TE04

MANUDYN III

Macrophytes and nutrient dynamics: process and field studies in the upper reaches of river bassins

DURATION OF THE PROJECT
Phase 1: 15/12/2006 – 31/01/2009
Phase 2: 01/02/2009 – 31/01/2011

BUDGET
853.480 €

KEYWORDS
Nutrient cycling, macrophytes, modeling, heavy metals

CONTEXT

Water quality and –quantity modelling is an important tool for integrated water management. However there is a lack of knowledge considering the role of macrophytes in these models. Models focusing on the role of macrophytes are really restricted to the plant itself. The link of these models and the more general water quality and – quantity models has to be done. The development of such models must thus rely on experiments designed to describe in a quantitative way the growth and decay of macrophytes in response to physical, biological and chemical external factors. Important factors are species composition, patch densities, water flow velocities, nutrient concentrations in the water and sediments, temperature and light. During this project we want to get insight into the above-mentioned factors.

PROJECT DESCRIPTION

Objectives

The general objective of this project is to develop a numerical tool allowing the quantitative description of the growth and decay of macrophytes, and of their interactions with nutrients from the water column and the sediments. For this purpose we will study, in detail, the growth, decay, and nutrient uptake, release and allocation processes of macrophytes in response to their various physical, chemical and biological controlling factors. These include light intensity, temperature, water quality, sediment quality, stream velocities and macrophyte or macro-algae species composition. Experiments will be performed at various spatial and temporal scales in order to develop integrated models describing the kinetics of growth and decomposition of river macrophytes. Once integrated into stream ecosystem models, this might serve as an efficient tool to explore various scenarios of macrophyte biomass controls. For example the effects of biomass removal (mowing) on in-stream nutrient retention can be evaluated, with the possible consequences for the downstream (estuary, coastal zone) ecosystems.

Methodology

As suggested from the result of the first MANUDYN project, the study of macrophyte growth and degradation processes, and of nutrient, light and temperature effects is a difficult task to be performed directly in the field, and this because of the heterogenic and complex interactions between streaming water, sediments and macrophyte patches. Therefore, in order to fulfil our objectives, experiments will be conducted at different scales taking into account an increasing complexity: from the simplest system taking into accounts a single macrophyte specimen to the most complex system considering several macrophyte patches within rivers. In parallel with the experiments, modelling will follow each of the scale steps.

INTERACTION BETWEEN THE VARIOUS PARTNERS

The project is organized into four work packages; the first three work packages consist of experiments at different scales. Considering the division of the project, the expertise of the four partners is integrated in all these three work packages.
Each task or subtask will be headed by one of the partners who will work in close collaboration with the coordinator to organize the preparation of reports.
The modelling aspect will be executed by the UA and Ulg who will work in close collaboration. Both partners have experience with modelling work. Meetings will take place at six monthly intervals to discuss their results whilst, at the same time, the future in terms of the overall project objectives will be considered.
The coordinator will supervise the quality of all performed actions: sampling must be carried out by people with the necessary experience and skills. Analyses should be performed according to the appropriate accreditations or standards. All steps in data or tool generation will be subject to stringent quality control and will be reported in detail. (e.g. nutrient-analysis will be performed according the accreditation standard ISO/IEC 17025)

SSD SCIENCE FOR A SUSTAINABLE DEVELOPMENT

MANUDYN III

Macrophytes and nutrient dynamics: process and field studies in the upper reaches of river bassins

EXPECTED RESULTS AND/OR PRODUCTS

The expected results of small and mid-scale experiments will provide an improved insight in the detailed processes of nutrient uptake in macrophytes where a high number of controlling factors such as light intensity, temperature, nutrient concentrations in the surface water will be tested. Both the increased understanding and the associated modelling will be essential for incorporating the role of macrophyte in the scope of integrated water management.

The better understanding of the detailed uptake and growth processes concerning freshwater macrophytes in the upper catchments and of the link between the catchment and the estuary can greatly improve the water quality management at the basin scale. It will be possible to evaluate the impact of different strategies on macrophyte populations and on the water quality at the interface between the headwaters and the estuarine system.

PARTNERS - ACTIVITIES

Coordinator: University of Antwerp, Ecosystem Management Research Group (ECOBE, Department of Biology)

The ecosystem management research group is involved in fundamental and applied research on ecological processes in watercourses and wetlands, as well as in research at the integrative level of management of ecosystems and river basins. Therefore, our group includes generalists and specialists and cooperates with various other national and international organizations and institutes to achieve its mission statement.

Vrije Universiteit Brussel, laboratory of Analytical and Environmental Chemistry

The research activities at the laboratory of Analytical and Environmental Chemistry, Vrije Universiteit Brussel, belong essentially to the domain of environmental sciences, global change and the impact of contaminated environment on public health status. As concerns environmental research, the focus is mainly on the aquatic systems. The marine and estuarine systems have been a long-standing research topic of ANCH lab. with roots as far back as the early seventies when the North Sea research projects were launched.

Ulg (Arlon Campus, Belgium), Sanitation and Environnement" Unit

The unit performs numerous expertises in the field of water treatment. Its R&D strategy consists in the development of devices and methods for a better knowledge and quantification of the physical and biochemical processes taking place in natural and artificial aquatic ecosystems.

The know-how enables to develop mathematical models that describe those ecosystems and permits to understand and optimize their purification performances.

Department of Spatial Ecology (RE) - Netherlands Institute of Ecology (NIOO) - Centre for Estuarine and Marine Ecology (CEME)

Since its foundation, the department of Spatial Ecology of the NIOO-CEME has put a major emphasis in studying the biophysical interaction between vegetations and hydrodynamics. Studies on the effect of various vegetations on hydrodynamics have been done by field studies (Bouma et al. 2005a, Temmerman et al. 2005a), by flume studies (Bouma et al. 2005b) as well as by applying process-based hydrodynamic models (Temmerman et al. 2005b). Comparative studies have demonstrated that this research group is also capable to relate these biophysical interactions across these different scales (Bouma et al. 2006). Thus, the department of Spatial Ecology offers highly relevant expertise on the biophysical interaction between vegetations and hydrodynamics to the project.

CONTACT INFORMATION

Coordinator

Patrick Meire
Universiteit Antwerpen (UA)
Departement Biologie, ECOBE
Universiteitsplein 1c
B-2610 Wilrijk
Tel:+ 32 (0)3 820 22 74
Fax:+32 (0)3 820 22 71
Patrick.meire@ua.ac.be
www.ua.ac.be/ecobe

Promoters

Frank Dehairs & Natacha Brion
Vrije Universiteit Brussel (VUB)
Pleinlaan 2
B-1050 Brussel
Tel:+32 (0)2 629 27 16
Fax:+32 (0)2 629 32 74
nnbrion@vub.ac.be

Jean-Luc Vasel
Université de Liège,
Place du Vingt Août
B-4000 Liège
Tel:+32-(0)63/230849
Fax:+32-(0)63/230 800
jlvasel@ulg.ac.be

Tjeerd J. Bouma
Netherlands Institute of Ecology (NIOO-KNAW)
Centre for Estuarine and Marine Ecology (CEME)
Korringaweg 7 4401 NT Yerseke The Netherlands
Tel: +31-113-577300
Fax: +31-113-573616
t.bouma@nioo.knaw.nl

Follow-up Committee

For the complete and most up-to-date composition of the Follow-up Committee, please consult our Federal Research Actions Database (FEDRA) by visiting http://www.belspo.be/fedra or http://www.belspo.be/ssd