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## **ARANGE Deliverable D6.5**

Compilation of dissemination  
and training material incl.  
DSToolBox

28.09.2015

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ARANGE - Grant no. 289437- Advanced multifunctional forest management in European mountain ranges

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Abstract:

D6.5 summarises the dissemination and training activities of the ARANGE project and demonstrates dissemination means such as the Corporate Design, the ARANGE Leaflet, the ARANGE Fact Sheets, the ARANGE press release, the Public Deliverables, and the Newsletter. It further provides a collection of ARANGE training material and the summary of the ARANGE Decision Support Toolbox.



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# 1 Introduction

With the ambition of “Knowledge-Based Bio-Economy” (KBBE) projects to particularly produce useful knowledge that can be directly used by an array of end-users the ARANGE project initiated stakeholder (SH) related processes in the very beginning of its lifetime. To attain impacts at various levels within European societies multiple target groups have been identified, understanding forest and land owners, forest professionals, policy makers, as well as SMEs amongst the key target users. In principle, two distinct tasks within the responsibility of WP 6 lead provided the basis for disseminating project results to both, stakeholders on the inside as well as at the outside of the ARANGE project.

The deliverable D 6.2 “Stakeholder engagement plan” elaborated on the various scales of stakeholder participation, addressing target audiences from local to international levels, and set the framework for a harmonized stakeholder approach across the seven Case Study Areas (CSAs) of ARANGE. Besides the nomination of a Case Study Responsible (CSR) for each CSA, the formal constitution of Regional Stakeholder Panels (RSPs) as well as the establishment of a Case Study Task Force (CSTF) were central elements of this report. Additionally, guidelines on the identification, selection and mapping of relevant SHs and processes regarding a regular reporting of SH interaction needs and activities were defined for that purpose.

Each of them had to be addressed by various dissemination activities utilizing a set of dissemination materials that were specifically tailored towards their individual needs. A detailed description thereof is available in the report D 6.3 “Dissemination plan”.

## 2 Dissemination material

As a platform for direct exchange numerous events facilitated knowledge transfer, amongst consortium partners as well as between ARANGE project members and external stakeholders. Various activities are still foreseen that target at further dissemination of project findings.

### 2.1 Corporate Design

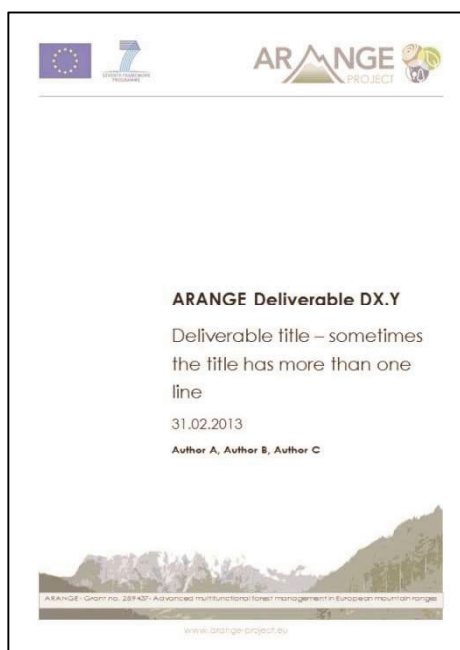
The ARANGE brand built on a Corporate Design logo in order to guarantee the recognition of project related dissemination for the wider public. The logo was applied to the official ARANGE website as well as the Internal Communications Platform and used to develop templates for i) presentations to be used whenever ARANGE results are presented and ii) project deliverables as a standard format for reports to the European Commission. In the following Figures 1-3 all three elements are shown.



**Figure 1: ARANGE Corporate Design logo**



**Figure 2: ARANGE MS Powerpoint template**



**Figure 3: ARANGE Deliverable template**

Any dissemination activity and publication originating from the project displayed the ARANGE logo in association with the European emblem and the logo of the Seventh Framework Programme of the European Union.

## 2.2 ARANGE Leaflet

The production of a generic information leaflet in order to introduce the project to interested parties was one of the first dissemination tasks. In cooperation with an EMAS certified national printing company the ARANGE Leaflet was developed under the premise of green production processes (see Figure 4).



**Consortium**

University of Natural Resources and Life Sciences Vienna (BOKU)

Swiss Federal Institute of Technology Zürich (ETH)

Centre National du Machinisme Agricole, du Génie Rural, des Eaux et des Forêts (CEMAGREF)

Technical University Munich (TUM)

Swedish University of Agricultural Sciences (SLU)

University of Ljubljana, Biotechnical Faculty (UL)

National Forest Centre (NFC)

Forest Research Institute – Sofia (FRI)

National Institute for Agriculture and Food Research and Technology (INIA)

European Forest Institute (EFI)

University Graz (UNIGRAZ)

The Institute of Forest Ecosystem Research (IFER)

Geoexpert Research and Planning GmbH (GEO)

Stichting BirdLife Europe (BLE)

Aranzada Gestión Forestal, S.L.P. (AGF)

RTD Services – Dr Stephen Matthew Webb (RTDS)

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**ARANGE PROJECT** 

Advanced multifunctional forest management in European mountain ranges

A Collaborative Project within the Seventh Framework Programme (Theme KBB.2011.1.2-07)

Funded by the European Commission

[www.arange-project.eu](http://www.arange-project.eu)




Pages 5,6 + 1 (from left to right)



The ARANGE project will evaluate the capacity of current forest management regimes and possible alternative future management to provide portfolios of ecosystem services from mountain forests. The project includes a wide range of forest types in the major European mountain ranges and seeks to develop and evaluate strategies for their multifunctional management under risk and uncertainty due to changing climate and socio-economic conditions.



To analyze conflicts and complementarities among ecosystem services from stand to landscape scale, improved models for the assessment and projection of ecosystem services as well as novel planning and

decision support tools will be developed together with SMEs and applied to regional case studies.

The project addresses four main ecosystem services...



...in seven European mountain regions:

- Iberian mountains
- Western Alps
- Eastern Alps
- Dinaric mountains
- Scandinavian mountains
- Western Carpathians
- Rhodope mountains

The overall aims of ARANGE are:

1. to investigate the potentials and limitations of current and possible future approaches to mountain forest management for providing portfolios of ecosystem services under current and future climatic and socio-economic conditions
2. to identify related risks and uncertainties
3. to translate the scientific state of knowledge about the efficient provision of multiple ecosystem services from mountain forests into decision support for policy makers and forest practitioners, so as to improve the robustness of planning tools in real-world decision making.

The four main pillars of ARANGE include






Pages 2,3 + 4 (from left to right)

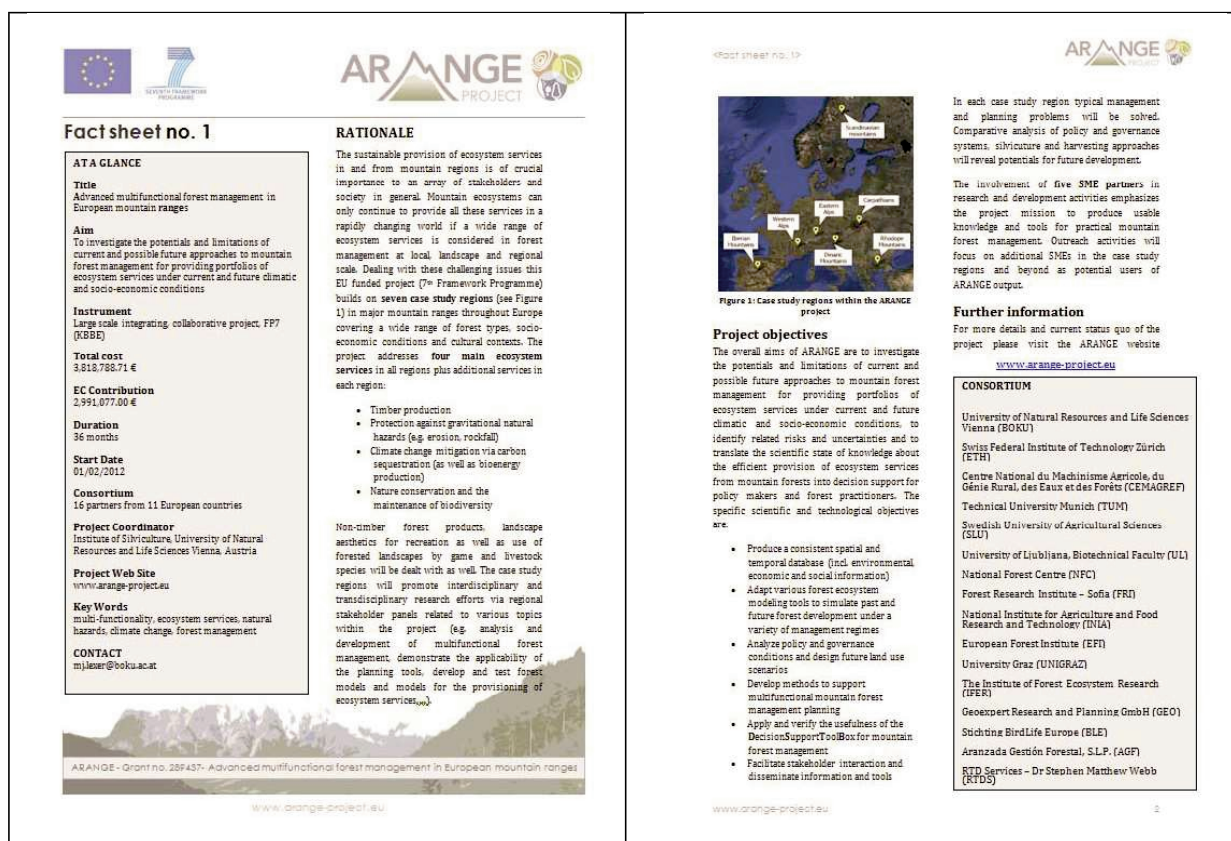
Figure 4: ARANGE Leaflet



In total 2.500 pieces were printed and split across consortium partners in order to provide a handy means of dissemination whenever travelling to or organizing some sort of info event (e.g. stakeholder meeting, scientific conference, project meeting).

