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Expert Panel-based Assessment of Forest Landscapes for Land Use Planning

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Forest landscapes are often not adequately taken into account by land use planning, leading to loss of biodiversity and reduction in ecosystem services and functions. One of the reasons relates to the data provided to planners, which tend to be limited to a description of the characteristics of forests—eg presence of a given vegetation type—rather than an assessment of their multiple values. Value assessments are important for prioritizing forest areas and consequently for steering development toward less sensitive sites. The present study aimed to transform forest inventories into composite, clear and consensual value assessments, in order to

provide support to land use decisions in forest areas (eg for location of ski infrastructure, conversion to agriculture, etc). An expert panel-based approach was employed to make an assessment of the nature conservation value of different forest types within an Alpine region. A geographical information system (GIS) database was then built up by linking the forest parcels with the results of the assessments. This information system is being used by the local Environmental Protection Agency to support land use planning procedures, such as environmental impact assessments (EIA) and strategic environmental assessments (SEA).

Forest landscapes in the Trentino

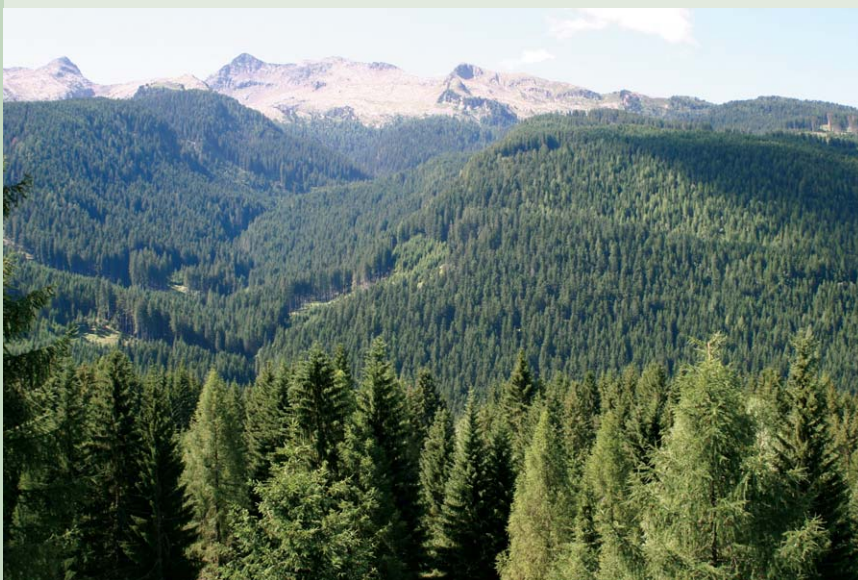
The Trentino is an Alpine region located in northeastern Italy and characterized by outstanding environmental assets. The region is a well-known destination for mountain tourism, and more than half of the land area is covered by forest (Figure 1). This pilot study focused on the Avisio Basin, which lies in the northeastern part of the Trentino. The area of the basin is about 1000 km², with elevations ranging from 200 to over 3100 m. Forests cover about 75% of the basin, which is still largely undeveloped, especially where the geomorphology puts severe constraints on land use. The main forest types are montane/submontane

spruce forest, Cembra pine forest, larch forest, silver fir forest, and mesophile broadleaved forest (Figure 2). Settlements and infrastructure are found mainly on the valley floors. Agricultural land is found between 500 and 1300 m, on the most favorably oriented slopes. The basin is characterized by a large portion of natural park and by several sites of community importance, which are protected areas established according to the European Union “Habitats” Directive.

Interviews and selection of evaluation objectives and criteria

Expert panels are playing an increasing role in ecological assessment; they often represent an efficient approach to informed decision-making, especially where there is great uncertainty and detailed empirical data are lacking. The use of expert panels is based on the premise that a consensus of experts will provide a more reliable answer to a question than response from a single expert. Expert panels were consulted for this study to assess the value of forest areas. In particular, in order to test the approach, one specific forest function was considered: protection of biodiversity and conservation of nature in the study region. This allowed a selection of experts with specific backgrounds and thus made it possible to obtain more reliable results. At a later stage, this approach will be integrated with analysis of the multifunctional value of forests.

