Uniwersytet Warszawski
Warszawski Ośrodek Ekonomii Ekologicznej

Value of non-timber forest products - case of Poland

Marek Giergiczny

Motivation

- This study was conducted for the Main Directorate of State Forest.
- Joint work conducted with prof. Tomasz Żylicz and dr hab. Mikołaj Czajkowski carried out in 2011-2013.
- Part 1:
  - Estimation:
    - recreational benefits provided by forests
    - benefits of picking mushrooms and berries
- Part 2:
  - Testing whether forest characteristics matter to people (CE)

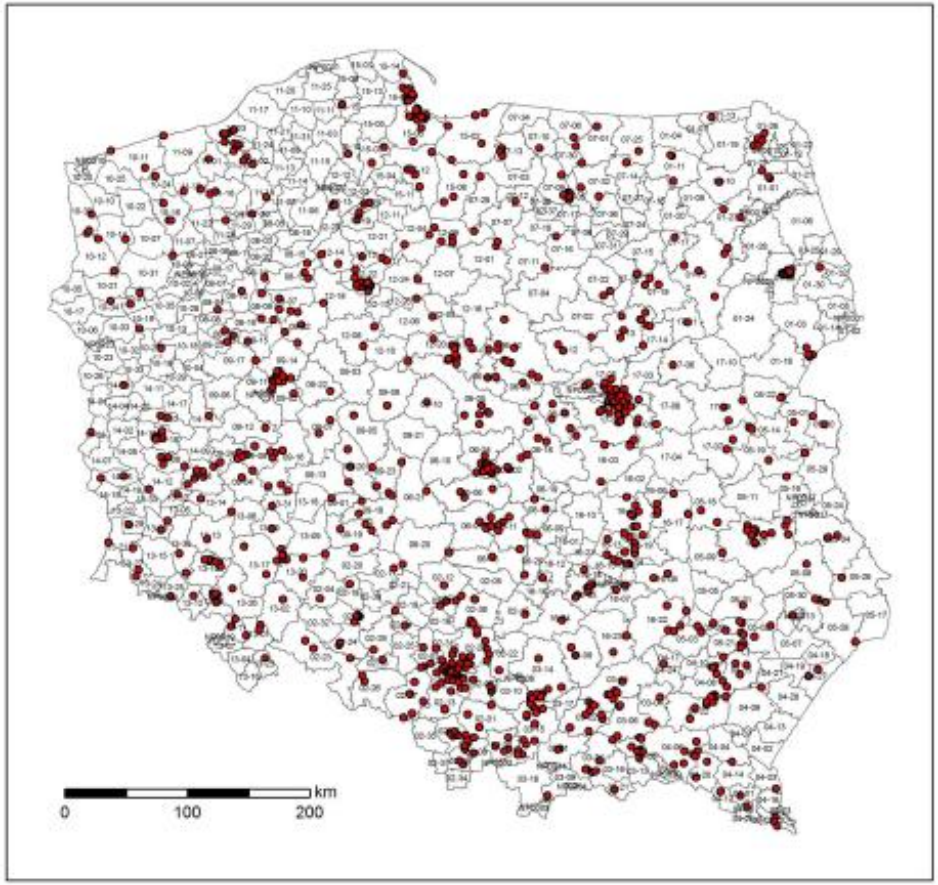
Recreational benefits of Polish forests

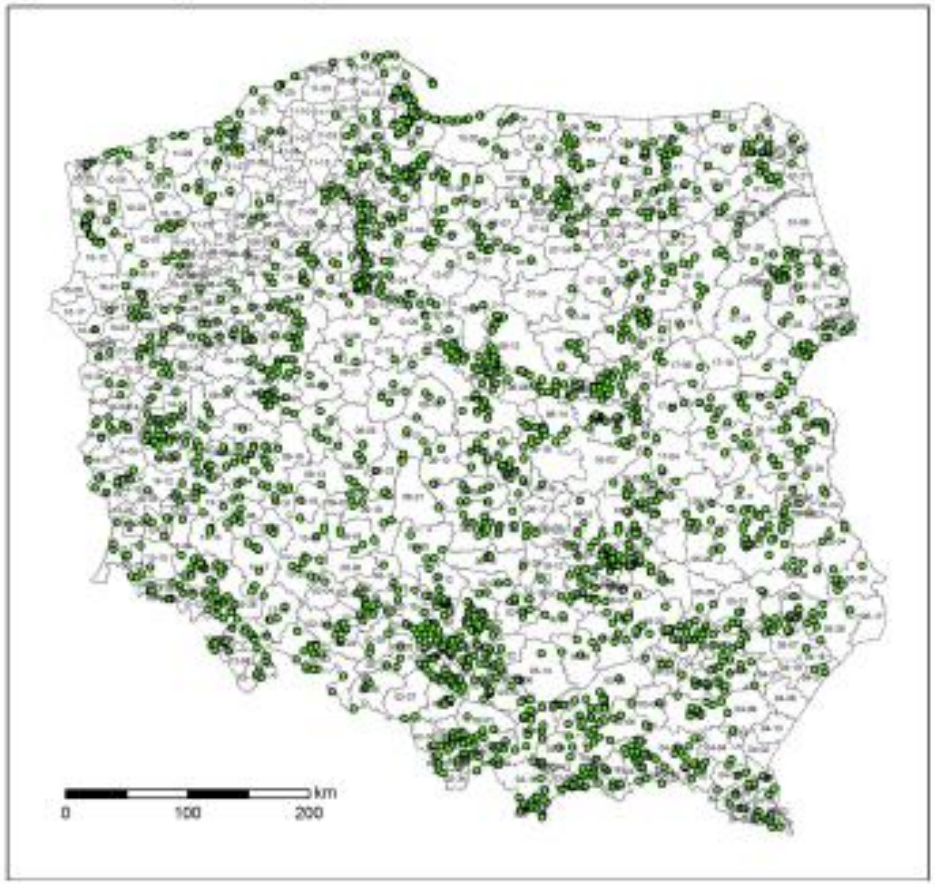
- Sample size 4 000 individuals (OMNIBUS, SMG-KRC)
  - 2 000 were interviewed in April
  - 2 000 were interviewed in October

