Dalälven River Basin

Georgia Destouni, 2012-05-06 update

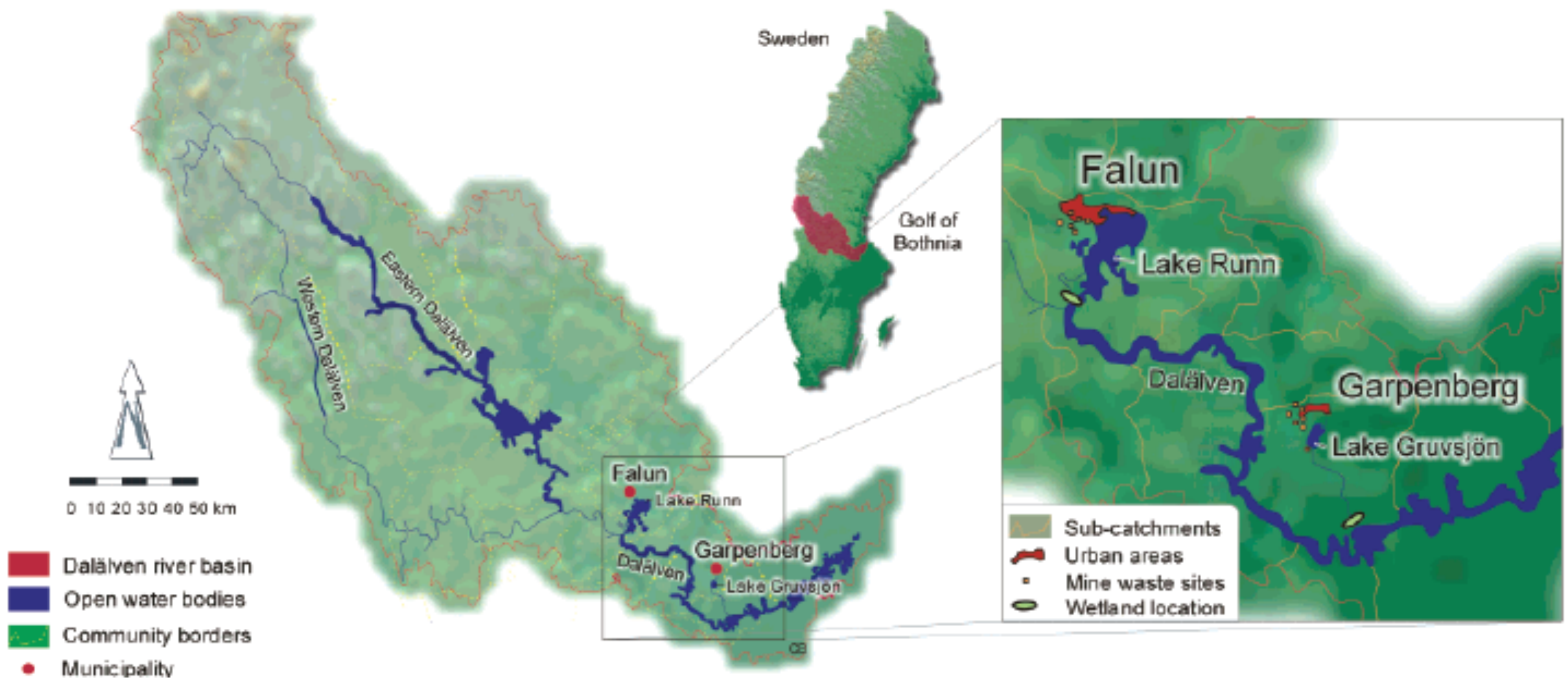

Figure. The Dalälven River Basin (left), its location in Sweden (middle), and two main areas, Falun and Garpenberg, of both historical and currently active mining importance (right). (From Baresel, PhD thesis, 2007)

Name and scale	Dalälven River Basin - 29,000 km^2.
Main research and management problems	The water pollution of most interest here is due to heavy metal leaching to the Dalälven River itself and through the river to the Baltic Sea. The pollution of local water bodies, in the near vicinity of mine waste sites, is also interesting locally and according to the EU Water Framework Directive. The contribution of zinc and cadmium from the Dal River to the Baltic Sea is estimated to be larger than for any other watercourse in Sweden. Therefore, the need of mine water pollution abatement is generally recognized for this catchment. Special focus is on zinc, copper and cadmium loading to the Dalälven River from mining activities within its two main areas, Falun and Garpenberg, of both historical and currently active mining importance (Figure, right). In Falun, mining started in the eighth century; producing many small and uncharacterized mine sites and wastes that may all contribute metal leakage to the Dalälven River and the Baltic Sea. The city of Falun, with its preserved mining area, has been declared a Protected Area on the UN World Heritage List. Garpenberg also hosts numerous mine sites, many of which are protected for their historical value. The reduction of pollution loads may involve different abatement measures, including wetland management and construction, in addition to source mitigation and other possible measures. The choice and allocation of resources among all the different possible abatement measures depends greatly on the coupled hydro-biogeochemical behaviour and effects of the linked subsurface-surface water systems in the basin and their responses to climate and other change in the region. With regard to GWEN, a main research question is: How do individual wetlands and wetland networks modulate the ecosystem services of filtering/attenuating the waterborne pollutants (especially heavy metals) in this basin?
Possible end-user?	The Dalälven River Basin is part of the Swedish Bothnian Sea water management district, one of total only five Swedish water districts that have been established for the catchment-scale water resource management required by the WFD. The regional water authority of this district, as well as the main municipal water utility companies in the region, and the overall Swedish sector organization of water utilities, Swedish Water, should be interested end users of relevant research results. In addition, various other authorities, organisations, companies and NGOs, which have some responsibility for, or are in some way using and/or impacting the water resources of this basin, should be interested in either actively participating in, or using the outcomes from ecohydrological research projects at this site.

