

ESF Exploratory Workshop on

# Linkages and feedbacks in highly dynamic, alpine, fluvial systems

Cornino (Italy), 30 June – 3 July 2008

Convened by:

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## SCIENTIFIC REPORT



## Executive Summary

The workshop ran as planned from 1-3 July 2008 and was attended by 22 delegates. The final list of delegates differed in two respects from the list submitted to ESF prior to the workshop. Dr Muhar was unable to attend, but her ecological expertise was replaced by the attendance of Dr Monaghan (IGB, Berlin) and also. Dr Perucca (Turin) replaced Dr Camporeale (Turin). Thus, there were 22 delegates, 3 local organisers plus Dr Rankenburg, representing ESF, at the workshop.

The workshop followed the provisional programme provided to ESF with the minor deviation of extending the 'state of the art' sessions for the entire first day and thus restricting the group and breakout discussions to the second and third days.

Significant progress was made in understanding perspectives on dynamic alpine fluvial systems from different areas of the natural sciences and in considering how future work could link these perspectives by focusing on particular building blocks that would allow enhanced understanding of system behaviour to be developed and that could feed into modeling and system management.

The workshop was particularly successful in identifying a number of areas where the different natural science disciplines can develop innovative joint research:

- (i) Interactions, feedbacks and threshold conditions are identifiable within all science thematic areas and across all spatial scales.
- (ii) Crucially, thresholds and feedbacks in one component or subsystem of highly dynamic fluvial systems can propagate across the entire system.
- (iii) Such feedbacks and threshold conditions are susceptible to conceptual, probabilistic and numerical modeling
- (iv) An understanding of feedbacks and thresholds is crucial to managing dynamic fluvial systems under scenarios of environmental change and thus needs to be fed into management tools.

The workshop has already resulted in a number of outputs including the establishment of a web site where delegates can download presentations from the workshop ([http://www.igb-berlin.de/veranstaltungen/frameset/veranst\\_ frameset.html](http://www.igb-berlin.de/veranstaltungen/frameset/veranst_ frameset.html)); and a list of scientific papers to be submitted for peer review and potential publication in a special issue of the journal 'Aquatic Sciences' (November 2008 submission deadline, March 2009 publication). Following the production of this special issue, we intend to apply to ESF for further networking funding.

## **Scientific Content of the Event**

The workshop addressed linked physical and ecological modelling of bar-braided, island-braided, wandering and transition reaches of European alpine rivers. A legacy of management has severely restricted extent and functioning of this ecologically-important reach type continuum. Models are needed to elaborate spatio-temporal interactions between ecological and physical factors at different scales and to identify the sensitivity and responses of these river types to environmental and management change. This fast-breaking area in river morphodynamics demands a multidisciplinary, European approach, and so the aim of the workshop was to bring together a group of European scientists to consider the best ways of progressing the relevant science.

The event commenced with a presentation from the ESF representative, Dr Kai, on the work of the ESF and its modes of funding.

The workshop then considered the state of the art in the different areas of the natural sciences relevant to the workshop theme. Presentations and discussions were grouped around six main themes.

Theme 1 (Landscape Perspectives) attempted a large spatial scale overview of highly dynamic alpine fluvial systems. Firstly, we defined more clearly the different river types under consideration and the bio-physical factors that governed their maintenance and transitions between types. Secondly, we considered the characteristics of these river types and the way in which their environmental heterogeneity interacts with ecosystem processes and biodiversity. Finally, landscape-scale human impacts on these systems were discussed with particular reference to multi-thread rivers in Italy and France.

Theme 2 (Modelling at the River Corridor Scale) considered broad-scale numerical, probabilistic and physical (laboratory) modeling approaches and discussed how these might be advanced.

Theme 3 (Modelling at the Channel Scale) discussed hydrodynamic approaches, focusing upon flow, sediment transport and channel boundary dynamics.

Theme 4 (Ecosystem Processes) emphasized two broad areas. First, the importance of interactions between the biota (particularly riparian and aquatic plants) and physical processes (particularly flow and sediment dynamics) and their implications for channel form, channel dynamics and threshold conditions between different river styles. Second, the crucial importance of self-organisation in ecosystem processes was discussed and their relevance to the biogeomorphology of river reaches.

Theme 5 (Biodiversity) focused on the importance of natural disturbances for biodiversity within highly dynamic alpine fluvial systems. In particular, discussion focused on evolutionary aspects, longitudinal patterns, succession and resilience, linkages and feedbacks, and the impacts of river management, climate change and invasive species.

Theme 6 (Flow regimes) cut across the other themes, considering natural and manipulated flow regimes, their implications for the physical characteristics, ecosystem processes and biodiversity of naturally dynamic alpine river systems.

