

# A geodatabase of the soil cultural heritage of Italy

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## Abstract

Soils can possess heritage characteristics and can be classified according to their "cultural value". The methodology used to evaluate and group pedosites of Italy, and the software developed to collect such information and create a specific geodatabase, are presented in this paper as an example for use in other countries. A map and a geodatabase storing 726 pedosites of Italy was created. Soil profiles as cultural heritage were: i) paleosols, ii) soils from the archaeological and paleontological sites, iii) soil displaying natural or anthropic processes and benchmarks of classifications. Pedosites as soilscape were: i) cultural landscapes; ii) soilscape determining the amenity of a panorama; iii) soilscape in fragile environmental balance; iv) soilscape that contribute to the maintenance of particular ecosystems. The criteria for the evaluation of pedosites and the suggestions for their protection were indicated as following: i) area and ii) type of scientific interest, iii) state of conservation, iv) type and v) intensity of risk, vi) level of knowledge, vii) geological age, viii) protection and ix) proposed protection, x) accessibility, xi) visibility, xii) exposure, xiii) observability. The geodatabase can be used at different scales, from the national to the local level.

## Key Words

Pedosite, geosite, paleosol, land planning, soil awareness, Mediterranean

## Introduction

The geosite concept (that is a geological site having scientific, historic and cultural heritage interest) has been internationally acknowledged (Todorov and Wimbledon 2004). The Council of Europe committee of ministers, in the Recommendation Rec (2004) on conservation of the geological heritage and areas of special geological interest (Adopted by the Committee of Ministers on 5 May 2004 at the 883rd meeting of the Ministers' Deputies) recommends that governments of member states identify in their territories areas of special geological interest, the preservation and management of which may contribute to the protection and enrichment of national and European geological heritage. At the same time, it was suggested to develop national strategies and guidelines for the protection and management of areas of special geological interest, embodying the principles of inventory development, site classification, database development, site condition monitoring and tourist and visitor management, to ensure sustainable use of areas of geological interest through appropriate management. As a role, databases of geosites take into account a few of the most important paleosols, but other kinds of soils displaying cultural heritage still lack of a specific interest. More recently, there has been a trend towards the evaluation of some hitherto inadequately recognised soil functions (such as its role as guardian of biodiversity, safe keeper of many archeological, paleotechnological and paleontological treasures) of values which are not immediately or easily quantified in monetary terms (Yaalon and Arnold 2000). The doors have thus been opened to the idea of taking into account a whole series of, broadly speaking, cultural aspects linked to the knowledge accumulated on a pedological site. This information may be connected to that site or be functionally dependent upon it, to the extent that the soil can be considered to all effects and purposes - including legal aspects - as having a "cultural heritage". While it is true that all soils "narrate" the events which have taken place on a territory, and therefore possess a certain cultural value, some can nevertheless claim superiority over the others, either because of the quantity of information preserved or else because of the quality or importance of this data.

Although there is still a lack of widespread systematic work in Italy, an increasing number of pedologists have substantially amplified their sensibility towards the cultural values of the soil. Over the years, some basic concepts have been developed, which permitted to consider new categories of pedosites, besides paleosols (Costantini 1999). Work has been carried out at both a local scale (Arnoldus-Huyzenveld and Gisotti 1999) and a regional scale (Brenna and Rasio 1999; Costantini *et al.* 2007). The idea of collecting pedosites of Italy was born during the second international symposium on the conservation of our cultural heritage, held in Rome in 1996. A pedosite was defined there as a georeferenced soil having cultural heritage, that is, a soil exposure or a soilscape where an extraordinary cultural interest has been recognized (Costantini 1999). In fact, a pedosite can take the form of an exposure or a trait of land, as soil possesses

both a vertical dimension – the profile – and a horizontal dimension – the soilscape. The actual collection of the pedosites started in the year 1999, as a side-activity of the national project dealing with the creation of a soil database of Italy and it is still in progress. The purpose of this work is to describe the methodology used to evaluate and group pedosites of Italy, and the software developed to collect such information and create a specific geodatabase. In addition, the map of pedosites having national interest is reported.

## **Methods**

The collaboration of many soil surveyors made the census possible. The information was seldom published, so it was necessary to interview the surveyor to collect it. Paleosols are exceptions, as many published studies could be considered, giving the possibility to better assess the relative scientific relevance of the pedosites. The pedologists who signalled the pedosites also furnished an empirical evaluation of their value, which was maintained as either local or regional area of interest. The classification of national or international pedosites was obtained with a uniform and original method.

