



SCIENCE AND EDUCATION **FOR**
SUSTAINABLE
LIFE

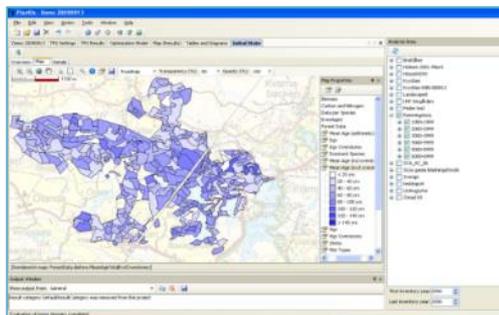
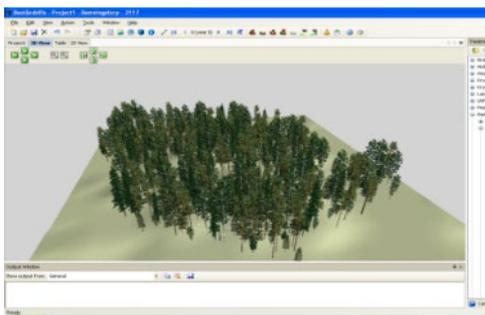
Using the Heureka system for evaluating the effect on biodiversity and other ecosystem services from harvesting bioenergy in Swedish forests

Jeannette Eggers, Johanna Lundström, Ylva Melin, Karin Öhman

Can an increased production of wood fuel be done in a sustainable way?

Heureka

A decision support system for forest planning and analysis – makes long term projections of forest conditions and consequences for ecosystem services on the basis that the forest is managed in different ways.



What is Heureka?

Heureka is..

- ..a system that can be used for analysis of a multi objective forestry
- ..a system that can be used to analyze specific issues, e.g. What are the consequences of applying continuity forestry at the landscape level?
- ..a system that can answering the questions of when, where and how should the forest be managed to achieve the objectives?..
- ..a system that can be used by many different groups; e.g. large and small forest owners, authorities, organizations, etc.



What is Heureka?

Heureka can e.g..

- ..apply a long planning horizon
- ..use different data, compartment data, sampled data, the NFI data
- ..be used for an economic evaluation of how the forest is managed
- ..be spatial, ie. actions and conditions can be linked to geographical locations
- ..simulate different management systems







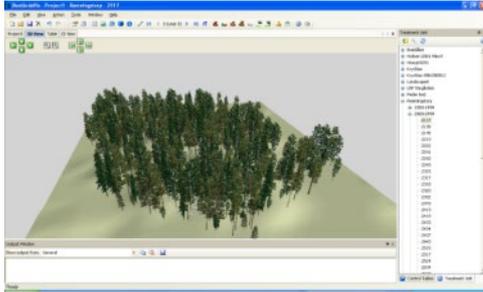




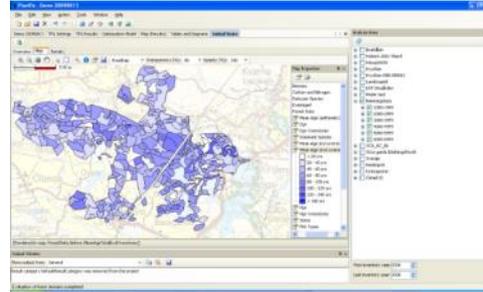




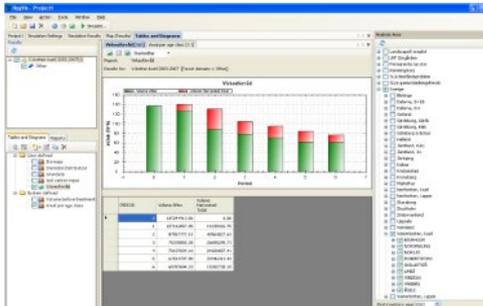
A set of software for different problem areas and users