FIGURE 1 Dense forest landscape in the study region. (Photo by Alessandro Franceschini)



First, interviews were conducted with experts in regional research institutes to select a preliminary list of evaluation criteria. Subsequently, the Delphi technique was adopted to refine these criteria and use them to assess forest types within the study area. Interviews led to establishment of a preliminary scheme consisting of 4 criteria:

- *Naturalness* refers to the degree to which an ecosystem presents biophysical alteration with respect to its potential conditions.
- *Rarity* is a measure of how frequently a forest type is found within a given area.
- The criterion of *outstanding ecological features* refers to the presence of elements such as small marshes, creeks, peat bogs, and monumental trees. These elements provide added ecological value because they act as microhabitats and they can enhance the biodiversity of the forest ecosystem in which they are located.
- *Human disturbances* consist of anthropogenic activities (trekking, picnic sites, grazing, etc) that may reduce the conservation relevance of a forest area.

Delphi survey for criteria assessment

The second step in the procedure consisted in assessing the 4 criteria for the different forest types in the study region. To this purpose, a broader panel of forest experts was set up, and a Delphi survey was conducted. A Delphi survey is a systematic procedure for soliciting the advice of a panel of experts, and whenever possible forging a consensus. It is based on structured and written questionnaires directed in “rounds” of opinion collection and feedback. In each round, responses are summarized and reported back to panelists, who have the opportunity to revise their judgments. Panelists were selected by asking the experts initially interviewed to propose qualified peers. The criterion for qualification as an expert was “knowledge of forest ecology and nature conservation principles, with relevant professional experience in the study region.” As a result, a final group of 14 experts who agreed to undertake the survey was brought together.