## 2.3 ARANGE Fact Sheets

As a means to share project related information with outside parties (e.g. ARANGE stakeholders, scientists, practitioners, land-owners, mountain community members) a standardized format of an ARANGE Fact Sheet was developed by WP 6 lead to be used by partners throughout the project for disseminating condensed information on specific ARANGE topics. The first edition (see Figure 5) was set up as a generic info sheet on key issues of the project and targeted at the effective dissemination of ARANGE in the beginning of its lifetime, particularly amongst members of the Regional Stakeholder Panels (RSP).



**Fact sheet no. 1**

**AT A GLANCE**

**Title**  
Advanced multifunctional forest management in European mountain ranges

**Aim**  
To investigate the potentials and limitations of current and possible future approaches to mountain forest management for providing portfolios of ecosystem services under current and future climatic and socio-economic conditions

**Instrument**  
Large scale integrating, collaborative project, FP7 (RBBE)

**Total cost**  
3.818.788,71 €

**EC Contribution**  
2.991.077,00 €

**Duration**  
36 months

**Start Date**  
01/02/2012

**Consortium**  
16 partners from 11 European countries

**Project Coordinator**  
Institute of Silviculture, University of Natural Resources and Life Sciences Vienna, Austria

**Project Web Site**  
[www.arange-project.eu](http://www.arange-project.eu)

**Key Words**  
multi-functionality, ecosystem services, natural hazards, climate change, forest management

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**RATIONALE**

The sustainable provision of ecosystem services in and from mountain regions is of crucial importance to an array of stakeholders and society in general. Mountain ecosystems can only continue to provide all these services in a rapidly changing world if a wide range of ecosystem services is considered in forest management at local, landscape and regional scale. Dealing with these challenging issues this EU funded project (7<sup>th</sup> Framework Programme) builds on seven case study regions (see Figure 1) in major mountain ranges throughout Europe covering a wide range of forest types, socio-economic conditions and cultural contexts. The project addresses four main ecosystem services in all regions plus additional services in each region:

- Timber production
- Protection against gravitational natural hazards (e.g. erosion, rockfall)
- Climate change mitigation via carbon sequestration (as well as bioenergy production)
- Nature conservation and the maintenance of biodiversity

Non-timber forest products, landscape aesthetics for recreation as well as use of forested landscapes by game and livestock species will be dealt with as well. The case study regions will promote interdisciplinary and transdisciplinary research efforts via regional stakeholder panels related to various topics within the project (e.g. analysis and development of multifunctional forest management, demonstrate the applicability of the planning tools, develop and test forest models and models for the provisioning of ecosystem services<sub>ecos</sub>).

**Figure 1: Case study regions within the ARANGE project**

**Project objectives**

The overall aims of ARANGE are to investigate the potentials and limitations of current and possible future approaches to mountain forest management for providing portfolios of ecosystem services under current and future climatic and socio-economic conditions, to identify related risks and uncertainties and to translate the scientific state of knowledge about the efficient provision of ecosystem services from mountain forests into decision support for policy makers and forest practitioners. The specific scientific and technological objectives are:

- Produce a consistent spatial and temporal database (incl. environmental, economic and social information)
- Adapt various forest ecosystem modeling tools to simulate past and future forest development under a variety of management regimes
- Analyze policy and governance conditions and design future land use scenarios
- Develop methods to support multifunctional mountain forest management planning
- Apply and verify the usefulness of the DecisionSupportToolBox for mountain forest management
- Facilitate stakeholder interaction and disseminate information and tools

In each case study region typical management and planning problems will be solved. Comparative analysis of policy and governance systems, silviculture and harvesting approaches will reveal potentials for future development.

The involvement of five SME partners in research and development activities emphasizes the project mission to produce usable knowledge and tools for practical mountain forest management. Outreach activities will focus on additional SMEs in the case study regions and beyond as potential users of ARANGE output.

**Further information**

For more details and current status quo of the project, please visit the ARANGE website [www.arange-project.eu](http://www.arange-project.eu)

**CONSORTIUM**

University of Natural Resources and Life Sciences Vienna (BOKU)  
Swiss Federal Institute of Technology Zürich (ETH)  
Centre National du Machinisme Agricole, du Génie Rural, des Eaux et des Forêts (CEMAGREF)  
Technical University Munich (TUM)  
Swedish University of Agricultural Sciences (SLU)  
University of Ljubljana, Biotechnical Faculty (UL)  
National Forest Centre (NFC)  
Forest Research Institute - Sofia (FRI)  
National Institute for Agriculture and Food Research and Technology (INIA)  
European Forest Institute (EFI)  
University Graz (UNIGRAZ)  
The Institute of Forest Ecosystem Research (IFER)  
Geoenvironment Research and Planning GmbH (GEO)  
Stichting BirdLife Europe (BLE)  
Aranzada Gestión Forestal, S.L.P. (AGF)  
RTD Services - Dr Stephen Matthew Webb (RTDS)

ARANGE - Grant no. 239437 - Advanced multifunctional forest management in European mountain ranges

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**Figure 5: ARANGE Fact sheet no. 1**

It was translated to all seven national languages covered by the ARANGE project (in the seven CSAs) and circulated by CSRs, inter alia as add-on to the formal welcome letter to RSG members. In addition all country-specific versions were published via the ARANGE website. WP 6 lead used this format again at the final stage of ARANGE in order to elaborate on main project findings and developed regionally explicit Fact Sheets in collaboration with CSRs (see Figure 6).

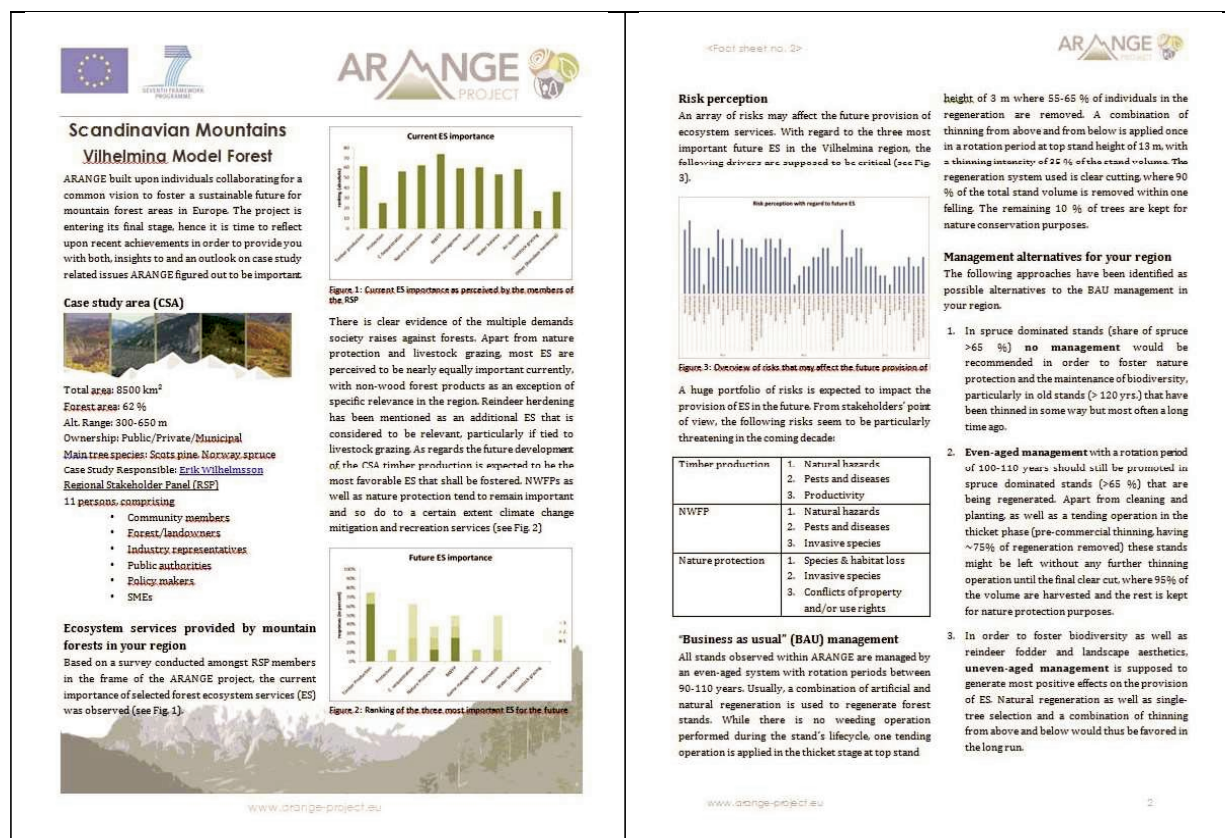


Figure 6: ARANGE Fact sheet no. 2 (example for Scandinavian Mountains)

