



## BOOK OF ABSTRACT

- I. SESSION DESCRIPTION
- II. SESSION PROGRAM
- III. ABSTRACTS

### I. SESSION DESCRIPTION

**ID: B3**

Forests for Water: scientific evidence and economic mechanisms for encouraging ecosystem service provision

#### Hosts:

	Title	Name	Organisation
<b>Host:</b>	Dr.	Paola Ovando-Pol	James Hutton Institute, Scotland
<b>Co-host:</b>		Gregory Valatin, David Ellisson, Christoph Wildburger	

#### Abstract:

Targeted woodland creation, as well as the restoration, conservation and management of trees, forest and riparian ecosystems has been attracting considerable interest for their potential in helping to achieve targets for fresh-water quality, water supply and hazard prevention, including flood risk management. As a result, in the past few decades there has been much effort to improve our understanding of the effects of different forest attributes, condition and management on water-related ecosystem services, as well as attempts to develop more comprehensive approaches that cover environmental, land use and climate issues. Yet, significant evidence gaps remain both with respect to quantifying the water-related benefits of forests and how to design mechanisms, such as financial and policy instruments that encourage the provision of ecosystems services. There is much still to learn too about integrating eco-hydrological and socioeconomic processes into forest and water resource management and sustainable development strategies.

Assessment and integration into decision-making of the economic value of forest and water resources to support more sustainable management strategies has been a recurring recommendation of many international forest and water expert meetings. The aim is to improve understanding and quantification of ecosystem services to increase confidence in



the development and application of schemes, to foster effective and equitable collaborative arrangements and partnerships based on sharing costs and benefits between users and providers.

Better knowledge of socio-economic, institutional and environmental interactions involving forests for water can help to meet specific development and economic targets, such as the EU Water Framework Directive (WFD) objective of all water bodies achieving good ecological status by 2027, and/or the 2030 Agenda for Sustainable Development Goals (SDGs) of ensuring availability and sustainable management of water and sanitation. Meeting those development and environmental targets in a cost-effective way will require mainstreaming incentive systems, such as Payment for Ecosystem Services (PES) schemes or broader PES-like mechanisms such as co-investment stewardship, in order to deliver effective and spatially-targeted restoration actions.

This session is promoted by the members of two scientific networks aiming to improve our theoretical and practical understanding of environmental, socio-economic and institutional factors affecting forest and water resource interactions. Those scientific groups are: (i) the Payments for Ecosystem Services (Forests for water): PESFOR-W COST Action, that aims to synthesize knowledge, provide guidance and encourage collaborative research for improving Europe's capacity to use forest-based PES to achieve the EU WFD targets; and (ii) the IUFRO Global Forest Expert Panel (GFEP) on forests and water, whose ultimate goal is to provide an holistic understanding of the interactions between forests and water in order to contribute to the 2030 Agenda for Sustainable Development by connecting SDG 6 on water and SDG 15 on forests, thus illustrating the cross-sectoral contributions of forests to the various SDGs.

In this session we encourage studies from a range of disciplines, including economics and other social sciences, natural sciences and engineering, as well as interdisciplinary studies, that bring together forestry, ecology, hydrology and climatology with policy and economics to provide a more holistic view of the complex interactions between forest and water resources. Both conceptual (methodological) and applied research papers are welcome. We particularly encourage papers that contribute to an improved understanding of the effectiveness of different financial and policy mechanisms in changing land owner and user behaviour to increase the provision of water-related ecosystem services based on quantitative data from experiments and pilot studies. We further seek papers that challenge the theoretical boundaries of forest-water interactions and attempt to address their potential contribution to the goals of landscape optimisation and climate change mitigation and adaptation at regional and continental scales.

### Goals and objectives of the session:

A. Draw lessons from the available empirical evidence on the Environmental Effectiveness, Cost-Effectiveness and Design and Governance of existing mechanisms to encourage the



provision of the water-related benefits of forests, including PES and PES-like schemes in developed and developing regions.

B. Explore the policy, economic, environmental and institutional implications of these lessons for the future development of policy and financial schemes.

