

Delineation of Green Infrastructure Buffer Areas with a Simulated Annealing: Consideration of Ecosystem Services Trade-Offs in the Objective Function

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Abstract : The biodiversity strategy of the European Union for 2030, mentions climate change as one of the key factors for biodiversity loss and considers green infrastructure as one of the solutions to this problem. In this line, the European Commission has developed a green infrastructure strategy which commits members states to consider green infrastructure in their territorial planning. This green infrastructure is aimed at granting the provision of a wide number of ecosystem services to support biodiversity and human well-being by countering the effects of climate change. Yet, there are not too many tools available to delimit green infrastructure. The available ones consider the potential of the territory to provide ecosystem services. However, these methods usually aggregate several maps of ecosystem services potential without considering possible trade-offs. This can lead to excluding areas with a high potential for providing ecosystem services which have many trade-offs with other ecosystem services. In order to tackle this problem, a methodology is proposed to consider ecosystem services trade-offs in the objective function of a simulated annealing algorithm aimed at delimiting green infrastructure multifunctional buffer areas. To this end, the provision potential maps of the regulating ecosystem services considered to delimit the multifunctional buffer areas are clustered in groups, so that ecosystem services that create trade-offs are excluded in each group. The normalized provision potential maps of the ecosystem services in each group are added to obtain a potential map per group which is normalized again. Then the potential maps for each group are combined in a raster map that shows the highest provision potential value in each cell. The combined map is then used in the objective function of the simulated annealing algorithm. The algorithm is run both using the proposed methodology and considering the ecosystem services individually. The results are analyzed with spatial statistics and landscape metrics to check the number of ecosystem services that the delimited areas produce, as well as their regularity and compactness. It has been observed that the proposed methodology increases the number of ecosystem services produced by delimited areas, improving their multifunctionality and increasing their effectiveness in preventing climate change impacts.

Keywords : ecosystem services trade-offs, green infrastructure delineation, multifunctional buffer areas, climate change

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