



Valuing the benefits and costs of provision of ecosystem services from Danish forests

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New ways to value and market forest externalities



Ecosystem services in private forests

Demand



Welfare from society's point of view :

Use / Non-use values

Recreation

Nature protection

Diverse interests and preferences

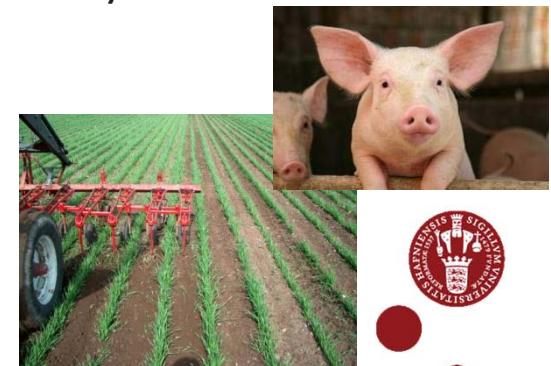
International obligations

Supply



Forest owners:
Management changes
(e.g untouched areas)

Δ Utility = - production loss
- flexibility + amenity values...



Ecosystem services in private forests

Demand



Stated preference studies of both sides (choice experiments, trade-offs)
(use/non-use....and direct cost / experienced loss/gains in utility)

Online survey

- general public
- app. 800 respondents

Focus: ecosystem services from
the public's point of view

- increased access
- protection of species
- groundwater (quality/quantity)

Supply



Letter -> Online survey

- forest owners (all size classes)
- almost 300 respondents
- cover 14.4% of private area

Focus: specific management changes
that provide ecosystem services

- untouched forest
- dead wood, broadleaves
- increased access
- lower property tax

Ecosystem services in forests – the public's preferences

Access: Access outside roads and path: 25% (sq), 50%, 100%



Species: Securing survival of endangered species: 0,50, 100 out of 660)



Natural processes: Presence of natural processes: as today



+ dead wood
+ untouched forest



Water: Securing groundwater production +20, +40 mio m³; 200.000 or 400.000 households' annual consumption



Price: 0, 250, 500, 750, 100, 1250 DKK



The public's preferences:

		Model 4	
		est.	t-rat.
Price	μ	-5.30	42.13
	σ	1.20	9.27
SP50	μ	1147.80	15.77
	σ	896.26	12.55
SP100	μ	1983.80	14.49
	σ	2144.79	18.45
NP1	μ	617.35	8.61
	σ	594.98	12.27
NP2	μ	849.64	11.49
	σ	1132.07	20.79
NP3	μ	724.45	10.15
	σ	522.40	9.52
Wat2	μ	570.57	8.04
	σ	754.32	18.60
Wat4	μ	777.92	10.34
	σ	1170.30	17.90
Access	μ_1	136.95	0.58
	θ_1	447.17	2.30
	μ_2	241.87	10.92
	θ_2	527.16	129.04
SQ	μ	-201.70	6.56
LL		-3499.66	
K		71	
ρ^{-2}		0.319	

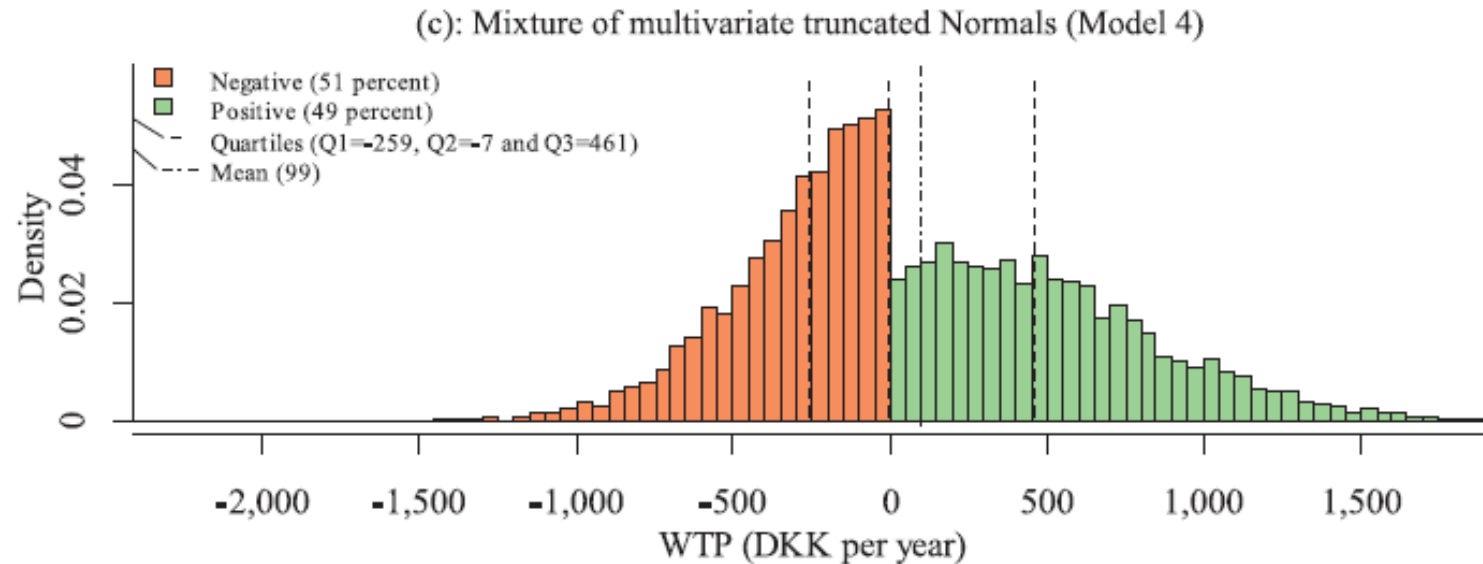
RPL model:

- with a mixture of truncated Normals for access

- High wtp for protection of species
- Natural processes (untouched areas + dead wood)
- Groundwater
- Although – very diverse preferences
- Access: 50%-100% merged to one level
- Especially for access -> two separate groups in the population



Ecosystem services in private forests – access



Negative group: Mean wtp -311 DKK (sd. 246)

Positive group: Mean wtp +522 DKK (sd. 363)

Policy implications: Overall mean wtp for increased access is positive, however the median is negative.

Campbell, Vedel, Jacobsen and Thorsen, 2013: Heterogeneity in the wtp for recreational access: distributional aspects, *Journal of environmental management and planning*.



Ecosystem services in private forests – forest owners' perspective

- Many initiatives rely on landowners' voluntary participation in schemes – or landowners private motivation
- Fragmented forest area -> most initiatives involve a lot of owners

Specific management changes:

-> the owner has to be willing to participate

-> i.e experience that Δ Utility (when summing up good and bad) is positive/zero

Survey on costs of provision:

- Based on specific management changes
- Relate to details of the current management on the property (analyses still on-going)



Forest ecosystem services – owners' perspectives

Attributes	Levels							
Set aside an area as untouched forest	No change	7%	15%					
Leave 5 old trees for natural decay	No change	Leave 5 old trees for natural decay						
Increase the area with broadleaves	0% broadleaves	25% broadleaves	50% broadleaves	75% broadleaves				
Increase the public's access	No change	Access for the public on foot up to 15 meters from roads and paths	Access for the public on foot everywhere					
Lower property tax /ha and year*	0 DKK	25 DKK	50 DKK	75 DKK	100 DKK	125 DKK	150 DKK	175 DKK

* per hectare for the entire forest property – registered in the deed (binding)



Main results: RPL model

- On average, owners require no compensation for:
 - Leaving 5 trees per ha for natural decay,
 - accepting a broadleaves restriction of up to 50% of the total forest area (potential sample bias though)'

They do require compensation for:

- Granting access on up to 15 meters from road and path, or everywhere on the forest floor, this is the most expensive element in the contract (on average 138 DKK, 276 DKK)
(maintain privacy close to home)
- Broadleaves restriction of 75%: 67 DKK in compensation
- Untouched forest: 8.3 DKK
(e.g. leaving 7% untouched of a 100 ha forest amounts to 5810 DKK/year for the entire forest)



Effect of current level of provision:

- Interaction effects:

Owners relate their demand for compensation to their current provision level

-> they lower the required compensation depending on their current provision level



One example: Access on foot everywhere in the forest - Demand and supply-side:

The public:

Large variation in preferences in the population

On average the wtp is positive for the population, but distributions in preferences matter

Positive /negative attitudes (app. 50/50 share):
-311 DKK (246)

+522 DKK (363)

Payment vehicle: Annual income tax/household

Statements...