Site conditions	The Dalälven River Basin includes approximately 75% forestland, 6% water, 4% agricultural areas, and mountains, marshes, and urban areas in the remaining 15% of its total area. The ecosystems of the lakes as well of the coastal waters recive high pollutant loads from the various historic and ongoing mining activities in the basin. The landscape, which was formed about 10 000 years ago by the withdrawing ice sheet from the last ice age, is composed of bare rock, till, valleys with glacifluvial deposits and numerous water courses. The area of till constitutes about 85%, with a mineral and rock content reflecting the underlying bedrock. Eskers and deltas of glacifluvial deposits cover about 5%. Sediment deposits composed of clay and silt is found below the highest marine level and covers about 6%. After deglaciation, large areas with shallow surface waters covering the mineral soils, and slopes with an outflow of groundwater, have been covered by peat. Bare rock covers about 4% and is found mainly around and below the highest marine level. The underlying bedrock is mainly made up of four parts. North of Lake Siljan, sandstone and limestone, being fanerozoic remnants of sedimentary rocks, make a circular depression, the 'Siljan ring'. A meteorite formed this structure 350 million years ago, creating fault zones and the depression, where the sedimentary rocks were protected from subsequent erosion. The basaltic rocks in the west and the sedimentary rocks of the Siljan region have a high weathering rate. Otherwise, the granite and porphyry rocks, which dominate the drainage basin, are characterised by low weathering rates.
Data and modelling	Surface water chemistry has been extensively surveyed in the drainage basin by the Dalälven River Water Management Association (Dalälvens Vattenvårdsförening - DVVF) and various investigations related to pollution caused by mining activities. Limited groundwater monitoring is carried out in the basin, but some local data are available around mining sites. Model studies of this basin include management and policy relevant analysis regarding waterborne metal loading and opportunities for its abatement, including by new constructed wetlands. Modeling and interpretation of available surface water data show important heavy-metal loading contributions from the subsurface water system of the basin that may continue to keep the metal loads at relatively high levels for long time after active source emissions at the surface have been abated. The rates and time scales of metal transport and mass transfer processes, their spatial-temporal variability and possible correlations and responses to climate and other types of change in the region need to be further investigated. In forthcoming work, investigations will focus on wetlands within this basin, and previous results will be used for regional inter-comparisons, and analyses of changes in hydroclimatic conditions and ecosystem services.

Site-related publications by GWEN participants	**Journal articles:** • Baresel C., Destouni G., ***Diffuse subsurface zinc loads from mining areas in the Dalälven River Basin, Sweden***, *Hydrology Research*, 40(5), 445-453, 2009. • Baresel C., Destouni G., ***Uncertainty-Accounting Environmental Policy and Management of Water Systems***, *Environ. Sci. Technol.*, 41(10), 3653–3659, 2007. • Baresel, C., Destouni, G., Gren, I.M. 2006. ***The Influence of Metal Source Uncertainty on Cost-Effective Allocation of Mine Water Pollution Abatement in Catchments***. *J. Environ. Manage.*, 78(*2*), 138-148. • Baresel, C., Larsén, K., Destouni, G., Gren, I.M. 2004. ***Economic Analysis of Mine Water Pollution Abatement in a Catchment***. In: ***Mining Impacts on the Fresh Water Environment: Technical and Managerial Guidelines for Catchment-Focused Remediation***. Younger, P.L., Wolkersdorfer, C. (Eds). *Mine Water and the Environment*, Suppl. Issue 1. Springer Berlin, pp 57-76. **Reports:** • Amezaga, J., Baresel, C., Destouni, G., Göbel, J., Gren, I.M., Hannerz, F., Larsén, L., Loredo, J., Malmström, M., Nuttall, C., Santamaría, L., Veseliè, M., Wolkersdorfer, C., Younger, P. 2004. ***Mining Impacts on the Fresh Water Environment: Technical and Managerial Guidelines for Catchment-Focused Remediation***. In (eds: Younger PL, Wolkersdorfer C) ERMITE Report D6, The European Commission Fifth Framework Programme, Energy, Environment and Sustainable Development, Contract No EVK1-CT-2000-0078, University of Oviedo. • Baresel, C., Larsén, K., Destouni, G., Gren, I.M. 2003. ***Economic Analysis of Mine Water Pollution Abatement on a Catchment Scale***. ERMITE Report D5, The European Commission fifth Framework Programme, Energy, Environment and Sustainable Development, Contract No EVK1-CT-2000-0078, University of Oviedo. • Salmon, S., Destouni, G. 2001. ***National Case Studies-3. Sweden***. ERMITE Report: D1, the European Commission Fifth Framework Programme, Energy, Environment and Sustainable Development, Contract No EVK1-CT-2000-0078, University of Oviedo, 26 p. **PhD thesis (supervised by GWEN participant G. Destouni):** • Baresel C., ***Environmental management of water systems under uncertainty***, *PhD thesis*, Department of Land and Water Resources Engineering, Royal Institute of Technology, Stockholm, 2007.