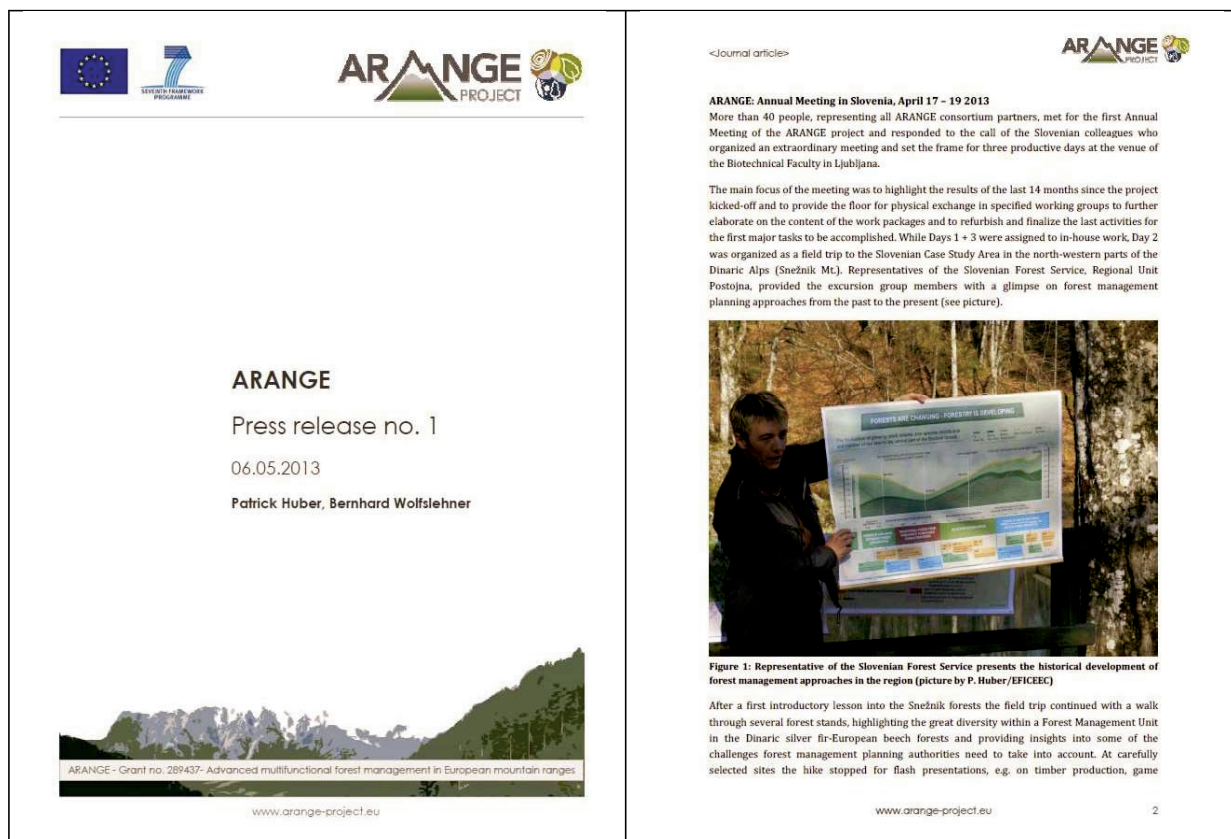
The following topics were addressed for each CSA:

- Case study specifications (i.e. total area, share of forest area, altitudinal range, ownership structure, main tree species)
- Case Study Responsible and Regional Stakeholder Panel information
- Current and future importance of ecosystem services provided by mountain forests in the region
- Risk perception with regard to the future provision of ecosystem services provided by mountain forests in the region
- "Business as usual" management of mountain forests in the region
- Management alternatives for mountain forests in the region

It targeted at a final feedback loop to the RSP members in particular but can be understood as a basis to inform (mountain) forestry professionals in each of the regions. Again CSRs are working on the translation to national languages in order to foster the dissemination in their countries. It is planned to collect the final versions in order to put it on the ARANGE website.

## 2.4 ARANGE press releases

With a particular focus on the Annual Meetings of the ARANGE project three so-called press releases were developed as a basis for broader distribution via selected communication channels (e.g. EFI news, EFICEEC-EFISSEE news) and published via the ARANGE website (see Figure 7).





<Journal article>



management and nature conservation. Packed with new knowledge the excursion continued with a group exercise focusing on potential forest management alternatives for four specific forest stands selected by the hosts, each of them presented and discussed as plenary session in the field.

ARANGE (Advanced multifunctional management of European mountain ranges) is a Collaborative Project within 7<sup>th</sup> Framework Programme and receives funding of the European Commission.

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## ARANGE

### Press release no. 2

03.06.2013

Patrick Huber, Bernhard Wolfslehner



[www.arange-project.eu](http://www.arange-project.eu)

Press release no. 2



#### 2<sup>nd</sup> Annual Meeting of ARANGE in Madrid, May 7 - 9 2013

Around two years after the project kick-off the ARANGE project convened for its 2<sup>nd</sup> Annual Meeting. The event was organized by the colleagues from INIA (Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria, Madrid).

The key objectives of the meeting were to wrap up the past and construct the future pathways of the ARANGE vision to guarantee that project outcomes meet the demands of the Knowledge-Based Bio-Economy (KBBE) to produce information and tools for an array of end-users. Hence, 2 days were assigned to the meeting room to discuss crucial tasks and set up a plan of action for the final months, while one day of excursion was to demonstrate the practical implications of the ARANGE project in the field.

The field trip brought the consortium to the Iberian Case Study Area, the Valsain forests ("Las Matas de Valsain" and "Pinar de Valsain") in the mountain range of the Sierra de Guadarrama. The main aim of the excursion was to gain insights both to the targets and conflicts of forest management in the region, where some of the best Scots Pine forests in Spain are located.

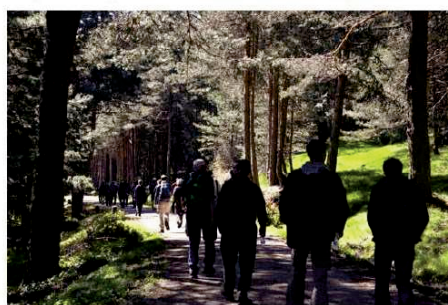


Figure 1: ARANGE field trip - hike through the Valsain forests (picture by M. Maroschek/BOKU)

Javier Donés, the forest manager of the Valsain forests introduced the current management approaches to the ARANGE group and explained, how the Guadarrama National Park was declared. One third of the Valsain forests are included in the "Peripheral Protection Zone" of the national park and are therefore subject to specific legal regulations, and require specific solutions for the long-term provision of multiple ecosystem services.

[www.arange-project.eu](http://www.arange-project.eu)

2

Press release no. 2

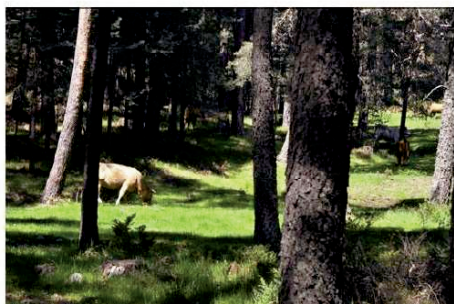


Figure 2: Livestock grazing in the Peripheral Protection Zone of the Guadarrama National Park (picture by M. Maroschek/BOKU)

Several stops at selected sites inside the Case Study Area were used for flash presentations that addressed a diverse range of management issues (e.g. timber production, nature protection, biodiversity conservation, livestock grazing). Moving now to practical work the consortium members were asked to apply the ARANGE concept hands-on and create new management ideas for oak coppice stands in the Valsain forests. Conducted in the National Centre for Environmental Education (CENEAM) it was explored how to further develop coppice management, while taking into account the habitat niches for the Imperial Eagle, water management for downstream drinking water withdrawals, high quality timber production, as well as educational aspects for CENEAM students. Concluding oral presentations in the field by each group supported that knowledge exchange with local experts is mandatory in order to understand regional context and incorporate local knowledge and expertise for future-oriented mountain forest management.

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3

Press release no. 2



Figure 3: Discussion on management alternatives in the oak coppice stands (picture by M. Maroschek/BOKU)

ARANGE (Advanced multifunctional management of European mountain ranges) is a Collaborative Project within 7<sup>th</sup> Framework Programme and receives funding of the European Commission.

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## ARANGE

### Press release no. 3

27.07.2015

Patrick Huber, Bernhard Wolflehner


[www.arange-project.eu](http://www.arange-project.eu)

Press release no. 3



### ARANGE Science Conference and final partner meeting Smokovac, July 7 - 10 2015

Almost 3.5 years have gone and ARANGE entered the very final stage of its project lifetime. A cornerstone event, the ARANGE scientific conference "*Mountain Forest Management in a Changing World*", was planned way beforehand to discuss potentials and limitations of current and possible future management of mountain forest ecosystems as well as related implications for policy and practice. The venue was selected carefully by the Organisers, in a picturesque mountain landscape in the High Tatra Mountains in Slovakia (Smokovac, Hotel Bellevue).



Organized as an open science conference this three-day event brought together 130 registered participants including international researchers, international mountain forestry stakeholders and ARANGE consortium partners. Following the welcome note of local hosts, three invited keynote speakers provided a conceptual framework for the coming days:

- Bernhard Wolflehner: Towards 2020 – The role of mountain forests for the pan-European goals and targets for European forests
- Timo Pukkala: Evaluating and planning for economic, ecological and social benefits from forests
- Peter Brang: Managing mountain forests in a changing climate: focused intensification to meet particular challenges?



The conference continued with four key presentations of the ARANGE project and provided room to share and discuss main findings and results in the plenary before the audience split-up for a set of individual scientific sessions. In total 48 oral and 31 poster presentations provided thought-provoking insights to this multi-faceted topic (see Table below).

[www.arange-project.eu](http://www.arange-project.eu)