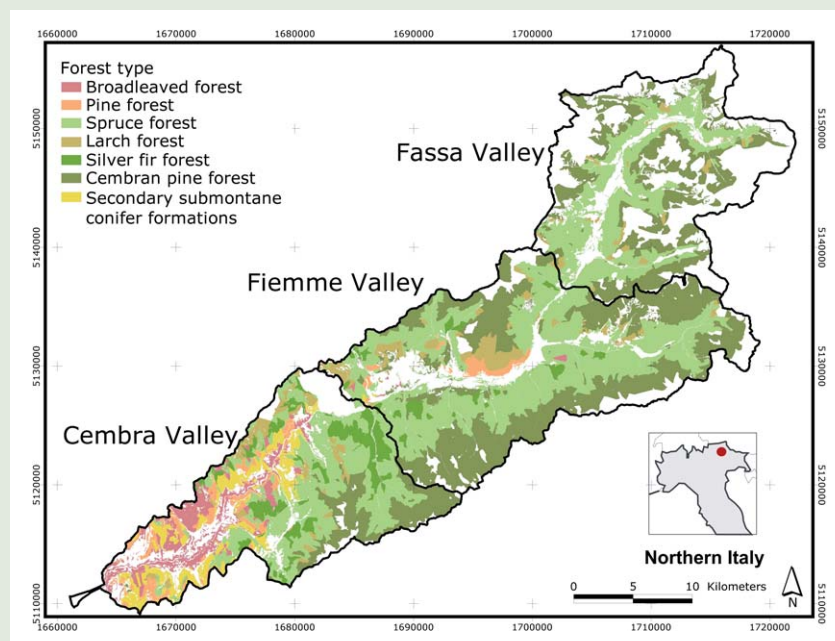
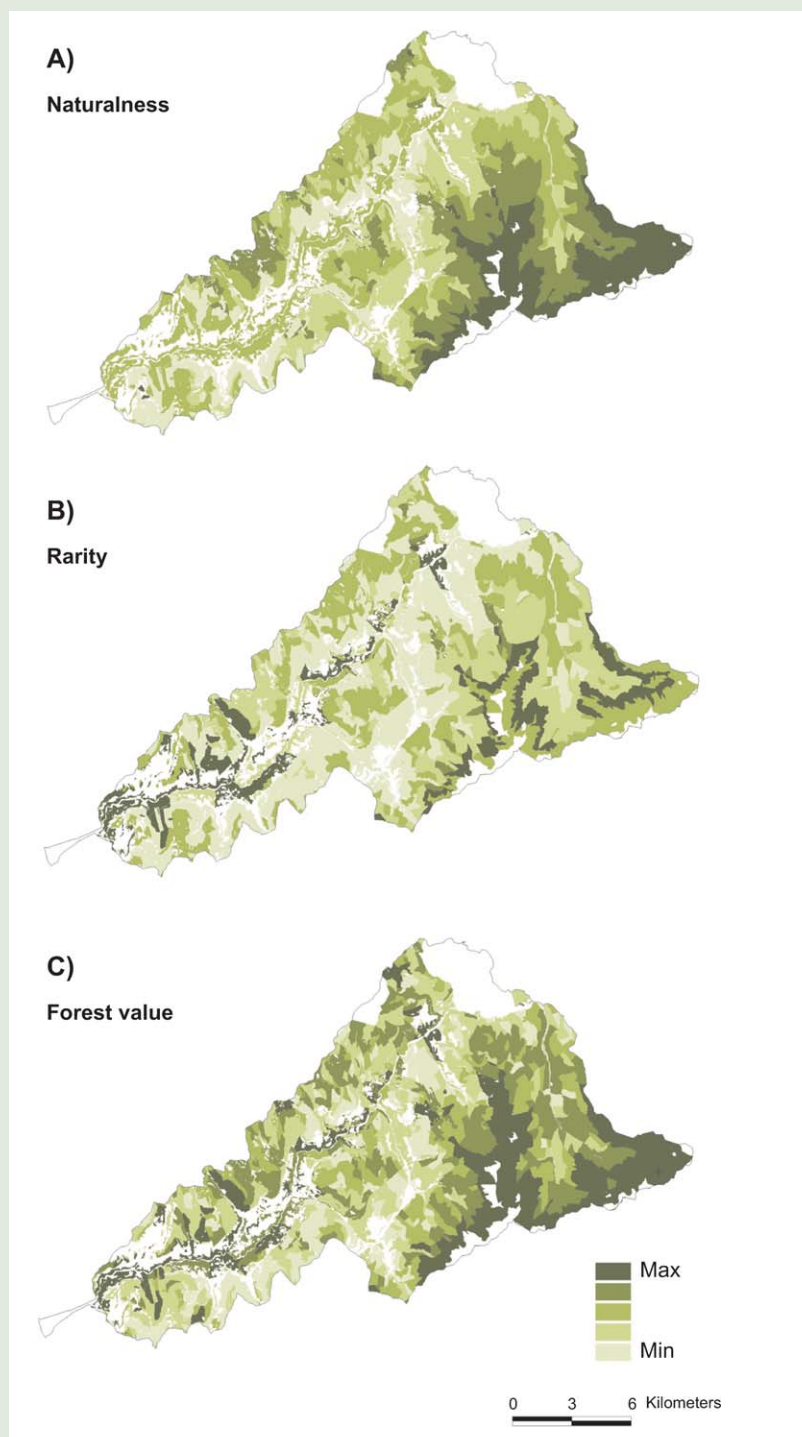


FIGURE 2 Forest landscapes in the Avisio Basin. (Map by Davide Geneletti and Giorgio Menapace)

In the first round of the Delphi survey, experts were given the description of the 4 criteria and asked to make comments and revisions. Moreover, panelists were invited to rate their own degree of knowledge about the forest types under evaluation. Panelists' feedback focused on 2 issues. The first concerned human disturbances. Experts claimed that tourism-related disturbances are very limited in space and affect only marginal and well-identified forest areas. Moreover, disturbances caused by grazing are extremely variable and difficult to generalize. Consequently, most experts suggested removing this criterion from the evaluation scheme. The second group of comments reported the difficulty of providing an assessment of forest types for the whole Avisio Basin, due to differences in environmental conditions and management. Panelists claimed that the naturalness and rarity of the different forest classes could be more meaningfully assessed separately for the 3 main physiographic sub-areas that form the Avisio Basin: the Cembra, Fiemme, and Fassa valleys (see Figure 2).

