

INFORMED Workshop on methodologies to design global change scenarios (GCS) for the Mediterranean forests

1-2 December, Solsona, Spain

Ecosystem services economic evaluation: information needs and constraints in using the estimated values.

Results of the LIFE project GESTIRE



Davide Pettenella
and Mauro Masiero

In the GESTIRE research group Mara Thiene, Riccardo Scarpa, Stefania Mattea and Cristiano Franceschinis were providing essential inputs

Outline

Background information

a. Literature review

b. Summary matrix

c. Choice experiment

d. Benefit transfer

e. Assessment of market products and services

Final considerations

Non-market
services

Outline

Background information

- a. Literature review
 - b. Summary matrix
 - c. Choice experiment
 - d. Benefit transfer
 - e. Assessment of market products and services
- Final considerations


Background info

- LIGE GESTIRE: EU LIFE+ projects for the management of Natura 2000 network in Europe (Prioritised Actions Framework)
- Budget (2012-2015): 3.26 M Euro
- Main objectives:
 - **Participated system** for managing the Natura 2000 network at regional level and improving its conservation status (species and habitats)
 - **Strategic Plan** for managing and financing (regional, national, EU funds) the Network over the next 10 years
 - Improved community **awareness**

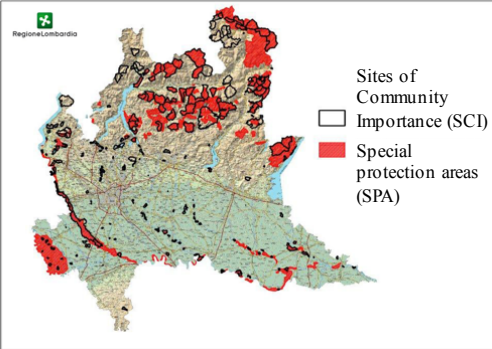
http://www.life-gestire.eu/en1_index.aspx

Background info: geographical scope

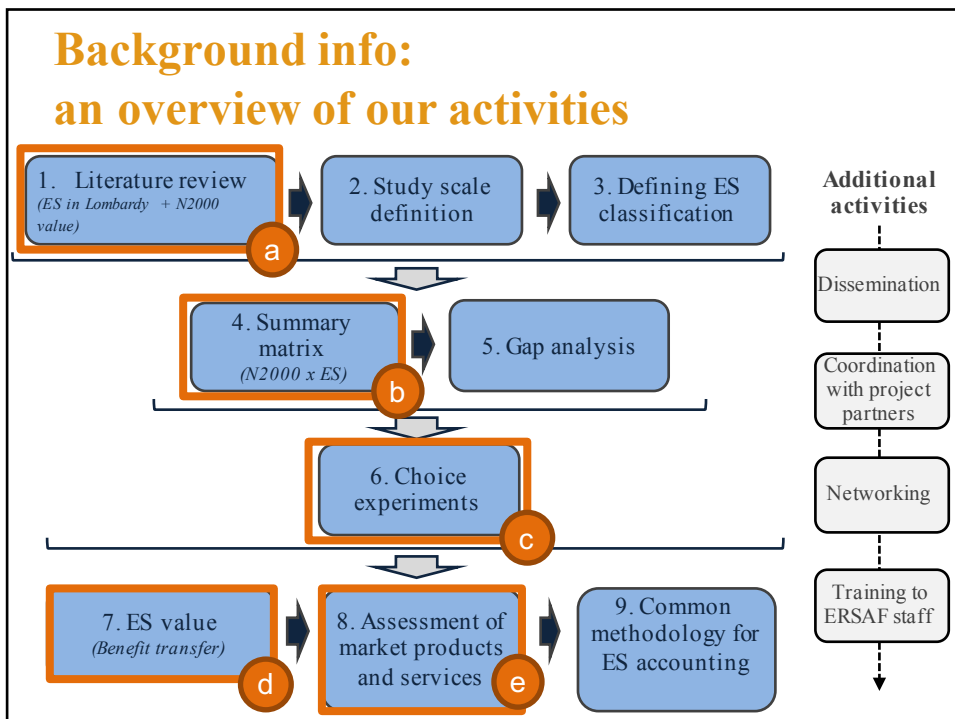
Lombardy



Natura 2000 network of protection areas in Lombardy



242 sites
 Total area: **372,000 ha** (16% of regional area)
30% = forests
 2008-2011 average management costs = **20 million €/yr.**