  - Respondents were asked about their visit to forests in the last 6 months (prior to the interview):
    - which forest they visited (exact location – google maps),
    - Number of visits,
    - Why (motivation),
    - How (mean of transport)

  The sample was representative w.r.t.:
  - gender, age (15-80 years), region, municipality size

Spatial distribution of places in which respondents were interviewed and forests they visited





Forests visits – descriptive statistics

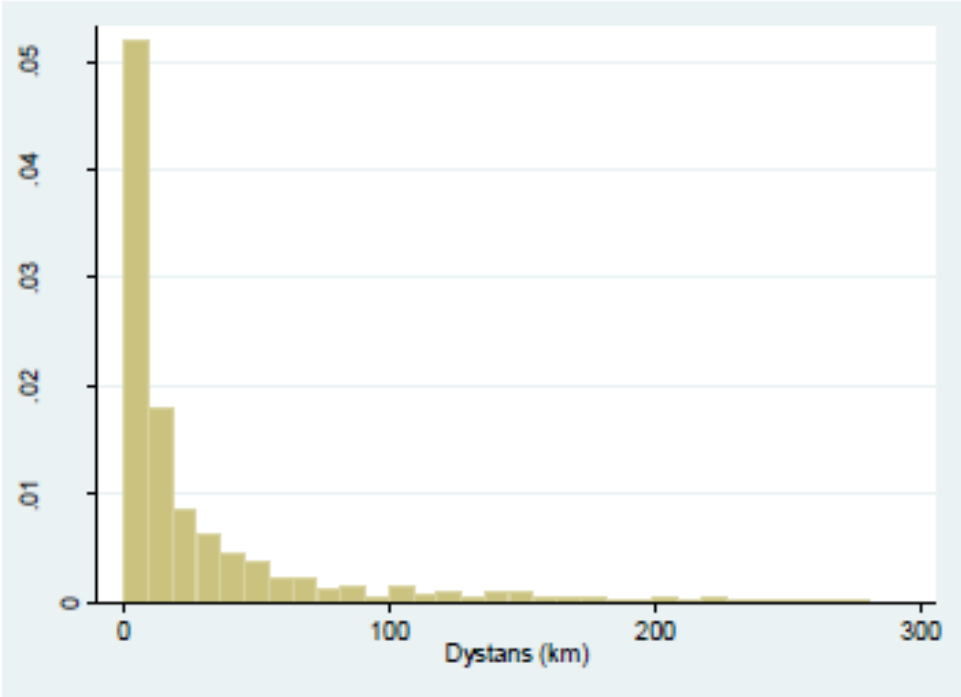
	Yes	Share
Summer (May – October)	1011	50,55
Winter (Nov – April)	678	33,90

	Summer		Winter	
Different forests	Number	Share	Number	Share
1	716	70,82	516	76,11
2	157	15,53	96	14,16
3	85	8,41	40	5,90
4	19	1,88	12	1,77
5 i więcej	34	3,36	14	2,06

	Persons	Mean	S.D.	Min	Max
Summer	1011	9,84	13,73	1	130
Winter	678	8,94	13,35	1	95

Distance travelled – forest visit

Centiles	Distance (both ways)
10	1,5
20	3
30	5
40	7
50	12
60	19
70	30
80	56
90	136



Travel cost method

- Negative binomial model (endogeneity, over-disperssion)

$$Pr\left(x_i \mid x_i > 0\right) = x_i \frac{\Gamma\left(x_i + \alpha^{-1}\right)}{\Gamma\left(x_i + 1\right)\Gamma\left(\alpha^{-1}\right)} \left(\alpha^{x_i} \lambda_i^{x_i - 1}\right)\left(1 + \alpha\lambda_i\right)^{-\left(x_i + \alpha^{-1}\right)}, \quad x_i = 1, 2, \ldots$$

	Poisson Model		**NB Model**	
	Model FE	Model RE	Model FE	Model RE
TC	-0,069 (-9,54)	-0,073 (-12,47)	-0,065 (-5,24)	-0,074 (-6,91)
N	1862			
groups	1441			
CS (zł)/person/visit	14,37 (9,58)	13,54 (12,53)	15,38 (4,89)	13,51 (6,14)

Summary of benefits from recreation and picking berries/mushrooms

Good or Service	Vists/person/year Kg or l/person/year	Total number of visits Total weight of mushr Total volume of berries	Value per unit	Total value mld zł	Value zł/ha
Recreation	8,00 visit/person/year	244,8 mln/year	13,51 zł/os	3,307	363,4
Mushrooms	8,24 kg/per/year	56,41 mln kg/year	5 zł/kg	0,28	30,8
Berries	7,39 l/per/year	12,79 mln l/year	5 zł/l	0,064	7,0
Suma				3,65	401,2

Forest characteristics (Edwards et al. 2012)

1. Stand age: from establishment to maturity
2. Variation in tree size within stand:
   from uniform to diverse. Number of canopy layers: from one to many
3. Variation in tree spacing within stand:
   from regular to different sized groups of trees
4. Extent of tree cover within stand : from sparse (e.g. seed trees) through moderate (e.g. shelter-wood) to full (closed canopy)
5. Visual penetration through stand Distance visible:
   from short to long. Understorey and shrub layer: from dense to absent
6. Density of ground vegetation cover up to 50 cm height within stand Ground cover:
   from absent to dense
7. Number of tree species within stand Number of species: from one to many
8. Size of clear-cuts Size of clear-cuts: from absent to large
9. Residue from harvesting and thinning. Volume of tree stumps, branches and other visible woody residue: from absent to high
10. Amount of natural deadwood (standing and fallen) Volume of deadwood: from low to high
11. Variation between stands along a 5 km trail through forest Number of forest stand types encountered: from one to many
12. 'Naturalness' of forest edges Proportion of 'natural' looking (i.e. not straight) edges: from low to high

Delphi survey

- For each region, a panel of experts with experience of forest preference research was invited to participate anonymously in a questionnaire survey.

