Protected areas are a leading global conservation strategy, but are not static “sanctuaries” devoted only to nature conservation. They are dynamic areas where both natural processes and the interactions of people and nature are fundamental to their values, and to devising effective strategies for conservation. Understanding the natural processes involved in the evolution of landscapes and the human influences shaping changes in those protected areas, and in their surroundings, is essential. Natural and man induced landscape dynamics in protected areas need to be recognised, monitored and managed in order to ensure effective protection is delivered, and to realise sustainable development that benefits local communities, through activities such as tourism.

In this session papers concerning the following topics are particularly welcome:

- natural processes in protected areas;
- man induced processes in protected areas;
- hazard and risk management in protected areas;
- strategies of monitoring landscape dynamics in protected areas;
- conservation of geomorphological features and processes;
- effective protection and management strategies for protected areas;
- geomorphological perspectives on vulnerability of cultural heritage;
- contribution of geomorphological approaches to conservation of biodiversity and cultural heritage.
GEOHISTORICAL AND GEOTOURISM MAPPING VERSUS GEOMORPHOLOGIC MAPPING: SCALE AND SYMBOL ISSUES

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Geoheritage and geotourism maps are (as geomorphologic maps), earth science thematic maps applied to research and diffusion of results.

So, although the questions related to the construction of the geoheritage and geotourism maps, namely those concerning the scale and legend of the maps, are not yet been properly discussed, there are not many things to be “invented”.

Why?

Because to build geoheritage and geotourism maps we need information from 2 available domains: 1) earth science information (mainly geologic, geomorphologic and hydrologic) that normally we can get from a geomorphologic detailed map; 2) cartographic information about what is a thematic map, what should be put in the base and in the content of the map, the properties of the symbols and relations with the scale, levels of legibility, etc.
If these 2 domains of research needed to build up geoheritage and geotourism are already developed, why there are still problems with the application of several principles in the construction of the maps?

Due to 2 types of problems:

1) The geoheritage and geotourism maps are made by earth scientists that have no specific formation in cartographic sciences (such as perception theories and legibility studies, analysis of human responses to symbols and complex contents, etc.). At the same time cartography scientists usually do not devote its skills applied to earth science maps.

2) Some earth science researchers seem to ignore the efforts already made in the field of geomorphologic mapping did mainly in the 60’s and 70’s of the XX century, but also today, namely by the IAG WG on Applied Geomorphological Mapping (Smith, Paron & Griffiths, 2011).
1st PROBLEM:

Geoheritage and geotourism maps are made by earth scientists that have no specific formation in cartographic sciences and cartography scientists usually do not devote its skills applied to earth science maps.

Not a very permeable frontier
How to solve this 1st problem?

Those that made the geoheritage and geotourism maps (earth scientists) have to gather information and skills about cartography issues.

Such as:

• “families” of thematic maps;
• concept of cartographic symbol (points, linear, areal, figurative, abstract, proportional, geometric, etc.);
• visual variables (size, value, texture, colour, orientation, form);
• perceptive properties of the symbols (selectivity, associativity, order, value, etc.);
• spatial support of the thematic map and its relation with the potential users;
• the scale of the map - relations with the content of the map and with the type of the cartographic generalization: structural (small reductions) or conceptual (medium and strong reductions), etc.
How to solve the 2nd problem?

• Those that made the geoheritage and geotourism maps (earth scientists) have to be informed about the scientific works done in the field of geologic and geomorphologic mapping.

• About geomorphologic mapping a lot have been done mainly in the 60’s and 70’s of the XX century (see, for instance, Klimaszewski, 1968; Demek, 1972; Demek & Embleton, 1976), but it is also being done today, namely by the IAG WG on Applied Geomorphological Mapping (see Smith, Paron & Griffiths, 2011).

• The discussion about scales and legends has been long, arduous and exhaustive. A lot of publications show the main results. Although there was not a total consensus about these issues, there was an agreement about some main questions, for instance those related to the types of map scales.
The question of the map scales

- There is **no reason to adopt different criteria** for the geoheritage and geotourism maps **from those adopted for the geomorphologic maps** (also thematic maps).

Adopted from Demek (1972), *Manual of detailed geomorphological mapping*:

- **Geomorphologic Plans** – **up to 1:10 000**
- **Large Scale** Geomorphologic Maps - **1:10 000 to 1:50 000** (exceptionally 1:100 000)
- **Medium Scale** Geomorphologic Maps – **1:50 000/1:100 000 to 1:500 000**
- **Small Scale** Geomorphologic Maps - **1:500 000 to 1:1 000 000**
  - Geomorphologic Maps of countries - **1:1 000 000 to 1:5 000 000**
  - Geomorphologic Maps of continents - **1:5 000 000 to 1:30 000 000**
  - Geomorphologic Maps of the Earth - **1:30 000 000 and lower scales**

However, as **since then** there has been a **need to do even more detailed geomorphologic maps**, we made small adjustments to this classification.
Classification of geomorphologic map scales from Rodrigues (1998):

- **Geomorphologic Plans** - up to 1:2000
- **Detailed Geomorphologic Maps** - <1:2000 up to 1:10 000
- **Large Scale** Geomorphologic Maps - <1:10 000 up to 1:25 000 or 1:50 000
- **Medium Scale** Geomorphologic Maps - <1:50 000 up to 1:500 000
- **Small Scale** Geomorphologic Maps - <1:500 000 up to 1:1 000 000

Of course the scale that should be used to do a geoheritage or geotourism map depends on the objectives of the map.

