Predicting the berry yields for North Karelia region, Finland

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Conference on “Wild Forest Products in Europe”, 13–14 October 2016 Barcelona

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Goal

- To integrate bilberry and cowberry yield models in large-scale forest planning system
- Use the models to simulate the effects of regional cutting scenarios on berry yields
- **Evaluate how the contents of cutting scenarios change when the economic value of berry yields is included in optimization**

Background

- Currently cutting scenarios strongly timber production oriented
  - Biodiversity, protected areas and other land-uses considered through constraints related to land-use classes
  - Carbon sequestration of trees and ground layer endogeneous variables
- NWFPs, recreation and various other ESs are thus largely excluded from regional cutting scenarios
- Aims to increase cuttings in future may have effects on various forest products and functions

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Concepts related to yields of berries

- **Biological yield:** total yield of berries in certain area during one year
- **Harvestable yield**: the part of the biological yield that can be collected with reasonable effort (amount of berries, location)
  - Berries: 20-30% of total yield
- Collected yield: actually collected yield (appr. 5-10% of total yield)

Approach – use of Hartmann formula

- Standing timber stock (forest) provides economic benefits already DURING rotation, e.g.
  - Landscape value (M_t)
  - Berries (B_t)
  - Carbon sequestration (H_t)

- Other benefits are taken into account when the net present value (NA)

- **Effect: the higher are the economic benefits – the longer is the rotation**

$$NA = \sum_{t=0}^{u} \frac{N_t}{(1+i)^t} = \sum_{t=0}^{u} \frac{R_t - C_t}{(1+i)^t}$$

$$NA = \sum_{t=0}^{T} \frac{R_t - C_t}{(1+i)^t} + \sum_{t=0}^{T} \frac{B_t + M_t + H_t}{(1+i)^t}$$

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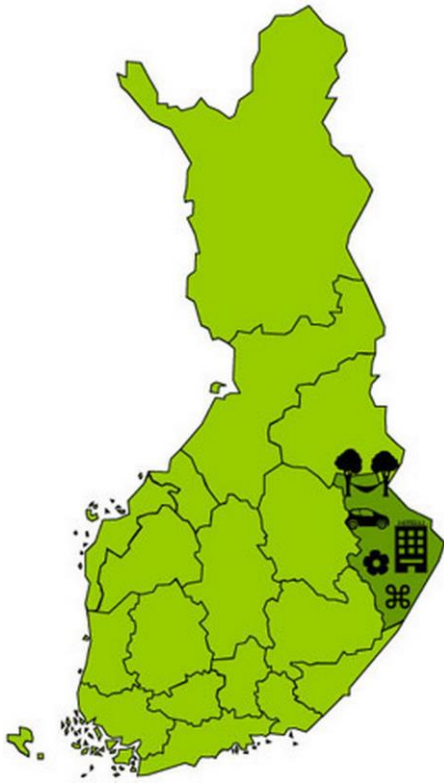
Materials

- North Karelia region: forestry land 1.59 mill. ha
- NFI data from 2009-2013 used in calculations (appr. 5700 calculation units)
- Cuttings allowed only in areas reserved for wood production (1.40 milj. ha) – protected or poor-productive areas excluded from timber production
  - Berry yields and also timber volumes calculated for whole area
- The total volume in 2014 was 186.5 mill. m^3 of which the volumes of pine, spruce, birch and other deciduous trees were 99.0, 50.4., 31.5 and 5.7 mill. m^3, respectively. The annual growth was 9.1 million m^3



Bilberry price 1.72 €/kg

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Methods

- MELA planning system (Siitonen et al. 1996)
  - Numerous empirical models used predict the development (growth, mortality, in-growth etc.) of trees
  - Biological and harvestable yields (> 10 kg/a/ha) predicted with models of Miina et al. (2009) for bilberry and Turtiainen et al. (2013) for cowberry.
  - Automated event simulation routines used to simulate a large number of feasible management schedules for each management unit
  - LP-based optimization package (Lappi 1992) used to find the optimal combination of management schedules for planning area
- Three typical cutting scenarios: BAU, sustainable even flow, max cuttings for which berry yield development simulated after optimization
- Multi-objective optimization with “sustainable even flow” scenario: the value of biological and harvestable yield of bilberry considered in the calculation of NPVs

