Socioecological Landscape Planning: An Approach to Multi-Functional Forest Management

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1 Introduction

In the socioecological landscape planning of natural resources, as presented in this article, sociocultural and ecological decision criteria are considered with 'traditional' timber production analyses in an integrated and holistic way. As the main phases, the approach involves: pinpointing sites that are important with respect to management objectives related to ecological or sociocultural considerations; elaborating different so-called ecological and sociocultural networks; producing alternative economically sound production programmes for areas not included in different combinations of ecological and sociocultural networks (resulting in different alternative management plans); evaluating the relative worth of alternative plans with respect to each relevant objective; and, finally, the holistic comparison of alternative management plans. In the following, the principles and rationale of the approach are briefly presented. Outline of a landscape planning case where the approach is being tested is described for illustrative purposes.

As is well-known among forestry professionals, and more generally among those of environmental management, broad-in-scope ecological reviews are applied in natural resources management to find means for securing the biodiversity of the landscape (e.g., Lackey 1998, Leitao and Ahern 2002). Determining the ecological potential of the planning area, producing alternative ecological solutions, and evaluating alternative solutions in relation to the preservation of the vitality of organisms require landscape-level ecological assessments. Ecological potential is a function of the present state of the area in terms of characteristics of species populations persisting in the area or near-by, and of the possibilities to maintain viable populations of different species, different habitats and the multi-formity of life in general. Defining area-wise operational ecological objectives in a justifiable way is possible only after the assessment of the ecological potential.

Landscape-level natural resources planning with special emphasis on ecological management objectives is often called ecosystem management (e.g., Grumbine 1994, Pirot et al. 2000) or, as has been usual in Finland, landscape ecological planning (e.g., Karvonen 2000). In practice, it often also includes considerations related to objectives other than those of just ecology, such

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as objectives related to wood production, forest recreation and nature tourism. Indeed, this kind of activity is ultimately a matter of multiple criteria natural resource planning. Then the central task of planning at the landscape level becomes that of reconciling the various objectives, forms of use, and multi-functionality of the area under consideration.

To take an example from practical forestry; sites of great ecological or amenity value are often taken into account by leaving some forest stands or other sub-areas outside forest treatment aimed at wood production. From the viewpoint of wood production, this creates set-aside areas of different kinds in the forests. Planning is at its most efficient if the choice of these sites is considered simultaneously in regard to all the relevant planning-case-wise objectives. However, a problem of central importance has been how to efficiently integrate sociocultural objectives into multi-functional planning. The socioecological landscape planning approach provides one solution for alleviating this integration problem.

2 Outline for the Socio-ecological Landscape Planning Process and Its Application

In the socioecological planning process, a host of different alternative networks consisting of ecologically valuable patches and connections between them are produced. These are called ecological networks. For areas belonging to a ecological network, only ecologically acceptable treatment options, if any, are allowed. Correspondingly, alternative sociocultural networks are elaborated with various amounts of land area reserved for recreational and other sociocultural purposes. Combinations of these two kinds of networks form the socioecological networks. If there are l ecological networks and n sociocultural networks, the number of alternative socioecological networks is $l \times n$.

In the next phase, when applied in forestry context, each socioecological network is provided with m alternative wood-production programmes involving different treatments for forest stands not set aside from wood production due to ecological or sociocultural values. Thus, we have $l \times n \times m$ alternative management plans each with different ecological, sociocultural, and economic consequences.

The first application of the approach in Kainuu, eastern Finland serves as the testing tool while at the same time also producing valuable information for the practical management of the area. The area is 3336 hectares in size, owned by the state, and governed by the Finnish Forest and Park Service. A landscape ecological natural resources plan had already been produced for the area, serving as a starting point for the elaboration of alternative ecological nertworks. Forestry sector is important for the regional economy. Thus, it is also important to secure the timber cutting possibilities. From the sociocultural viewpoint, the area's most important activities are related to recreational use of forests and nature tourism.

The area in question had previously been inventoried for its soil and growing stock as well as data related to recreational use with reference to the special ecological sites and coarse woody debris. In regard to the recreational aspects, the existing data were supplemented by data collected in separate field inventories. The foremost item related to recreational use in the study area is a popular hiking route passing through it including lean-tos and campfire sites, for instance. Of prominent ecological value are the numerous small water systems in the area and the associated diverse shoreline forests. Three networks related to sociocultural objectives, and three networks of ecological items were drawn up.

The first ecological network alternative included only habitats of great ecological value. Shoreline forests, spring habitats, rock outcrops and cliffs, old-growth forests, and individual forest islets surrounded by mires are examples of these. In order to produce a network, the statutory ecological items were supplemented as necessary by forest compartments serving as ecological corridors and stepping stones. In the second stage of the ecological solution, the area of the network of items to be set aside was increased by, for example, extending the buffer zones drawn around streams. Moreover, new items were included in the second ecological network alternative: e.g. old forests and stands with plenty of coarse decayed

