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NWRM
Natural Water Retention Measures

Forests and Water

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Outline

- Some background and thoughts
- Trees – pumps or sponges?
- Peatland restoration on Finland
- Kylmäojan korpi: an urban wetland case study

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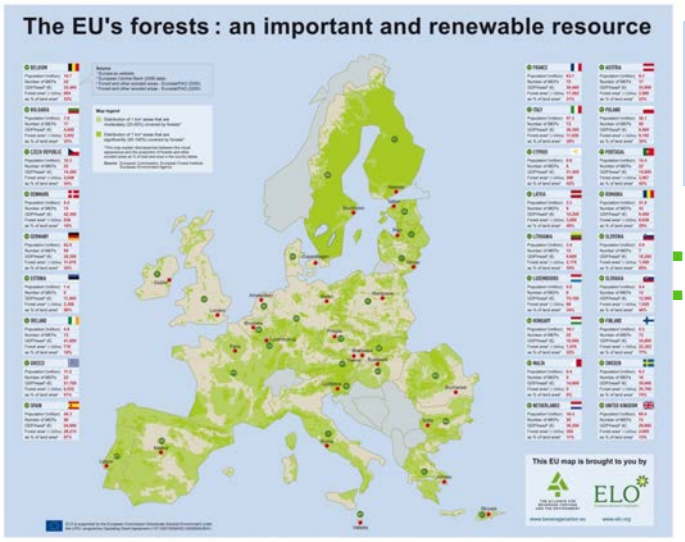
Background

- "Natural Water Retention Measures aim at restoring and maintaining water-related ecosystem services by natural means"
- Forests provide hydrological and water quality regulating services
- Land-use and land-use change – conservation, afforestation, reforestation
- Climate change – intensification of the water cycle; more extreme events, more often

Forest cover in Europe



LATVIA	
Population[1](million)	2.3
Number of MEPs	8
GDP/head[2] (€)	10,200
Forest area[3] (1,000ha)	3,056
as % of land area[4]	49%

- a lot of forest
- a lot of potential for forest NWRMs

Forests in River Basins

- Forests, although providing hydrological services, are not managed for water management *per se*
- Environmental forestry (water quality) measures, e.g. limiting size of harvesting area, use of riparian buffer zones
- Forests tend to be upstream from agricultural, urban, and flood risk areas
- Role of forests/trees in flood planes and urban forests?

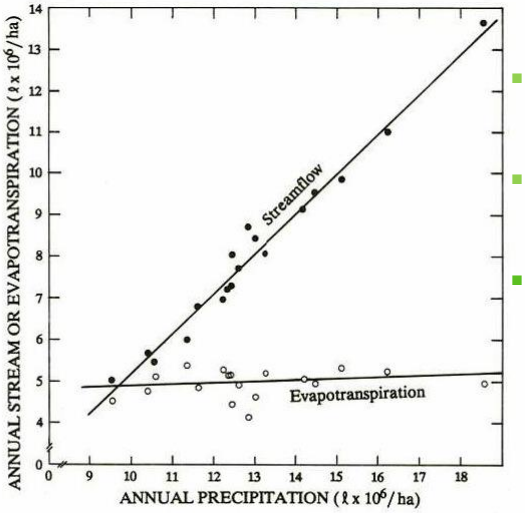
Urban forests: Central Park, Helsinki

- Central park is a 700 ha of forest, pre- dominantly old-growth forest
- NWRM role?
- Viikki Street Tree Research Project http://www.helsinki.fi/koekatu/index_en.htm

Trees - Pumps or Sponges?

- **Pump effect**
  - Higher evapotranspiration (interception, lower albedo, deeper rooting), water "mining"
  - Reduced annual and base (low) flows, ground- and surface water recharge
- **Sponge effect**
  - Canopy interception
  - Increased infiltration (rough surfaces, forest floor)
  - Increased soil water retention (forest floor, soil organic matter)
  - Reduced runoff (peak flows), reduced risk of flooding and erosion

