User Needs, Possibilities and Limitations of Remote Sensing for Natura 2000 Habitat Monitoring - Results from the European MS.MONINA Project

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1. Introduction

As part of the implementation of the Habitats Directive (92/43/EEC), member states throughout the European Union have selected outstanding natural areas on their territory to become part of a Natura 2000 network of protected areas. The aim of this directive is to reach and maintain a favourable conservation status for the most typical or most threatened habitat types and species in Europe, listed in the annexes to the directive. To monitor progress towards this aim, member states are required to deliver six-yearly reports on the conservation status of each habitat and species (Art. 17 of the directive), based on sound monitoring data covering their whole territory (Art. 11). For habitats, such data not only include the range and area, but also an assessment of the habitats' specific structures and functions and their typical species, or in short, their quality.

2. Habitat Quality Monitoring Needs

To monitor a habitat's specific structures and functions, several member states have drawn up lists of indicators that can be used to assess the quality of a habitat patch in the field. Indicators that are typically evaluated comprise structural characteristics (e.g. proportion of dead wood in a forest), disturbance-related criteria (e.g. grass and tree encroachment in open habitats), characteristics related to the floristic composition (e.g. number of key species present) and landscape configuration (e.g. connectivity and isolation) (Bock et al. 2005, Tiner 2004). Vanden Borre et al. (2011) provide an example from the Flemish habitat quality assessment manual (T'jollyn et al. 2009). Given the diversity and the large number (currently 231 on the Annex 1 of the directive) of the habitats, it is no surprise that the list of indicators is very long. Moreover, many indicators apply to only one or a few habitat types (Figure 1). If one adds to that the large set of site-specific requirements from site managers in the frame of appropriate conservation management (Art. 6 § 1 of the Habitats Directive), the need for data in this field becomes extremely huge and diverse.

Remote sensing has repeatedly been suggested as a highly suitable tool to cover these data needs (e.g. Nagendra 2001, Kerr and Ostrovsky 2003, Turner et al. 2003, Gross et al. 2009). But despite several studies aiming at developing practical applications of remote sensing in Natura 2000 monitoring, the step towards actual operational use apparently still is a big hurdle to take (Vanden Borre et al. 2011).

3. Remote Sensing Applicability

MS.MONINA (*Multi-scale Service for Monitoring Natura 2000 Habitats of European Community Interest*, http://www.ms-monina.eu) was an FP7 project in the frame of Copernicus

(formerly GMES), aiming to develop dedicated earth observation based services to help authorities and managers at European, national (EU member states) and local (protected sites) level comply with their monitoring and reporting obligations on habitats under the Habitats Directive (Lang et al. 2012). Within the local-level oriented work package, project partners gathered their collective experience in the form of 16 mostly pre-existing methods for habitat mapping or monitoring through remote sensing, together with existing data on their targeted habitat types and preferred study sites. An analysis of the user requirements for these sites showed that only very few requirements ('indicators') are sufficiently widely used and potentially suitable for the development of a more generic remote sensing approach (e.g. shrub and tree encroachment in open habitats). This is not necessarily problematic, since Spanhove et al. (2012) showed that indicators often are correlated with one another, and that fine-scale, difficult to record indicators can be modelled to a certain extent using coarse-scale, more easily assessable indicators.

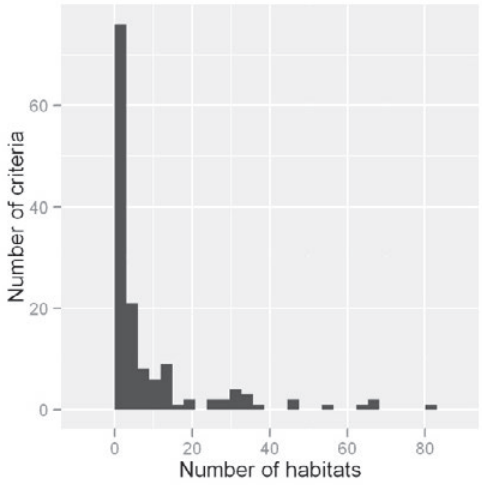

Figure 1: Histogram of the number of habitats in which a given criterion ('indicator') is used in the Flemish manual for habitat quality assessments (T'jollyn et al. 2009). The majority of the criteria are used for a few habitat types only.

But even if remote sensing focuses on these suitable indicators, the question remains whether developed methods are effectively widely applicable. Figure 2 shows the assumed applicability of a set of six remote sensing approaches, each used to assess shrub and tree encroachment in open habitats, as perceived by the developers and/or providers of the method. The graph illustrates the providers' optimistic viewpoint on the broad usefulness of their methods across a wide range of habitats (black and orange dots), but it should be noted that actual testing has only been done on a limited number of habitats and biogeographical regions (green dots).