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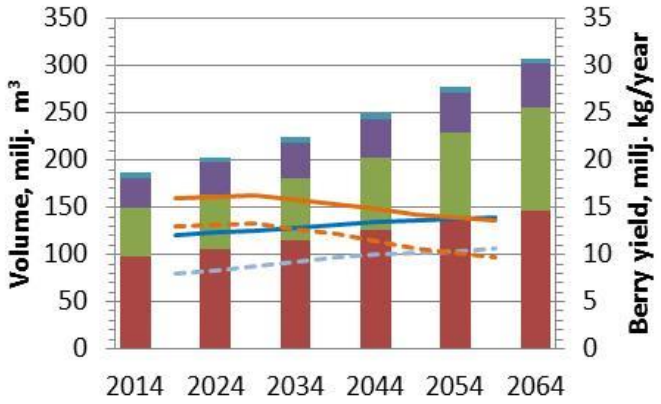
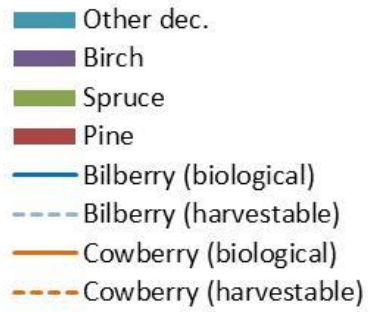
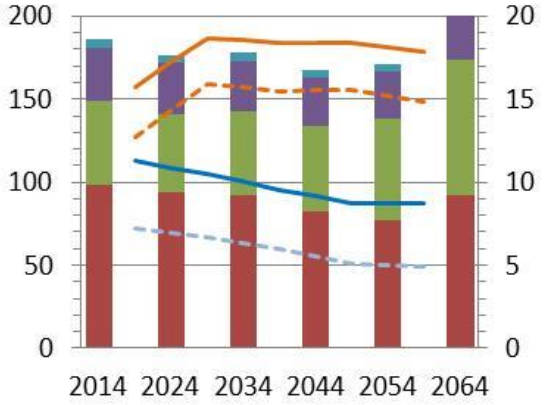
Development of growing stock volumes and berry yields (biological and harvestable) in cutting scenarios in North Karelia

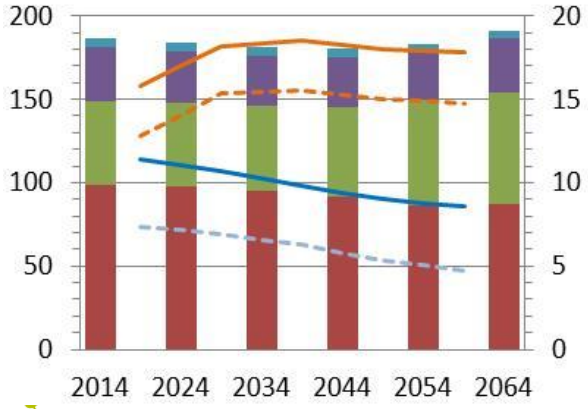
BAU-scenario



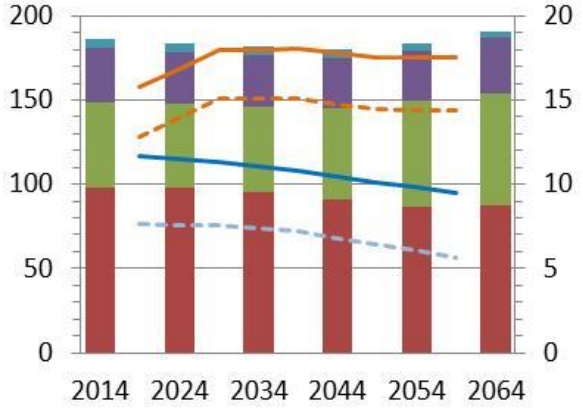


MAX NPV (5%)