The recommendations of the panelists were included in a new version of the questionnaire, in which assessment of the 3 criteria (ie rarity, naturalness, and outstanding ecological features) for the different forest types within each sub-area

FIGURE 3 Naturalness, rarity, and composite forest value indices for the Cembra Valley, based on the expert panel's assessments. (Maps by Davide Geneletti and Giorgio Menapace)



was to be provided. A value scale ranging from 0 to 5 was proposed for each criterion. Furthermore, experts were asked to assign a numerical weight to the criteria, ie an indication of their relative impor-

tance in determining the overall nature conservation value of a forest area. The results of the survey were analyzed, tabulated, and fed back to panelists. In this way, experts had an opportunity to revise their answers in light of the information generated from collective responses, as well as from individual comments and considerations. The preliminary round of interviews was conducted by 2 individuals and took about 4 weeks. Interviews were spaced in time in order to allow processing of the information collected, a search for further references, and refining of the questions and the preliminary proposal. Delphi survey sheets were administered by e-mail, and experts were given 3 weeks to answer in each round. The overall duration of the survey was 14 weeks.

Forest landscape value maps

The definitive results were linked to forest inventories in a GIS, and used to generate the maps shown in Figure 3. For the sake of conciseness, results are presented only for the Cembra Valley. The highest naturalness values were given to montane spruce forests, Cembran pine forests, and montane dwarf pine woods. These formations are mainly found at elevations ranging from 1600 to 2000 m (see Figure 2). As to rarity, the highest scores were assigned to mesophile submontane broadleaved forests, alder woods, and Cembran pine forests. Outstanding ecological features were assessed by assigning high importance to the presence of wetlands and peat bogs, followed by streams and screes. Through weighted linear combination of the scores assigned to the 3 criteria it was possible to compute the composite forest value map, which is shown in Figure 3C. As can be seen, the highest values are mainly associated with patches of mesophile broadleaved forest distributed along the valley floors, and to forests of Cembran pine located in the southeasternmost sector of the valley.

Applying the results to land use planning

This study was conducted within the framework of a cooperation agreement



FIGURE 4 Conifer stands broken up by ski infrastructure. (Photo by Alessandro Franceschini)

with the Environmental Protection Agency of the Trentino. The Agency is currently using the results as a decision support tool to account for forest assets in spatial planning, and particularly in the procedures of EIA and SEA. As a test application, forest value analysis was used to assess the provisions of the Spatial Coordination Plan of the Trentino concerning the siting of future ski areas. The demand for new skiing facilities has increased steadily in the Alps, also fueled by the reduced availability of snow at existing facilities as a result of climate change. This raised concerns about the environmental impact of ski infrastructure (Figure 4). The Avisio Basin is characterized by an economy strongly linked to winter sports. In order to orient the future development of ski infrastructure in the basin, the Spatial Coordination Plan of the Trentino identified 8 areas (with an overall surface of over 600 ha) that could be devoted to the expansion of existing ski centers.

An interference buffer computed around the proposed areas was overlaid on the forest value map, so as to estimate the potential impact on forest ecosystems caused by the future enlargement of ski centers. The results showed that half of

the surface of the proposed areas interferes with forests that belong to the top 2 value classes. This preliminary analysis indicates clearly that the location of new ski centers should be revised in order to account for the distribution of forest ecosystems that are considered important for nature conservation.

The approach illustrated here is being repeated for the whole Trentino region, and integrated with similar studies that focus on other ecological components, such as animal and plant species, bodies of water, agro-ecosystems, Alpine ecosystems, etc. It will then be extended so as to account for the multifunctionality of forest landscapes. Specific panels for the different issues (eg recreation, economy) will be set up, as well as a multidisciplinary panel to integrate them. The purpose is to construct an information system in which natural elements are described and assessed, providing a gradation of values that can guide planners. The aim is to overcome more traditional planning practices, in which nature conservation is perceived in a binary fashion: either presence or absence of protected areas. This perception offers little support to land use planning outside such areas, opening the way to uncontrolled impacting activities.

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