2

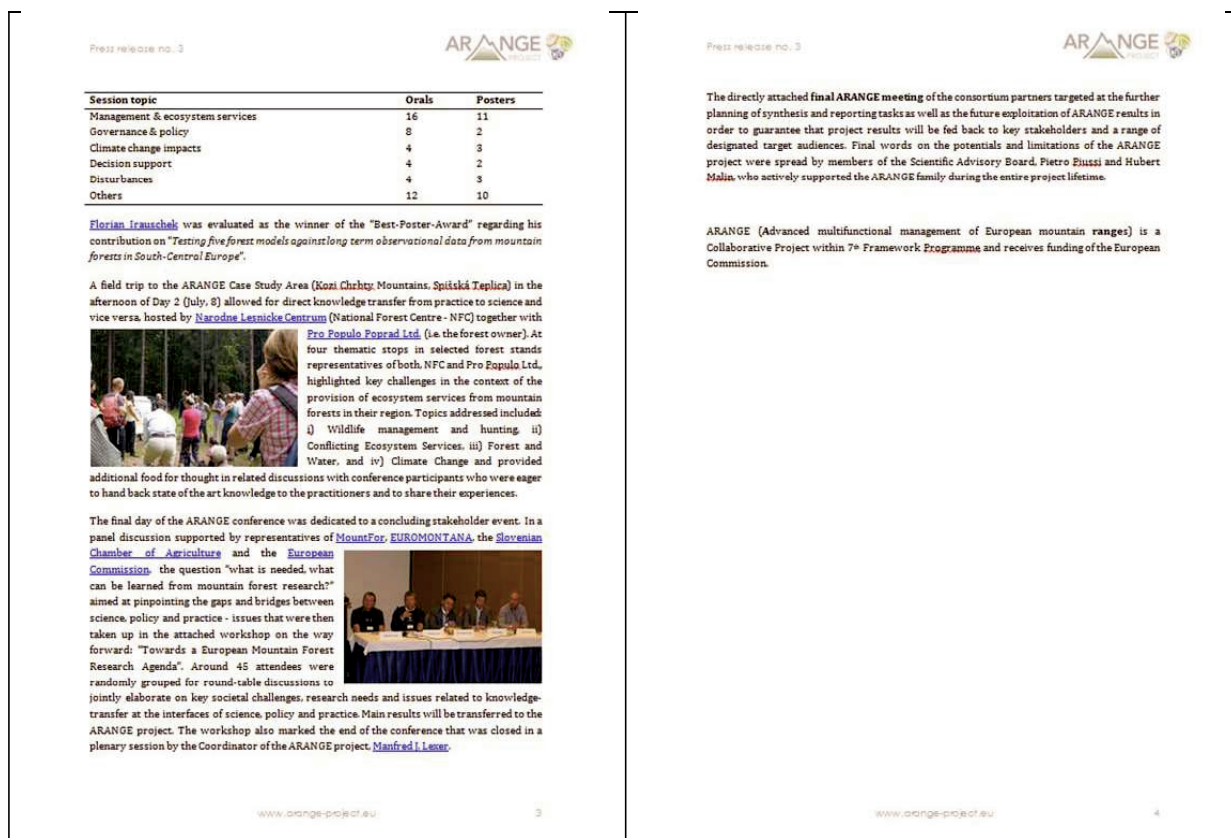


Figure 7: ARANGE press releases no. 1 – 3

In strong cooperation with the Coordinator, WP 6 lead developed an article for "International Innovation", one of the leading global dissemination resources for the wider scientific, technology and research communities. It is the flagship publication of Research Media Agency providing insight and analysis on current scientific research trends, as well as funding and policy issues. Available both digitally and in print, International Innovation is free to access and each edition showcases research from a discrete thematic area or region. The ARANGE article was published in "International Innovation Environment" during August 2013 (see Figure 8).





Figure 8: ARANGE article published in International Innovation (Research Media Ltd., 2013)

As part of the involvement in *International Innovation*, ARANGE had the opportunity to provide a list of partners, collaborators, project officers and stakeholders in the project that received the finished publication:

- a hard copy of the journal upon release (limited to 50 contacts)
- a digital version of the publication (up to 1000 contacts)

Additionally, the Coordinator received 100 hard copies exclusively for general dissemination purposes, most of them distributed to Austrian forestry stakeholders and at selected scientific events (e.g. CI-Forum Vienna, EFICEEC Annual Meeting 2014, StarTree General Assembly Meeting 2014). The electronic version of the article has been placed on the official ARANGE website and is available for download via [http://www.arange-project.eu/wp-content/uploads/ARANGE\\_Brochure\\_final.pdf](http://www.arange-project.eu/wp-content/uploads/ARANGE_Brochure_final.pdf).

## 2.5 Public Deliverables

Within the lifetime of ARANGE a set of Deliverables has been produced in the frame of each Work Package. The following list highlights the reports that were designated to be made available publicly.

Deliverable	Deliverable title	Status
D 1.1	Historic climate data for case studies	Available on ARANGE website
D 1.2	Catalogue of harmonized environmental variables	Available on ARANGE website
D 1.3	Current and historical forest management practices	Available on ARANGE website
D 1.4	Climate change scenarios for case studies	Available on ARANGE website
D 2.1	Improved and tested forest models for case study regions	Available on ARANGE website
D 2.2	Models and linker functions (indicators) for ecosystem services	Available on ARANGE website
D 2.3	Analysis of historic & current forest management practices, forest dynamics and related ES	submitted
D 3.1	Report on the policy framework as related to multifunctional mountain forest management	Available on ARANGE website
D 3.2	Future scenarios of mountain forest landuse in the case study regions	Available on ARANGE website
D 3.3	SCI paper on governance systems	Article published in "Lesn. Cas. For. J. 60 (2014) 159-167"
D 4.1	Manuscript on improved data acquisition for multifunctional mountain forest	submitted
D 4.2	Manuscript on multi-criteria decision aid in selecting mountain forest	submitted
D 4.5	Improved DSToolBox version 1.0 for multifunctional forest management	submitted
D 5.1	Manuscript on interaction affects and trade-offs among different ecosystem services	submitted
D 5.2	Recommendations for multifunctional forest management strategies	submitted
D 5.3	Policy frameworks to secure the multifunctionality of mountain forests	submitted
D 5.4	Documentation of DSToolBox application in selected	submitted

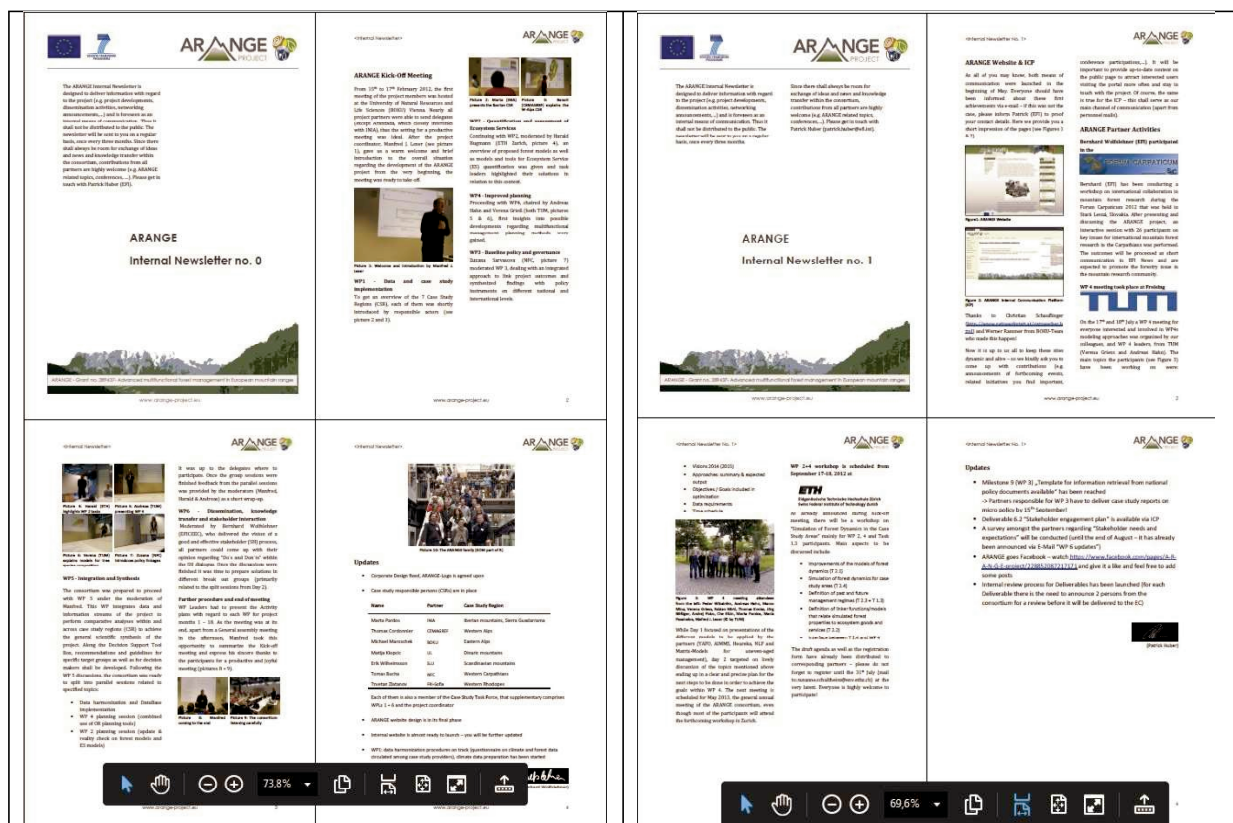


	case study regions	
D 6.1	ARANGE public website	Online
D 6.5	Compilation of dissemination and training material incl. DSToolBox	submitted

Most of the public deliverables have already been approved by the European Commission and could thus be published via the official ARANGE website. Outstanding reports, which are currently under review, will be published as soon as they have been accepted.

## 2.6 Internal Newsletter

The ARANGE Internal Newsletter was designed to deliver information with regard to the project (e.g. project developments, dissemination activities, networking announcements,...) and was established as an internal means of communication. Thus it was not meant to be distributed to the public. The newsletter series (see Figure 9) has been initiated directly after the Kick-Off Meeting of ARANGE in Vienna (February 15-17, 2017) and was prepared in strong collaboration with the Coordinator.