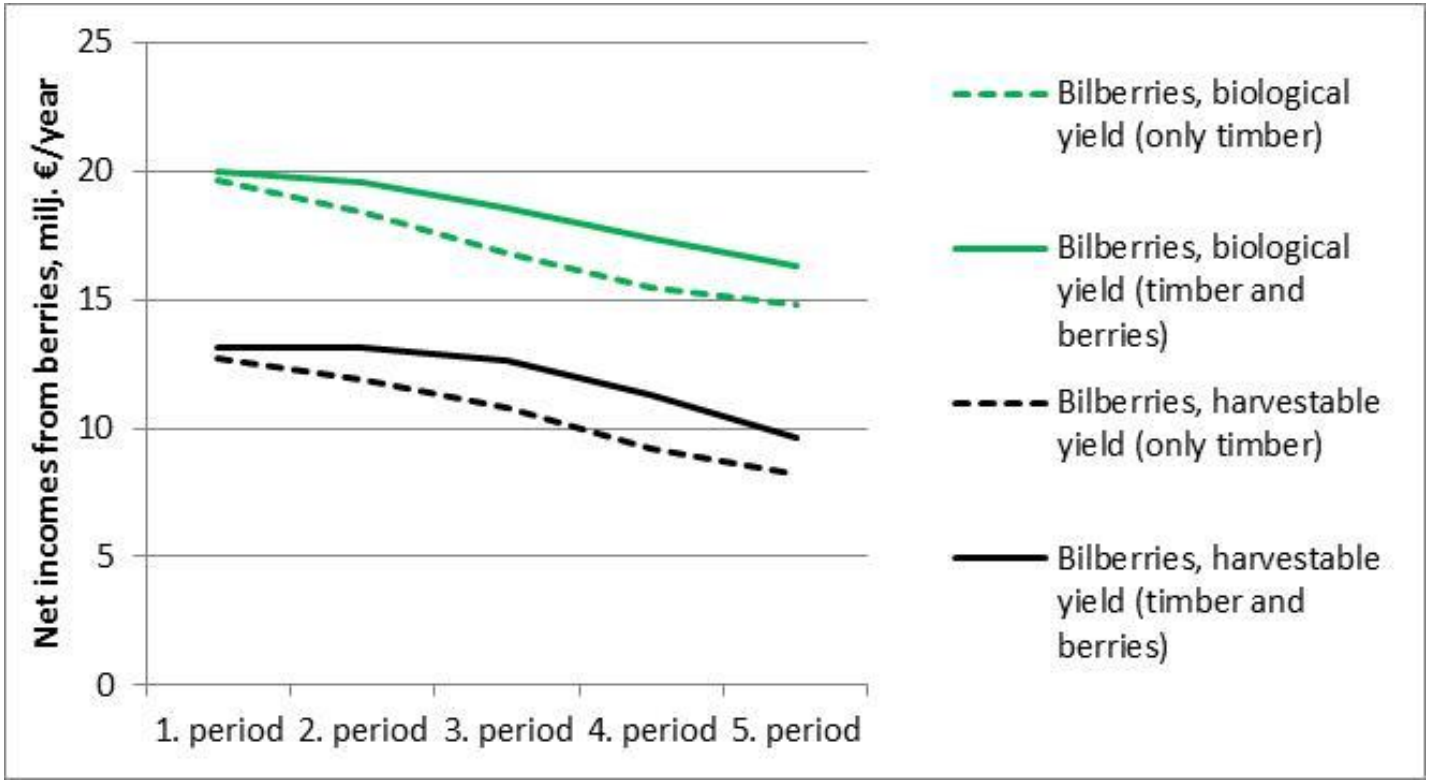


Even Flow



Even Flow with biological yield of bilberries

Bilberry yields (biological and harvestable) in different scenarios



