considering the sequence and morphological characters, of organic (OL, OF, OH) and/or organo-mineral (A) horizons.

The humus survey is pioneer in the Mediterranean environments.

Relationship humus/vegetation = ecological indicator to monitor the ecosystem

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All the oak woodlands investigated belong to the same plant association - *Echinopo siculi - Quercetum frainetto* Blasi et Paura 1993.

A multi-set of indicators:

1) Ellenberg and Hemeroby indicators

2) Coverage of different forest layers

3) New Index of Floristic Coherence (FCI) derived from the phytosociological survey

4) Soil/humus measured parameters

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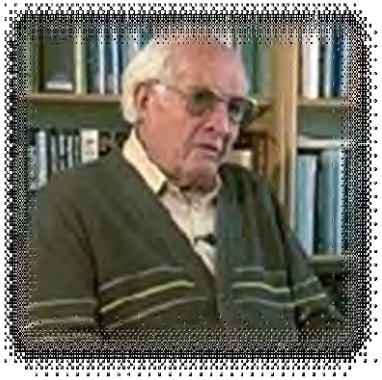
Bioindication according to Ellenberg (1974, 1979)

- A set of numbers given to each plant species to quantify the value of environmental indicator



Six indices in a scale from 1 to 9:

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Climatic factors

- L= index of light: ranged from shadow (1) to high radiation in open spaces (9)
- T= index of temperature: describes a thermic gradient from species of cold climate (1) to species of mediterranean climate (9)
- K= index of continentality : based on the species chorology ranged from atlantic (1) to continental eurasiatic species (9)

Soil factors

- F= index of soil moisture: ranged from xeric (1) to moist soils (9). Three values 10-11-12 were added to indicate soils periodically or permanently inundated
- R= index of pH: ranged from acid (1) to basic substrates (9)
- N= index of nitrogen: ranged from oligotrophic (1) to euthrophic soils (9)

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In addition, in order to detect ecosystem functionality, two combined indices were utilized (Rogister 1978; Godefroid et al., 2005):

R*N index (pH*Nutrients), expressing the humus quality and the turn-over of organic matter;

R/N index espressing the nitrogen plant availabilty.

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Advantages of Ellenberg model

Quantifies and synthesizes environmental requirements of species and communities in an ecosystem.

Shifting from a **multi-dimensional** system based on floristic matrices, **to a smaller dimension.**

Overcomes the approach exclusively based on floristic analysis.

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Index of Hemeroby

Measure of the man impact on the ecosystem

Anthropic component of the disturbance:

Mechanical (removal of the biomass, f.i.) or chemical

Scale from 0 to 9

Measures of Coverage of different forest layers:

tree dominant layer – **T1**

tree dominated layer – **T2**

tall shrub layer – **S1**

low shrub layer – **S2**

herb layer – **H1**

Floristic Coherence Index – **FCI** was calculated by the ratio between number of coherent species occured in each relevé and species number of the *relevé typus*. FCI was ranged between 0 and 1: 0 refers to the maximum floristic distance from the *typus*, 1 corresponds to the reference association.

We developed and firstly applied this index to evaluate the disturbance effects in each stand from floristic point of view.

$$FCI = \frac{\text{N°coherent species}}{\text{N° species relevé typus}}$$

Relevé typus	
Echinopo siculi-Quercetum frainetto Blasi et Paura 1993 (syn. Carpino orientalis-Quercetum cerridis Blasi 1984)	
Ann Bot 1993 - n°51	Coverage
Acer campestre	0,5
Anemone apennina	2
Asplenium adiantum-nigrum	0,5
Brachypodium sylvaticum	0,5
Carpinus orientalis	3
Clinopodium vulgare	0,5
Cratageus monogyna	1
Cytisus villosus	1
Echinops siculus	0,5
Euphorbia amygdaloides	0,5
Erica arborea	1
Festuca drymeja	3
Fraxinus ornus	1
Genista tinctoria	0,5
Hedera helix	1
Lathyrus niger	0,5
Lathyrus venetus	1
Lonicera etrusca	1
Ligustrum vulgare	0,5
Luzula forsteri	0,5
Melica uniflora	1
Melittis melissophyllum	1
Oenante pimpinelloides	0,5
Phillyrea latifolia	0,5
Potentilla micrantha	1
Primula vulgaris	0,5
Ranunculus lanuginosus	0,5
Quercus cerris	3
Quercus frainetto	3
Rosa sempervirens	1
Rubia peregrina	0,5
Ruscus aculeatus	2
Scutellaria columnae	1
Silene italica	0,5
Smilax aspera	1
Sorbus domestica	0,5
Sorbus torminalis	0,5
Stachys officinalis	0,5
Teucrium siculum	0,5
Tamus communis	0,5
Viola alba subsp. denhartii	0,5
Viola reichenbachiana	0,5