Outline

Background information

- a. Literature review
 - b. Summary matrix
 - c. Choice experiment
 - d. Benefit transfer
 - e. Assessment of market products and services
- Final considerations

a. Literature review

146 studies/reports collected, analyzed and organized under a database:

#	Servizio Ecosistemico	Alpha NE	Tipologia di Ecosistema	Gruppo	Sito	Regione	Metodologia	Valore	Unità	Anno	Valore €2014	Unità2	Fonte	
1	Ricreazione	C2	Lago		Lago d'Iseo	L	TC		134	€/persona	2005	159,97	€/persona	Paccagnan (2005)
2	Fissazione del carbonio	R1	Foresta	Foreste in Lombardia	Lombardia	L	costate NEE registrate		4,6	TgCO2/anno	2007			Ossola (2007)
3	Biodiversità'	R9	Produzioni vegetali agricole estensive (prato permanente)	Seminativi coltivati in Lombardia	Lombardia	L	Indennizzo (mancati redditi e maggiori costi)	270,00	€/ha	2007	310,23	€/ha	Allegati PSR Lombardia 2007-2013 (2007)	
4	Fidejussione e biodiversità' (corridoi ecologici)	R4, R9	Filari, siepi e fasce tampone boscate	Planura lombarda	Lombardia	L	Indennizzo (mancati redditi e costi di manutenzione)	525,00	€/ha	2007	603,23	€/ha	Allegati PSR Lombardia 2007-2013 (2007)	
5	Fidejussione e biodiversità' (corridoi ecologici)	R4, R9	Filari, siepi e fasce tampone boscate	Collina e montagna lombarda	Lombardia	L	Indennizzo (mancati redditi e costi di manutenzione)	450,00	€/ha	2007	517,05	€/ha	Allegati PSR Lombardia 2007-2013 (2007)	
6	Biodiversità'	R9	Fascia di rispetto e fosso adiacente a risaie	Risale lombarde	Lombardia	L	Indennizzo (mancati redditi e maggiori costi)	da 135,00 a 165,00	€/ha	2007	da 155,00 a 190,00	€/ha	Allegati PSR Lombardia 2007-2013 (2007)	
7	Biodiversità'	R10	Praterie di montagna (ad alto valore naturalistico)	Prati permanenti di montagna	Lombardia	L	Indennizzo (maggiori costi e maggiori oneri)	87,00	€/ha	2007	99,96	€/ha	Allegati PSR Lombardia 2007-2013 (2007)	
8	Biodiversità'	R11	Praterie di montagna (ad alto valore naturalistico)	Praterie di collina e montagna	Lombardia	L	Indennizzo (maggiori costi e maggiori oneri)	da 149,00 a 174,00	€/ha	2007	da 171,00 a 200,00	€/ha	Allegati PSR Lombardia 2007-2013 (2007)	
9	Fertilità' del suolo	R9	Suoli agrari	Suoli agrari	Lombardia	L	Indennizzo (mancati redditi e maggiori costi)	da 190,00 a 360,00	€/ha	2007	da 218,00 a 413,64	€/ha	Allegati PSR Lombardia 2007-2013 (2007)	
10	Regolazione dei disturbi e regolazione del clima	R5, R2	Foresta (imboschimento delle superfici agricole)	Boschi permanenti a scopo ambientale o protettivo	Lombardia	L	Indennizzo (mancati redditi e maggiori costi)	700,00	€/ha	2007	804,3	€/ha	Allegati PSR Lombardia 2007-2013 (2007)	
11	Regolazione dei disturbi e regolazione del clima	R5, R2	Foresta (imboschimento delle superfici agricole)	Arboricoltura da legno a ciclo medio/lungo	Lombardia	L	Indennizzo (mancati redditi e maggiori costi)	da 440,00 a 700,00	€/ha	2007	da 505,56 a 804,30	€/ha	Allegati PSR Lombardia 2007-2013 (2007)	
12	Bellezza paesaggistica	C1	Foreste urbane (alberi ornamentali di cipressi)	Foreste urbane (alberi ornamentali di cipressi)	Lago di Garda	T	VC (Individual WTP)	da 1,11 a 1,28	€/persona	2010	da 1,2 a 1,4	€/persona	Notaro_DeSalvo(2010)	
13	Bellezza paesaggistica	C1	Foreste urbane (alberi ornamentali di cipressi)	Foreste urbane (alberi ornamentali di cipressi)	Lago di Garda	T	(annual WTP) (valore turistico)	da 2.839,865 a 3.274,799	€/anno	2010	da 3080 a 3552	€/anno	Notaro_DeSalvo(2010)	
14	Bellezza paesaggistica	C1	Foreste urbane (alberi ornamentali di cipressi)	Foreste urbane (alberi ornamentali di cipressi)	Lago di Garda	T	(totale)	da 100 a 150 milioni	€	2010	da 108 a 163 milioni	€	Notaro_DeSalvo(2010)	
15	Qualità' dell'acqua	R4	Uso irriguo: cereali, frutteti		Bacino del Po	varie	VM	da 309 a 3.682	€/ha	2004	da 373,89 a 4453,22	€/ha	Massarutto_et_al(2005)	