C. Sketch guidelines for the institutional-economic design of policy and financial instruments to promote sustainable forest management and more targeted tree planting to enhance the provision of water-related ecosystem services

D. Coordinate a new agenda on water/land and climate, for bringing together science and policy, from cross-cutting policy integration to implementation on the ground, and trigger interest for institutional and donors support

**Planned output / Deliverables:**

A Special Issue on Forests and Water is envisaged

**Related to ESP Working Group/National Network:**

[Biome Working Groups: B3 – Forests & Woodlands](#)

**II. SESSION PROGRAM (B3)**

**Date of session:** Tuesday, 16 October 2018

**Time of session:** 08:45 – 13:00

**Timetable speakers**

Time	First name	Surname	Organization	Title of presentation
08:45–08:55	David	Ellison	Swedish University of Agricultural Sciences, Ellison Consulting	Introduction to the Session, IUFRO Global Assessment Report of the GFEP on Forests and Water
08:55–09:15	Gregory	Valatin	Forest Research	Woodlands for water Payments for Ecosystem Services: an overview of initial findings, activities and ambitions of the PESFOR-W COST Action



Time	First name	Surname	Organization	Title of presentation
09:15–09:30	Eliza	Maher Hasselquist	Department of Forest Ecology and Management, Swedish University of Agricultural Sciences	Analysing the effects of policy change on forest–water protection in Sweden over time
09:30–09:45	Cristian	Accastello	University of Turin; Department of Agriculture, Forest and Food Science (DISAFA)	Assessing the cost–effectiveness of payments to woodland owners for water services
09:45–10:00	David	Ellison	Swedish University of Agricultural Sciences, Ellison Consulting	Integrating Forest–Water Interactions into PES Schemes
10:45–10.15			General discussion	
11:30–11:45	Linnéa	Jägerud	Swedish Forest Agency	Business model for a blue–green market place to reduce risks for urban flooding
11:45–12:00	Attila	Tóth	Slovak University of Agriculture in Nitra	Direct Supports of the Slovak Agricultural Paying Agency as Potential Economic Mechanisms for Encouraging Ecosystem Service Provision
12:00–12:15	Paola	Ovando	The James Hutton Institute	Optimal harvesting decision paths when timber and water have an economic value





Time	First name	Surname	Organization	Title of presentation
12:15–12:30	Claudia	Carvalho–Santos	CIBIO–InBIO – Research Center in Biodiversity and Genetic Resources, University of Porto, Portugal	Forests as promoters of water ecosystem services – insights from Portugal
12:30–12:45	General discussion			

### III. ABSTRACTS

*The abstracts appear in alphabetic order based on the last name of the first author. The first author is the presenting author unless indicated otherwise.*

#### 1. Type of submission: **Abstract**

B. Biome Working Group sessions: B3 Forests for Water scientific evidence and economic mechanisms for encouraging ecosystem service provision

#### **Assessing the cost–effectiveness of payments to woodland owners for water services**

*First author:* Cristian Accastello

*Other author(s):* J. Abildtrup, C. Accastello, M. B. Andreucci, B. Blagojevic, A. Chikalanov, A. El Mokaddem, J. Fiqueron, S. Garcia, M. Gonzalez–Sanchis, C. Giupponi, A. Japelj, L. Keca, D. Little, M. Lyubenova, T. Nisbet, P. Ovando, A. Paletto, C. Petucco, S. Posavec, B. Rugani, M. Termansen, G. Valatin, R. Yousefpour

*Affiliation, Country:* University of Turin; Department of Agriculture, Forest and Food Science (DISAFA), Italy

Payments for ecosystem services (PES) have emerged over the last decades for encouraging practices that are expected to deliver positive environmental externalities. Maintaining and managing forests/woodlands, and planting trees and shrubs are nature–based solutions to enhance watershed services such as filtering water, regulating water stream flows, control erosion and sediments load, and protecting against hazards (e.g., floods, landslides). The evaluation of the environmental and cost effectiveness of PES to achieve relevant sustainable



