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Evaluation of the implementation of a goal-oriented peatland rehabilitation plan

*Michael Trepel**

Schleswig-Holstein State Agency for Nature and Environment, Department of Freshwater Ecology, Hamburger Chaussee 25, D-24220 Flintbek, Germany

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ABSTRACT

Ecological restoration is a problem-driven scientific discipline. Thus an evaluation of the restoration strategies is needed periodically to improve the concepts. In Northern Germany, the Environmental Ministry adopted a peatland action plan in 2002 with the goal to (I) rehabilitate the water quality improvement potential of degraded peatlands and (II) to create suitable habitat conditions for endangered wetland species. The plan is implemented in a series of stages. The goals are clearly stated in the plan. For state-wide site selection, a GIS-based peatland information system was developed. For each peatland, information about land use, hydrology, conservation status, species occurrence and soil is stored in the database. Peatland sites with a high risk for nitrogen leaching are identified by calculating a land use intensity index. A flow path-oriented decision support system was developed to calculate the effect of land use and water management changes on nitrogen outflow and nitrogen transformation. The model result – absolute reduction of nitrogen outflow – is transformed into a cost-effectiveness value, which is used by water authorities to rank funding proposals. The DSS is developed as user-friendly, web-based software; its handling requires basic knowledge of landscape hydrology. However, local authorities do not use both tools intensively. For them, the most important factor for site selection is the possibility of land acquisition. To improve goal-oriented site selection and planning, local authorities need more training and a better hydrological understanding. To improve the effectiveness of ecological restoration projects, training and capacity building are as important as tool development and research.

1. Introduction

Globally peatlands are the most widespread wetland type. They cover large areas in the northern hemisphere (Canada, Scandinavia, Russia, Siberia), Southeast Asia, southern Africa and South America (Mitsch and Gosselink, 2000; Joosten and Clarke, 2002). Peatlands fulfil a wide range of ecological services. Approximately one third of the global terrestrial carbon is stored in peat soils, they influence global climate through their emissions, they have a high potential for water quality improvement and they can support robust rural livelihoods when used in a sustainable way (De Groot, 1992; Maltby et al., 1994; Joosten and Clarke, 2002). However, despite their ecological importance, until now peatlands have been underrepresented in regional, national and local conservation and rehabilitation plans. To increase awareness of peatlands at all levels, the Guidelines for Global Action on Peatlands were written and finally adopted by the Contracting Parties of the

* Tel.: +49 4347 704 445; fax: +49 4347 704 402.
E-mail address: mtrepel@lanu.landsh.de.

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Ramsar Convention in Valencia, Spain in 2002 (Ramsar, 2002). During recent years, several action plans for peatlands have been developed for countries in central and eastern Europe, Russia and Southeast Asia (Bragg and Lindsay, 2003; Trepel, 2003a; Wetlands International Russia, 2003; GEC, 2003). These plans differ in their strategies. While some focus on conservation of the most ecologically valuable sites, others also identify the need to develop less peat-destructive land uses and water management on peatland sites. The selected strategy does not depend only on the peatlands found in a specific region. The conservation and rehabilitation strategy needs to consider the socio-cultural conditions and the quality of peatlands in the planning region (Van Andel and Grootjans, 2006). For countries with a significant proportion of undisturbed peatlands, it is important to build up a conservation plan leading to strong protection of the most ecologically valuable sites and their surroundings. In countries where the majority of peatlands were lost during the last century due to agriculture, forestry and peat extraction, it is important to develop rehabilitation plans, in addition to conservation plans. Under such conditions, restoration is only one potential use among many competing for the land resource. Thus, it is necessary to clearly formulate restoration aims and select the most effective sites for successful plan implementation.

The aim of this paper is three-fold: firstly, it describes the steps for how a peatland rehabilitation plan was developed and implemented in the Federal State of Schleswig-Holstein, Germany; secondly, it describes the tools for site selection on the state and site scale to select the most effective sites; and thirdly, it evaluates the usefulness of the tools and discusses further strategies to improve plan implementation.

2. Writing a peatland rehabilitation plan

In the summer of 1995 a working group was established at the State Agency of the Environment. Members of this group came from the three departments of Water Management, Nature Conservation and Soil and Geology located at the State Agency and additionally experts from the university. The group activities were supervised by members from the Environment Ministry. The working group first wrote a draft action plan describing the distribution of peatlands in the State and the goals for peatland rehabilitation, and developed an implementation strategy at the site scale. The draft version of the plan was discussed twice in an iterative process with stakeholders representing farmers' organizations, water boards and nature conservationists. Finally the plan was adopted by the Environmental Ministry of the Federal State of Schleswig-Holstein in July 2002 (Environmental Ministry Schleswig-Holstein, 2002).

2.1. Aims of the peatland rehabilitation of Schleswig-Holstein

The aim of the peatland rehabilitation plan in Schleswig-Holstein is to rewet approximately one third of the state's peatland area (30,000 ha). The main goal of the plan is to use the rewetted peatlands for the reduction of non-point source pollution entering surface water bodies. The rational for this approach is that agriculture is the main source of nutrient input into ground and surface waters as well as into the North and Baltic seas (EEA, 2005). A reduction of nutrient inputs into water bodies requires actions at all stages of nutrient transport through the landscape. Because peatlands cover nearly 10% of the state's terrestrial surface, these sites offer excellent conditions for nutrient transformation via denitrification, sedimentation or plant uptake (Mitsch and Gosselink, 2000; Trepel and Palmeri, 2002; Trepel, 2003b; Hoffmann and Baattrup-Pedersen, 2007). The plan is a contribution to the implementation of the European Water Framework Directive (European Community, 2000) by improving the ecological quality of surface water bodies due to reduced nutrient input. At the same time, at the rewetted sites the habitat conditions for species adapted to wet conditions improve. The plan offers funding for land purchase and the development of a new water management at these sites. Potential project leaders are local water boards or nature conservation foundations that have developed a realistic water management plan for the peatland in question. Two tools were developed to assist in the selection of the most effective sites and measures, a GIS-based peatland inventory and a web-based decision support system for the quantification of nitrogen transformation in peatlands with a changed water management. Both tools are described in Sections 3 and 4 in more detail.

2.2. A stepwise approach for plan implementation

The implementation of the peatland rehabilitation plan follows the Ramsar Guidelines for Wetland Restoration and the principles of Ecological Engineering (Mitsch and Jørgensen, 2003). According to these guidelines, a stepwise implementation is chosen. First the goals of the rehabilitation plan have to be formulated. This was done by the working group when drafting and discussing the rehabilitation plan. Secondly, the most effective peatland sites have to be identified on the state scale. For this purpose, a GIS-based database was developed. Thirdly, at sites identified at the mesoscale, the effectiveness of different water management measures on the goal of nitrogen transformation and reduction of nitrogen input into surface water bodies has to be tested in order to choose the most effective measures. In the fourth step, these measures have to be implemented and the success of the rehabilitation measure has to be measured with a monitoring programme adapted to the site-specific geohydrological conditions and goals. For practical reasons, steps two to four are implemented more or less simultaneously.

3. A GIS-based peatland inventory

The successful implementation of peatland action plans should be based on the use of accurate information on the distribution of peatland types and quality to define region-specific restoration aims and to detect regional trends in quality. Therefore, a GIS-based peatland inventory was developed and applied in the Federal State of Schleswig-Holstein (Germany) (Fig. 1). The aims for development of the database are: to combine all available peatland-related digital data held by the State Agency for Nature and Environment of the State of Schleswig-Holstein within one information system; to offer