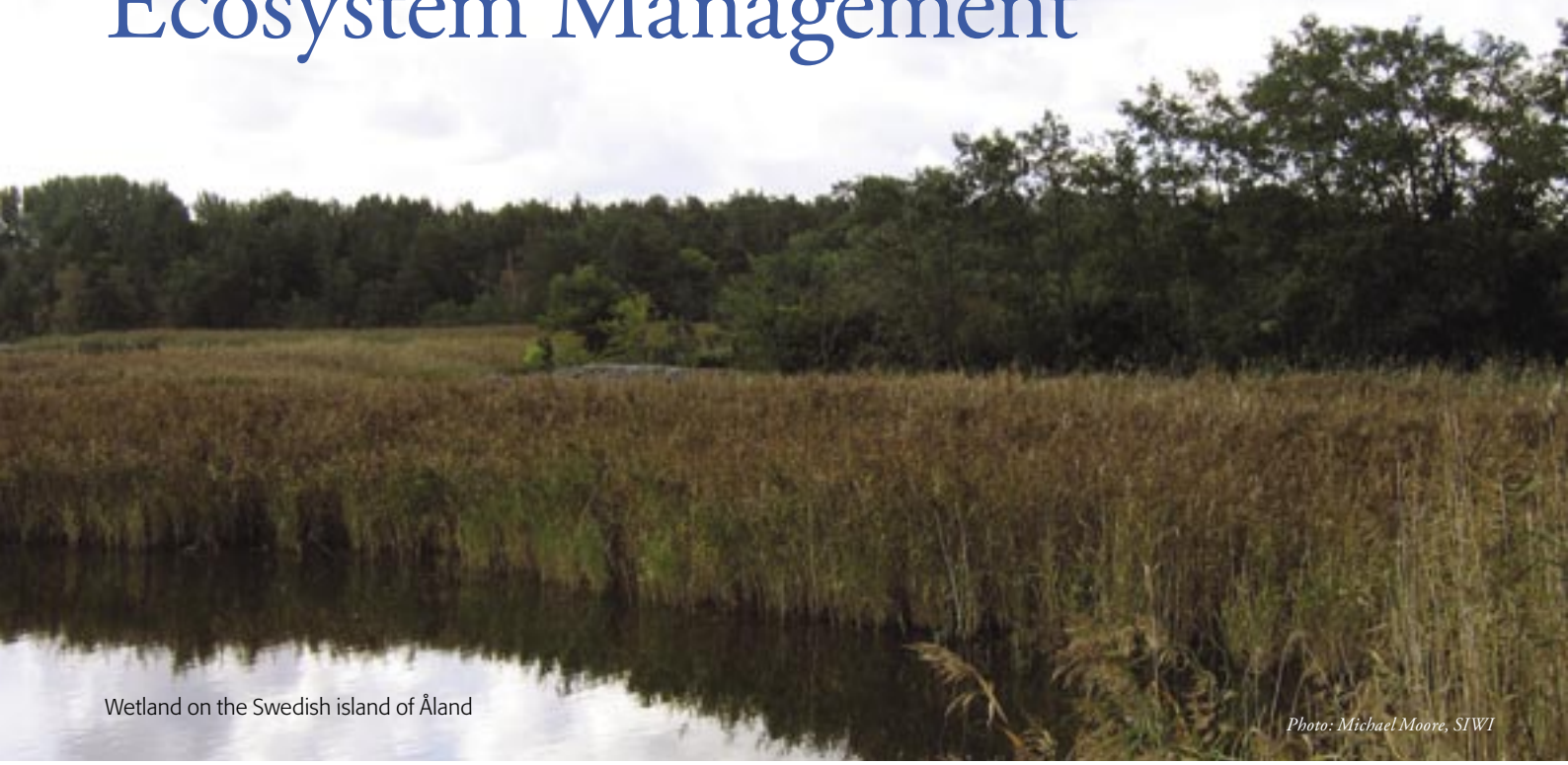
Water is the Entry Point to Better Ecosystem Management



Wetland on the Swedish island of Åland

Photo: Michael Moore, SIWI

Ecosystems are living parts of the physical environment, building up the life support system for all living creatures. This makes human-induced ecosystem destruction all the more hazardous for those living today and, especially, for the coming generations. Since water is the "bloodstream" of the biosphere, good water management can help protect ecosystems. In this article, SIWI Professor Malin Falkenmark looks at where we are in terms of entering ecosystem protection into Integrated Water Resources Management (IWRM).

Avoiding ambiguity: ecosystems differ!

Humans have long modified the land they live on and the water they use. Food production, timber harvesting, energy production, water supply, wastewater disposal, etc., have been used to drive socio-economic development. Since the time of the 1972 United Nations Conference on the Human Environment, in Stockholm, efforts to achieve environmental sustainability have gone on, but with rather modest results. A basic dilemma, originating from these land and water modifications, is the completely different views of ecosystems by the ecological and hydrological communities. Concepts borrowed from physics help explain the different views: the ecological community takes the Eulerian view, by focusing on variability in a point, whereas the Lagrangean view of hydrologists looks at variability along a line. Lack of precision when using central concepts such as ecosystems and wetlands continues to delay results desired in the wake of the 1972 meeting.

