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Designing peri-urban forest reserves networks using systematic conservation planning

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Summary
Current public policies promote networks of forest reserves that are set-aside from conventional forestry. Designing a network of old-growth woodland is a challenging task for forest managers trying to balance ecological benefits and economical/social costs over large spatial and temporal scales. This was precisely the situation facing foresters trying to design a Nature discovery park in the largest uninterrupted stand of forest on the Swiss Plateau situated just north of Lausanne (40 km2). The objective was to identify forest surfaces maximizing the biological potential for old-growth reserves, while minimizing the surface to 10% of the total area under scrutiny (400 ha).

We applied systematic conservation planning (SCP), an optimizing method that is widely used in conservation biology (Margules & Sarkar 2007; Margules & Pressey 2000; Moilanen et al. 2009). Our study area was composed of 4000 one-ha planning units. Each planning unit was characterized by seven conservation features describing forest structure (average tree diameter, proportion of indigenous trees, stand structural diversity), composition (vegetation alliance, presence of endangered species, occurrence of protected habitats) and function (position in the ecological network). Both the selection and the weighting of all 7 conservation features were compiled in agreement with public administrations responsible for both forest and nature management. The algorithmic approach (Marxan) was designed in order to simultaneously maximize the values of the seven conservation features using only 10% of the study area.

The product of this approach is an irreplaceability value that is attributed to each planning unit, and reflects how important a given hectare is to achieving the conservation goals. This value was then used to create a heat map (Figure 1) locating 14 core areas of high value for old-growth reserves. Because these areas (indicated in green in Figure 1) are relatively small (median: 24 ha) and disjoint, they do not allow for the emergence of large scale ecological processes. The heat map was then used to delineate five larger patches (median: 101 ha) concentrated on core areas while expanding towards areas of lower irreplaceability but allowing the appearance of large-scale ecological processes.

Because of small scale heterogeneity, the independent mapping of each conservation feature does not reveal any obvious pattern and doesn't allow for a visual identification of areas where conservation features are simultaneously maximized. The use of systematic conservation planning algorithms allows for the emergence of a general pattern where none is apparent.

Systematic conservation planning is a rigorous decision support tool that requires wide acceptance by all stakeholders, especially in peri-urban areas: the implication of a large spectrum of representatives is therefore of utmost importance during all stages of the process. The product (a heat map of irreplaceability values) proved an efficient communication tool and provided the basis for community-wide workshops on the design of a peri-urban forest reserve network.

Key References
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Figure 1: A reserve network heat map used as decision support tool.