



## Efficient FOREst Management Strategies for Ecosystem Service provision

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**Context** — Forests cover 30% of metropolitan France, and are home to numerous animal and plant species. In addition to wood products, forests provide a wide array of ecological and social benefits such as climate regulation, nutrient cycling, water purification, recreation. Quantifying and mapping the supply of such services is crucial to improve landscape multifunctionality, and shed light on decisions relative to regional planning and land use.

**Objectives** — The objective is to investigate which management options can reconcile economic, ecological and social objectives in forest areas. In particular, we will assess synergies and trade-offs between different forest ecosystem services while accounting for spatial heterogeneity in land use, and explore the spatial distribution of service supply. We will finally define cost-effective forest management strategies for the joint provision of different services.

**Approach** — We aim at developing a spatially-explicit forest model integrating objectives of ecosystem services provision under several management options, including even-aged forest, uneven-aged forest and reserve forest. We will use production possibility frontiers to assess synergies and trade-offs between the services under scrutiny, namely wood provisioning, global climate regulation (through carbon sequestration and storage), recreation. Conservation of biodiversity will be set as a constraint. The model will be applied to the *Ballons des Vosges* Regional Nature Park.

**Key results** —

- Based on the forest management plans of the National Forestry Office (ONF), an intern collected available data to map current forest use in the public part of the *Ballons des Vosges* park (species and management strategies) as well as corresponding wood production.
- We developed a map of forest attractiveness in order to quantify the recreation service currently provided by the forests of the park. To this end, we combined two models using data from a survey held in the Lorraine region. The first one explains forest attractiveness through biophysical characteristics of the visited forests. The second one estimates attractiveness based on agents' recreational demand according to their sociodemographics (travel cost method). As the models only cover part of the park, estimated functions are transferred to the rest of the park area based on GIS data. A combined attractiveness index allows us to determine which forests are the most attractive both due to their own biophysical attributes and the demand for outdoor recreation.
- We generated a biodiversity index in spatially explicit terms using the InVEST model. More precisely, the index measures habitat quality, which is potentially favourable to a richer biodiversity.

- We started interacting with researchers from other disciplines. On the one hand, several discussions with the teams involved in the forest growth model CAPSIS (e.g., Z. Mao and F. de Coligny, INRA UMR AMAP, and P. Vallet, IRSTEA LESSEM) allowed us to identify the modules which may be applied to the park conditions. They would simulate alternative forest management options and the corresponding services. On the other hand, we offered Y. Dujardin (INRA, UMR MIAT) to apply to our problem its original algorithms for multiobjective spatial optimization (reference point method).

**Main conclusions including key points of discussion** — The results about recreational attractiveness and habitat quality demonstrated that the strategy of the park authorities is consistent with respect to the objectives mentioned in the park charter for these two services. However, it aims at preserving the strengths of given areas rather than improving weaknesses.

**Future perspectives** — In the next step we will integrate data on recreation, habitat quality and wood production in the same spatially-explicit model based on a map of forest land use in the public area of the park.

**Valorisation** —

*From supply to demand factors: What are the determinants of attractiveness for outdoor recreation?*

L. Tardieu, L. Tuffery - Ecological economics, 2019, 161:163-175.