- 23 docs specific for Lombardy areas (16%); the rest is for areas with similar characteristics
- Almost none out of 146 specifically addressing Natura 2000 issues

Outline

Background information

a. Literature review

b. Summary matrix

c. Choice experiment

d. Benefit transfer

e. Assessment of market products and services

Final considerations

b. Summary matrix (1/2)

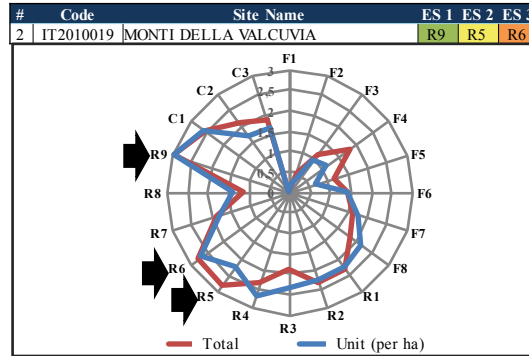
Identification of the **3 main potential ecosystem services (ES)** for each Natura2000 site, i.e. habitat likely to deliver ES (1 low; 2 medium; 3 high), based on:

- habitat type(s) and extension (ha)
- previous studies and assessment/scoring exercises - Bastian *et al.* (2012), Schirpke *et al.* (2013) + WG discussion & elaborations
- habitat state of conservation
- habitat ES density, i.e. higher unit potential (i.e. per ha) - MGN (2014)
- intrinsic heterogeneity and biodiversity (e.g. priority habitats)

b. Summary matrix (2/2)

ES codes:

F1	Crops
F2	Fodder and grazing
F3	Game and fish species
F4	Raw materials (wood, fibers..)
F5	NTFPs
F6	Medicinal plants
F7	Genetic resources
F8	Drinkable Water
R1	Carbon sequestration
R2	Climate regulation (local scale) and water quality
R3	Water-cycle regulation
R4	Water purification
R5	Protection against erosion and landslides
R6	Hydrogeological services
R7	Pollination
R8	Biological pest control
R9	Biodiversity habitats
C1	Aesthetic value
C2	Tourism and recreation
C3	Cultural, education and spiritual value



Summary matrix (data are available for all 242 sites):

#	Code	Site Name	Prov.	Type	Region	ES 1	ES 2	ES 3	ES 4	ES 5	ES 6	ES 7	ES 8	ES 9
1	IT2010018	MONTE SANGIANO	VA	pSCI	Alpine	C1	R9	C2						
2	IT2010019	MONTI DELLA VALCUVIA	VA	pSCI	Alpine	R9	R6	R5						
3	IT2010020	TORBIERA DI CAVAGNANO	VA	pSCI	Cont.	R6	R9	C3						
4	IT2010021	SABBIE D'ORO	VA	pSCI	Cont.	F4	R3	R5	R6	C1	C3	F3	F7	F8
5	IT2010022	ALNETE DEL LAGO DI LAGO DI VARESE	VA	pSCI	Cont.	F4	R3	R5	R6	C1	C3	F3	F7	F8
6	IT2020010	LAGO DI SEGRINO	CO	pSCI	Alpine	C1	R7	R9						