4) soil/humus measured parameters

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- pH
- water content expressed as *field capacity*
- organic Carbon %
- total Nitrogen %

RESULTS

To analyse the differences among the stands in relationship with different tree cutting turnover (rotation age), we divided the relevés in three groups:

oldest with the last tree cutting dated from 1950 and 1970;

intemediate with the last tree cutting dated from 1985 and 1993;

recent with the last tree cutting dated from 2000 and 2008.

Floristic matrix of 143 species x 48 relevès was transformed in an eco-matrix of 20 indicators/parameters x 48 relevès.

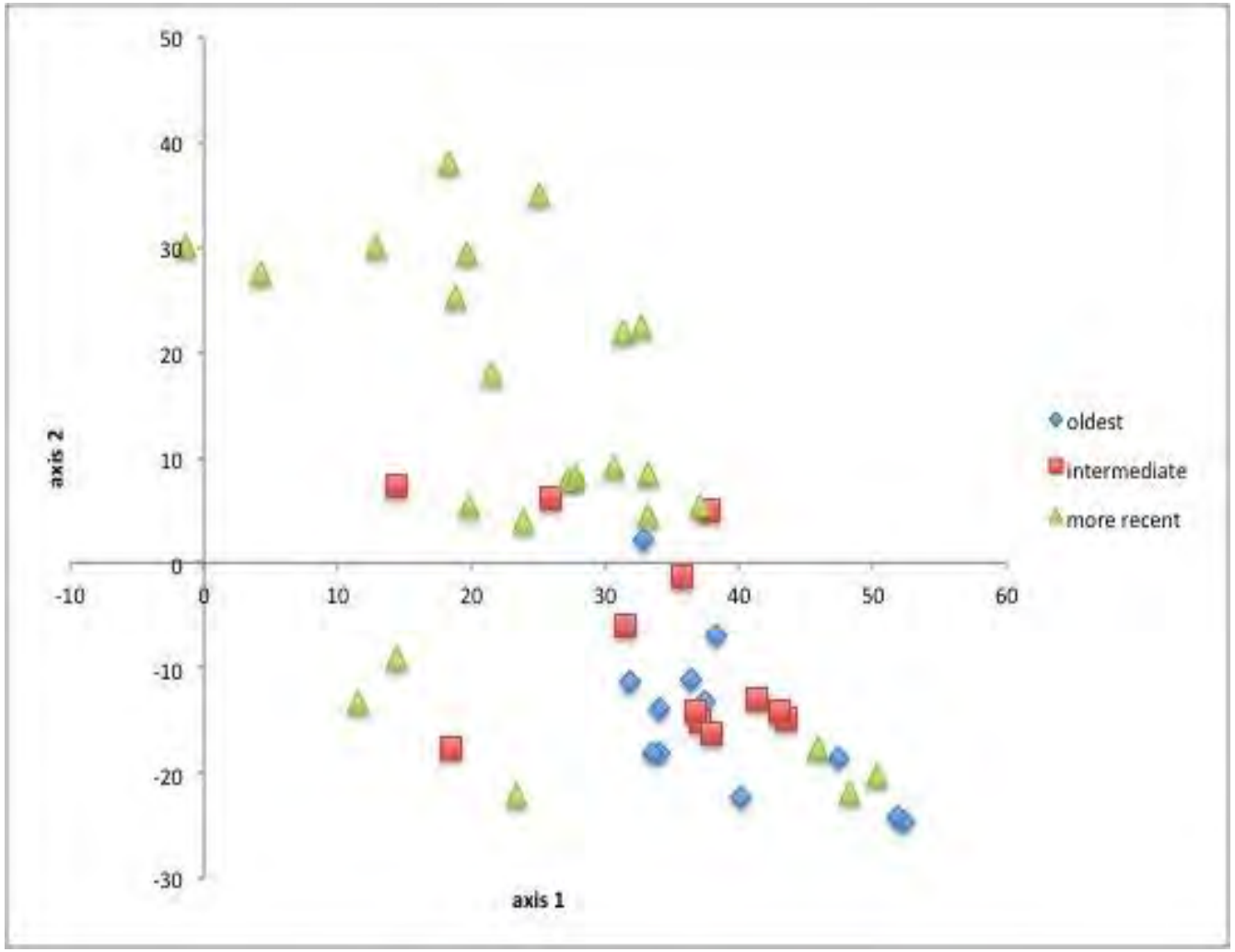
Floristic and ecological comparison with the relevé typus (rel. typ.)