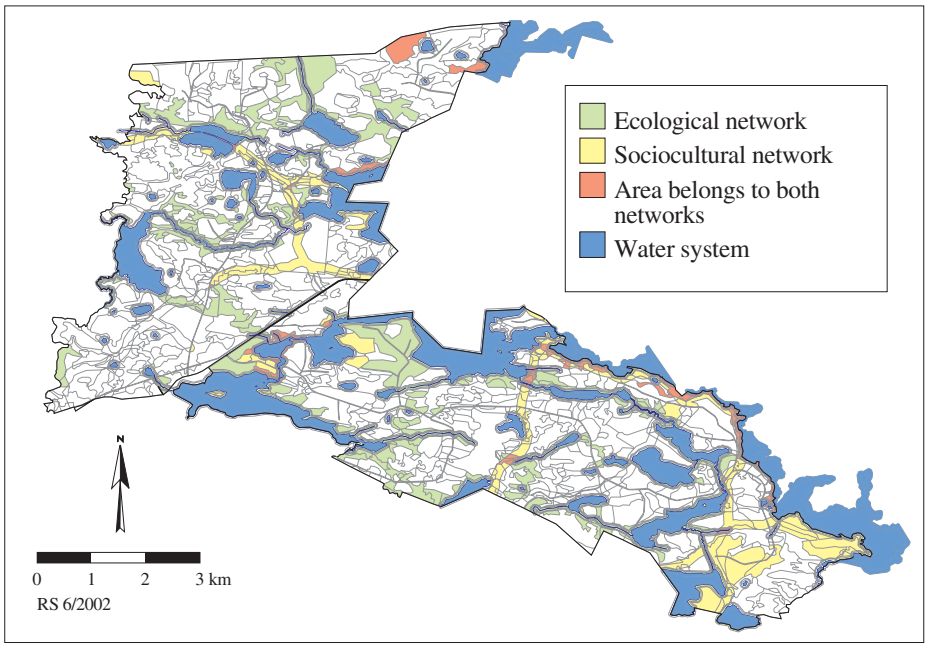

Fig. 1. An example of alternative socioecological networks in the case study where the socioecological landscape planning approach is being tested.

woody debris, and the capercaillie (*Tetrao urogallus*) leks. The third and most intensive ecological network was produced both by including new items and corridors as well as by extending the width of buffer zones.

The basis for alternative sociocultural networks was provided by the hiking route passing through the area. The first stage consisted mainly of recreational structures already in place in the planning area. Also some scenically important places were included in the network. They were sought out using a GIS application and aided by visibility analysis. Participatory citizen feedback was utilized in the determination of places of great sociocultural interest. For the more intensive sociocultural network, the number of areas that were set aside for the recreational use was extended primarily by enlargening the path network. Scenic aspects were taken tender care in buffer zones along paths. In the third stage, the network was expanded by also individual recreational-use items.

The next step was to merge the three recreational-use and the three ecological networks within a GIS application. This resulted in nine landscape level basic solutions combining ecological and recreational-use values and serving as the starting point for the production of alternative socioecologically oriented landscape plans.

The forest plans covering all the stands in the area and their treatment programmes were finally produced such that each basic solution compliant with the combinations of ecological and sociocultural networks was provided with four wood-production programme alternatives. The wood-production programmes were compiled using simulation of forest development and numerical optimisation.

The final choice among the alternative plans is up to the management objectives and their weightings. There are no universal rules to be applied everywhere what comes to the criteria and their relative importance. Methods developed for multiple criteria decision support (MCDS) can be made use of in evaluating alternative plans holistically in regard to the objectives set for the

area (Kangas et al. 2000). Of MCDS methods, the Analytic Hierarchy Process (AHP) and its regression versions, outranking methods, voting theoretical methods, Stochastic Multicriteria Acceptability Analysis, and A'WOT (a hybrid of AHP and SWOT analysis), for instance, have already been tested in natural resource planning within the Finnish Forest Research Institute or Finnish Forest and Park Service (for a review and experiences on forestry MCDS, see Kangas et al. 2001, Kangas and Kangas 2002).

3 Final Remarks

The socioecological landscape planning approach was rather briefly presented in this paper. However, there are versatile application possibilities of the approach and its different phases, especially of the different layers of socioecological networks. For example, the areas subjected to use pressures from more than one objective can be pinpointed by analysing the network alternatives formed by means of GIS applications. When selecting items to be set aside, this information can be used to favour areas, whose objectives can be interconnected observing the principles of overlapping use. When this is done, several different functions will be simultaneously practised in the same area, e.g. hiking and game management. On the other hand, the method serves as an aid in preventing conflicts, as it can be used to pinpoint areas that are potential sources of the conflict. The measures compliant with the objectives in these areas are in mutual conflict, which means that the use forms must be differentiated.

So far, we have just elaborated and preliminary tested the socioecological landscape planning approach (Store et al. 2002). Detailed descriptions and results of the case study where the approach has been tested, as well as the methods and techniques applied, will be published later. The approach has not yet been widely applied in practice. However, the Finnish Forest and Park Service, governing the vast majority of State-owned lands in Finland, has decided to apply the approach in natural resources planning within a pilot project in Kainuu region. Evaluations of different realisations of the approach will be conducted along the on-going tests and further studies also, especially concerning MCDS methods and their suitability to different planning tasks and different planning processes.

The socioecological landscape planning approach, as introduced in this article, has been developed for supporting complex multiple criteria decisionmaking processes within the field of natural resource management. Elaborating socioecological networks as well as using MCDS methods in the evaluation of alternative plans can also serve as channels and platforms for public participation. In its present applications, the socioecological landscape planning approach has been fine-tuned for suiting the planning requirements in boreal coniferous forests. Especially the principles of forming ecological networks need some elaboration in other regions. However, we think that the ideas of the approach might be applicable elsewhere, too.

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