

# Risks and protection of a Murgian area of great environmental importance

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## KEY-WORDS

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This study examines the vast area of Matera's Murgia and specifically a part of the ravine belonging to Matera, an area protected by numerous national and regional laws. This area is characterized not only by human settlements dating back to the early Paleolithic, but also by a very particular and intense landscape the area is marked by Matera's Sassi, an ancient rupestrian town protected by UNESCO, and the Regional Park of Matera's Murgia as well, a public Institution aiming to the development of tourism as well as for the preservation of the territory and the environment.

Natural events combined with the action of man have caused some environmental degradation phenomena and also slopes instability. These phenomena have been analysed by the authors using advanced technologies, such as the Environmental Monitoring System called "SIMONA" (Lazzari, 2011).

The studied area is located between the Fossa Bradanica and the edge of the Apulian Murgia, called Murgia Materana, consisting of plateaux characterized by a tabular structure, delimited by clayey hills and interrupted by valleys and deep erosional gullies whose sides are usually very steep, as the canyon of ravine (Fig. 1).

Geologically, the area is characterized by a dolomitic-calcareous basement (Altamura's Limestone), dating back to the Cretaceous period. It is affected by widespread karst phenomena such as dolines, and limestone pavements covered in transgression by lower Pleistocene calcarenitic deposits (Calcareniti di Gravina formation).

In these rocks the characteristic system of hypogeums of the area of Matera's Sassi develops. Upward, the stratigraphical serie continues with blue-gray marls and clays, sands, sandstones and finally with conglomerates, (subappennine Clays, Monte Marano's and Sturato's Sands and Irsina's conglomerates) (Boenzi et al, 1971).