Forest catchment rainfall, runoff and evapotranspiration



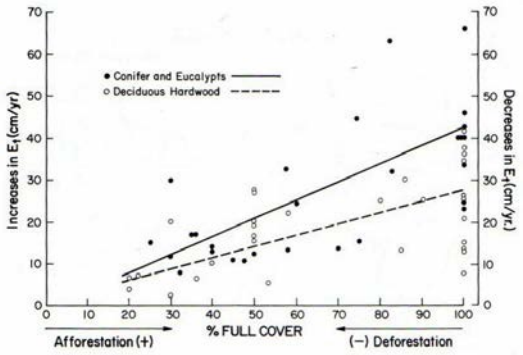
- Hubbard Brook Watershed, New Hampshire, US
- Northern Hardwood ecosystem
- Streamflow strongly determined by amount of precipitation

Source: Likens G.E. & Bormann F.H. 1995. Biogeochemistry of a Forested Ecosystem. (2nd edition), Springer-Verlag

Forest cover and evapotranspiration

A 10 % change in forest cover changes annual ET by:

- 40 mm for coniferous (or eucalypts) forests
- 25 mm for deciduous hardwood temperate forests
- 10 mm for brush or grass cover
- Runoff would show the opposite of ET changes



Bosch, J.M. & Hewlett, J.D., 1982. J. Hydrol., 55: 3-23

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Is more forest cover an oversimplification?

- Generally assumed that conserving (extending) forest cover in upstream watersheds is the most effective measure for enhancing both the water availability and preventing floods in downstream
- Recent research indicates that impacts of forest cover on downstream annual and seasonal flows may not be so clear cut
- "Benefits of upstream forest cover on regulating seasonal downstream floods may have been overestimated, especially regarding major events affecting large-scale watersheds and river basins" (FAO. 2008. Forest and Water. FAO Forestry Paper 155)

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Land-use in Finland

Land use	mill. ha
Water	3.4
Agriculture	2.7
Built-up areas	1.0
Transport routes	0.5
Forest	26.6
Total area	**33.8**

Photo: Arto Halttunen

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Restoration of drained peatlands in Finland

Forest land	mill. ha
Mineral soil	17.2
Peatlands	
Undrained	4.1
Drained	4.7
Restored	**0.02**
Roads, depots	0.2
Total	26.2

- Restoration <0.4% of drained peatland area
- Done for habitat restoration, **not** for downstream regulation of runoff

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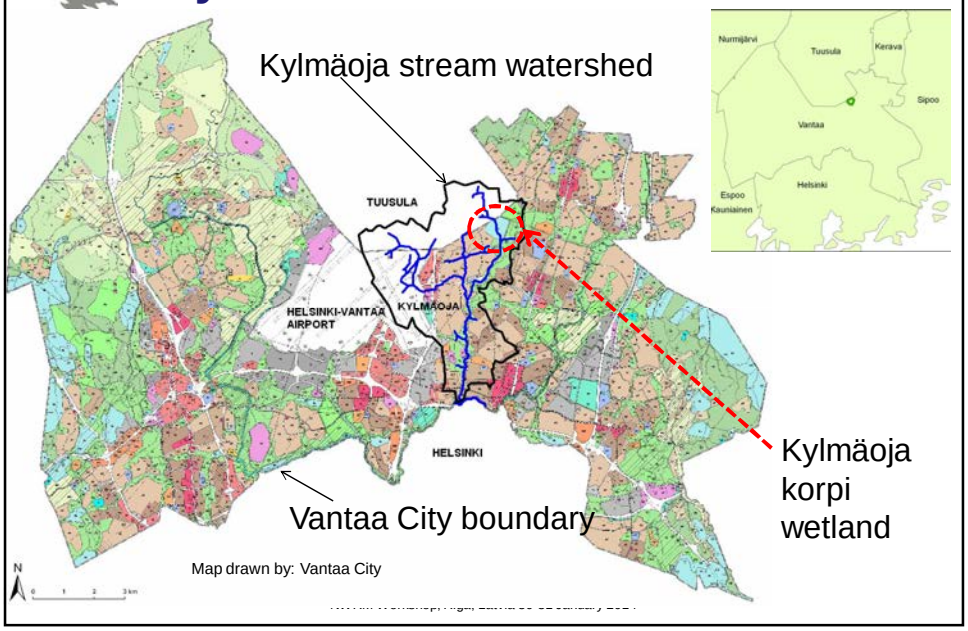
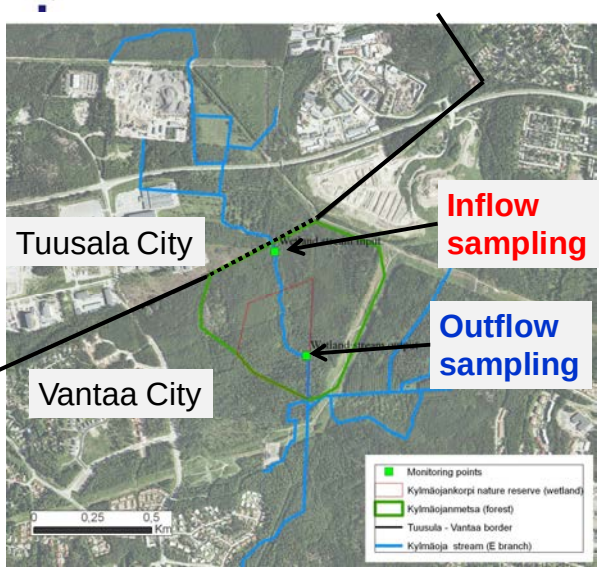
Kylmäojan korpi wetland, Vantaa City



