Smart Forest toolbox for close-to-nature, multi-purpose, adaptive and sustainable forest ecosystem management - DRAFT

Christian Rosset, Gaspard Dumollard, Hannes Horneber, Hugues Clavadetscher, Ulrich Fiedler

Management of forest ecosystems is challenging, especially close-to-nature silviculture. It requires excellent knowledge of forest ecosystems to shape natural processes over decades to provide multiple forest ecosystem services. Each silvicultural intervention must be like a puzzle piece snapping into place, completing the dynamic picture of a well-managed, evolving forest area that meets public needs and forest owner interests sustainably.

A crucial aspect of forest ecosystem management is the ability to make informed decisions based on complex data. This involves structuring and organizing the decision-making process across both spatial (from individual trees to large forest areas) and temporal (from short-term to long-term) scales. A decision support system (DSS) is an essential tool in this context, providing the necessary framework to integrate diverse information and facilitate effective decision-making. We developed one such DSS, named WIS.2, to support close-to-nature sustainable forest ecosystem management. The system's first step involved structuring the decision framework across the relevant scales, incorporating critical information to support decisions. The second step was creating an interactive user interface that allows users to visualize how individual decisions influence the entire forest ecosystem, run long-term simulations of various management scenarios, and translate these simulations into concrete, actionable steps. The system is designed to be flexible, with the capability to adjust interventions continuously as conditions change, a feature that has become even more important in the context of climate change and its uncertainties. Nearly 20 years after its initial release, WIS.2 remains in use for both teaching and practical forest management applications.

Key ingredients for use of WIS.2 DSS are data on the current conditions and past development of a forest area, as well as formalized knowledge on close-to-nature silvicultural management. Taking advantage of impressive technological developments, we have been working closely with IT specialists and practitioners to develop digital tools to complement WIS.2. We conduct applied research and tool development in an agile, pragmatic way, considering Roger's criteria for successful diffusion of innovations. In particular, the tools should provide a clear added value for decision-makers. They should also be simple to understand to avoid the "black box" effect. Modelling the right level of simplification for effective decision-making is critical given the overall complexity of the system, requiring close collaboration between scientists and practitioners. Additionally, collaboration with IT specialists and user interface designers is essential to develop attractive, intuitive digital tools. The resulting tools are being used successfully in practice: MOTI, a smartphone app for forest inventory, has been downloaded more than 50,000 times; TBk, a forest cartography tool, has been used on several hundreds of thousands hectares [3]; and martelage.sylvothque.ch has one of the largest networks of marteloscopes (silvicultural observation and training plots) in Europe for practicing and sharing about close-to-nature silviculture [4].

The tools continue to be developed, such as WIS.2 with the current development of a new web-based version for both even-aged and uneven-aged management and MOTI with a new version using augmented reality.

List of references: https://orcid.org/0009-0001-6284-5135