Outline

Background information

a. Literature review

b. Summary matrix

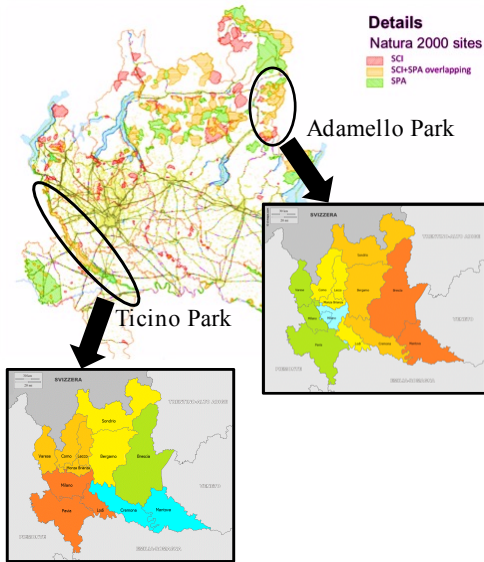
c. Choice experiment

d. Benefit transfer

e. Assessment of market products and services

Final considerations

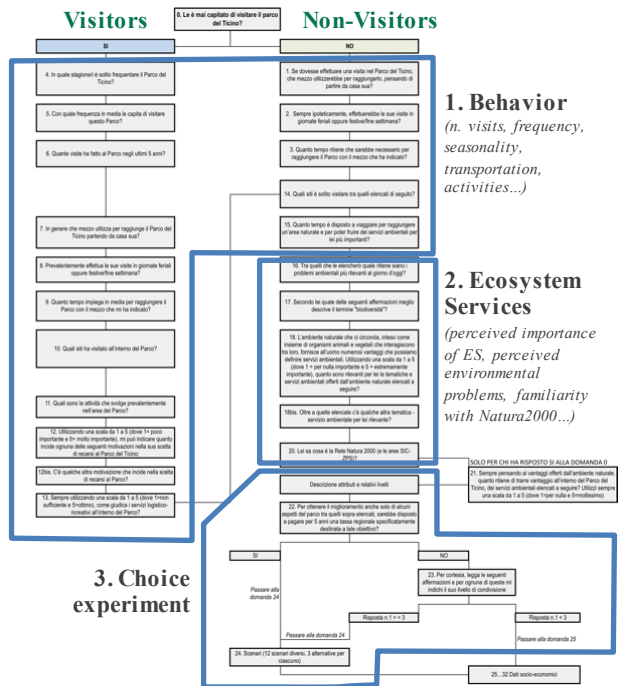
c. Choice experiment (1/11)



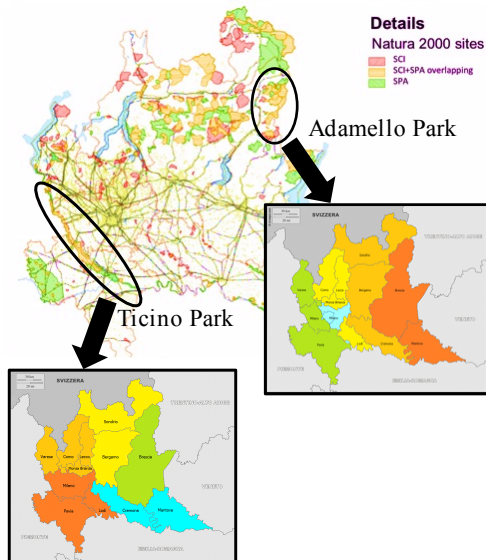
- 2 on-line questionnaires, with different panels (1,500 + 1,500)
- preliminary pilots (30 + 30)
- target: residents, 18-65 years old
- sample stratification according to socio-economic characteristics and distance from assessed areas (5 zones)
- different interview paths for visitors and non-visitors