- Overall, 46 experts participated:
  - 10 in in Great Britain panel
  - 12 in Nordic panel
  - 14 in the Central Europe panel
  - 10 Iberia panels

Attribute	Relationship to recreational value[a]			
	Great Britain ($n = 10$)	Nordic Region ($n = 12$)	Central Europe ($n = 14$)	Iberia ($n = 10$[b])
1. Size of trees	P	P	P	P
2. Variation in tree size	P	B	P	P
3. Variation in tree spacing	P	P	P	B
4. Extent of tree cover	B	P/B	B	B
5. Visual penetration	B	B	B	P
6. Density of ground vegetation	B	B	B	N
7. Number of tree species	P	P	B	P
8. Size of clear-cuts	N	N	N	N
9. Residue	N	N	N	N
10. Amount of natural deadwood	B	N	B	B
11. Variation between stands	P	B	P	P
12. 'Naturalness' of forest edges	P	P	P	P

P – positive

B – Bell s shape

N – Negative

Attribute importance

Attribute	Ranked mean importance				Overall ranking
	Great Britain	Nordic Region	Central Europe	Iberia	
1. Size of trees	11	12	11.5	10	12
2. Variation in tree size	12	2	6	2	5
3. Variation in tree spacing	9	4	8	1	5
4. Extent of tree cover	7	6	7	7	7
5. Visual penetration	4.5	8	5	12	9
6. Density of ground vegetation	1	1	3	5.5	1
7. Number of tree species	4.5	5	2	8	3
8. Size of clear-cuts	10	10	10	9	11
9. Residue	8	11	1	11	10
10. Amount of natural deadwood	2	7	4	3	2
11. Variation between stands	3	9	11.5	5.5	8
12. 'Naturalness' of forest edges	6	3	9	4	5

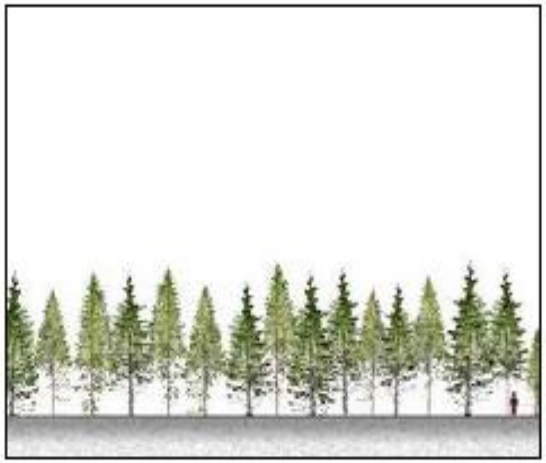
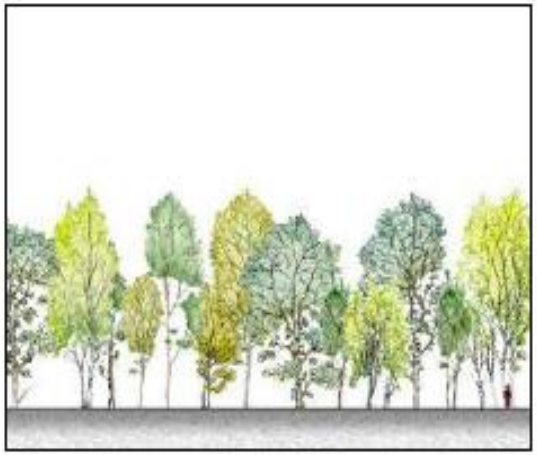
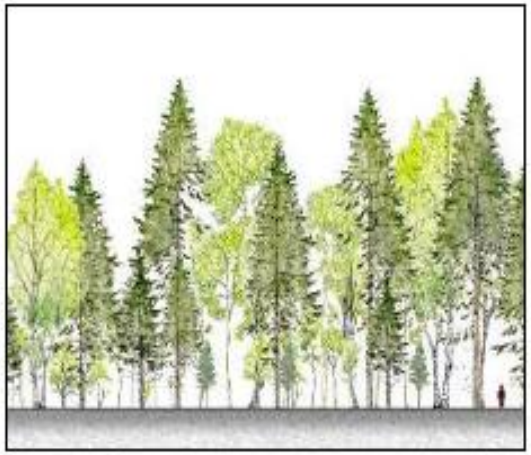
[a] 12 = highest; 1 = lowest.