Discussions of all of these themes, led the group to identify some key cross-cutting areas where progress is needed:

- (i) The identification of the system properties and drivers that control system resilience at different spatial and temporal scales.
- (ii) The relevance of these properties and drivers for the ecosystem services provided by highly dynamic alpine fluvial systems.
- (iii) The implications of climate and related hydrological changes and human interventions for these properties, drivers and thus ecosystem resilience and services

To achieve progressing in addressing these cross cutting areas, it was agreed that research needed to focus on three main areas:

- (i) The study of the building blocks of highly dynamic alpine fluvial systems, including the study of elementary biogeochemical processes, species and community resilience to changes in these elementary processes, and in particular the identification of interactions, feedbacks and threshold conditions. Successful study of such building blocks requires joint field studies from which shared databases can be generated.
- (ii) The study of overall system behaviour to test hypotheses through the development and validation of models that use shared databases and other archive information
- (iii) The evaluation of approaches to managing these systems that build upon (i) and (ii) but develop much broader multi-criteria approaches to guiding management.

## **Assessment of the Results**

The workshop provided the opportunity to review current knowledge of linkages and feedbacks between hydrogeomorphic and ecological processes in 'natural', dynamic, European alpine rivers across a range of space and time-scales. From this we gained enhanced conceptual understanding to underpin model development for bar-braided, island-braided, wandering and transition reaches under scenarios of environmental and management change. Our summary of current knowledge and enhanced conceptual understanding will be presented in a special issue of the journal 'Aquatic Sciences'.

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## **Final Programme**

### Day 1 (July 1):

9.00 – 12.30 ‘*State of the Art*’ Invited presentations from a small number of workshop attendees, followed by questions, on the current state of knowledge of particular physical and ecological aspects of bar-braided, island-braided, wandering and transition river reaches. These presentations will encompass field observations and experiments, laboratory experiments and numerical modelling.

12:30 – 13.30 *Lunch*

13:30 – 17.30 ‘*State of the Art*’ continued

17:30 – 19:30 Visit to Monte Ragogna for panoramic view and discussion of bar-braided, island-braided and wandering reaches of the mountain and plain sectors of a good example river

20.00 Conference Dinner

### Day 2:

9.00 – 10.00 ‘*Establishment of Workshop Groups and Sub-themes*’ based on the discussions of the ‘state of the art’ presentations, identify modelling subthemes and appropriate break-out groupings. Initiate break-out group discussions to agree mode of working.

10.00 – 12.30 ‘*Approaches to Integrated Modelling 1*’ Main break-out group discussion sessions to identify modeling approaches in different thematic sub-areas

12:30 – 13.30 *Lunch*

13.30 – 16.30 ‘*Approaches to Integrated Modelling 2*’ Reports from break-out groups and full workshop discussion on morning sessions. Identification of inter-group gaps and any necessary sub-theme adjustments to ensure comprehensive outputs from the workshop.

16:30 – 19:30 Visit to the Flagogna reach of the Tagliamento to extend discussions within an island-braided reach which is currently the focus of integrated physical and ecological field investigations.

20.00 Dinner

### Day 3:

9.00 – 12.30 ‘*Approaches to Integrated Modelling 3*’ Break-out groups refine ideas and document (in writing) the key outputs from their discussions.

12:30 – 13.30 *Lunch*

13.30 – 15.30 Whole workshop discussion of the way forward and responsibilities in delivering multi-author papers and a research proposal based on the workshop proceedings.

15:30 END OF WORKSHOP

## **Statistical Information**

The workshop was attended by 22 delegates.

There were three female and 19 male delegates.

Eight of the delegates were at an early career stage (in temporary posts or within the first five years of an established post)

The delegates were drawn from the following European countries: Austria (1), France (5), Germany (3), Italy (5), Netherlands (1), Poland (1), Switzerland (3), United Kingdom (3).

## Final List of Participants

(22 delegates, 1 ESF representative, 3 local organizers)

Country	Name	Email	Affiliation
<b>Austria</b>	Prof. Helmuth Habersack	helmut.habersack@boku.ac.at	Water, Atmosphere and Environment Department, University of Natural Resources and Applied Life Sciences, Vienna
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	Dr Massimo Rinaldi	mrinaldi@dicea.unifi.it	Department of civil Engineering, Florence University
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<b>Representative of the ESF</b>	Dr Kai Rankenburg	krankenburg@esf.org	Life, Earth and Environment Sciences European Science Foundation BP 90015 1 quai Lezay Marnésia 67080 Strasbourg Cedex France

<b>Local Organisers</b>	Dr Walter Bertoldi Dr Guido Zolezzi Dr Luca Zanoni	<a href="mailto:walter.bertoldi@ing.unitn.it">walter.bertoldi@ing.unitn.it</a> <a href="mailto:guido.zolezzi@ing.unitn.it">guido.zolezzi@ing.unitn.it</a> luca.zanoni@ing.unitn.it	Dipartimento di Ingegneria Civile e Ambientale, Via Mesiano, 77 I-38050 Povo (Trento) Italy
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