policy goals has been core in the scientific debate on PES implementation. PES effectiveness can be hampered by diverse environmental, institutional and socio-economic factors and drivers operating at different spatial and temporal scales, as well by the potential synergies and trade-offs in the provision of environmental services, and climatic risks and uncertainties. The proposed contribution provides a critical review of relevant studies and findings dealing with the analysis of the environmental and cost effectiveness of PES, with special attention to payments for water purification services. The review takes stock of the theoretical and applied PES evaluation approaches, and examines how to respond to the specific challenges involved in evaluating the performance of forest-based solutions to enhance water quality. Special attention is given to the estimation of additionality in the provision of water services, and to the spatial and temporal heterogeneity of PES opportunity and implementation costs. After having identified the peculiarities and challenges that affect the cost-effectiveness analysis of forest-based solutions for water services, this study develops a general conceptual framework to evaluate cost-effectiveness of forest for water PES. This framework is illustrated applying a case-study to validate the proposed methodology framework. Finally, the authors discuss the implications and lessons drawn from existing approaches to PES cost-effectiveness analysis and identify future research needs to better improve the basis for implementing efficient and sustainable forest and water resources policies.

**Keywords:** PES assessment, Water quality, Forest for water actions, Nature based Solutions for climate adaptation

2. *Type of submission:* **Abstract**

**B. Biome Working Group sessions:** B3 Forests for Water scientific evidence and economic mechanisms for encouraging ecosystem service provision

### **Forests as promoters of water ecosystem services – insights from Portugal**

*First author:* Claudia Carvalho-Santos

*Other author(s):* Ana Faria Lopes, Ângelo Sil, João Azevedo, João Pedro Nunes, João Pradinho Honrado

*Affiliation, Country:* CIBIO-InBIO – Research Center in Biodiversity and Genetic Resources, University of Porto, Portugal

Forests provide multiple ecosystem services, with relevance for the ones related to water. It is widely accepted that forests greatly influence the water cycle, promoting



evapotranspiration, improving infiltration, reducing surface runoff and consequently soil erosion, although sometimes at expenses of a reduction in total water yield. In fact, forests are targeted for several measures to restore freshwater and land ecosystems, conserving biodiversity and at the same time improving the revenues of landowners, especially if Payments for Ecosystem Services (PES) are in place. However, the environmental effectiveness of these measures is not always acknowledged, especially due to the lack of local studies. Therefore, the objective of this presentation is to gather information based on modelling exercises applied to case-studies in Portugal, in which forests influence the provision of ecosystem services related to water in terms of quantity and quality. First, the results from an econometric model based on spatial variables applied to continental Portugal will be presented. Results suggested the existence of a positive and significant effect of local forest cover on water treatment cost savings of 0.056%. Secondly, scenarios of afforestation were simulated in SWAT (Soil and Water Assessment Tool) for two watersheds of northern Portugal. Results revealed that forests have a positive role on the regulation of water, in particular for the scenario of native deciduous type of trees, such as oak. Moreover, forests influence water quality, in terms of less nitrates in the river, and less soil erosion, when compared to a scenario of agricultural expansion. Lastly, a SWAT application in a small watershed in Central Portugal with scenarios of afforestation vs. fires, showed that soil erosion protection and water quality regulation provided by forests might be negatively affected by fire occurrence. Overall, further work should be done to consider fire risk over PES schemes applied to the Mediterranean forest.

**Keywords:** Forests, Water ecosystem services, Fire, Environmental effectiveness, Modelling

3. *Type of submission:* **Abstract**

**B. Biome Working Group sessions: B3 Forests for Water scientific evidence and economic mechanisms for encouraging ecosystem service provision**

**Analysing the effects of policy change on forest–water protection in Sweden over time**

*First author:* Eliza Maher Hasselquist, Katarina Eckerberg

*Other author(s):* Hjalmar Laudon, Irina Mancheva

*Affiliation, Country:* Department of Forest Ecology and Management, Swedish University of Agricultural Sciences, Department of Political Science, Umeå UniversitySweden, Sweden

To protect and improve forest water has become a pertinent environmental issue to resolve in national policy, spurred not least the EU Water Framework Directive. Little is known,