Therefore, in MS.MONINA, we set up some tests of transferring and applying methods to different settings, i.e. other study sites than the ones for which they were developed. Although a quantitative analysis of the results was not possible, it was clear that some techniques did well, but many others failed or needed at least substantial adaptations. Several factors may be contributing to this low transferability: variations in user needs, characteristics of the sites, habitats and species composition, timing and quality of the imagery, training data requirements of the algorithm, etc. Despite the huge potential of remote sensing, the lack of transferability of

some remote sensing methods is undoubtfully a major obstacle towards operational systems. New method developments will need to take care to avoid this pitfall. Meanwhile, when existing methods are transferred to other settings, it should be taken into account that adaptations to the method will generally be unavoidable.

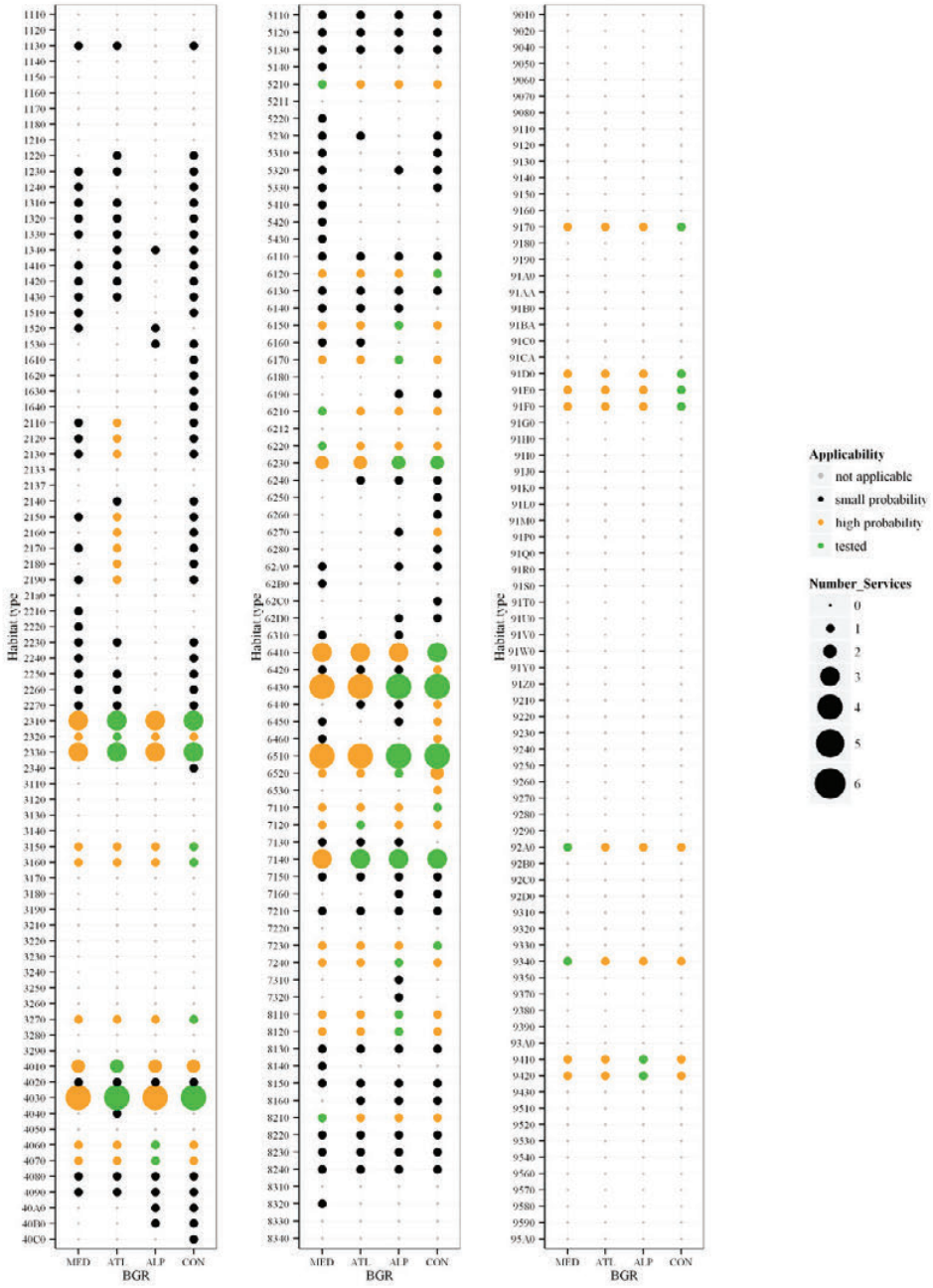

Figure 2: Assumed applicability of six ‘shrub and tree encroachment’ methods across habitat types (four digit codes, *y*-axis) and biogeographic regions (BGR, *x*-axis, MED: Mediterranean, ATL: Atlantic, ALP: Alpine, CON: Continental), based on expert judgements by the service providers. For simplicity, the colour only reflects the highest assumed applicability probability and ignores the opinions of service providers that gave a lower probability.

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