General structure of the choice experiment questionnaire for Ticino Park

Questionario Progetto Life+ GESTIRE: Esperimenti di scelta (Parco del Ticino) - STRUTTURA



c. Choice experiment (2/11)



- 2 on-line questionnaires, with different panels (1,500 + 1,500)
- preliminary pilots (30 + 30)
- target: residents, 18-65 years old
- sample stratification according to socio-economic characteristics and distance from assessed areas (5 zones)
- different interview paths for visitors and non-visitors
- WTP for a 5 years new Regional Tax to improve quality of ecosystem services in the area(s)

c. Choice experiment (3/11) Attributes: Adamello Park

Attributes	Abbreviation	Levels
Slope Stability	STAB_10	10 km safe roads (1/6 on 60 km) (baseline)
	STAB_20	20 km safe roads (1/3)
	STAB_35	35 km safe roads (7/12)
	STAB_45	45 km safe roads (9/12)
Flora Conservation	CON_0	0 ha meadows managed (baseline)
	CON_200	200 ha meadows managed (1/16)
	CON_250	250 ha meadows managed (1/13)
	CON_300	300 ha meadows managed (1/11)
Fauna	FAUN_2	2 fauna sighting sites (baseline)
	FAUN_5	5 fauna sighting sites (+3)
	FAUN_7	7 fauna sighting sites (+5)
	FAUN_10	10 fauna sighting sites (+8)
Recreation	FLOR_1	1 floristic trail (baseline)
	FLOR_2	2 floristic trails (+1)
	FLOR_4	4 floristic trails (+3)
	FLOR_6	6 floristic trails (+5)
Landscape	SEC_450	450 ha dry-stone wall in good state (baseline)
	SEC_453	453 ha dry-stone wall in good state (+3 ha)
	SEC_455	455 ha dry-stone wall in good state (+5 ha)
Tax	COST	Regional Tax (0€, 2€, 5€, 10€, 15€, 20€)

c. Choice experiment (4/11)

Attributes: Ticino Park

Attributes	Abbreviation	Levels
Carbon sequestration	RCO_0	0% CO ₂ emission reduction (baseline)
	RCO_5	5% CO ₂ emission reduction (-0,42 tCO ₂ /yr./inhab.)
	RCO_10	10% CO ₂ emission reduction (-0,84 tCO ₂ /yr./inhab.)
	RCO_20	20% CO ₂ emission reduction (-1,67 tCO ₂ /yr./inhab.)
Water quality	WATQ_2	Ticino River water quality (2 indicator species) (baseline)
	WATQ_3	Ticino River water quality (3 indicator species) (+1)
	WATQ_4	Ticino River water quality (4 indicator species) (+2)
Biodiversity	MAR_320	320 ha water meadow (baseline)
	MAR_400	400 ha water meadow (+80ha)
	MAR_450	450 ha water meadow (+130ha)
Landscape	BVED_0	0 scenic views with screened detractors (0 on 25) (baseline)
	BVED_6	6 scenic views with screened detractors (1/4)
	BVED_8	8 scenic views with screened detractors (1/3)
	BVED_12	12 scenic views with screened detractors (1/2)
Recreation	ITIN_62	62 thematic trail (baseline)
	ITIN_65	65 thematic trail (+3)
	ITIN_67	67 thematic trail (+5)
Tax	COST	Regional Tax (0€, 2€, 5€, 10€, 15€, 20€)

c. Choice experiment (5/11)

Choice sets

120 choice sets → 10 x 12 independent sub-sets
(12 scenarios per interview, randomized distribution)

An example for
a scenario for
the Adamello
Park

Attributes	Alternatives		
	A	B	C
Slope stability, safe roads	20 km	10 km	45 km
Flora conservation	250 ha	0 ha	250 ha
Fauna sighting sites	2 sites	7 sites	5 sites
Floristic trails	6 trails	6 trails	2 trails
Dry-stone walls	455 ha	453 ha	450 ha
Tax (5 years)	5 €	5 €	10 €
Choice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Adamello Park → 17.532 (12×1.461) observations

Ticino Park → 17.484 (12×1.457) observations

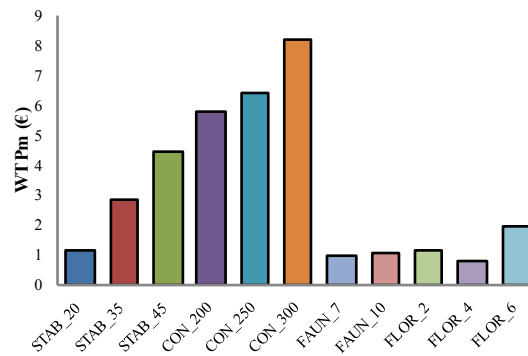
c. Choice experiment (6/11) Results: Multinomial Logit (MNL) Model

MNL Model for Adamello Park (17,532 obs.)