however, about the effects in forest management practice. Do changes in policy actually lead to increased measures to protect forest water? Historic data in Sweden over the last fifty years enables us to analyse the relationship over time between the introduction of specific policy instruments for forest water protection and the effects on forest management practices. More specifically, we study the development of the sizes of forest clearcuttings, riparian zones, and 'biotope protection areas'. A case study of the Krycklan catchment area in North Sweden is used to illustrate the development in more detail. The policy has changed substantively over time. While state subsidies were provided towards forest drainage back in the 1930s, from the late 1970s and onwards forest legislation has emphasized the need to protect waterlogged areas and riparian zones. The Forestry Act from 1994 now places equal weight to forest production and environmental protection. In parallel, since several decades, education of forest owners and entrepreneurs to incorporate nature protection measures in forest management has taken place. Voluntary forest certification has also grown rapidly, placing increased emphasis on nature protection. We find that the effects of forest policy changes are ambiguous. While the sizes of clearcuttings has remained remarkably constant, the riparian protection zones along streams and the 'biotope protection areas' set aside near streams have increased since the early 1990s and onwards. We conclude that these changes in practice can be attributed the collective influence of the different policy instruments, but that the awareness among forest actors of forest water protection is still in need of substantive improvement.

**Keywords:** forest water, water quality, riparian buffer, policy change, effectiveness

4. *Type of submission:* **Abstract**

B. Biome Working Group sessions: [B3 Forests for Water scientific evidence and economic mechanisms for encouraging ecosystem service provision](#)

### **Integrating Forest–Water Interactions into PES Schemes**

*First author:* David Ellison

*Affiliation, Country:* Swedish University of Agricultural Sciences, Ellison Consulting, Switzerland

Payment for Ecosystem Service (PES) systems are a frequently used tool for encouraging investments in forests for the purposes of the provision of reliable and clean freshwater resources. However, knowledge about forest–water interactions is rapidly changing, rendering it somewhat difficult to keep up-to-date with the science, and thus with relevant





and resilient forest–water strategies. Ellison et al (2017, 2012) highlight, in particular, the lack of attention paid to up– and downwind forest–water interactions. And while up– and downstream forest–water interactions are comparatively well understood, even these interactions are not always carefully followed when it comes to planting new forests and engaging in forest landscape restoration (see e.g. Filoso et al 2017). This paper, therefore, looks at a number of PES schemes in different countries in an attempt to assess their ability to integrate up–to–date science on forest–water interactions. To the best of our knowledge, no current schemes forest–water PES schemes have successfully integrated up– and downwind forest–water interactions, despite their potential for positive adaptation benefits. Most forest–water PES schemes focus solely on up– and downstream forest–water interactions. Even these strategies, however, often fails to adequately understand the current forest–water science. The paper provides recommendations on how to improve forest–water PES schemes in order to better optimize outcomes.

**Keywords:** Forest, Water, PES, MBI

5. *Type of submission:* **Abstract**

**B. Biome Working Group sessions:** [B3 Forests for Water scientific evidence and economic mechanisms for encouraging ecosystem service provision](#)

### **Optimal harvesting decision paths when timber and water have an economic value**

*First author:* Paola Ovando, Matthias Speich

*Affiliation, Country:* The James Hutton Institute, Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), Switzerland;United Kingdom

We develop a modeling framework that combines: (i) an uneven–aged forest growth model, based on growth and mortality predictions of a dynamic forest landscape model, (ii) an optimal control model that determines the path of control and state variables, which in turn are defined by tree harvesting and forest stock, respectively, and (iii) a water yield function that depends on changes in the leaf area index (LAI). This modeling framework is used to forecast the effects of economic–driven harvesting decisions on water yields in the Navisence River catchment (South–Western Swiss Alps) in view of local timber and water benefits. Water benefits are assessed as the environmental price of water given current demands for drinking and irrigation water and hydro–power production, and their corresponding market–based gross margins and production costs. We simulate optimal harvesting decisions given



the initial forest structure at each 200 m x 200 m grid cell, a set of restrictions to harvesting, and specific species survival and growth probabilities, which are in turn affected by changes in LAI and diametric class. We apply this model using different harvesting restriction levels over 20 and 40-years' time horizons, and integrating single and joint timber and water benefits. The restrictions to harvesting allows the simulation of a more timber-oriented forestry, with lower harvesting restrictions, and a more close-to nature management with higher harvesting restrictions, aimed at favoring forest protective functions including water quality regulation. We examine the effect of changes in timber and water values on harvesting decisions, and their impact on water yields at the catchment level. The results suggest that water benefits have a slight influence on harvesting decisions. Nonetheless, when only water is accounted for, optimal harvesting decisions would include all tree species and different diameter classes, as when only timber or timber and water values are jointly considered.