From a hydrological perspective, there are two fundamental categories of ecosystems: land-based and water-based systems. The former, terrestrial ecosystems, may be located in recharge areas in a catchment (forests, savannah grasslands), in discharge areas (springs, groundwaterfed wetlands, meadows), or be inundation-dependent (flood plains). The habitat of aquatic ecosystems is water in rivers, lakes and deltas. Aquatic ecosystems are particularly vulnerable since their habitats are affected by a whole gamut of human activities upstream, a fact that may well explain why aquatic ecosystems have been identified as the type that has suffered the largest biodiversity loss – 50% – in the last 30 years.

A fundamental point, then, is that in order to obtain mutual understanding and more effective collaboration – not the least when they're communicating with policy- and decision makers – the ecological and hydrological communities must be more accurate when speaking of "ecosystems."

Protecting ecosystems: why?

There have been massive advocacy efforts in recent decades to explain why ecosystems must be protected. The advocacy usually refers to both biological and hydrological functions. Biologically, ecosystems are said to be highly beneficial since they provide ecosystem services such as food, timber, cattle feed, climate regulation, pollination, and cycling of elements (oxygen, nitrogen, carbon dioxide). They also provide biodiversity in terms of species richness and help protect against exterior change from droughts, storms, pollution, climate change, etc. In effect, biodiversity acts as a global insurance policy. Species richness is fundamentally important for recovery after disturbance, since species with similar functional roles can replace each other.

Hydrologically, the accepted "truth" about wetlands – that they act as sponges, reducing flood flows and releasing water

during dry periods – has been shown to be quite misleading. Most wetlands evaporate more than other land types and reduce the flow downstream during dry periods. Many headwater wetlands increase flood peaks, since by being saturated they rapidly convey rainfall to the river.

Protecting ecosystems: what?

In particular, the crucial ecosystem functions in the natural landscape need to be protected. These include bird and insect habitats; primary production of food, timber and biofuels; safe habitats for fishery; and ecosystem resilience – the insurance against collapse. The water manager needs to know which biological landscape components are the crucial ones upon which to focus.

Since, for instance, upland forests are essential for aquifer recharge, they have to be protected to secure groundwater for populations downstream. Protection of groundwater recharge will also be essential for groundwater-dependent terrestrial ecosystems in the discharge areas, such as wetlands and meadows. Upland forests have to be protected also to avoid erosion. Similarly, cloud forests in mountains have to be protected because of their role in "harvesting" fog water used as the water supply of local populations. Mangrove forests along the coast have to be protected because of their role for flood protection.

Stream flow has to be protected as the lifeline and water source for populations downstream, and because of its role as habitat for fish production and thereby for food supply and income generation. Large lakes which are particularly important for large fishing populations also have to be protected; they generate social security. Iconic sites deemed particularly important in the landscape also need protection for such social reasons. A lush local forest, an unusually beautiful lake, a wetland with especially rich biodiversity or fundamental for bird flyways, etc., are examples of these types of icons.

Protecting ecosystems: how?

On a general level, the answer to this question is by taking an ecosystem approach to water management. This can be done by paying adequate attention to hydrologic-ecological linkages and dependencies, such as between a forest and groundwater recharge made possible by its root system, or between a grazed floodplain and the periodical inundations underlying the grass production. Some of the land and water modifications degrading ecosystems are, fortunately, avoidable and can be minimised, whereas others are unavoidable and have to be addressed by trade offs, based on stakeholder negotiations.

The "how" to protect has two dimensions: what should enter into water management, and what are the institutional requirements to make it possible? The first question may be clarified through diagnostic analysis: identifying major ecological issues in a catchment, the root causes of ecosystem degradation and the causal chains involved. This analysis has to identify the water determinants, i.e. characteristics of certain water elements forming the basis of a particular ecosystem. Such determinants will have to be secured through adequate water management, water quality protection or land cover protection. Strategic action plans have to be developed, incorporating for instance minimum residual stream flow for habitat protection downstream (so-called environmental flow), maximum contaminant concentrations (for similar reasons), forest protection areas in recharge areas of fundamental aquifers, flood flow mimicking in a flow-control dam structure, etc.

> *"The ecological and hydrological communities have to develop a shared, understood language.*

The second question finds its answer in institutional capacity building and good governance. Governance has to make possible a managing of land-based human activities within river basins that influence availability and quality of water resources and therefore the ecosystems depending on those resources. An ecosystem approach means incorporating into IWRM water-dependent land use and ecosystem functions of particular relevance for human benefits. It means achieving multiple river basin management goals in multiple sectors by optimising the different ecosystem functions of importance for those sectors. And, it means to secure resilience – and their capacity to withstand environmental pressure and perturbations without degradation or collapse – of crucial ecosystems.

The Millennium Project Task Force on Environmental Sustainability stressed the need for structural changes in terms of strengthening institutions and governance, improving environmental expertise available in and predictable funding for environmental agencies and institutions, improving interagency coordination, and correcting market failures and distortions. The cost of environmental degradation should be entered in national accounts. Environmentally damaging subsidies should be phased out, property and land-tenure rights strengthened and national and international regulatory frameworks improved.

Photo: Annika Börje, SIWI

Mangrove, Kenya

Speaking the same language

Some pitfalls in our efforts to actually achieve what Stockholm in 1972 set out to do can be avoided in if ambiguity in central concepts such as ecosystems is removed, and if simplistic hydrological statements are avoided. Hydrologists have to involve themselves more in clarifying relevant hydrological function and water determinants. For the water manager, focus has to be on water-ecosystem linkages and interdependencies, clarifying what particular catchment elements to incorporate into the IWRM process. To this end the ecological and hydrological communities have to develop a shared, understood language.

By Prof. Malin Falkenmark, SIWI,
e-mail: malin.falkenmark@siwi.org

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