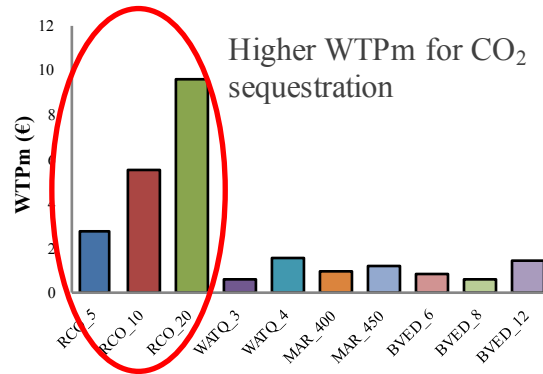
Choice	Coefficient	Std. Error	z	95% Confidence Interval		WTP _m	Significance
COST	-0,108	0,002	-71,31	-0,111	-0,105		***
STAB_20	0,125	0,027	4,67	0,072	0,177	1,156	***
STAB_35	0,305	0,027	11,32	0,252	0,358	2,828	***
STAB_45	0,478	0,026	18,54	0,428	0,529	4,433	***
CON_200	0,621	0,028	22,21	0,566	0,676	5,751	***
CON_250	0,693	0,029	24,30	0,637	0,748	6,417	***
CON_300	0,884	0,027	33,31	0,832	0,936	8,193	***
FAUN_5	0,015	0,028	0,54	-0,039	0,069	0,137	
FAUN_7	0,098	0,027	3,66	0,046	0,151	0,912	***
FAUN_10	0,116	0,026	4,48	0,065	0,166	1,071	***
FLOR_2	0,118	0,027	4,33	0,065	0,171	1,093	***
FLOR_4	0,082	0,027	3,00	0,028	0,135	0,758	***
FLOR_6	0,201	0,026	8,12	0,158	0,258	1,925	***
SEC_453	0,001	0,022	0,04	-0,042	0,044	0,009	
SEC_455	0,001	0,022	0,43	-0,033	0,052	0,087	

Note: ***, **, * = 99%, 95% and 90% significance

Individual mean WTP (WTP_m) for selected ecosystem services in Adamello Park



Individual WTP (WTPm) for selected ecosystem services in Ticino Park



c. Choice experiment (9/11) Results: summary of average WTP values

Adamello Park

Attributes	Abbreviation	Average WTP (€)
Slope Stability	STAB_10	-
	STAB_20	2.71
	STAB_35	2.28
	STAB_45	7.64
Flora Conservation	CON_0	-
	CON_200	7.62
	CON_250	9.15
	CON_300	15.01
Fauna	FAUN_2	-
	FAUN_5	1.05
	FAUN_7	2.11
	FAUN_10	2.92
Recreation	FLOR_1	-
	FLOR_2	1.45
	FLOR_4	1.62
	FLOR_6	4.55
Landscape	SEC_450	-
	SEC_453	-0.86
	SEC_455	0.72

Ticino Park

Attributes	Abbreviation	Average WTP (€)
Carbon sequestration	RCO_0	-
	RCO_5	8.30
	RCO_10	13.42
	RCO_20	24.75
Water quality	WATQ_2	-
	WATQ_3	-0.57
	WATQ_4	-0.38
Biodiversity	MAR_320	-
	MAR_400	0.83
	MAR_450	2.02
Landscape	BVED_0	-
	BVED_6	1.33
	BVED_8	-2.09
	BVED_12	2.86
Recreation	ITIN_62	-
	ITIN_65	-1.56
	ITIN_67	-0.05