### *Soil profiles as pedosites*

Soil profiles as pedosites were the followings:

i) Paleosols. Dated paleosols were considered particularly important, in that they can be used as stratigraphic markers and thus give more accuracy to the mapping of Quaternary formations. ii) Soils from the archeological and paleontological sites. Pedosites of this category were only signalled when there was a clear recognition of the input provided by pedological studies in understanding the environmental processes which exerted an influence on ancient human settlements. iii) Soils displaying at best natural and anthropic processes. Included in this group were the soils representing the main taxonomic units of the pedological classification, as well as the benchmark profiles of the main types of Italian soil.

### *Soilscares as pedosites*

Soilscares declared as pedosites included:

i) Soils characterising a precise and important cultural landscape. The characteristics of the soil, its fertility and the agricultural landscape are factors which interact to form a characteristic “whole” or “unit”. ii) Soils as panoramic beauty. These soils were acknowledged as contributing to the amenity and attractiveness of a landscape through their colour. iii) Soils occurring in fragile environmental balance. iv) Soils that support fragile ecosystems, like soils related to specific biotopes, in particular, some wetlands.

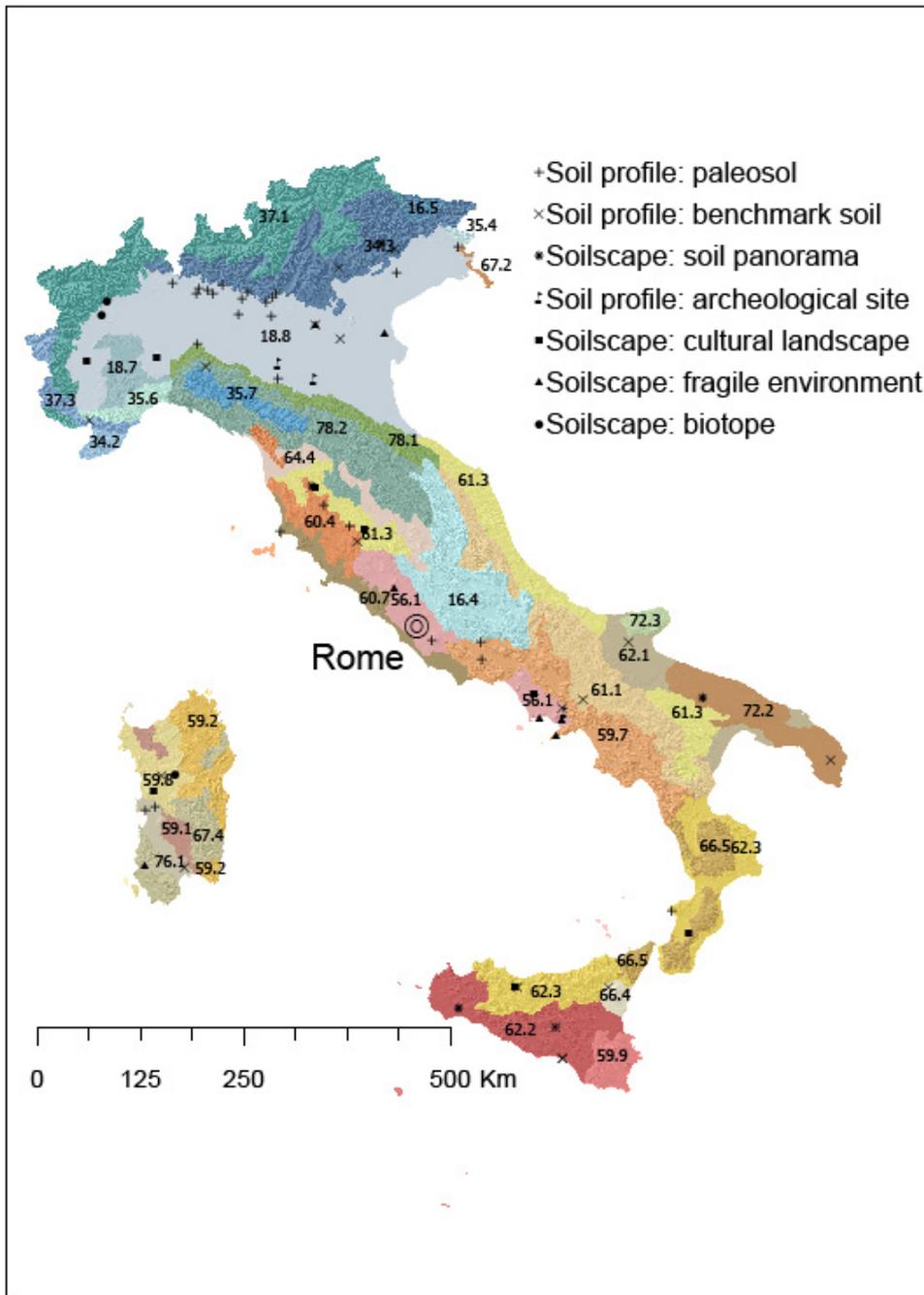
### *Criteria for the evaluation of pedosites*