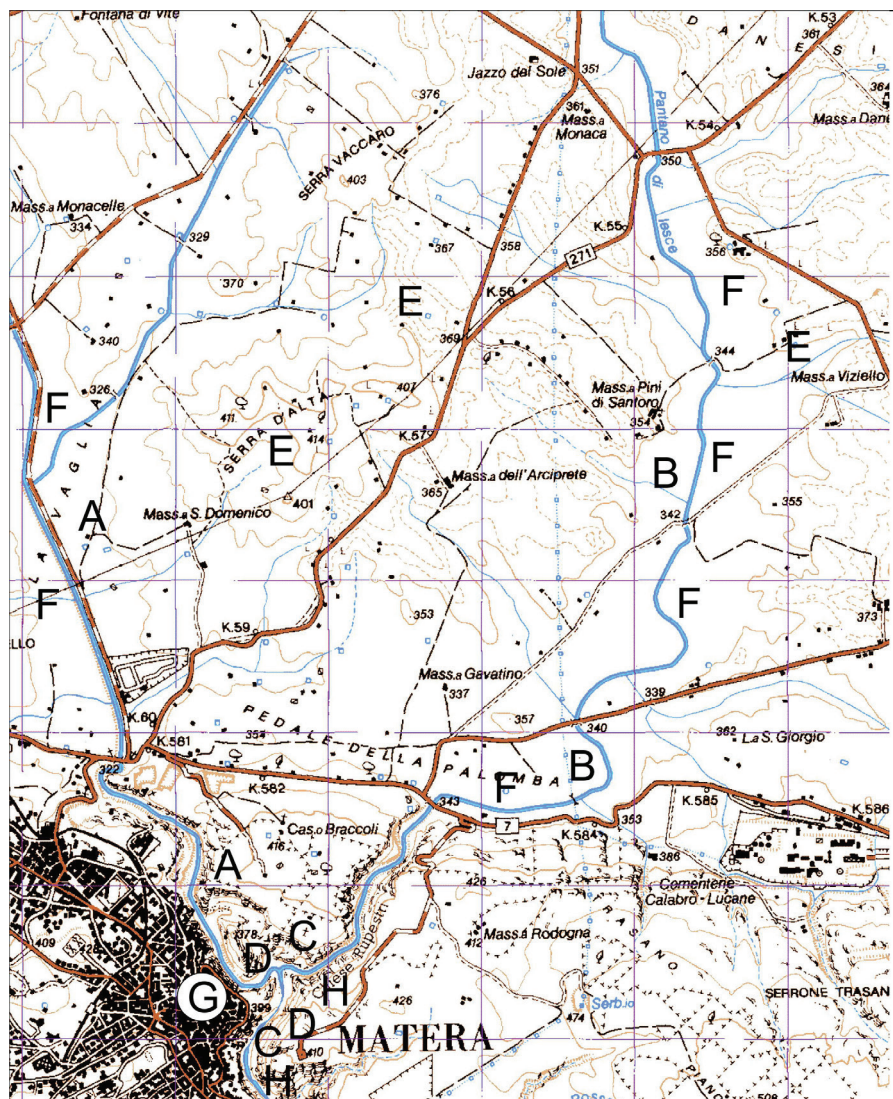


Fig. 1 Map of the high basin of Gravina Torrent - (A) Ravine; (B) Jesce; (C) Canyon; (D) landslides in rock; (E) Erosion in the area; (F) overflowing areas; (G) hypogeums in Matera's Sassi; (H) rupestrian churches.

In the valleys and on the reliefs, the most recent soils are composed of both alluvial and detritic deposits as well as of terra rossa. The examined area occupies the upper basin of Gravina torrent in Matera, from the border with Apulia up to Montescaglioso. It is characterized by many elements of danger both natural and induced by human intervention as it happens with Matera and its commercial, industrial and agricultural area located on the borders with the municipality of Altamura.

The main factors of environmental hazard and risk identified by the inspections in the field and from remote sensing are:

- Pollution phenomena of watercourses and aquifers;
- Floodings and overflows in the high basin;
- Superficial and deep landslides;
- Instability of natural and anthropical hypogeums system

These factors determine a widespread environmental degradation, the loss of cul-

tural properties of great value and a high risk for urban areas.

In order to follow a proper risk assessment, the various elements were not considered separated from each other but as part of a single system of environmental instability, which has to be monitored and restored.

The surface and underground water system is quite simple in its various physical components, with branches above all in the high basin at the border with Puglia region.

The climate is typically Mediterranean with dry summers and rainy winters characterized by extreme rainfall events which are rare but ruinous. The water system, made up of the Gravina torrent (tributary of Bradano) and its secondary branches (Jesce torrent), is influenced, in its hydraulic system, by the degree of permeability of soil, that is somewhat variable, and by the relation between areas composed of permeable and impermeable lithotypes, as well as by the rainfall. (Fig. 2)

So, in autumn and in winter torrential run-offs are appreciable, whereas during the dry summer water-flows are quite low and sometimes absent (Caloiero, 1993).

Water-flows are generally quite low even for the slight water absorption due to calcareous formations.

In this context, the Murgia plateau drainage network, which is sparsely branched, and often developed on permeable soils, does not show an active circulation of water and only during particularly intense or prolonged rainfalls may collect valuable water volumes.

The sudden floods of the main river courses induce phenomena of unexpected inundations as it occurred in winter 2011 when some people died because of flood.

It is, therefore, necessary to organize a better control of torrential channels, by reducing the influx of debris in them, through vegetation covers and an adequate system of drainage for leaching waters.

A significant element is that the main watercourse is the final step of all purification plants of civil refluents of Matera and Altamura. It is also the final step of the effluent treatment plants serving the industrial areas and certain purification plants of private industrial and civil refluents. It follows that run-offs, flowing down into the Gravina torrent, are for long periods of the year fed by the waste of private purification and draining plants, consequently causing pollution. (Fig. 3)

The surface aquifer flows predominantly in sands and is supported by fine muddy-clayey deposits (Subappennine clays), which are basically impermeable.