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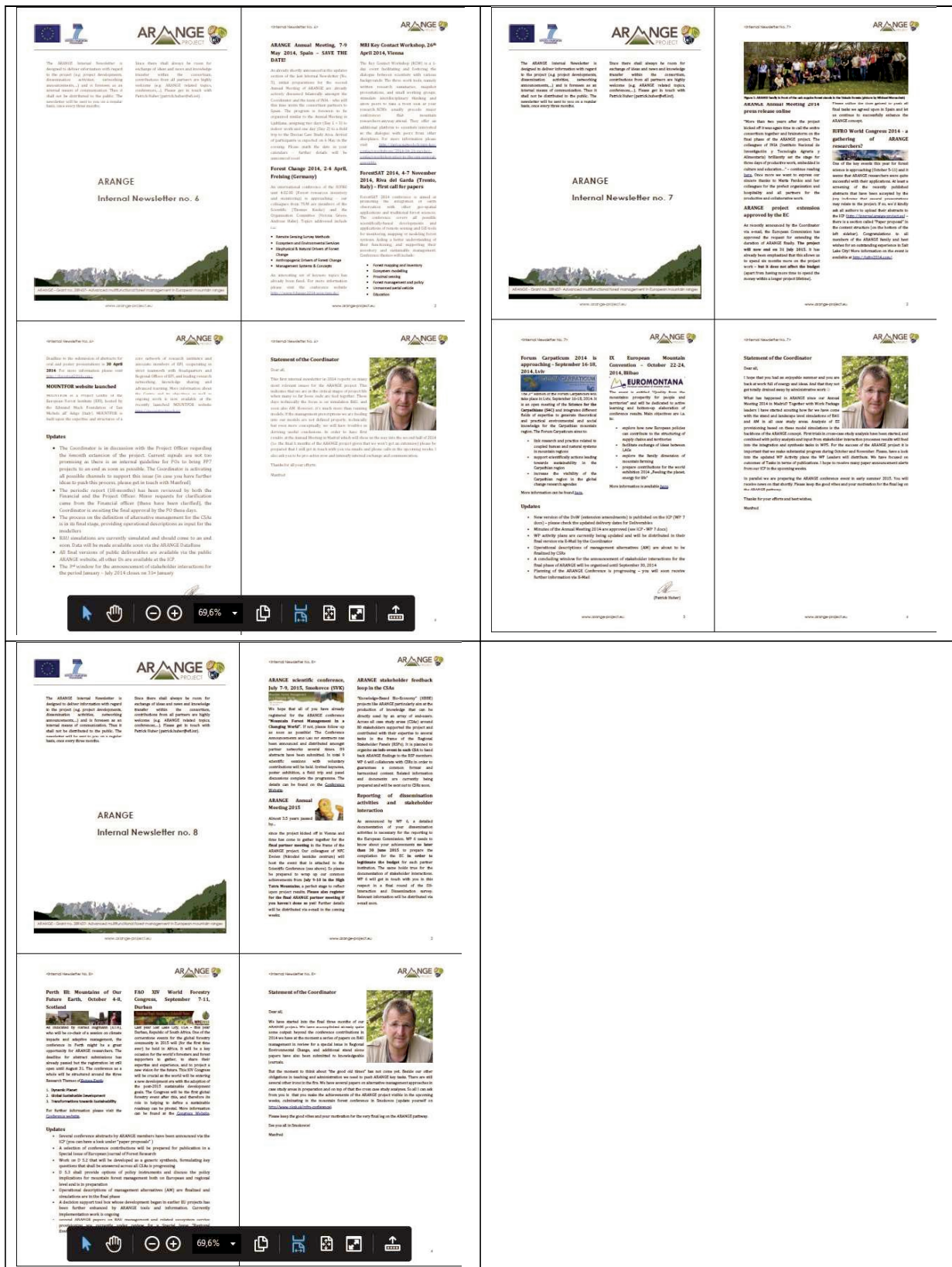


Figure 9: ARANGE Internal Newsletter (no. 0 - 8)

The main objective of this regular communication channel was the exchange of ideas and news as well as knowledge transfer within the consortium, thus it was open to partner contributions.




## 3 Training material

With the objective to raise awareness and understanding of scientific findings, an array of actions aims at the distribution of project results across various levels of European society. In ARANGE a set of target group specific activities have been conducted and will be further

### 3.1 ARANGE generic project presentation


A generic presentation was set up to be used and modified for further outreach by consortium members (see Figure 10). The actual presentations given by the ARANGE consortium are referenced in deliverable D6.4.



**ARANGE**  
Advanced multifunctional forest management in European mountain ranges


Name of speaker/s

23.07.2015



**Technical data**

- **Total Cost:** 3,818,788.71 €
- **EC Contribution:** 2,991,077.00 €
- **Duration:** 36 months
- **Start Date:** 01/02/2012
- **Coordinator:** Manfred J. Lexer/ BOKU Vienna

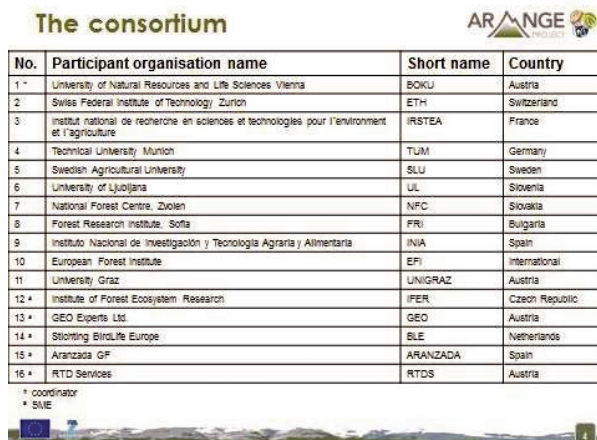


**The consortium**

16 partners from 11 countries

1 international partner

4 SMEs



**The consortium**

No.	Participant organisation name	Short name	Country
1 *	University of Natural Resources and Life Sciences Vienna	BOKU	Austria
2	Swiss Federal Institute of Technology Zurich	ETH	Switzerland
3	Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture	IRSTEA	France
4	Technical University Munich	TUM	Germany
5	Swedish Agricultural University	SLU	Sweden
6	University of Ljubljana	UL	Slovenia
7	National Forest Centre, Zvolen	NFC	Slovakia
8	Forest Research Institute, Sofia	FRI	Bulgaria
9	Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria	INIA	Spain
10	European Forest Institute	EFI	International
11	University Graz	UNIGRAZ	Austria
12 *	Institute of Forest Ecosystem Research	IFER	Czech Republic
13 *	GEO Experts Ltd.	GEO	Austria
14 *	Stichting BirdLife Europe	BLE	Netherlands
15 *	Aranzada GF	ARANZADA	Spain
16 *	RTD Services	RTDS	Austria


\* coordinator  
\* SME

### main ideas & vision

- to investigate the **potentials and limitations** of current and possible future approaches to mountain forest management **for providing portfolios of ES** under current and future climatic and socio-economic conditions **at stand and landscape scale**;
- to identify related **risks and uncertainties**;
- to translate the scientific state of knowledge about the efficient provision of multiple ES from mountain forests into **decision support for policy makers and forest practitioners**, so as to improve the robustness of planning tools in real-world decision making.

### Concept & pillars (i)

- The four main pillars of the concept underlying ARANGE are
  - (1) 7 regional case studies



### Concept & pillars (i)


- The four main pillars of the concept underlying ARANGE are
  - (1) 7 regional case studies
  - (2) strong stakeholder involvement,
  - (3) state-of-the-art models and tools to predict forest conditions and assess ecosystem services
  - (4) novel planning and decision support tools.

the 7 case study regions

- represent the diversity of ecological & socio-economic conditions in European mountain ranges
- provide the frame for comparative analysis (management, XES, policy framework & governance, ...)
- demonstrate case study specific problems and solutions


### CSR Rhodope Mountains, Bulgaria

Forest Enterprise of Shiroka Laka  
Area of case study: total 9300 ha; forested land 9000 ha





- 700 – 2000 m
- Acidophilous *Picea* forests (*Vaccinio-Picetea*) – 60%
- Scots pine forests – 20%
- Sub-Mediterranean pine forest with endemic black pines – 10%
- Silver fir forests – <5%
- Beech forests (*Luzulo-Fagetum* & *Asperulo-Fagetum*) – <5%

### CSR Montafon, Austria



- altitude: 595 – 1900 m asl
- mean annual T: 8 – 1 °C
- mean annual P: 1300 – 1500 mm
- limestone – crystalline bedrock
- Species composition:
  - Picea abies* 96%
  - Abies alba* 3%
  - Fagus sylvatica*, *Pinus sylvestris*, *Larix decidua*, *Acer pseudoplatanus*, ... 1%
- mean annual increment: 5.9 m<sup>3</sup>/ha
- average annual cut: 18,000 m<sup>3</sup>

### CSR Sierra Guadarama, Spain

	MONTES DE VALSAIN	CABEZA DE HIERRO
ALTITUDINAL RANGE	1200-2265 m	1260-2000 m
TOTAL AREA (Km <sup>2</sup> )	100	20
OWNERSHIP	PUBLIC	PRIVATE
FOREST TYPES	Natural managed Scots pine stands <1400 m: Scots pine + Pyrenean oak >1800m: alpine shrubs	
SYLVICULTURE	Shelterwood system Group system	Shelterwood system Uneven-aged silviculture



### CSR Vercors, France

**VERCORS MASSIF**

- Forest : 16000ha
- 2/3 public
- Dominant species: Silver fir, Norway spruce, European beech
- Management : Uneven-aged forests

2009 291km<sup>2</sup>

Legend: Broadleaves - closed, Broadleaves - open, Conifers - closed, Conifers - open, Wood - closed, Wood - open, Transition areas, Open areas, Villages, Water, Dark soils

### CSR Carpathians, Slovakia

- Area 3000 ha
- Norway spruce 77% silver fir, larch, pine
- Broadleaves ~ 9%
- Ownership: church

### CSR Dinaric Mountains, Slovenia

total area: 5051 ha  
forest area: 4922 ha  
forest cover: 97.4 %

main forest type: Illyrian montane beech forests (montane silver fir-European beech forests)

forest types with minor importance: Illyrian submontane beech forests, montane spruce-silver fir forests, nemoral spruce forests, dwarf pine forests

### CSR Vilhelmina, Sweden

Area: 880.000 hectares  
530.000 ha forest land (FAO def.)  
350.000 ha productive forest land (>1 m<sup>3</sup>/ha.yr)

Land use: Forest management 40 %, Protected forest area 21 %, Non-forested area 38 %

### Concept & pillars (ii)

- The project addresses **four main ecosystem services** across all case study regions
  - (1) timber production,
  - (2) protection against gravitational natural hazards,
  - (3) the role of forests in climate change mitigation (carbon sequestration, bioenergy production),
  - (4) nature conservation and the maintenance of biodiversity.
- **Non-timber forest products**, landscape aesthetics for **recreation** as well as use of forested landscapes by **game and livestock species** will be dealt with as well.
- Major parts of analysis will employ **state-of-the-art models** of forest dynamics at stand and landscape scales and gravitational hazards, combined with **historical data**
- The development focus of the project will be on **planning and decision support tools** and approaches.

