Alterations caused to soil organic matter by post-fire rehabilitation actions in a pine forest from Doñana National Park (southwest Spain).

José A. González-Pérez [1], Nicasio T. Jiménez-Morillo [1,2], Antonio Jordán [2], Lorena M. Zavala [2],
Arturo J.P. Granged [2,3], and Francisco J. González-Vila [1]
1) Institute for Natural Resources and Agrobiology of Seville (IRNAS, CSIC), Sevilla, (Spain).
2) MED_Soil Research Group, University of Seville, Sevilla, (Spain).
3) Department of Applied Physics – I. University of Seville, Sevilla, (Spain).

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INTRODUCTION

Post-fire rehabilitation actions and recovery attempts of burned soils include a range of management practices (tillage, tree logging, reforestation . . .), in some cases producing an additional damage to that directly caused by fire. Among negative impacts derived from unappropriated rehab practices are the increase soil erosion, loss of soil fertility and alterations in the hydrological cycle. Analytical pyrolysis (Py-GC/MS) is an appropriate technique to study organic matter characteristics within complex matrices.

OBJETIVE →

"To assess the chemical alterations caused by burning and post-fire rehab plans to soil organic matter (SOM), through analytical pyrolysis".

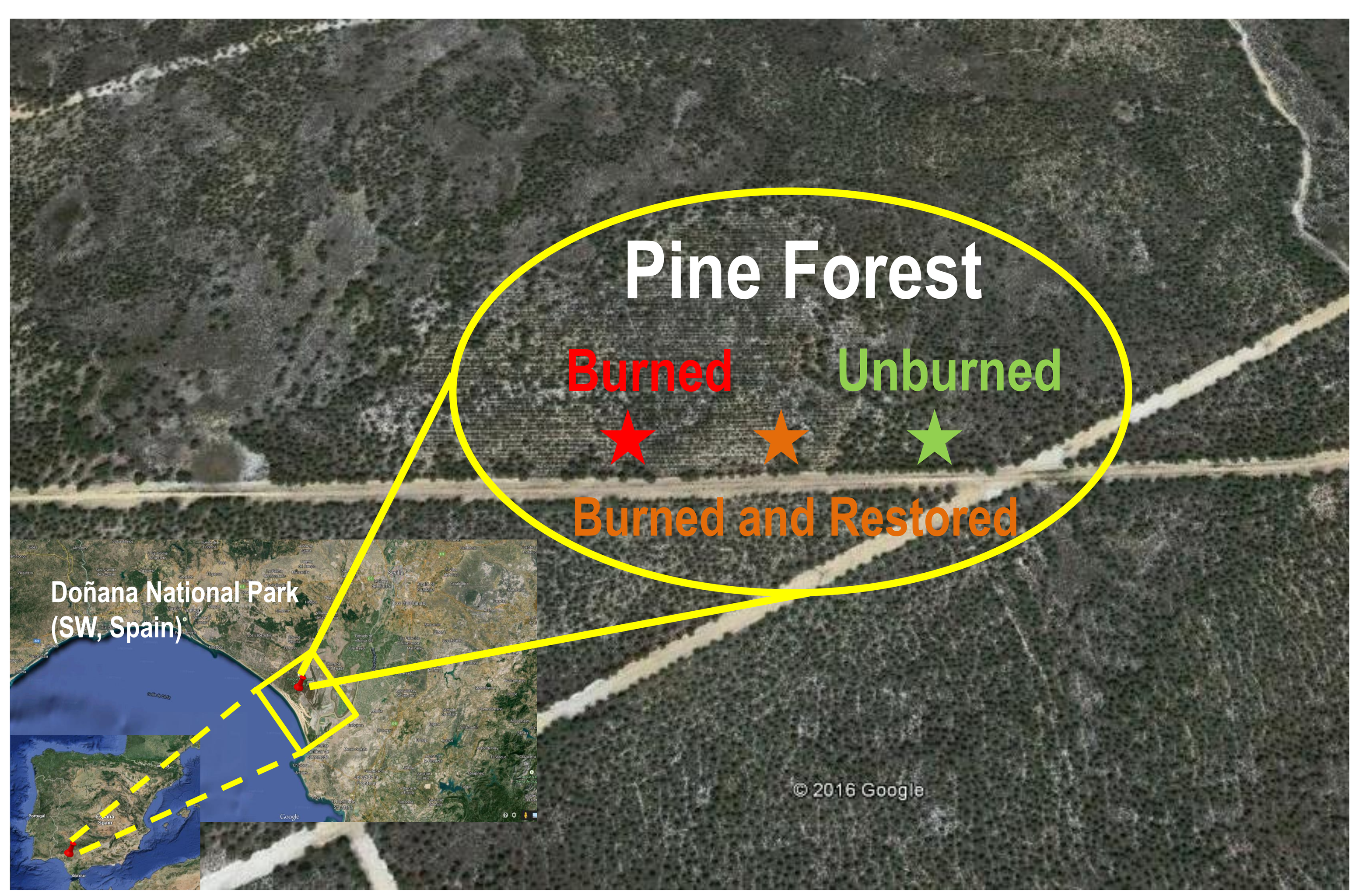

Figure 1. Study Area

METHODS

Fire and post-fire rehab actions impact on SOM is studied in a sandy soil under a well developed canopy pine (Pinus pinea) stand that was affected by a wildfire in August 2012 in Doñana National Park (SW Spain, Fig.1). Bulk samples as well as its more important sieved soil fractions (coarse, 1–2 mm, and fine, <0.05 mm) collected from an undisturbed burned area (B) and in an adjacent burned area after rehab practices (BR) (logging and extraction of burned trees) were studied. An additional adjacent unburned (UB) area was used as a control. Each sample was made by combining five to six sub-samples taken within a circular area of ca. 20 m^2 under a well-developed canopy. The samples were taken from the first 3 cm of soil after removing the litter layer.