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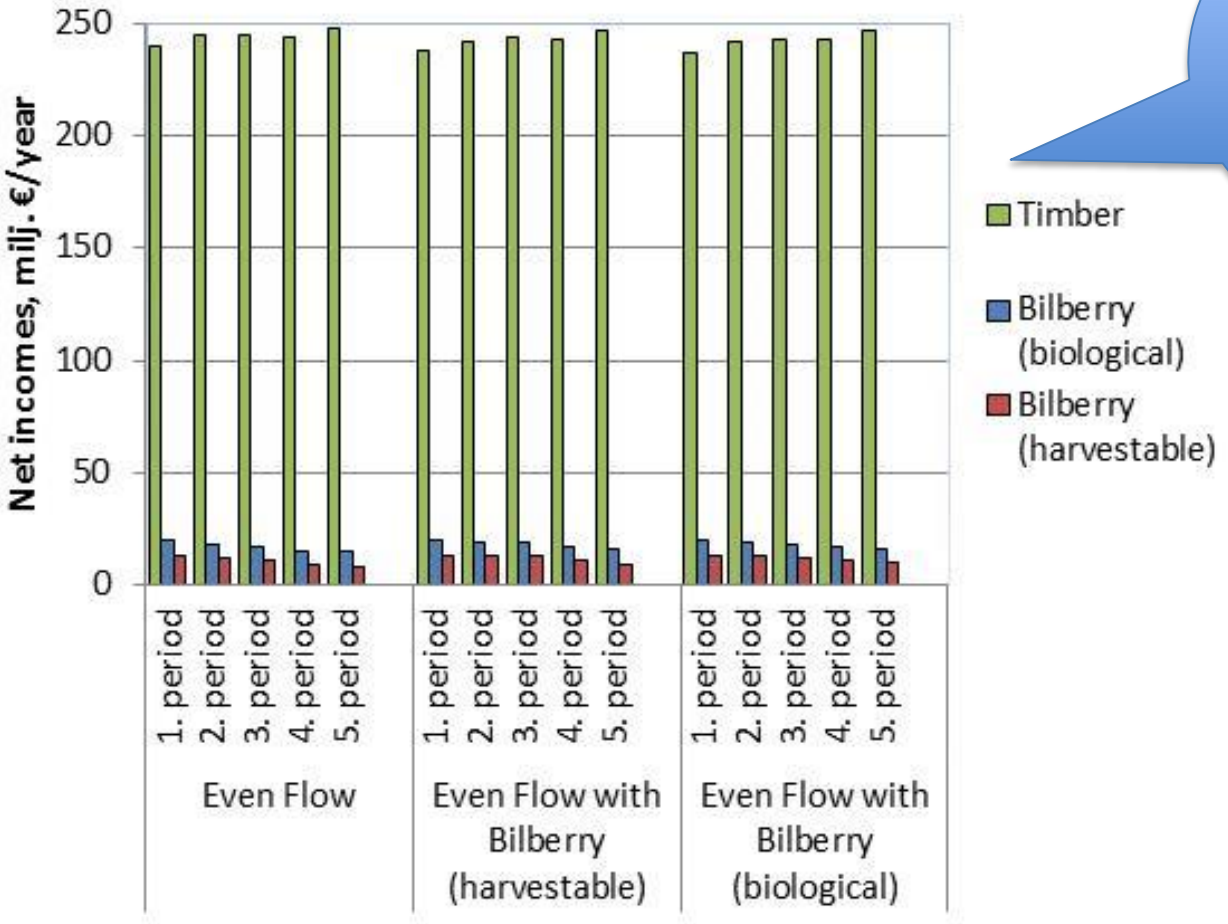
Net incomes from timber harvesting and bilberries (biological and harvestable yields)



