

Leveraging Google Street View for monitoring invasive plant dynamics in the Guadalfeo Watershed (Southern Spain): patterns of *Ailanthus altissima* expansion and *Opuntia ficus-indica* regression

Jessica Bernal-Borrego¹, Laura Bayas-Barrientos¹, Pablo González-Moreno¹

¹ Department of Forest Engineering, University of Córdoba, Córdoba, Spain
z12beboj@uco.es

Monitoring invasive plant species in mountains and remote areas remains a critical challenge for biodiversity management. We explored the potential of Google Street View (GSV) as a virtual sampling tool to monitor the spatiotemporal dynamics of two contrasting invasive species—*Ailanthus altissima* (Mill.) Swingle and *Opuntia ficus-indica* (L.) Mill.—along a 66 km stretch in the Guadalfeo watershed (Southeast Spain). The analysis utilized historical GSV imagery from 2008 to 2023, capturing key variables such as patch size, roadside location, altitude, infrastructure coverage percentage, height categories, and observable damage levels. The data collection also recorded zones with high extensions beyond the initial 10-meter observation buffer and areas subjected to management measures. The 10-meter limit was selected based on practical considerations related to GSV image resolution, general visibility constraints, and comparability with previous roadside survey studies. Preliminary observations indicate that *A. altissima* patches densify and increase in height within short timeframes, especially in road curves coinciding with runoff pathways, under bridges, and near infrastructure. Rapid post-disturbance re-sprouting was observed in regions affected by a major fire in Sierra de los Guájares (2022), highlighting the species' resilience. In contrast, *O. ficus-indica* exhibited a regression pattern associated with *Dactylopius opuntiae*, its biological control agent. However, some areas adjacent to agricultural lands showed better conservation of *O. ficus-indica*, likely due to human care, reflecting its cultural value in the region. Manual removal efforts were also observed in certain areas. While manual delineation of patches in GSV remains time-intensive, this approach effectively captures diverse invasion dynamics, complementing traditional field-based surveys. The method shows scalability potential for monitoring other plant species with distinct roadside traits. Future developments will integrate AI-based automation for patch delineation, enhancing efficiency and the development of dynamic spatio-temporal models. This research highlights GSV's value for tracking invasive species and informing adaptive management in semi-arid, fire-prone ecosystems.

Keywords: *Ailanthus altissima*, *Opuntia ficus-indica*, Google Street View, invasive species monitoring, spatiotemporal dynamics, Guadalfeo Watershed, post-fire resilience, biological control, virtual sampling methodology.