Indicators	Range in dataset	*Rel. Typ.*
FCI	0.05- 0.40	1
L	3.7- 6.2	3.6
T	5.7- 8.5	6.6
K	4.0- 5.3	1.3
F	3.4- 4.4	5.5
R	1.8- 5.9	7.0
N	2.0- 5.0	5.5
RxN	3.5- 27.7	38.2
R/N	0.9- 1.6	1.3
H	1.5- 3.4	2.2

PCA

- **Ax. 1** correlated with FCI and Ellenberg soil indicators – F, R, N, R*N, R/N

- **Ax. 2** correlated with measured parameters : *field capacity*, pH, Organic Carbon, total Nitrogen and C/N



Soil and flora are distributed on two different gradients

One-way analysis of variance (ANOVA)

Indicators and parameters distinguishing the three different ages groups:

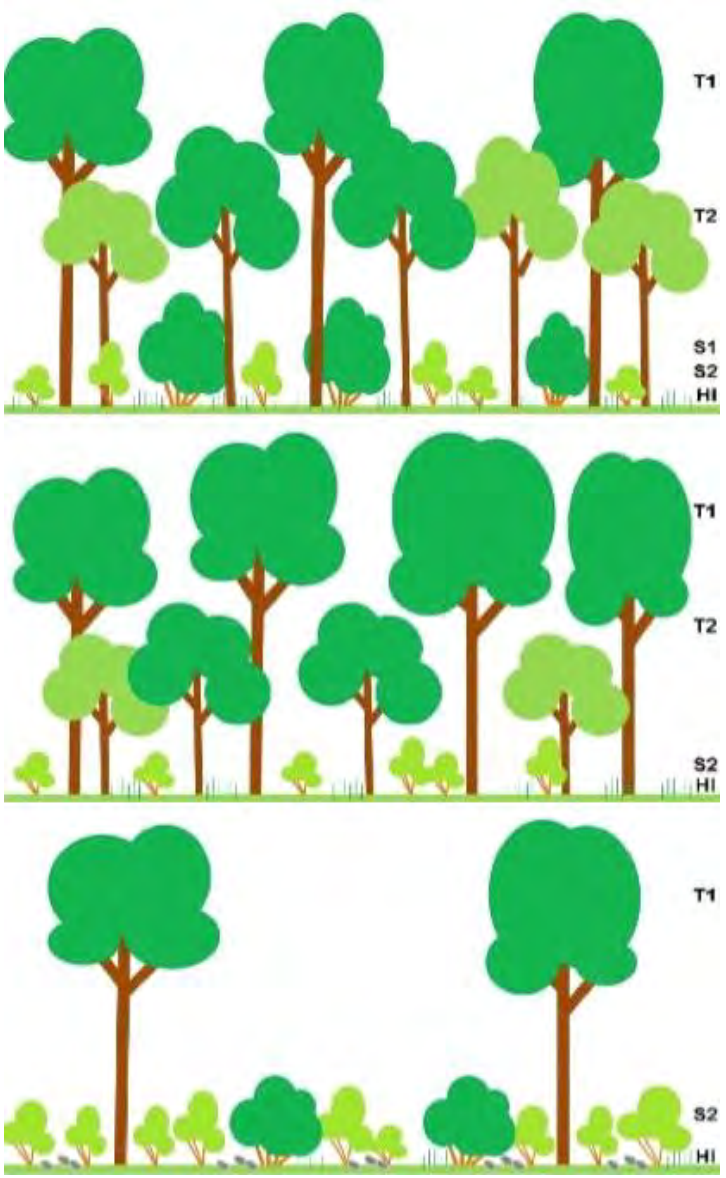
T-temperature	F(2, 45) = 4.487	p = 0.017
R/N-nitrogen plant availability	F(2, 45) = 4.440	p = 0.017
T1 coverage	F(2, 45) = 25.341	p = 0.000
S2 coverage	F(2, 45) = 3.958	p = 0.027
Hl coverage	F(2, 45) = 8.281	p = 0.001
Field capacity	F(2, 45) = 5,821	p = 0.006
pH	F(2, 45) = 1,446	p = 0,006
Total Nitrogen %	F(2, 45) = 3,855	p = 0.029