Forest attributes – CE (1000 respondents)

- Forest type (coniferous, mixed, broadleaved)

- Tree species - (1, 2, 4, 5)
- Age (40, 70, 100 years)
- Age variation (even-aged, two-aged, uneven-aged)
- Density of ground vegetation (low, medium, high)
- Variation in tree spacing (from regular to irregular)
- Naturalness of forest edge (regular and sharp, irregular and sharp, irregular with wide ecotone)
- Volume of deadwood (low, medium, high)
- Forest diversity (the same forest type and age, the same forest type and variation in age, different forest types and variation in age)
- Understorey and shrub layer: from dense to absent
- Management intensity (low, shelterwood, clear-cutting)
- Residue from harvesting and thinning (from absent to high)
- Presence of tourist infrastructure (none, picnicking sites, picnicking sites + educational paths)
- Distance (5, 15, 30, 60 km)

Overlapping attributes

			
Typ lasu	las iglasty	las liściasty	las mieszany
Liczba gatunków	1	4	2
Wiek najstarszych drzew	40 lat	70 lat	100 lat
Zróżnicowanie wieku	las jednowiekowy	las dwuwiekowy	las różnowiekowy

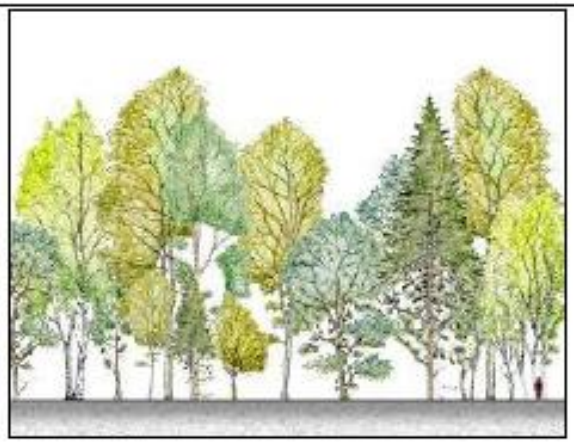
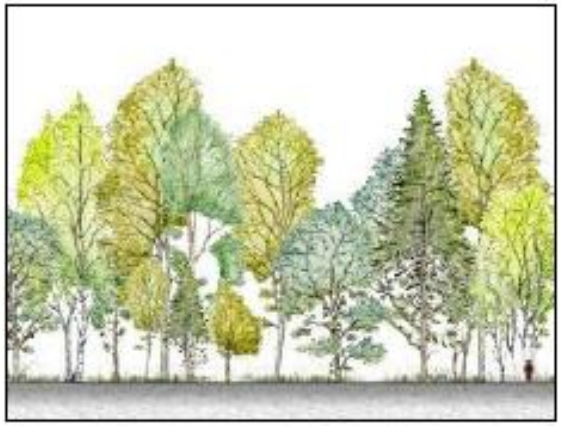
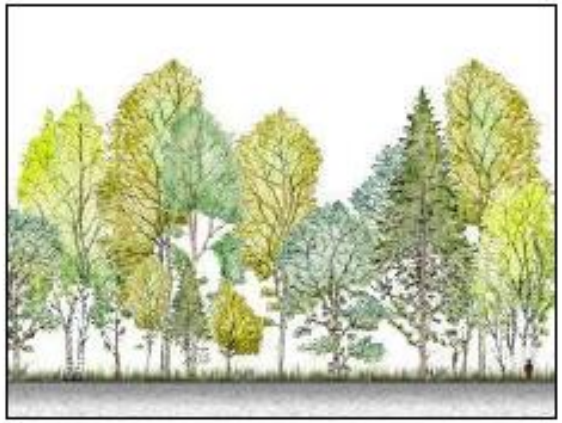
Atrybuty specyficzne dla każdej z 3 części

- W pierwszej części ankiety rozważono następujące trzy cechy:
- **wysokość runa leśnego** (wizualizacja)
- **rozmieszczenie drzew** (ikony)
- **kształt i rodzaj granicy lasu** (ikony)

- W drugiej części badania lasy były opisane za pomocą trzech innych cech, mianowicie:
- **martwego drewna** (wizualizacja)
- **różnorodności lasu** (ikony)
- **pozostałości po pracach leśnych** (ikony)

- A w trzeciej części badania były to:
- **gęstość podszytu** (wizualizacja)
- **Intensywność gospodarki leśnej** (ikony)
- **infrastruktura rekreacyjna i turystyczna** (ikony)

Ground vegetation

		
Brak runa	**Runo średnio-wysokie**	**Runo wysokie**
		

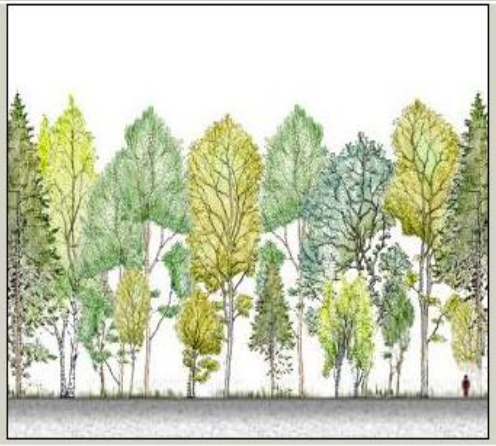
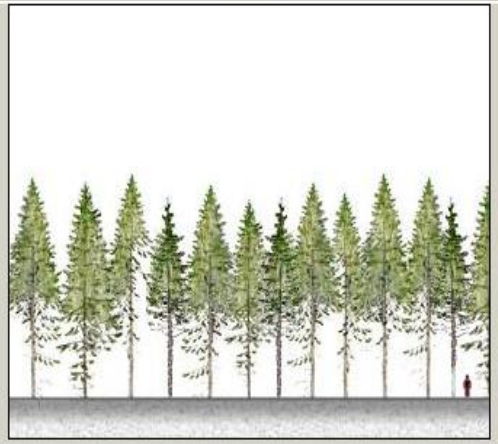
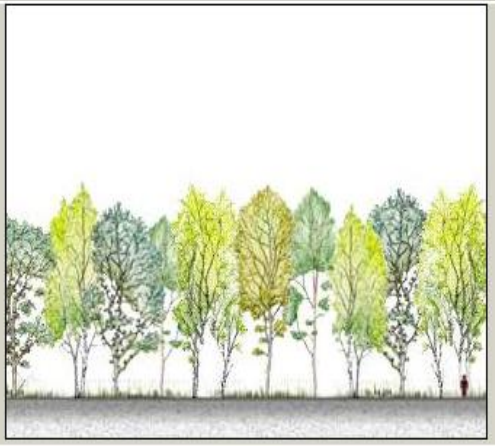
Tree spacing