### Project structure

WP3 Policy and governance, WP4 Improved planning, WP2 Quantification of ES, WP1 Data & case study implementation, WP6 Stakeholder interaction & dissemination, WP7 Project coordination & management, WP5 Integration & Synthesis

### Multifunctionality...

protection, timber, climate mitigation, hunting, biodiversity, water resources, recreation

### ARANGE concept & pillars visual

management, climate, stand, provision of ecosystem services, models & tools (e.g. rockfall), linker functions, directly from forest models, landscape, landscape model



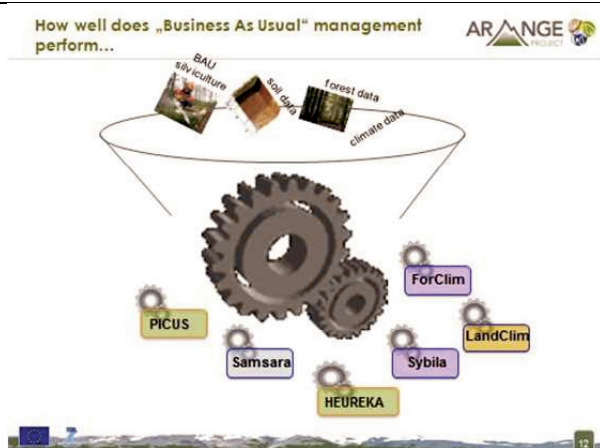
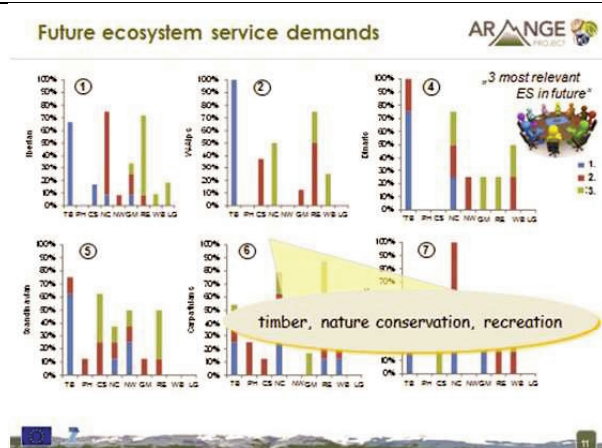
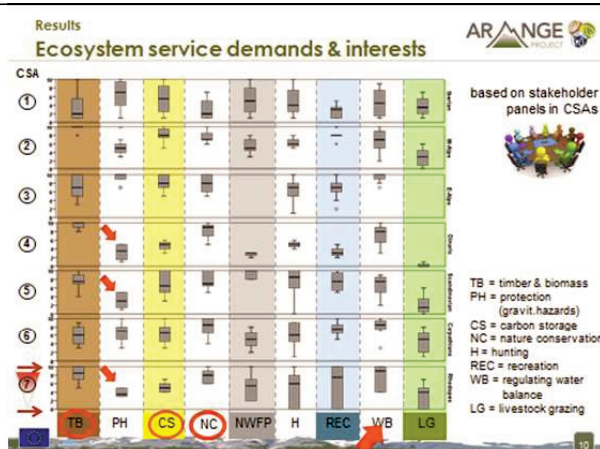
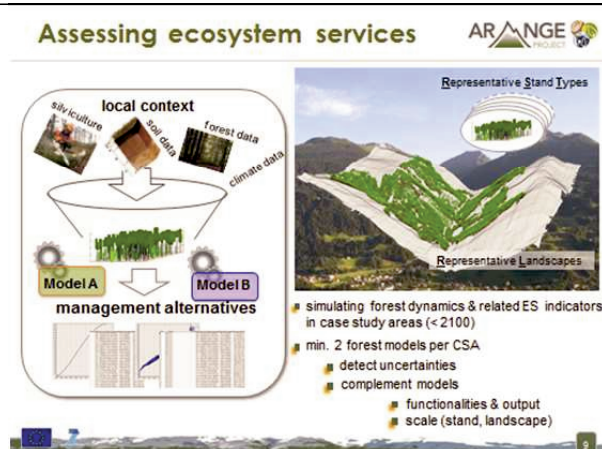
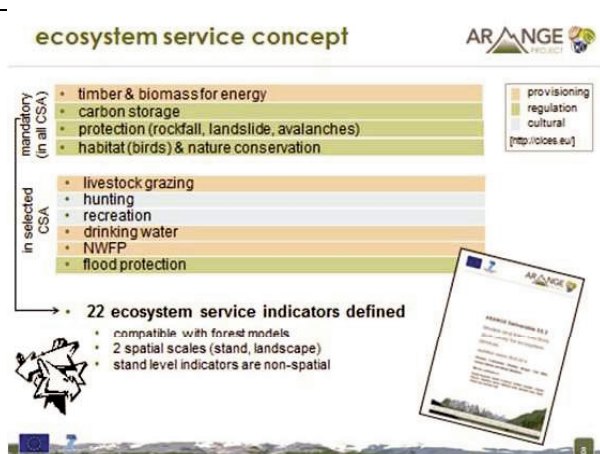
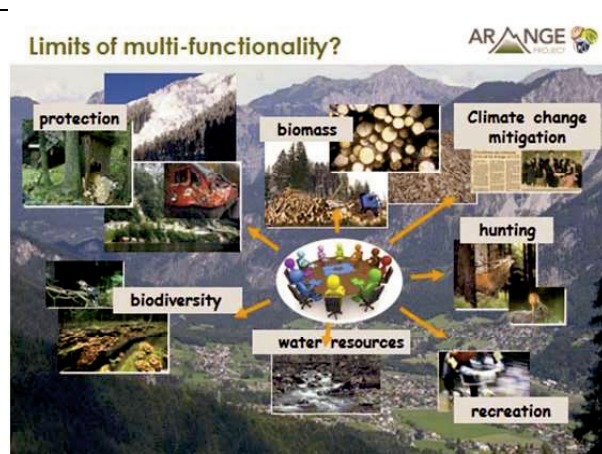


Figure 10: ARANGE generic project presentation

Manfred J. Lexer et al. (2014)- CURRENT AND FUTURE PROVISION OF ECOSYSTEM SERVICES IN EUROPEAN MOUNTAIN FORESTS (IUFRO World Congress Salt Lake City)

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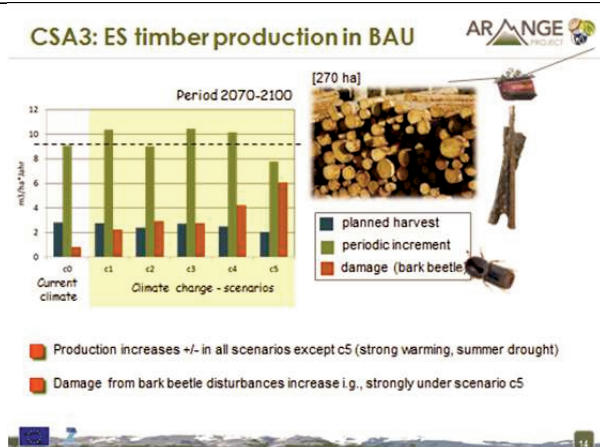




### Results „Business As Usual“ management

	BAU management regime	current ES provision	climate change impact on ES
1	EAHF [group shelterwood] coppice [Qu. pyrenaica] [marginal sites]	TP Pinus sylv. Quercus pyr. NC & PH	TP & CS
2	UAHF [single tree selection] [10-15 year intervals]	TP reduce target DBH PH & NC	TP & CS PH & NC
3	UAHF [group selection] [20-30 year intervals]	TP & CS & PH NC (browsing)	TP & CS & PH NC
4	EAHF [irregular shelterwood] UAHF [group selection] [10 year intervals]	TP & NC Abies alba Fagus sylvatica	TP & CS
5	EAHF [clear out & plant] [in transition from UAHF]	TP & CS NC	TP & CS
6	EAHF [small clear cuts & plant] [stripwise shelterwood]	TP NC (but: bark beetles)	TP & CS
7	EAHF [shelterwood (patches)] UAHF [marginal sites]	TP & CS & PH NC	TP & CS PH

EAHF = even-aged high forest UAHF = uneven-aged high forest



### CSA3: Protection against landslide & erosion (linear scaling)

Protective effect

- low
- moderate
- high

Current climate c1 c2 c3 c4 c5

2013 2100

Protective effect improves (i) „greening“ of unstocked areas (ii) faster regeneration processes

Under strong warming / dry summer (c2, c4, c5) increasing bark beetle disturbances turn the net effect into negative

### summary & outlook

- demanded regional ES portfolios include conflicting objectives
- the conflicting ES demands will intensify:
  - timber & nature conservation (intensification vs extensification),
  - timber & protection particularly in small scale ownership structures (uncoordinated management)
  - constraints on harvesting techniques limit „fine-grained“ silviculture as means for climate change adaptation
- this indicates the need for „segregative“ approaches
  - ES portfolios with no/ low conflict potential
- setting aside of larger areas in coniferous mountain forests may be no option (intensifying disturbance regimes jeopardize key ES)

### ARANGE Scientific Conference

#### „Mountain Forest Management in Europe“

7-9 July 2015

SPA Navy Smokovec, Tatra Mountains, Slovakia

First Announcement will follow soon!

### thank you!

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E-mail: [mj.lexer@boku.ac.at](mailto:mj.lexer@boku.ac.at)  
web: <http://www.arange-project.eu>

Advanced multifunctional forest management in European mountain ranges 27.09.2015



Thomas Cordonnier et al. (2015) - ANALYZING ECOSYSTEM SERVICES WITH FOREST DYNAMICS MODELS: ADVANCES, PITFALLS AND PERSPECTIVES (ARANGE Final conference)

## Analysing ecosystem services with forest dynamics models

### Advances, pitfalls and perspectives

Cordonnier T., Courbaud B., Lafond V., Mao Z., Elkin C. and M. Lexer  
IRSTEA, ETHZ, BOKU, UNBC

28.09.2015

Advanced multifunctional forest management in European mountain ranges

## The Arange framework

Case study area 1      Case study area 7

analysis 1      analysis 7

cross case study analyses

Wood production, carbon storage, biodiversity conservation, protection against gravitational hazards

## From models to ecosystem services

STANDS

- Management module
- height/diameter/spatial distributions of tree species
- wood extraction
- stand structure
- indicators of ecosystem services delivery

LANDSCAPES

- LANDCLIM
- HEUREKA
- indicators of ecosystem services delivery

LINKER FUNCTIONS

- Growth, mortality, regeneration (competition, disturbance)
- deadwood

## Three main issues

- Does the model reproduce well the effect of management on stand structure and dynamics?
  - Performances of the different models?
  - One model everywhere or specific models for each case study area?
- How to define relevant indicators and associated linker functions?
  - Developing specific tools or using current features of the models?
  - A common set or specific indicators for each case study area?
- How to analyse the relationships between climate change, management and ecosystem services?
  - How to quantify ES vulnerability to climate change?
  - How to illuminate trade-offs and synergies?