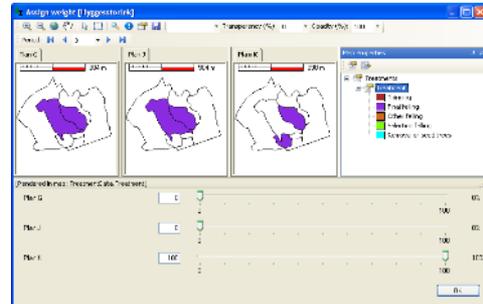
StandWise



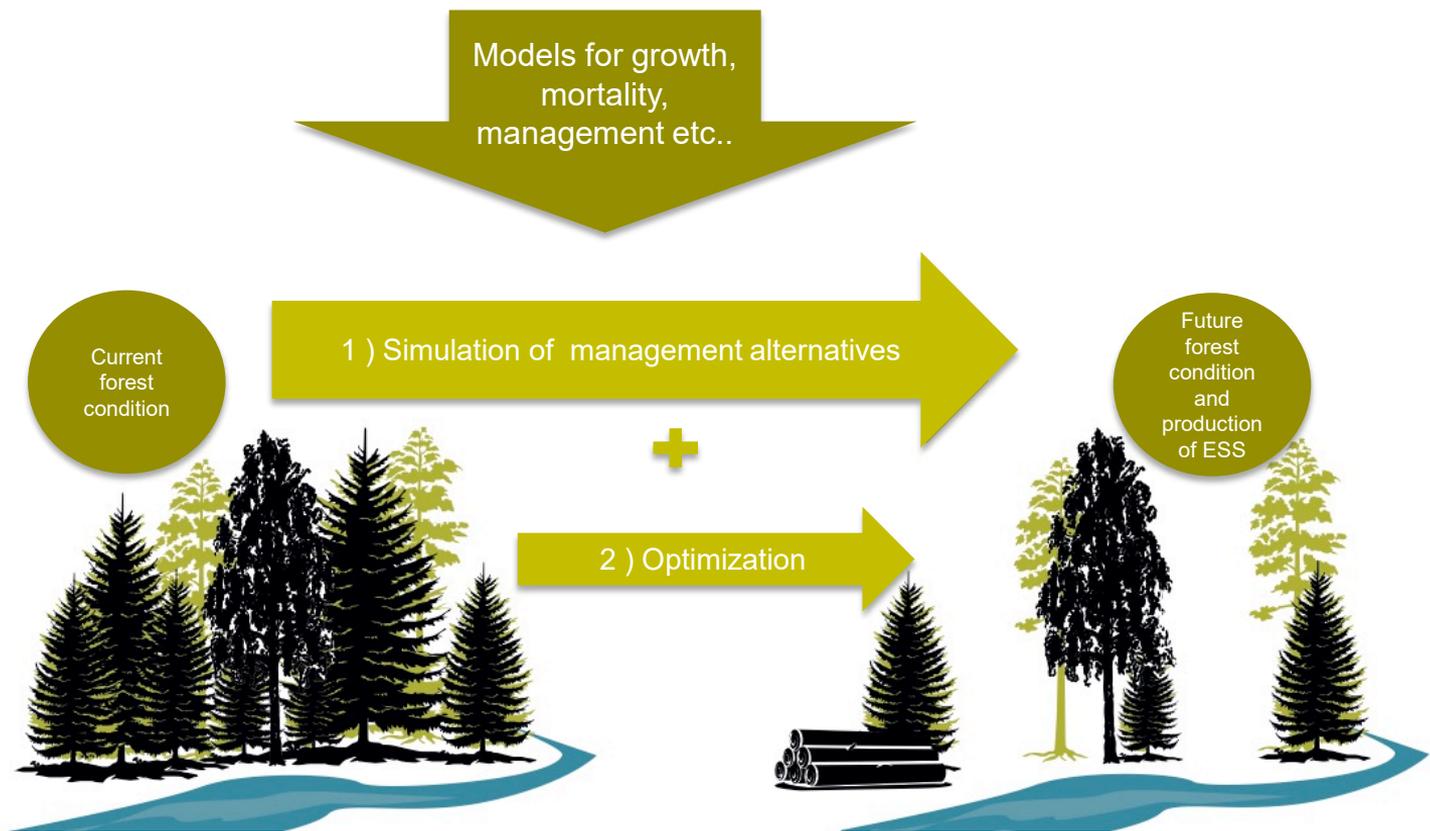
PlanWise



RegWise



MCDA: PlanEval



Objective

- 1) To investigate the impacts on core ESS related to forests if forestry is optimized for wood fuel harvesting
- 2) To investigate the trade off between wood fuel harvesting and biodiversity and other ESS
- 3) If NFI data and DSS could be used in this type of studies?