The post-hoc LSD test showed wich age group differed from each other:

group a (oldest) differed from group c (recent) for T – temperature (p=0.007), Coverage of S1 (p=0.026), Coverage of S2 (p=0.008);

group b (intermediate) differed from the other groups for R/N (gr. a p=0.007; gr. c p= 0.022); F (gr. a p=0.046; gr. c p= 0.031);

group c (recent) differed from group b for Coverage of T2 (p=0.015) and for pH (p=0.017), while from the other groups for Coverage of T1 (gr. a and gr. c p= 0.000) , Coverage of Hl (gr. a p=0.000; gr. c p= 0.029) and field capacity (gr. a p=0.004; gr. c p= 0.018) and total nitrogen % (p=0.014).

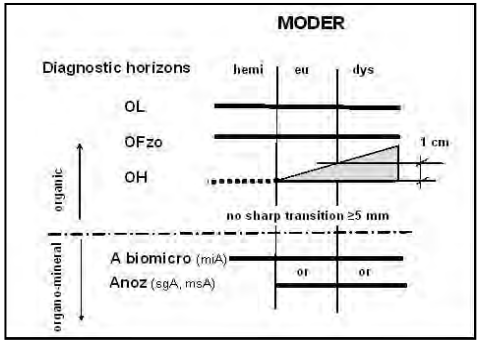


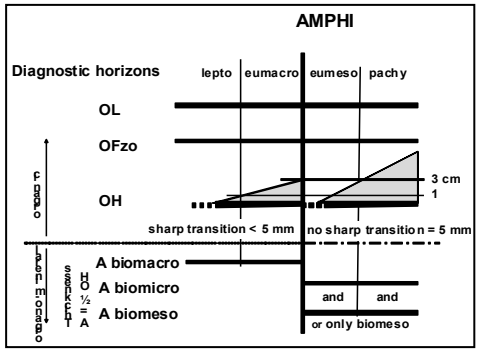
Humus forms

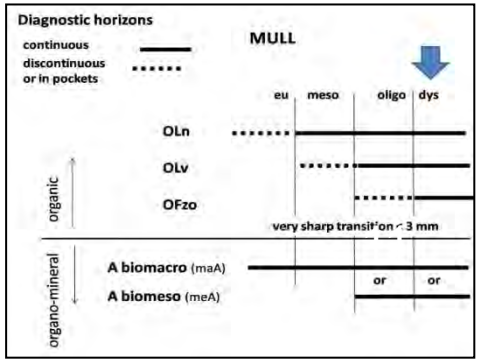
✓In the oldest group (12), moder (6) and amphi (3) forms are dominant whereas mull forms are only 3;

✓in the intermediate group (12) there are 6 mull forms and 6 amphi (4) and moder (2) forms;

✓in the recent group (24) there are no moder forms and the mull forms are dominant (14).







Time of transformation of organic matter in available nutrients

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In conclusion, the analysis of the ecosystem through the humus/soil parameters and ecoindicators applied to flora and vegetation demonstrated to be an effective tool to detect and monitor diversity changes in the flora composition, forest structure, ecological species requirements and soil/humus parameters.

The four set of indicators and parameters allowed to detect the ecosystem complexity by this integrated approach

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GRAZIE

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