		
Regularne	**Średnio-regularne**	**Nieregularne**
		

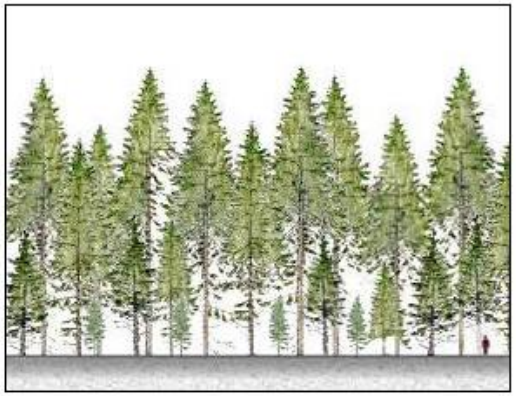
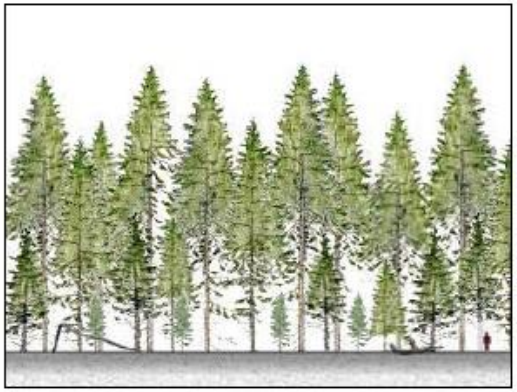
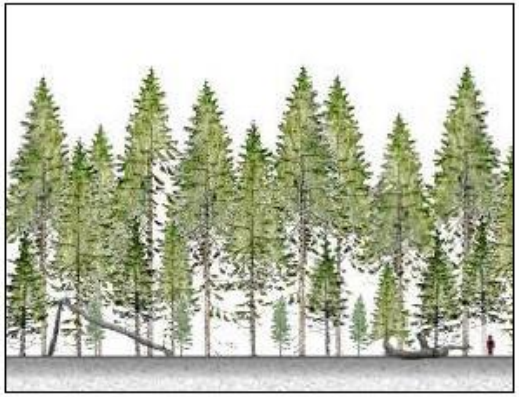
Naturalness of forest edge

		
Regularna granica i wyraźne przejście	Nieregularna granica i wyraźne przejście	Nieregularna granica i stopniowe przejście
		

Choice task example – **part I** (3*10 choice tasks)

	Las 1	Las 2	Las 3	
				
Typ lasu **Liczba gatunków** **Wiek drzew** **Zróżnicowanie wieku** **Runo**	Mieszany 5 gat 100 lat Dwuwiekowy Średnio-wysokie	Iglasty 1 gat 70 lat Jednowiekowy Brak	Lisciasty 4 gat 70 lat Jednowiekowy Średnio-wysokie	**Żaden**
Rozmieszczenie	Średnio-regularne 	Regularne 	Średnio-regularne 	
Granica	Regularna granica i wyraźne przejście 	Nieregularna granica i wyraźne przejście 	Nieregularna granica i stopniowe przejście 	
Odległość	60 km	5 km	15 km	
Twój wybór	○	○	○	○

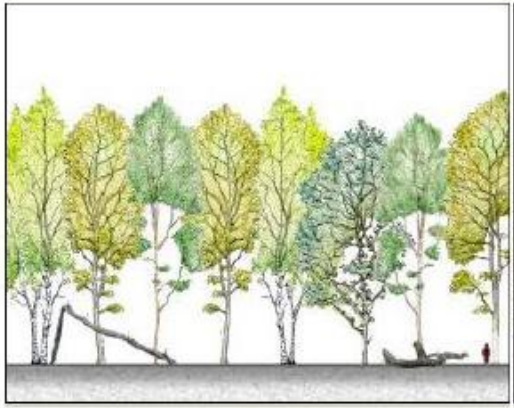
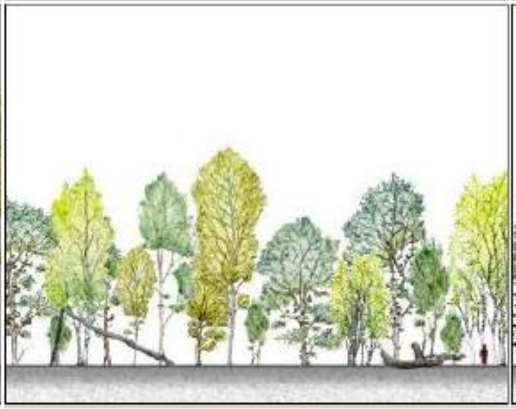
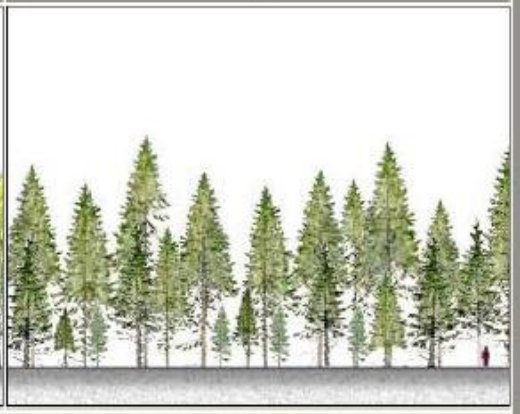
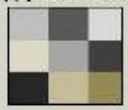
Part II specific attributes