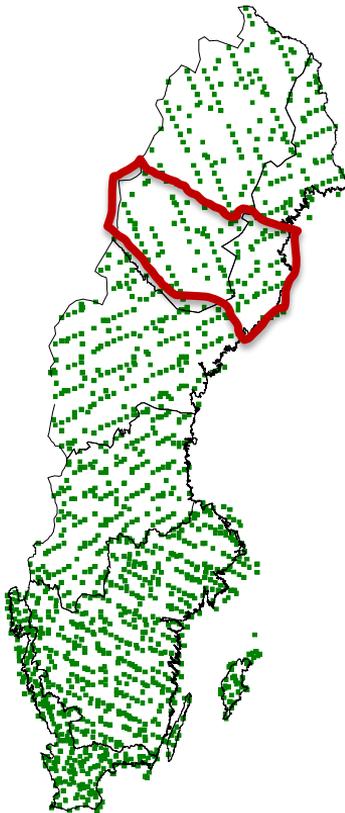
Included ecosystem services

Ecosystem services	Indicator	Classification
Biofuel production	ton residues extracted	provisioning services
Reindeer husbandry	number of hectares suitable for reindeer pasture	provisioning services
Carbon sequestration	total C stock in soils, trees, stumps and roots	regulating services
Recreation	index between 0 and 1 describing a plots suitability for recreation	cultural service

Biodiversity

Biodiversity aspect	Indicator
Old forest	hectare forest > 140 years
Mature broadleaf forest	hectare forest with age > 80 and broadleaves >= 25% (of basal area)
Large trees	number of trees/hectare > 40 cm
Dead wood	m ³ /hectare

Analysis area



Description of the analysis

1. Simulation of a set of possible management alternatives for each plot with different effects on the ESS and different levels of biofuel harvest using Heureka

2. Selection of management alternative for each plot by using the optimization tool in Heureka



Optimization

Maximize



Biofuel

1

Biofuel

Reindeer pasture

Recreation

C stock

Old forest

Mature broadleaf-rich forest

Large-diameter trees

Deadwood

If the forest management is optimized for wood fuel harvesting how much reindeer pasture, recreation etc do you get?

s.t the amount of wood harvested for pulp and timber each period > todays level

Optimization

Maximize

	Biofuel	Reindeer pasture	Recreation (sum all p)	C stock (p20)	Old forest (p20)	Mature broadleaf-rich forest (p20)	Large-diameter trees (p20)	Deadwood (p20)
Biofuel	1							
Reindeer pasture		1						
Recreation			1					
C stock				1				
Old forest					1			
Mature broadleaf-rich forest						1		
Large-diameter trees							1	
Deadwood								1

s.t the amount of wood harvested for pulp and timber each period > today's level

Results

	Biofuel	Reindeer pasture	Recreation (sum all p)	C stock (p20)	Old forest (p20)	Mature broadleaf-rich forest (p20)	Large-diameter trees (p20)	Deadwood (p20)
Biofuel	100	31	26	2	20	22	35	53
Reindeer pasture	64*	100	88	49	79	71	70	50
Recreation	83	87	100	80	93	89	89	77
C stock	89	89	88	100	87	93	88	95
Old forest	33	42	66	44	100	43	57	39
Mature broadleaf-rich forest	10	33	51	50	26	100	20	39
Large-diameter trees	41	46	56	49	63	44	100	40
Deadwood	73	65	57	81	64	69	63	100