## Which model, where and how?

- Each partner uses his model (if available) on his case study area.
- Some models are adapted to and applied in several case study areas
  - PICUS
  - FORCLIM
- Comparisons of model outputs on one case study area based on historical data of stand structure and management.
- All models use a common set of linker functions/indicators to assess ecosystem services for BAUM and AM.
- Each partner can use specific linker functions/indicators.

## Adapting models to case study areas

### Adapting PICUS for the sub-mediterranean domain

PICUS v1.5

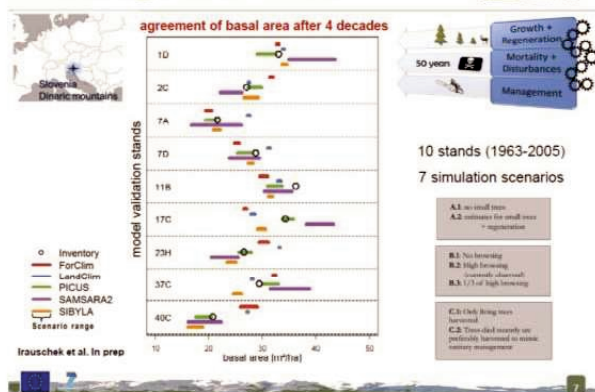
one-layer bucket soil model  
No vertical water flow

PICUS v1.6

multi-layer soil model  
vertical water flow (saturated, unsaturated)  
More details in water balance (interception, evaporation from soil surface, ...)



## Confronting models with data



## Defining a common set of indicators

- Known to be related to the ES considered.
- Measurable and comparable.
- Universal so to include all ARANGE project's case study areas.
- Consistent with the ARANGE project's data.
- Applicable for models and tools of ARANGE.
- Based on basic calibrated model outputs.

Finding the lowest common denominator between model outputs !



## Biodiversity conservation

Name	Formula / description	Landscape
Tree species diversity	$D = \exp\left(-\sum_{i=1}^S p_i \ln p_i\right)$ with $p_i = \frac{E_i}{G}$	$\alpha, \beta, \gamma$ diversities
Tree size diversity	$H_{DBH} = \frac{H_{DBH} + H_{DBH}}{2}$ $H_{DBH} = -\sum_{i=1}^S \frac{E_i}{G} \ln \left(\frac{E_i}{G}\right)$ $H_{DBH} = -\sum_{i=1}^S \frac{E_i}{G} \ln \left(\frac{E_i}{G}\right)$	$\alpha, \beta$ and entropies
Volume of dead wood	standing dead trees with DBH $\geq 5$ cm and lying dead wood originating from trees with DBH $\geq 5$ cm	• 10%, 50% and 90% weighted percentiles • % landscape area with dead wood volume $> X m^3$ By default $X=30 m^3$
Abundance of large standing dead trees	$LSDTN = \sum_{i=1}^S k_i$ $k_i = 1$ if $DBH_i \geq D_{LSDT}$ $k_i = 0$ if $DBH_i < D_{LSDT}$	• 10%, 50% and 90% weighted percentiles • % landscape area with abundance of large dead living trees $> X$ By default $X=2$
Abundance of large living trees	$LLTN = \sum_{i=1}^S k_i$ $k_i = 1$ if $DBH_i \geq D_{LLT}$ or $DBH_i \geq D_{LLT}$ $k_i = 0$ if $DBH_i < D_{LLT}$ or $DBH_i < D_{LLT}$	• 10%, 50% and 90% weighted percentiles • % landscape area with abundance of large dead living trees $> X$ By default $D_{LLT}=50$ cm and $D_{LSDT}=70$ cm

Cordonnier et al. 2014. Deliverable 2.2

## Protection against rockfalls

Forest stand			Topography			Rock		
Name	Abbreviation	Units	Name	Abbreviation	Units	Name	Abbreviation	Units
Stand density	$N$	Stems/ha	Slope value	slope*	degree	Diameter of the rock	$\Phi_{\text{ref}}$	m
Average diameter at breast height	$DBH$	cm				Rock density	$\rho$	kg/m <sup>3</sup>
Percentage of evergreen species	EvG	%				Initial tree fall height	$F_0$	m
Percentage of deciduous species	DecD	%						

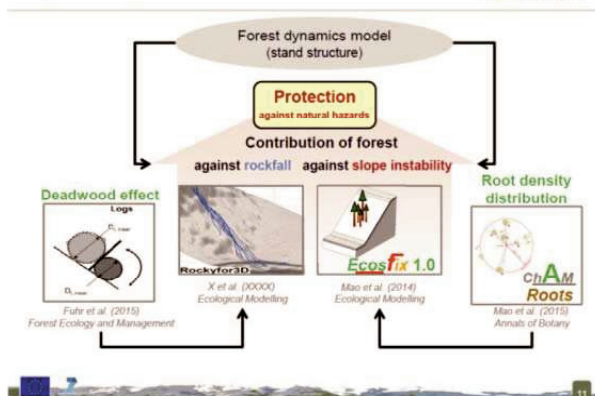
If  $G_{\text{stand}} \geq 10 m^3/ha$

$$d = \frac{3.352 \times 10^{-4} \times \left(0.5 \times p + p \times \left(\Phi_{\text{ref}}^{-0.5} \times \left[2 \times 0.81 \times \left(\frac{270}{\cos(\text{slope}^*)} \times \ln(\cos(\text{slope}^*) - 0.6)\right) \times 0.64 \times \text{slope}^* \right] + 0.25 \times p \times \left(\Phi_{\text{ref}}^{-0.5} \times p\right)\right)}{1}$$

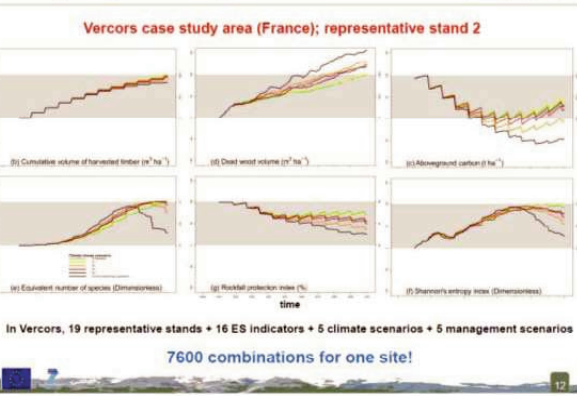
$RPI = 1 - \max(0, 1-d)$

Cordonnier et al. 2014. Deliverable 2.2

## Beyond simple structural-based indicators?



## Analysing ES: a nightmare?



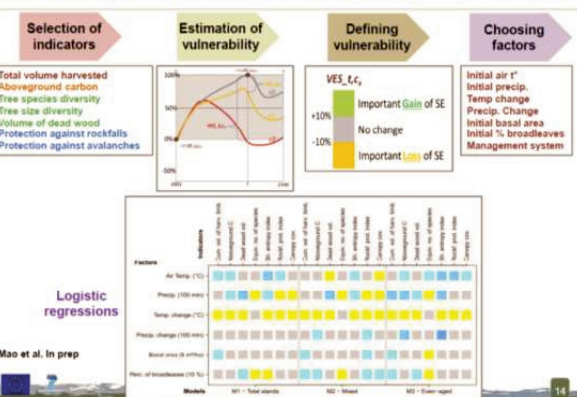
In Vercors, 19 representative stands + 16 ES indicators + 5 climate scenarios + 5 management scenarios

7600 combinations for one site!

## Reducing the dimensionality of the analysis

- Correlation analysis of ES indicators.
- Working on a limited set of interpretable independent variables.
- Working on a subset of case study areas (common features).
- Using optimisation procedures.

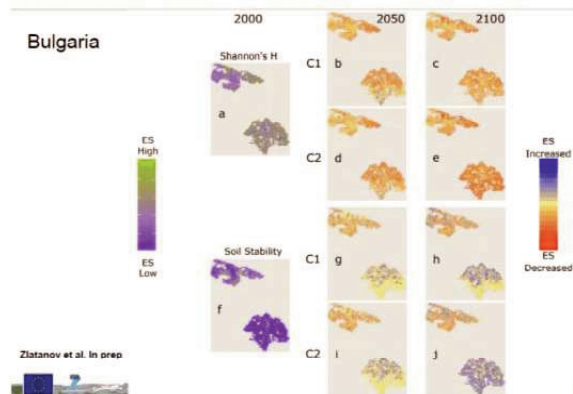
## e.g. logistic/multinomial regressions



## Analysing landscape results



### Bulgaria



Zlatanov et al. In prep



## Conclusions



- High interest of comparing model outputs in the same case study area
  - How to control the "model effect" in cross-case study analyses?
- Defining a common set of ES indicators / linker functions is feasible
  - Can lead to target simple structural-based indicators.
- Several options exist to analyse ES relationships
  - Cross-case study analyses are complex and results are difficult to synthesize

## Perspectives

- Promoting model comparisons and uncertainty analyses for cross-case study analyses.
- Promoting long-term data acquisition of management actions and stand dynamics.
- Developing process-based modules in forest dynamics models to improve linker functions.
- Promoting model coupling to improve ES assessment.



# Thomas Knoke (2015) - APPROACHES TO CONSIDER MULTIPLE ECOSYSTEM FUNCTIONS AND BENEFITS IN LANDSCAPE OPTIMIZATION (ARANGE Final conference)

**Approaches to consider multiple ecosystem functions and benefits in landscape optimization**

Thomas Knoke TUM Institute of Forest Management - [www.forst.wzw.tum.de/ifm](http://www.forst.wzw.tum.de/ifm)

Advanced multifunctional forest management in European mountain ranges 27.09.2015

**Questions and structure**

- (1) Which approaches exist for multiple service analysis/ optimization?
- (2) How can they be applied to "optimize" landscape level management in mountainous areas?

**Constituents of well-being**

Millennium Ecosystem Assessment, 2005, Washington, DC, Island Press, with alterations

1. Background: People don't live from food alone
2. Approaches: A schematic flow chart of actions
3. Constrained economic optimization: ARANGE example
4. Multiple service optimization: Restoration plans for abandoned pasture grounds in the Ecuadorian Andes
5. Conclusions

-2-

**People don't live from food alone**

"Until recently mankind has more or less taken for granted the gas-exchange, water-purification, nutrient-cycling, and other protective functions ... Now, of course, it is painfully evident that such balances are being affected, often detrimentally."