		
Brak	**Średni**	**Wysoki**
		

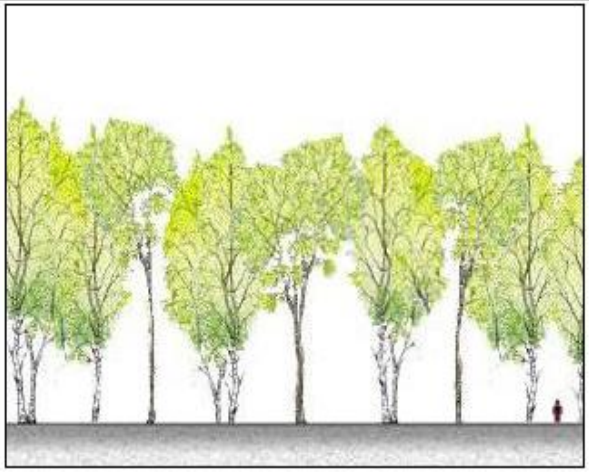
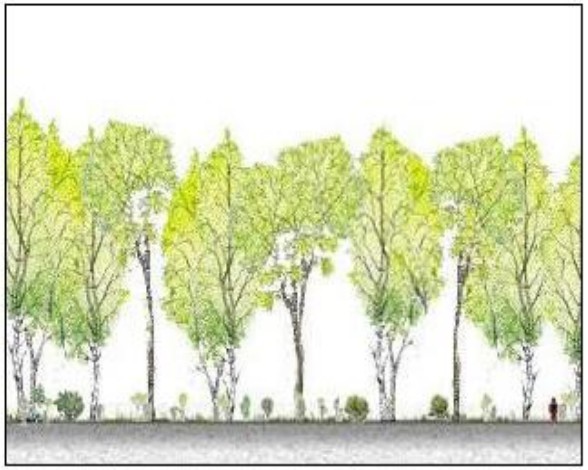
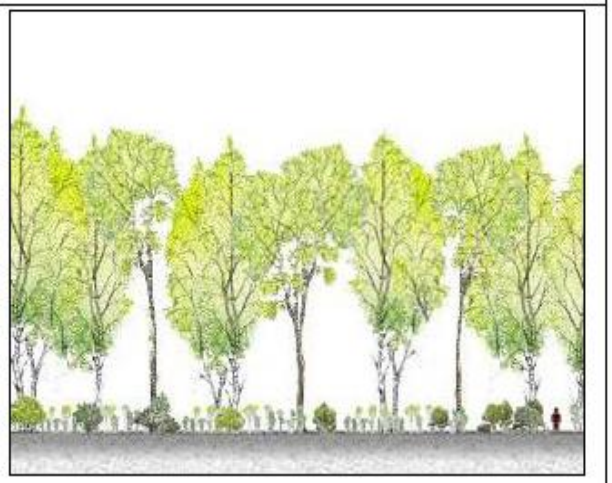
Residue from harvesting and thinning

		
Brak	**Średni**	**Wysoki**
		

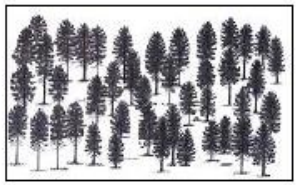
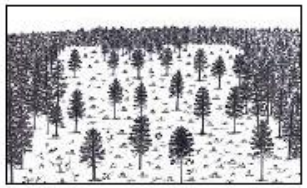
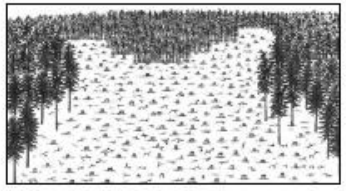
Choice task example – part 2

	Las 1	Las 2	Las 3	
				
Typ lasu **Liczba gatunków** **Wiek drzew** **Zróżnicowanie wieku** **Martwe drewno**	Lisciasty 4 gat 100 lat Jednowiekowy Wysoki	Lisciasty 4 gat 70 lat Różnowiekowy Wysoki	Iglasty 1 gat 70 lat Różnowiekowy Brak	**Żaden**
Różnorodność lasu	Różne typy lasu i różny wiek 	Ten sam typ lasu i różny wiek 	Ten sam typ lasu i różny wiek 	
Pozostałości po pracach leśnych	Średni 	Średni 	Brak 	
Odległość	30 km	30 km	15 km	
Twój wybór	○	○	○	○