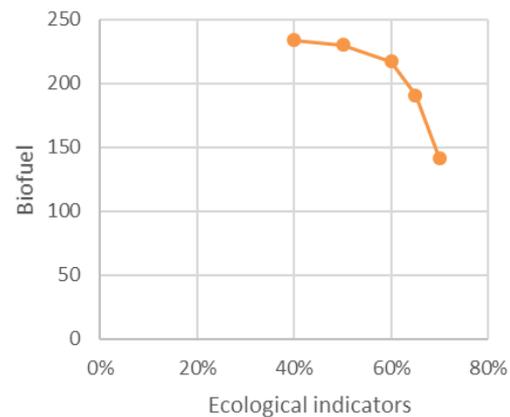
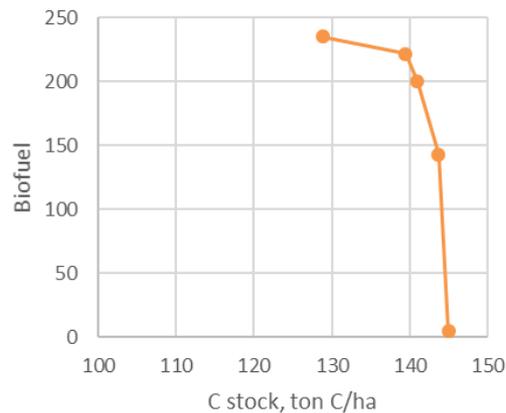
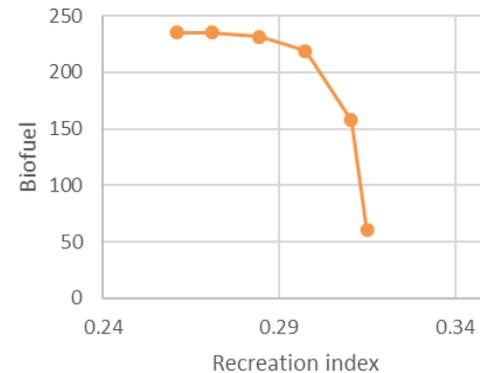
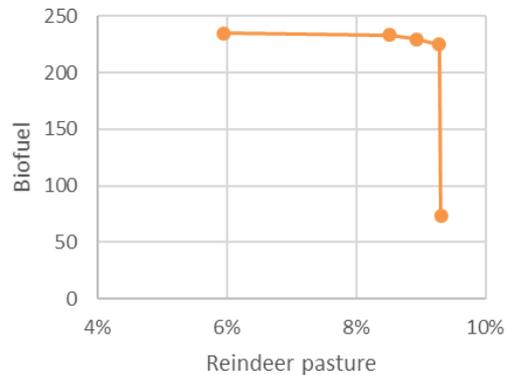
* % of maximal production for that ESS

Optimization model

What is the trade off between wood fuel harvesting and biodiversity and other ESS

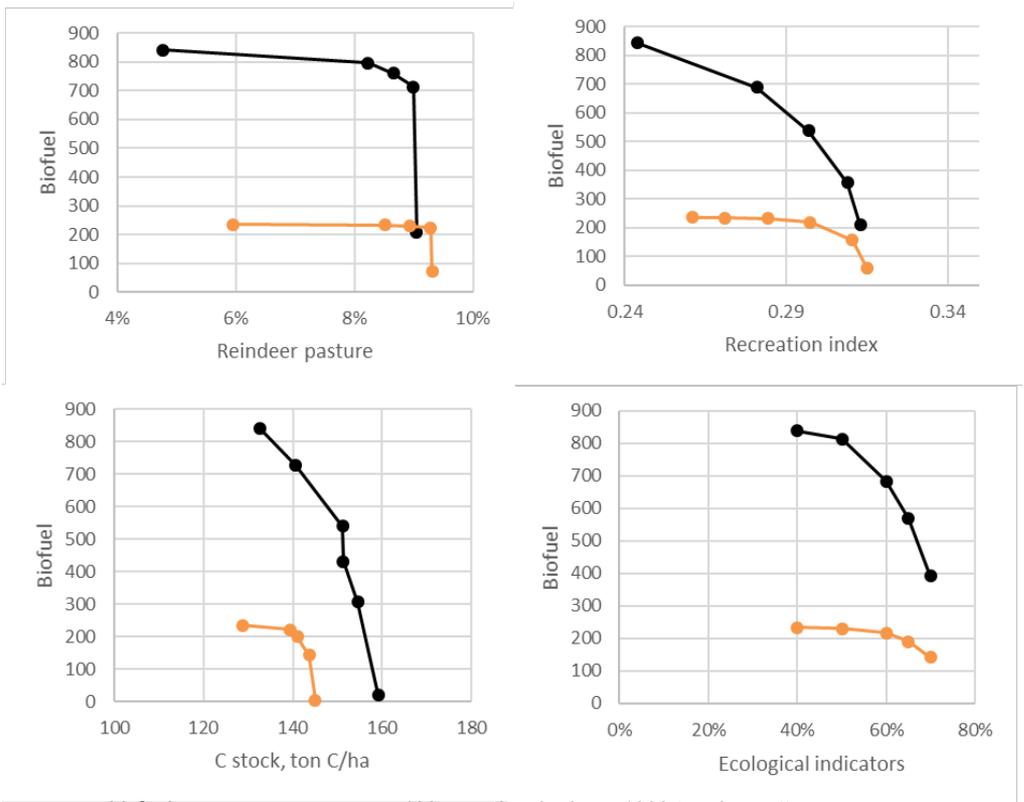
	Max Biofuel							
st	Reindeer pasture	>	X % of maximal level					
	Harvested pulp wood each period	>	Today's level					
	Harvested timber wood each period	>	Today's level					