The classification of the pedosite value followed the specifications of the pedosite category.

i) Level of interest (importance). The pedosites were classified of international, national, regional and local interest. ii) Types of scientific interest. Every pedosite was specified up to five types of interest. iii) State of conservation. iv) Type of risk to lose natural/cultural heritage. v) Degree of risk to lose natural/cultural heritage. vi) Level of knowledge. The cultural value of a pedosite took into account the quantity and quality of the studies carried out on it. vii) Geological age. In this section the estimated age of the pedosite was reported, when possible and relevant. Eight classes were considered: Holocene, late, middle and early Pleistocene, Pliocene, Miocene, ages prior to these. viii) Protection. A pedosite belonging to a protected area was considered particularly worthy, not only because its conservation was deemed easier, but above all because its potential scientific, didactic, and touristic values were enhanced. ix) Proposed protection, or “measures”. x) Accessibility. xi) Visibility. xii) Exposure. xiii) Observability.

### *The geodatabase*

An original geodatabase was created to store the pedosites. Since pedosites could be either soil profiles or soilscares, every record of the new geodatabase referred to a point or an areal location (polygon). Therefore, every soil profile was located with its point coordinates, while a soilscape was formed by one or more polygons. The database created runs with the software Access® (versions 2000 and followings) and its tables were structured so as to be easily imported into national and international Geosites databases. Data can be entered by means of a form with combo box menus. The software permits to store photographs and to print the form of the pedosite. The main tables are: “t\_pedosites”, “bibliography” and “Soil\_region”. The fields of the table t\_pedosites are those described in the paragraphs above, plus the identification codes, the local name of the soil, site indications (nation, region, province, place), pedosite surveyor, soil classification,



**Figure 1. Map of the national pedosites and soil regions of Italy.**

according to either Soil Taxonomy (Soil Survey Staff 1999) or World Reference Base for Soil Resources (IUSS-ISRIC-FAO-ISSDS 1998), geological formation, and a note with a free wide description of the pedosite. The fields of the table bibliography are those which can be retrieved from a standard bibliographic citation. The fields of the table “Soil\_region” are the same of the European database (Finke *et al.* 1998). The geographic information of pedosites instead is stored in the tables: “l\_pedosites\_gdb” and “p\_pedosites\_gdb”. All the geographic information can be read through the software ArcGIS (versions 8.x and followings).

## Results

The geodatabase stores at present 726 pedosites. The majority of them are paleosols (598) followed by pedosites showing natural or anthropic processes (benchmarks, 58), and cultural landscapes (36 pedosites). There are some 107 pedosites with national degree of interest, 228 regional, and 391 with local interest. The few pedosites acknowledged at international level were joined to national ones. The conservation state of pedosites is good for 72%. There are some 79 pedosite at risk of loss of cultural heritage, especially because of anthropic risk (89%). The geodatabase links the database with the map of the Italian soil regions,

allowing the viewer to query the pedosites for any typological criterion and soil region attribute. The map depicts the state of the art about the most important pedosite heritage of Italy, that is pedosites of national and international interest, which are only the 14.7 % of the total. Hence the criteria adopted for their selection seem to have been sufficiently severe. Most pedosites belong to the profile category (83 pedosites). As expected, the majority of them (61) are paleosols, 19 are profiles showing natural and anthropic processes, and 3 are archeological sites. There are 24 soilscape pedosites: 9 cultural landscapes, 7 soilscape have delicate balance, 4 soilscape have scenic value and other 4 are biotopes.

## Conclusion

The current national geodatabase is certainly not exhaustive and affected by an uneven density of soil studies; however, it provides an initial indication of the quantity, quality, distribution and diversity of the pedosites in Italy. The geodatabase, freely available on demand from the authors, was build up so to help a soil scientist to recognize and evaluate the cultural value of a soil, and it can be used at different scales, from the local to the national and continental. The most detailed information, in particular, can be of particular interest for land planners, especially in the delineation of protected areas such as Geoparks and in the singling out of hot spots. This is a kind of information which is neither provided nor easily obtainable from a soil maps. Finally, most relevant pedosites of Italy can be overlaid on GoogleEarth, by downloading the file “pedosites\_it.kml” from [http://www.soilmaps.it/download/dt-Soilsites\\_of\\_Italy\\_26.kml](http://www.soilmaps.it/download/dt-Soilsites_of_Italy_26.kml). It seems possible and indeed desirable for further work to be carried out elsewhere, especially in countries where soils possessing cultural heritage are threatened by urbanization, using the same or similar principles and methodologies, so as to complete a list of soils having cultural heritage at the continental and, in perspective, at the global scale.

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