Attributes part III – understory density

		
Brak	**Średnia gęstość**	**Wysoka gęstość**
		

Management intensity

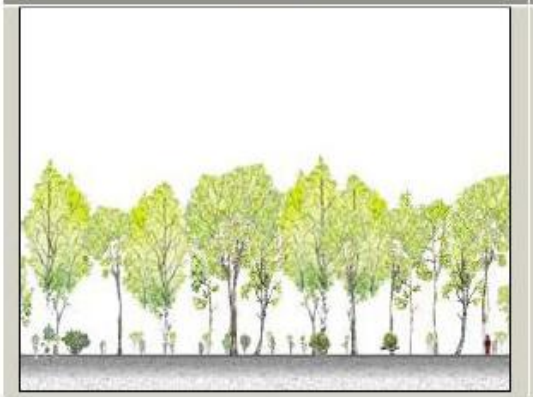
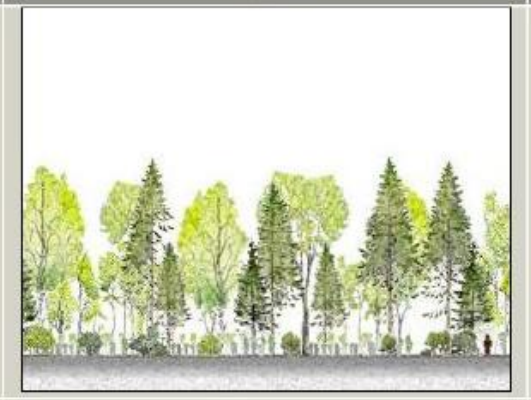
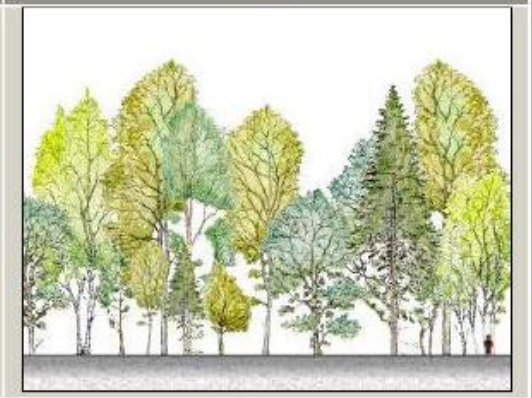
Niski	Średni	Wysoki	Bardzo wysoki
			

Tourist infrastructure

Fig 12. Infrastruktura turystyczna i rekreacyjna

		
Brak	**Średni**	**Wysoki**

Choice task example – part III

	Las 1	Las 2	Las 3	Żade
				
Typ lasu Liczba gatunków Wiek drzew Zróżnicowanie wieku Gęstość podszytu	Lisciasty 1 gat 70 lat Jednowiekowy Średnia gęstość	Mieszany 2 gat 70 lat Dwuwiekowy Wysoka gęstość	Mieszany 5 gat 100 lat Różnowiekowy Brak	
Intensywność gospodarki leśnej	Wysoka 	Bardzo wysoka 	Wysoka 	
Infrastruktura turystyczna i rekreacyjna	Brak 	Średni 	Brak 	
Odległość	5 km	15 km	60 km	
Twój wybór	○	○	○	○

Poziom bazowy	Poziom	MRS	Istotność statystyczna
Brak	Wiaty, miejsca piknikowe i ścieżki dydaktyczne	21,9	***
Wiek (40 lat)	Wiek (100 lat)	14,9	***
Brak	Wiaty i miejsca piknikowe	14,8	***
Iglasty	Mieszany(5 gat.)	11,6	***
Iglasty	Mieszany(2 gat.)	8,7	***
Ten sam typ i wiek	Zróżnicowanie (różny typ, różny wiek)	8,6	***
Wiek (40 lat)	Wiek (70 lat)	7,3	***
Jednowiekowy	Różnowiekowy	6,2	***
Granica regularna i wyraźna	Granica nieregularna-wyraźna	5,4	***
Ten sam typ i wiek	Zróżnicowanie (ten sam typ, różny wiek)	4,6	***
Rozmieszczenie regularne	Rozmieszczenie nieregularne	4,1	***
Iglasty	Liściasty (4 gat.)	3,5	***
Jednowiekowy	Dwuwiekowy	3,2	***
Brak	Martwe drewno (średni poziom)	2,6	**
Brak	Podszyt średnio-gęsty	2,5	**
Brak	Runo średnio-wysokie	1,7	
Rozmieszczenie regularne	Rozmieszczenie średnio-regularne	0,9	
Granica regularna i wyraźna	Granica nieregularna-stopniowa	-0,7	
Brak	Pozostałości po pracach leśnych (średni poziom)	-2,5	**
Iglasty	Liściasty (1 gat.)	-4,0	***
Brak	Runo wysokie	-6,0	***
Brak	Podszyt gęsty	-6,8	***
Niska	Intensywność gosp. leśnej - Rębnia częściowa	-7,5	***
Brak	Martwe drewno (wysoki poziom)	-8,2	***
Niska	Intensywność gosp. leśnej - Drzewa nasienne	-17,0	***
Brak	Pozostałości po pracach leśnych (wysoki poziom)	-20,5	***
Niska	Intensywność gosp. leśnej - Zrąb zupełny	-29,0	***

Ignored attributes

Ignored attribute	Number of respondents
Ground vegetation	98
Forest type	113
Distance	120
Forest diversity	128
Understorey density	140
Tree spacing	143
Management intensity	145
Age	210
Tree species	213
Age variation	215
Tourist infrastructure	218
Natural deadwood	255
Forest edge	360

Results – summary

Attribute	CE	Experts	MRS (km)	MRS - Rank
Forest type	1	-	15,6	4
Age	2	1	14,9	5
Ground vegetation	3	9	7,7	9
Forest diversity	4	1	8,6	8
Tree spacing	5	5	4,1	12
Understorey density	6	7	9,3	7
Management intensity	7	3	29	1
Tourist infrastructure	8	-	21,9	2
Residue from harvesting and thinning	9	11	20,5	3
Age diversity	10	6	6,2	10
Natural dead wood	11	8	10,8	6
Forest edge	12	4	6,1	11