**Keywords:** Forest growth model, optimal-control model, uneven-aged forest management, water yield.

6. *Type of submission: Abstract*

B. Biome Working Group sessions: B3 Forests for Water scientific evidence and economic mechanisms for encouraging ecosystem service provision

### **Direct Supports of the Slovak Agricultural Paying Agency as Potential Economic Mechanisms for Encouraging Ecosystem Service Provision**

*First author:* Attila Tóth

*Affiliation, Country:* Slovak University of Agriculture in Nitra, Slovakia

The Slovak Agricultural Paying Agency provides funding from European Agricultural Fund for Rural Development (EAFRD) to Slovak farmers. Payments from this source consist of seven categories. From the point of view of encouraging ecosystem provision, two categories seem to be especially relevant: 1) Payments for agro-environmental and climate (AEC) measurements, 2) Payments for first afforestation of agricultural land. Both categories can be considered as potential tools for the establishment of woodlands for water quality. Payments for AEC measurements include for instance a) creation of multifunctional field boundaries – so called bio-strips on arable land; and b) protection of water resources in the Protected Water Management Area Žitný ostrov, which is the largest river island in Europe and the



largest source of drinking water in Central Europe. All other payments are more compensation-oriented and meant for farmers cultivating land with specific restrictions or obligations (e.g. cultivating NATURA 2000 areas or biotopes of protected species). This paper provides a review of annual reports of the Slovak Agricultural Paying Agency from the last five years (2013–2017); with the aim to analyse to what extent these payments have been implemented. Protection of water resources, as well as creation of multifunctional field boundaries, have appeared in national reports only since 2015, for the last three years, however they have not been utilised (paid) yet. Payments for first afforestation of agricultural land have appeared in national reports, but they have not been paid for the last four years and even in the period between 2007 and 2015, they have not had a large share in the overall payments. This study shows that although there are potential measurements for establishment of forests or woodland for water quality in Slovakia, none of these have been well utilised and implemented so far.

**Keywords:** agro-environmental measures, direct payments, forests for water, green infrastructure, payments for ecosystem services

7. *Type of submission: Abstract*

B. Biome Working Group sessions: B3 Forests for Water scientific evidence and economic mechanisms for encouraging ecosystem service provision

**Woodlands for water Payments for Ecosystem Services: an overview of initial findings, activities and ambitions of the PESFOR-W COST Action**

*First author:* Gregory Valatin, Thomas Nisbet

*Other author(s):* Zuzana Sarvasova, Lars Högbom, Rik De Vreese, Paula Gatto, Yiyang Cao

*Affiliation, Country:* Forest Research, United Kingdom

Around half of EU river catchments report below standard water quality and diffuse pollution poses long-term chronic risks for over a third of European freshwater bodies. The EU Water Framework Directive (WFD) aims to restore Europe's water bodies to "Good Ecological Status" by 2027, but many Member States are struggling to achieve this. Meeting WFD targets in a cost-effective way will require mainstreaming incentives such as Payment for Ecosystem Services (PES) schemes to deliver effective, spatially-targeted restoration actions. The PESFOR-W COST Action plans to synthesize knowledge on existing PES schemes that encourage use of woodland creation to reduce agricultural diffuse pollution and improve





water quality, to create a spatial repository of case studies, and to provide guidance for development of new schemes. To help underpin development of woodlands for water projects, the Action aims to build ‘look-up’ tables to demonstrate how environmental effectiveness of woodland creation is influenced by key parameters (for example, the width of buffers) and explore the potential for creating a Woodland Water Code along similar lines to the Woodland Carbon Code for the carbon benefits of woodland creation projects in the UK. Ways to better link evidence on the multiple benefits of woodlands and currently disparate PES schemes in pursuing goals of the wider carbon–water policy nexus will also be explored. The Action focuses on water quality improvement in relation to five main categories of pollutants: Nitrates; Phosphates; Pesticides; Fecal Indicator Organisms; and Sediment. An initial review of previous studies on the effectiveness of targeted woodland creation (Pérez Silos, 2017) found, for example, that woodlands buffers reduce nitrate concentrations by over 70% on average in both oceanic and Continental climates, with the strength of effect strongly related to buffer width.

**Keywords:** Payments for Ecosystem Services; woodland creation; water quality; cost-effectiveness; carbon–water policy nexus;