

Soil and geomorphological parameters to characterize natural environmental and human induced changes within the Guadarrama Range (Central Spain)

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Mediterranean mountain ecosystems are often complex and remarkably diverse and are seen as important sources of biological diversity. They play a key role in the water and sediment cycle for lowland regions as well as preventing and mitigating natural hazards especially those related to drought such as fire risk. However, these ecosystems are fragile and vulnerable to changes due to their particular and extreme climatic and biogeographic conditions. Some of the main pressures on mountain biodiversity are caused by changes in land use practices, infrastructure and urban development, unsustainable tourism, overexploitation of natural resources, fragmentation of habitats, particularly when located close to large population centers, as well as by pressures related to climate change.

The objective of this work is to select soil and geomorphological parameters in order to characterize natural environmental and human induced changes within the newly created National Park of the Sierra de Guadarrama in Central Spain, where the presence of the Madrid metropolitan area is the main factor of impact. This is carried out within the framework of the Guadarrama Monitoring Network (GuMNet) of the Campus de Excelencia Internacional Moncloa, where long-term monitoring of the atmosphere, soil and bedrock are priority. This network has a total of ten stations located to the NW of Madrid and in this case, three stations have been selected to represent different ecosystems that include: 1) an alluvial plain in a lowland pasture area (La Herrería at 920 m a.s.l.), 2) mid mountain pine-forested and pasture area (Raso del Pino at 1801 m a.s.l.) and 3) high mountain grassland and rock area (Dos Hermanas at 2225 m a.s.l.). At each station a site geomorphological description, soil profile description and sampling was carried out. In the high mountain area information was obtained for monitoring frost heave activity and downslope soil movement. Basic soil laboratory analyses have been carried out to determine the physical and chemical soil properties.

The parent material is gneiss and associated deposits and, as a result, soils are acid. The soils have a low to medium organic matter content and are non-saline. They are moderately to well drained soils and have no or slight evidence of erosion. The soil within the high mountain area has clear evidence of frost heave that has a vertical displacement of the surface in the centimeter range. The stations within the lowland and mid mountain areas represent the most degraded sites as a result of the livestock keeping, whereas the high mountain area is mainly influenced by natural environmental conditions. These soil and geomorphological parameters will constitute a basis for site characterization in future studies regarding soil degradation; determining the interaction between soil, vegetation and atmosphere with respect to human induced activities (e.g. atmospheric contamination and effects of fires); determining the nitrogen and carbon cycles; and the influence of heavy metal contaminants in the soils.