The forest owners:

Access is a well-known public good

The most dis-motivating ecosystem service of the ones investigated here

On average, 276 DKK/ha in compensation

Hunting interests matter:

-increases compensation from 276 to 370 DKK/ha for access everywhere

Attitude towards providing benefits for the local community (motivating factor for entering a scheme):

-decreases the required compensation for access from 276 to 114 DKK/ha

(note potential endogeneity)



Further analyses and policy implications:

Spatial perspectives on both benefits and costs of forest ecosystem services

- interests in recreational access (rural / urban areas)
- the value for the public of the ecosystem services also varies spatially
- the costs of provision varies between regions/owners

Scope for targeting the provision of ecosystem services

- based on (low) costs and (large) benefits – however, not necessarily simple when we look into more than the mean wtp (distributional aspects)

Also diversity among owners:

Landowners are motivated by a variety of things...

- often only the sum of money is addressed
- what provides personal utility for owners is more complex (e.g. objectives of ownership, hunting, attitude, social norms....)



Thank you!



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Appendix

Attribute description and abbreviation	Status quo	New attribute levels				
Access on foot outside roads and paths (Access)	Access on road and path and on 25% of the area also outside road and path	Access outside road and path allowed on 50% of the area			Access outside road and path allowed on 100% of the area	
Amount of the 660 endangered species which are ensured survival (SP50, SP100)	660 endangered species in forests	50 species are ensured survival through specific initiatives			100 species are ensured survival through specific initiatives	
Opportunity for natural processes in the forest (NP1, NP2, NP3)	Low level: Dead trees left in forests only occasional. 0.01% untouched forest reserves	Medium level: 5 trees are left to natural decay per hectare (100m x 100m). Area of untouched forests reserves unchanged (0.01%)	High level: 7% of the broadleaved forest area is set aside as untouched forest reserves	Very high level: 7% of the broadleaved forest area is set aside as untouched forest reserve and 5 trees are left to natural decay in the rest of the forest		
Increased recharge of groundwater, metered in number of households' consumption (Wat2, Wat4)	The amount of groundwater for drinking purposes under forests is the same as today	Groundwater recharge increases with 20 million m ³ – corresponding to the annual consumption of 200.000 households. This corresponds to app. 10% of the households in the case study area			Groundwater recharge increases with 5 million m ³ – corresponding to the annual consumption of 400.000 households. This corresponds to app. 10% of the households in the case study area	
Additional income tax per year for your household (Price)	0 DKK	250 DKK	50 0DKK	750 DKK	1000 DKK	1250 DKK

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Ecosystem services in private forests

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Appendix: Results - RPL model, incl. random distributions

	Coefficient	Standard error	Z	WTA	95% confidence interval
Random parameters in utility functions					
UNTOUCH	-.12831***	.03843	-3.34	8.3***	(3.5 - 13)
DEAD	-.01345	.07688	-.17	.87	(-8.8 - 11)
BLEAVE25	-.42471	.35469	-1.20	274	(-17 - 72)
BLEAVE50	-.06619	.56173	-.12	427	(-67 - 75)
BLEAVE75	-1.03211**	.43762	-2.36	67**	(13 - 120)
ACC	-2.13885***	.41657	-5.13	138***	(80 - 196)
Non-random parameters in utility functions					
ASC	5.02759***	.66266	7.59	-324***	(-410 - 239)
PRICE	.01550***	.00186	8.32		
HAVEUNTOUCH*UNTOUCH	.12350***	.04292	2.88	-8.0***	(-13 - -2.5)
HAVEDEAD*DEAD	.23213**	.10223	2.27	-15**	(-28 - -2.0)
HAVE50%B*BLEAVE50	-.29468	.68692	-.43	190	(-68 - 106)
HAVE75%B*BLEAVE75	.27988	.52430	.53	-181	(-84 - 48)
HAVEACC*ACC	1.79302**	.75053	2.39	-116**	(-214 - -18)
POS*ACC	1.26332***	.40209	3.14	-81***	(-134 - -30)
HUNT*ACC	-.72268*	.40671	-1.78	47*	(-4.2 - -97)
Standard deviation of normal distributed random parameters					
UNTOUCH	.12685***	.02904	4.37		
DEAD	.28454***	.09635	2.95		
BLEAVE25	1.34095*	.70483	1.90		
BLEAVE50	1.02257*	.61317	1.67		
BLEAVE75	.89612	.63405	1.41		
ACC	1.26434***	.30872	4.10		
Standard deviations of error component					
Sigma*10	5.21697***	.69586	7.50		
Number of respondents / Pseudo R²	283/0.5906				
Log-likelihood / R² adjusted	-763.7/0.5879				
Restricted LL / χ^2	-1865.4/2203.4				

-Interactions with current provision level

-compensation for main effects: untouched, broadleaves 75%, access (high)

-owners consider their current provision

- a lot of heterogeneity also



Appendix: Results - RPL model, forest owners

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