However, what are the positions about the scale of these maps?

- **Carton, Coratza & Marchetti (2005)** – 1st approach to the question of scale in geomorphologic sites mapping. They fix the limit between the so called small scale maps (less than 1:200 000) and the large scale maps (greater than 1:200 000). WHY? Because they say so!!!
• More recently, Coratza (also co-author of the previous paper) & Regolini-Bissig (2009) refer medium and large scale geomorphosite maps (giving as example two maps at 1:25 000 and 1:12 500 scales) and small scale maps. However, there is no discussion about scale and it is even written that the working scale can be international, national, regional or local.

**Conclusion**

In the specialized literature there are no information about the scales to be used in geoheritage and geotourism maps and there confusions between scale and symbols, although the two things are connected.
The question of the map symbols

• There is no reason to adopt different criteria for the geoheritage and geotourism maps from those adopted for thematic maps.

Everybody agree that we can use point, line or area symbols.

In the maps of points we can use only dots or introduce the size to express value (area or volume proportional to the value, i.e., \( A=V \) for a representation using proportional circles, better that use spheres).

We can do the same for the maps of lines (using different thicknesses of the lines).

There are big problems with the use of color and of symbols with different shapes, that are the 2 techniques more used in the geoheritage and geotourism maps.
Color problems:
- there are **subjective concepts** of colors from person to person;
- the **primary colors do not give an order**;
- there are **conventional colors** used for certain purposes (hipsometric colors, temperature maps, precipitation maps, Munsell colors, etc.);
- problems due to **deficiencies of (cromatic) vision**;
- etc., etc.

Symbols with different shapes:
- **quite used** to represent the geosites, **can be figurative/pictorial** (fossil, cave, mineral, etc.), that are difficult to draw, **or abstract** using points, squares, triangles, stars, flags and many other symbols that you can imagine...

Result: **we cannot read the hole map neither do our target public!!!** Why? We can only “read” and compare the spatial distribution of a type of symbol each time.
Some examples of geoheritage and geotourism maps

From D. Castaldini - Intensive Course - “Geosites: methodology, recognition and mapping, as natural resources for the tourist valorization”, Lisbon, May 2012
From D. Castaldini - Intensive Course - “Geosites: methodology, recognition and mapping, as natural resources for the tourist valorization”, Lisbon, May 2012

Method of study of the Touristic-Ambiental Maps (Castaldini)

- Bibliographic research
- Aerial and Satellite images interpretation
- Field survey
- Regional Technical Map (CTR) Ortophotos

GEOMORPHOLOGIC MAP

3 D Image

GEOTOURIST MAP

Tourist information

Geomorphologic map of Salse di Nirano
Legend of the Geomorphologic map of Salse di Nirano
Geotourist map of Salse di Nirano
Legend of the Geotourist map of Salse di Nirano

**GEOTOURISTIC INFORMATION**

- **Centro Visite Cà Tassi**
- **Ecomuseo Cà Rossa**
- **Stazione meteorologica**
- **Strada di accesso principale**
- **Area di parcheggio: a) pubblico; b) per disabili; c) privato**
- **Percorso escursionistico**
- **Percorso didattico con bacheche illustrative**
- **Punto di osservazione: a) panoramico, b) con binocolo**
- **Ponte pedonale**
- **Fontana**
- **Area di sosta attrezzata**
- **Osservazione avifauna**
- **Luogo di ristoro e/o pernottamento**

**GEOLOGICAL AND GEOMORPHOLOGICAL CHARACTERISTICS**

- Argille di origine marina
- Pliocene inferiore - Pleistocene inferiore
- Marine clays
- Lower Pliocene - Lower Pleistocene
- Depositi di colata fangosa delle salse
  - Mud-flow deposits of mud volcanoes
- Salsa o gruppo di salse a cono
  - Cone-shaped mud volcano or group of cone-shaped mud volcanoes
- Salsa o gruppo di salse a polla
  - Level-pool mud volcano or group of level-pool mud volcanoes
- Depositi per acque superficiali
  - Deposits due to superficial waters
- Frana
  - Landslide
- Orlo di scarpata di calanchi e/o di frana
  - Edge of badlands scarp and/or landslide scarp
- Crinale, spartiacque
  - Ridge, watershed
- Corso d'acqua principale
  - Main stream
- Laghetto
  - Pond
- Zona umida
  - Marsh
- Area produttiva dismessa
  - Disused farming area
- Argine artificiale
  - Artificial embankment
- Area di cava dismessa
  - Abandoned quarrying area
One of several volcanic necks located North of Lisbon. These bodies were responsible by the Lisbon Vulcanic Complex from the Upper Cretaceous.

Basalt columns
Crionival deposits in the Fornia geomorphosite, Estremadura Limestone Massif, Portugal (ML Rodrigues, 2010)