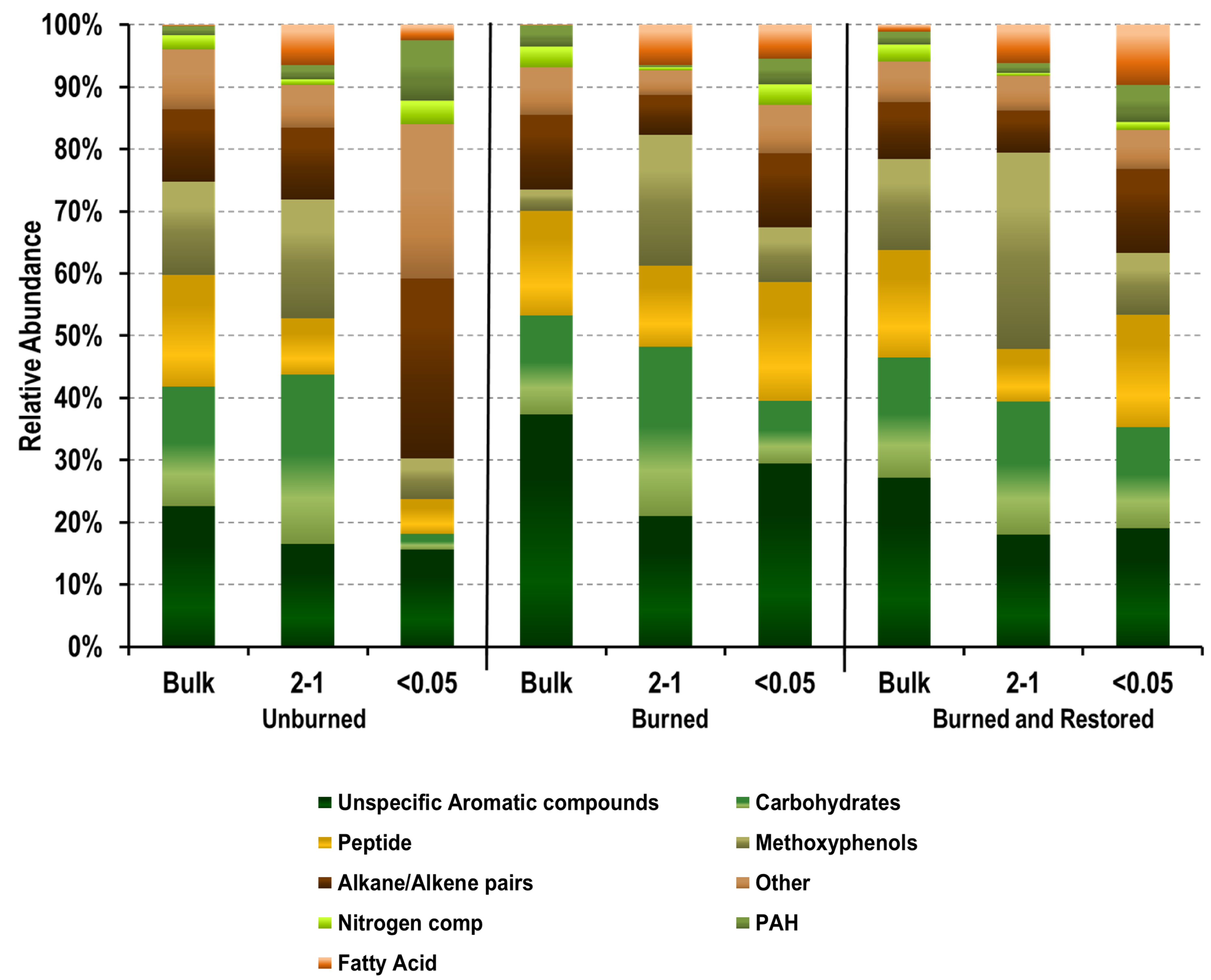

Figure 2. Relative percentage of the main chemical families identified by Py/GC/MS from Bulk, coarse (2-1 mm) and fine (<0.05 mm) of each scenario.

RESULTS AND DISCUSSION

Conspicuous differences among bulk samples from the B, BR and UB control areas were found in the relative proportions of the main molecular families obtained by analytical pyrolysis, including alkane/alkene pairs, unspecific aromatic compounds (UAC), peptides, methoxyphenols, fatty acids, carbohydrates, N-compounds and polycyclic aromatic hydrocarbons (PAH) (Fig.2). The B site SOM showed lower proportion of lignin methoxyphenols and higher of UAC and PAH than the SOM from the UB site. This indicates that fire produced methoxyphenol de-functionalization, increasing the proportion of recalcitrant compounds. With respect to soil size fractions, in all cases, the coarse fraction showed a high content of carbohydrate-derived compounds and methoxyphenols followed by fatty acids, in line with inputs of new litter from stressed post-fire vegetation (Jiménez-Morillo et al., 2014).

The BR soil coarse fraction showed the highest proportion of methoxyphenols whereas that from the UB soil showed the highest value for alkyl compounds. With respect to the fine soil fractions, although SOM composition varied largely from one area to another, it was found generally more altered than in the coarse fractions.

SOM from the UB fine fraction shows a high proportion of alkyl compounds and comparatively lower amount of carbohydrate- and lignin-derived ones. The B soil fine fraction did not show a high contribution from alkyl compounds, which may indicate the occurrence of thermal cracking of alkane/alkene linear chains during the forest fire (González-Pérez et al., 2008). The SOM from the BR soil fine fraction was found of a more labile nature (high relative proportions of fatty acids, peptide and carbohydrate-derived compounds) than that in the UB and B soils. This contribution from labile compounds may be explained by topsoil mixing caused by the post-fire rehab actions i.e. soil tilling/ploughing and burn tree logging and removal.