Results



biofuel: average per year over 100 year time horizon, 1000 ton dry matter

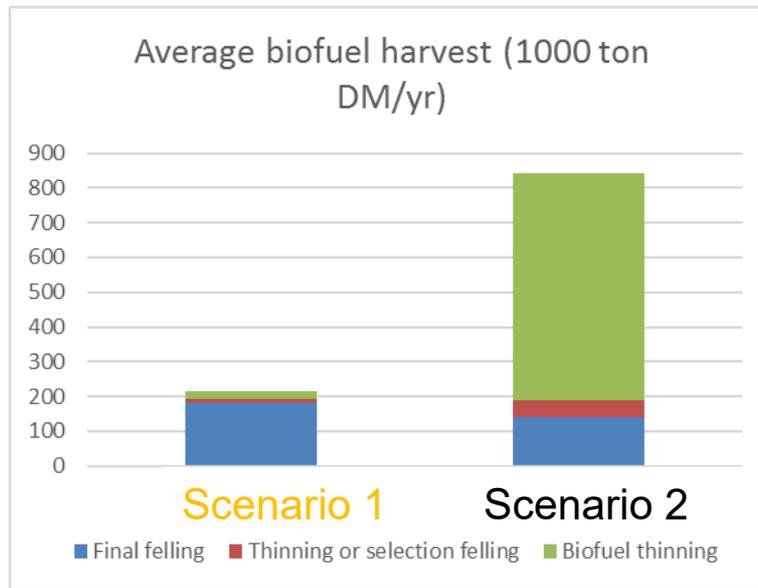
Results



biofuel: average per year over 100 year time horizon, 1000 ton dry matter

Scenario 1 (forest residue extraction only in final fellings, respecting current restrictions (such as no extraction on wet soils))
Scenario 2 (strong focus on bioenergy: forest residues can be extracted in both thinnings and final fellings on appropriate sites and biofuel thinning is an option in almost all stands)

Results



Conclusion

1) To investigate the impacts on core ESS related to forests if forestry is optimized for wood fuel harvesting

”There is a clear effect on other ESS, especially on indicators connected to biodiversity.”

Conclusion

2) To investigate the trade off between wood fuel harvesting and biodiversity and other ESS

”There is a clear trade off between wood fuel harvesting and the other ESS.”

Conclusion

3) Could NFI data and a DSS be used in this type of studies?

”Yes, it is possible to use NFI data for advanced analyses in systems like Heureka.”

Thank you!

More information about Heureka:

<https://www.slu.se/heureka>

More information about the Swedish NFI:

<https://www.slu.se/en/Collaborative-Centres-and-Projects/the-swedish-national-forest-inventory>