Kylmäojan korpi wetland, Vantaa City



- 11.3 ha protected, forested wetland swamp, surrounded by forest

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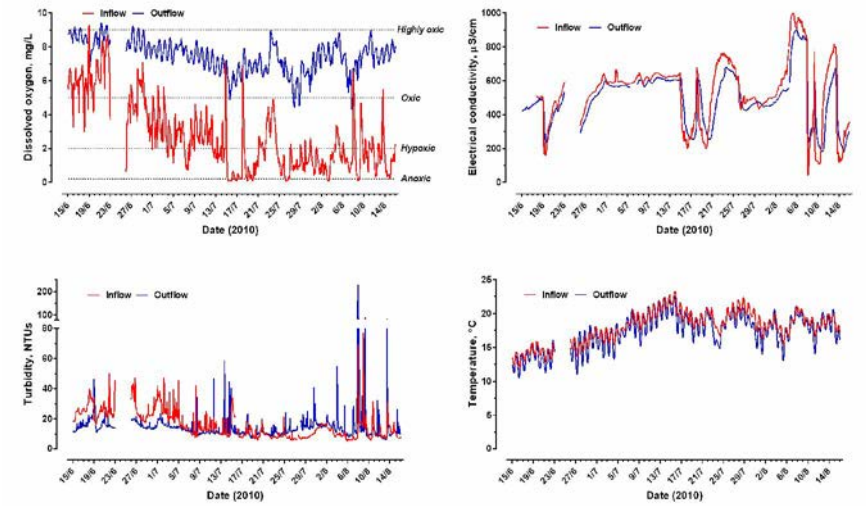
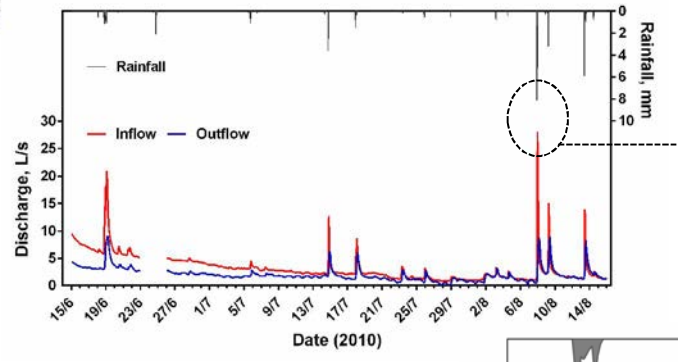
Water quality effects of wetland

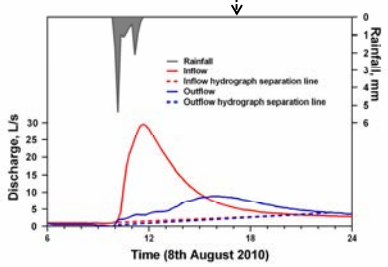


Taylor, A. 2012. MSc thesis, Faculty of Agriculture & Forestry, University of Helsinki
Cooperation with Vantaa City (Ulla-Maija Rimpiläinen) is acknowledged

Flow effects of wetland



- Attenuation:
- Reduced peak flow
- Flow delayed and dispersed



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Conclusions

- Forest generally reduces runoff; it:
  "*slows* it down,
  spreads it out, and
  soaks it in"

  (EPA. http:/water.epa.gov/polwaste/green/video.cfm/)

- High cover of forest in EU – high potential for NWRMs

- Clear beneficial impacts of forest on water quality, however impacts on runoff regulation less clear and may have been overstated

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