In autumn and in winter it is fed by rainwaters which enter the ground with slow

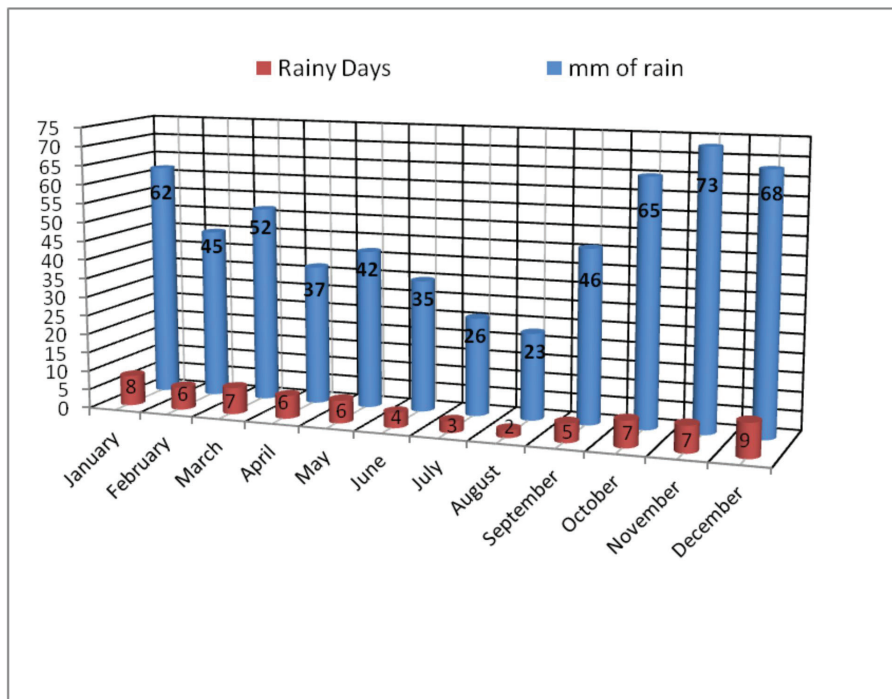


Fig. 2 Rainfall and rainy days in Matera



Fig. 3 Pollution into Jesce torrent

movements of filtration. In rural areas it is subjected to drainings through surface wells. It is rarely present in the urban area of Matera, but highly dangerous when determining the plastic deformation of clays in urban areas. The deep aquifer develops into the Mesozoic dolomitic-calcareous basement which is permeable through jointing and karstification, giving to the aquifer a significant hydrogeological anisotropy.

In fact, sometimes the aquifer circulates freely, at a considerable depth from the ground level, while in other cases it is in pressure below impermeable horizons.

Coming from the highest Murgia's areas, the karst stratum flows down to the sea, which is the first level of the subterranean water flow, bringing with it the polluting substances absorbed in the high basin.

It is, therefore, necessary to solve the pollution phenomena with suitable public and private purification plants, while exerting at the same time an efficient control as well as an efficient prevention.

With regard to stability and evolution of slopes, mappings in the field and remote sen-

sing allowed to identify two different types of failures.

The first one appears on loose soils and lies mainly within the high basin of the Gravina and Jesce torrents where rapid erosion phenomena (erosional gullies and flows) occur together with deeper landslides represented by clayey flows or by mixed landslides due to rockfall and subsequent flow.

Further downstream, in the area of Matera's Murgia, where more resistant but jointed rocks prevail, the mass movements are activated. They are mainly related to the collapse and rolling of single rocky elements or to landslides due to collapse, especially along the edge of the ravine in the Sassi area and in those parts where there are artificial voids overlapped and weakened by weathering (Fig. 4).

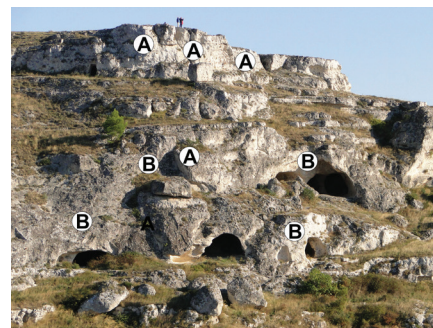


Fig. 4 Landslides in the ravine of Matera - (A) Fractures; (B) Collapses

These phenomena cause damage both to the most important hypogeums, such as the rupestrian churches, and to some districts of Matera's Sassi, where the weakening of the subsoil affects the safety and stability of houses.



In order to protect the system of hypogeums and after a proper assessment on their state of preservation, it was necessary to realize renewal interventions such as the barrings of unstable external rocky elements, anchorages and protective barriers, drainage systems and the strengthening of some internal structural elements. These interventions are useful in order to consolidate and protect the most important areas both from an artistic as well as from an environmental point of view since they represent a unique geosite.

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