NPV 5.5 % higher when the value of biological yield included

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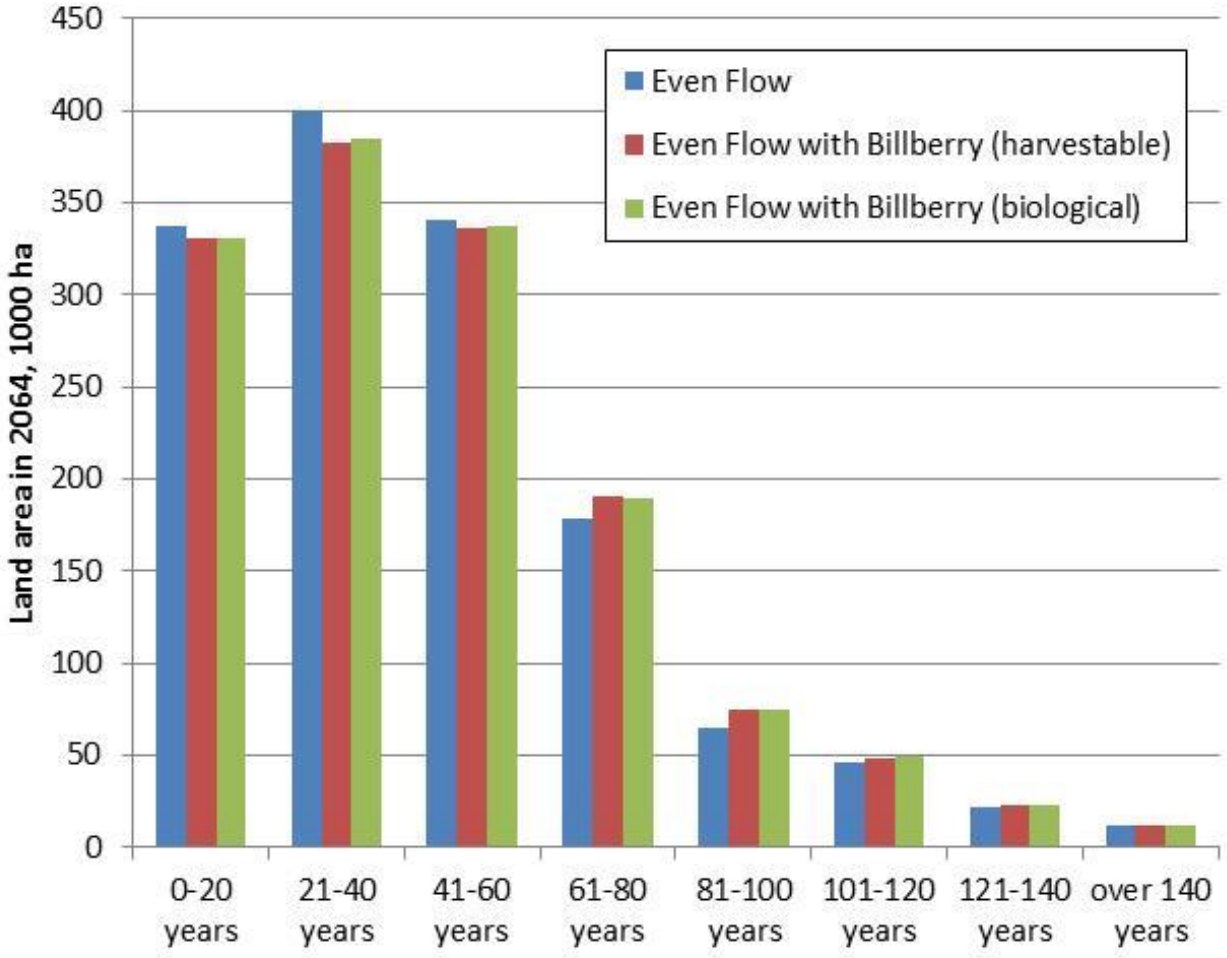
Age class development



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Discussion

- Integration of the value of berry yield in optimization had expected but minor effects
  - Very small effects on timber production
  - Berry yields (value) increased more than 10%, but are also decreasing
  - **Age-class structure developed positively for bilberry and recreation**
  - Is the current market price biased?
- Biological yield of bilberry relevant - an umbrella species for various ESs
- Next steps: new scenarios with higher bilberry prices that reflect also other attached values

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Thank you.