Conclusions

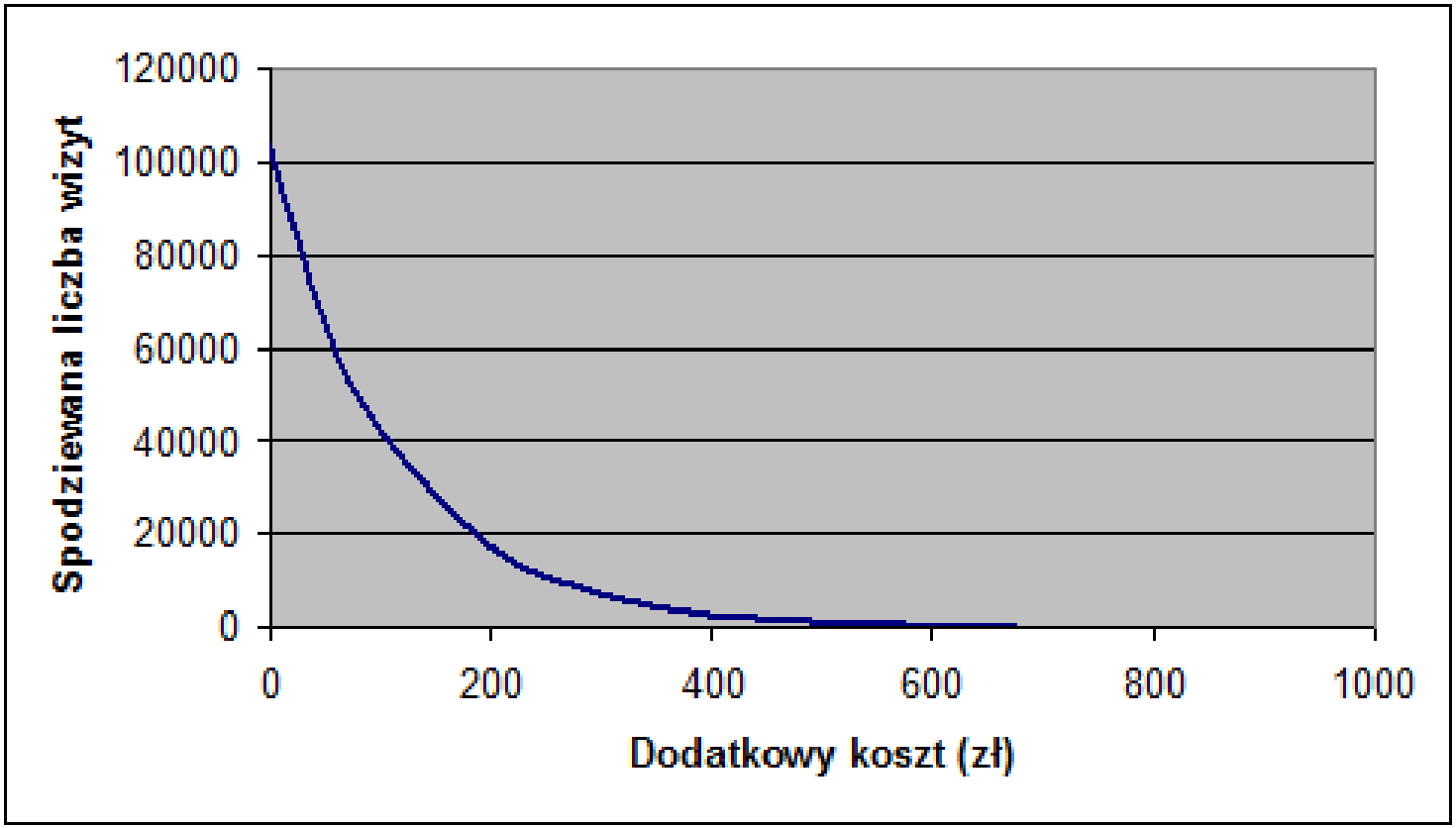
- In terms of use value, NTFP and timber forest products give benefits of similar magnitude (i.e. 700 zł/ha – timber and 401 zł/ha – recreation+ mushroom and berries)

- We find high correlation between social and nature functions
- Experts' views and true respondents' preferences substantially diverge
- Simple assigning weights and ordering attributes based on weights is likely to lead to wrong policy conclusions
- Strength of preferences has to be taken into account (MRS)

The Bialowieza forest – TCM application

year	Timber (1000 m3)	Revenue	Profit	Nature protection spending	Sum
2000	120	4 315 224	128 444	151 711	280 155
2001	122	3 688 107	79 981	182 370	262 351
2002	110	4 168 696	253 229	201 775	455 004
2003	140	5 219 851	-122 242	573 009	450 767
2004	145	3 616 943	54 033	643 932	697 965
Mean	**127,4**	**4 201 764**	**78 689**	**350 559**	**429248**

The Bialowieza forest – demand curve



Consumer curplus 11.5 mln zł/year, whereas the mean revenue 4.2 mln/year

The Bialowieza forest national vs. local preferences

	Option A:	Option B:	Option C:
	Status Quo	Extension of the National Park	Other Form of Protection
Natural Ecological Proceses	**no change –** protection of natural ecological proceses at 16% of the forest area	**no change –** protection of natural ecological proceses at 16% of the forest area	**no change –** protection of natural ecological proceses at 16% of the forest area
Rare Species of Fauna and Flora	**no change –** decline threatening *extinction*	**substantial improvement –** better condition of current *standings and their* expansion	**partial improvement –** maintaining and better condition of current standings
Ecosystem Components	**no change –** lack of some components and decrease in quality of the existing ones	**minor improvement –** regeneration of deteriorated components on 10% of the forest area	**partial improvement –** regeneration of deteriorated components on 30% of the forest area
Cost – your tax increase (yearly)	0 zł	50 zł	10 zł
CHOICE	☐	☐	☐

The Bialowieza Forest - Choice experiment (Mikolaj)

	WTP	s.e.
National	82.3	18,7
Podlaskie	68.9	21,2
Bialowieza	-8.3	-12,9
Sample size	400 National level, 50 Region level, 50 Local level	

The Bialowieza forest – CE (Polforex)

Results

- Three groups (sample sizes):
  - National - 900
  - Regional - 100
  - Local - 100

	WTP	S.E
Polska	76,83	7,45
Podlaskie	62,92	14,38
Białowieża	-47,73	15,24