ACKNOWLEDGMENTS

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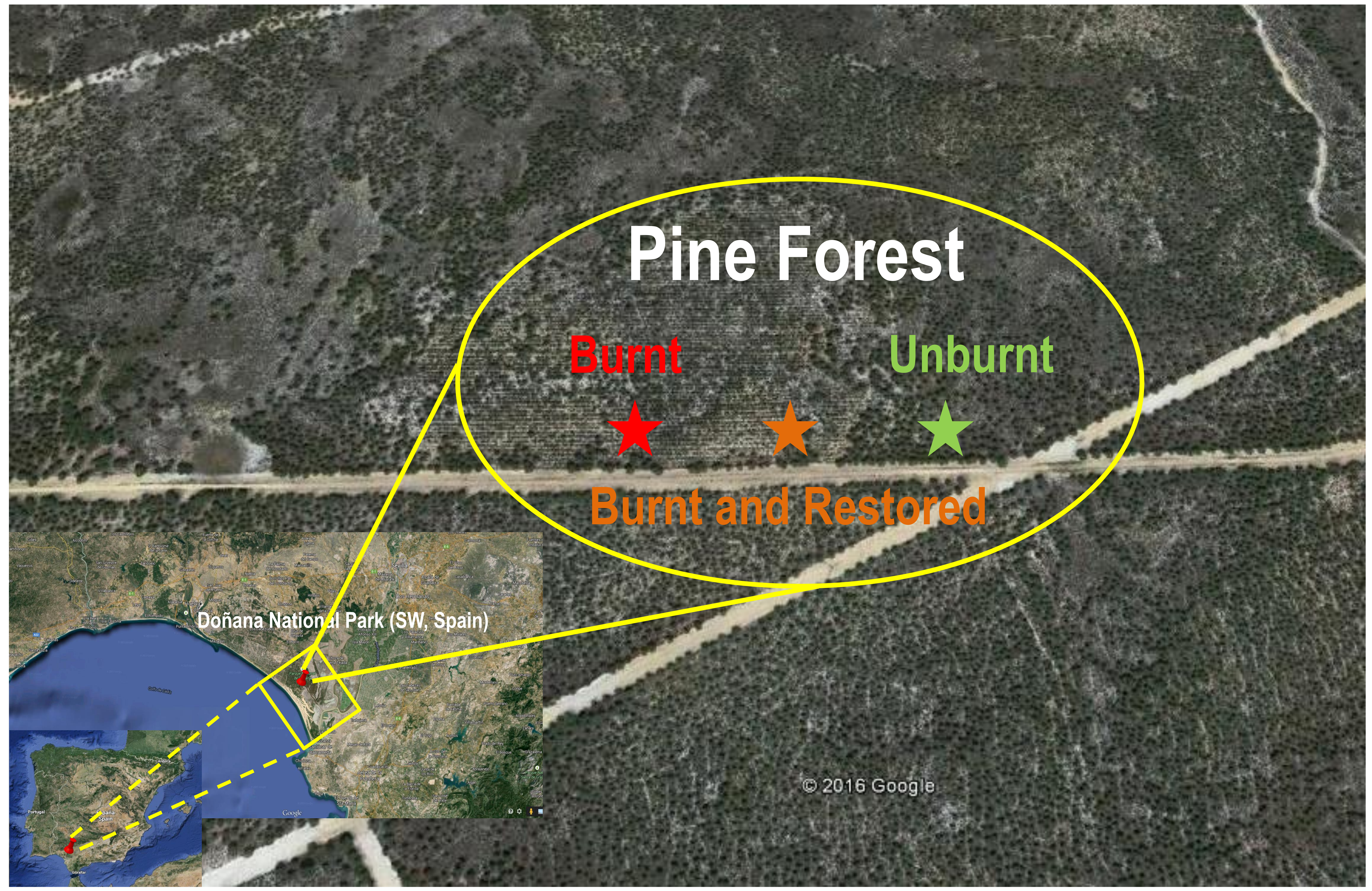
Pine Forest
Burnt
Unburnt
Burnt and Restored
Doñana National Park (SW, Spain)
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