Odum (1969) *Science* **164**: 262-270.

Eugene P. Odum suggested a **Compartment Model**: A mixture of different types of ecosystems at landscape scale, including undisturbed areas.

**How much should we have of a specific ecosystem?**

Haber (1990) *Physiol Ecol Japan* **27**: 131-146  
Knoke et al. (2012) *Forst Ecol Environ* **10**: 438-445

-3-

**Schematic to integrate service optimization into decision making**

Britta Uhde

Uhde et al. (2015) *Environmental Management*  
DOI 10.1007/s00267-015-0503-3

1. Optimization approach (one main objective)
2. Multiple service optimization

Fig. 1 Schematic example for an application of a hybrid method in a planning process

-4-

**Schematic of the ARANGE optimization approach**

Fabian Härtl

Verena Grieb (now Professor at UBC)

Andreas Hahn

-5-

**Impact of climate and protective function on economic return**

The **protective function** requires minimum crown cover rate of 50% (Frehner et al. 2005). Assuming an average age of 80 years, in a fully regulated forest, 250 m<sup>3</sup>/ha may be assumed to fulfil that requirement.

Montafon CSA				
	Net Present Value		Annuity	
	[EUR/ha]	STD	[EUR/(ha*a)]	STD
BL	-731	540	-15	11
BL VolMin 250	-1.008	504	-21	11
A1	1.127	661	24	14
A1 VolMin 250	467	580	10	12

Slovakian CSA				
	Net Present Value		Annuity	
	[EUR/ha]	STD	[EUR/(ha*y)]	STD
BL	18.117	931	359	18
BL VolMin 250	15.864	888	314	18
A1B	17.658	969	350	19
A1B VolMin 250	14.823	883	294	18

Frehner et al. (2005) Bundesamt für Umwelt, Bern.

-6-

## 7.

## 8

## 9

## -10

## 11

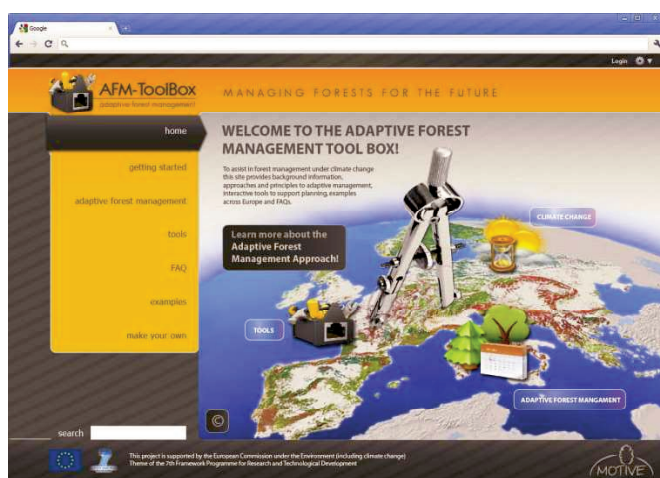
Millennium Ecosystem Assessment, 2005.



### 3.3 Decision Support Tool Box

The ARANGE decision support toolbox was implemented as a prototype in the course of project. It contains:

- A ToolBox website
- A Vulnerability assessment tool
- A Mixed integer programming tool
- A Landscape scale assessment tool
- A Data import/export tools
- A Data viewer tool



**Figure 11: ARANGE AFM Toolbox start screen**

The tools of the AFM ToolBox aim at providing decision support for selected topics in the context of mountain forest management. The prototype of the ToolBox both new and old tools, i.e., tools that were developed within the frame of the ARANGE context, and tools that were developed in earlier projects and have been adapted to meet the demands of the ARANGE project.

The adapted legacy tools are (1) the “Vulnerability Assessment Tool”, which facilitates multi-criteria techniques to assess climate change impacts of different forest management scenarios on the provisioning of ecosystem services, and (2) the “Optimized Management Plan” tool. The latter tool provides an optimization algorithm to establish an “optimal” management plan for a landscape given a user-defined objective function. Both tools are pure online tools and run in a web-browser.

The newly created tool is LAT, the Landscape scale Assessment Tool. The tool combines a technique for creating realistic single tree initializations based on remote sensing data with functionalities for the assessment of landscape level indicators. The latter can be fed by ARANGE data (i.e., stand level simulations combined to landscapes). Due to the high demands for computation and visualization power, the LAT tool is designed as a client tool which is downloaded and installed on the user computer (the tool is available for Windows, Linux, and Mac platforms). Further information on the toolbox is given in ARANGE deliverables D4.5, and D5.4.

The toolbox is a central element for the post-project life of ARANGE. It is a training tool for the case study region, which requires additional effort to fill it adequate data and preference information according to their stakeholders. It is freely available for project partners and builds hence an instrumental element to keep ARANGE conception and scientific progress viable after the project end.

The vulnerability analysis tool has been specifically designed for interactive analysis of climate change impacts on ecosystem services provisioning, and the exploration of management effects on these impacts. It combines functions allowing a broad overview of results, and also possibilities to focus on single cases with a high level of detail. The following screen shots can only provide a limited glimpse on the user experience provided by the tool.

The prototype was explicitly tested for the Bulgarian case study in the Rhodope mountains and is ready to answer questions on:

- Impact of climate change for Business as usual management
- Impact of climate change for alternative management
- Impact of switching to alternative management (under climate change)
- Impact of switching to alternative management when climate does not change

The tool provides a vulnerability assessment for single cases with additional analysis options (Figure 12). Figure 12 shows the “vulnerability surface” combining the “impact” on the x-axis with the “adaptive capacity” on the y-axis. The latter is assessed by a small “questionnaire” above the diagram. The lower part of the screen is occupied by additional single-case analysis diagrams. These diagrams show a profile that of impacts over ecosystem services (or on indicator level) for several periods, or for several management scenarios, or climate change scenarios. By these facilities, it will be possible to analyse the specifics of ARANGE studies in-depth, as well as in future applications based on the data collection and assessment set-up as developed in ARANGE, and transfer these findings to a wider audience in an interactive manner.

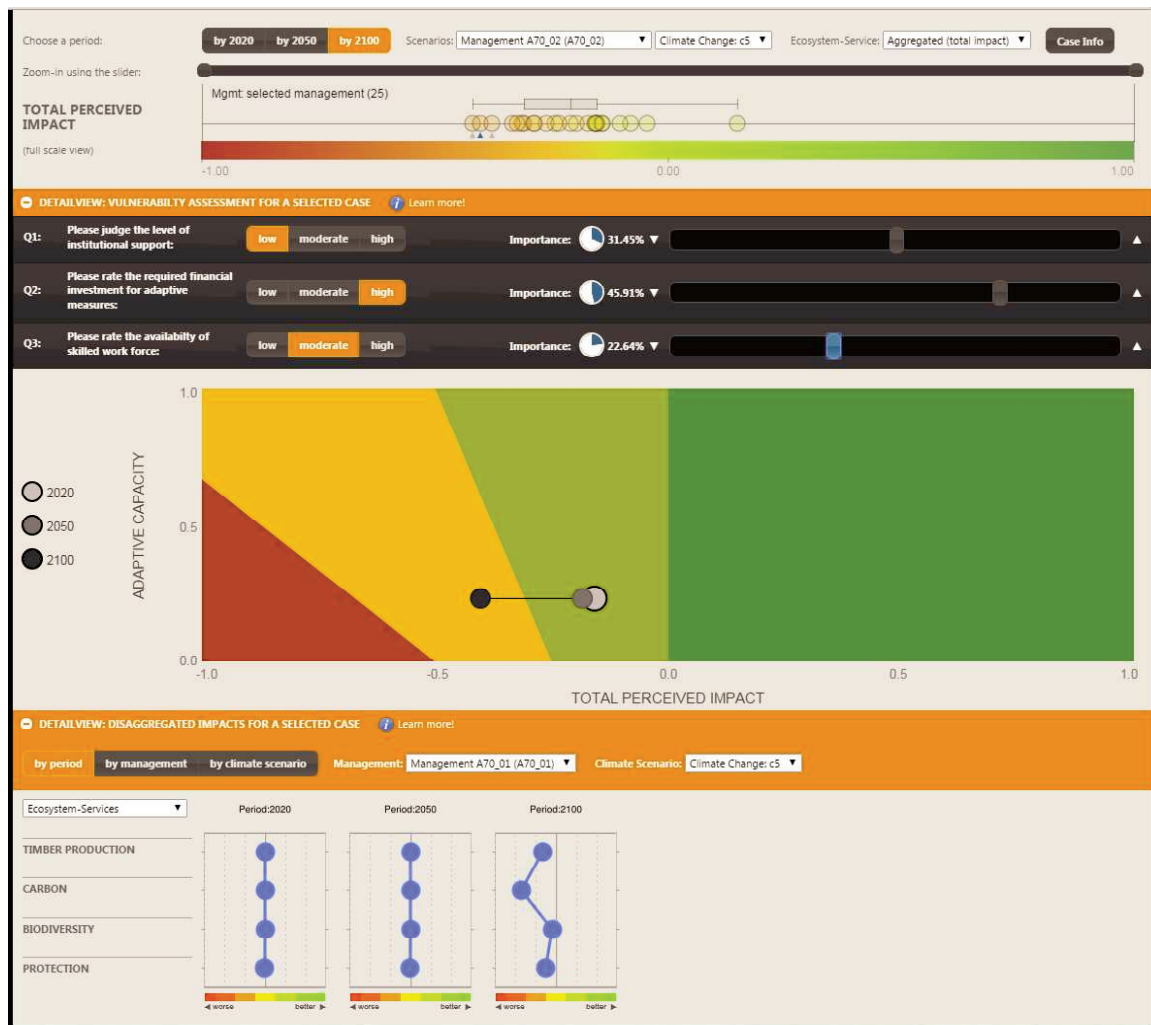


Figure 12. The detail view of the VA-Tool.

## **Literature**

EC (s.a.): Guide to Intellectual Property Rules for FP7 Projects. Version 3. Online:  
[http://ec.europa.eu/research/participants/data/ref/fp7/89593/ipr\\_en.pdf](http://ec.europa.eu/research/participants/data/ref/fp7/89593/ipr_en.pdf) [17.06.2015]