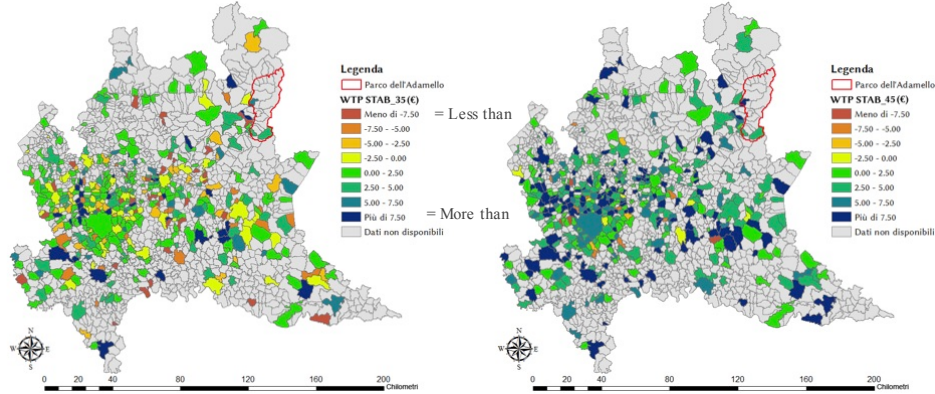
c. Choice experiment (10/11)

Results: mapping WTP values (a)

Adamello Park: WTP for slope stability

Attribute: safe roads, Level: 35 km

Attribute: safe roads, Level: 45 km



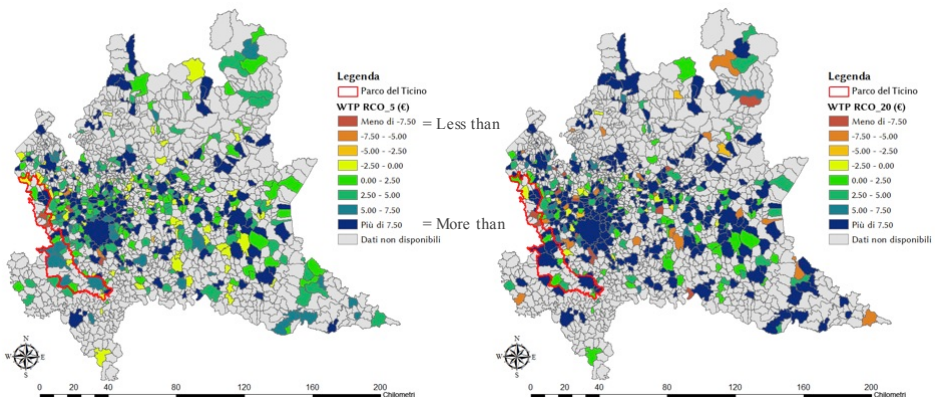
c. Choice experiment (11/11)

Results: mapping WTP values (b)

Ticino Park: WTP for CO₂ sequestration

Attribute: CO₂ reduction, Level: 5%

Attribute: CO₂ reduction, Level: 20%



Outline

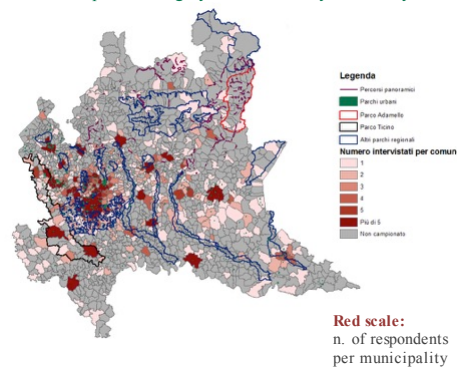
Background information

- a. Literature review
 - b. Summary matrix
 - c. Choice experiment
 - d. Benefit transfer**
 - e. Assessment of market products and services
- Final considerations

d. Benefit transfer (1/3)

- **Benefit Function Transfers (BFT)** to transfer WTP values to areas not covered by the surveys
- Identification of socio-economic, territorial and environmental variables that might influence WTP → forecast of WTP values in areas not covered
- **Multiple regression** and least squares method

Adamello Park: no. of interviews per Municipality
→ Municipalities in grey: not covered by the survey



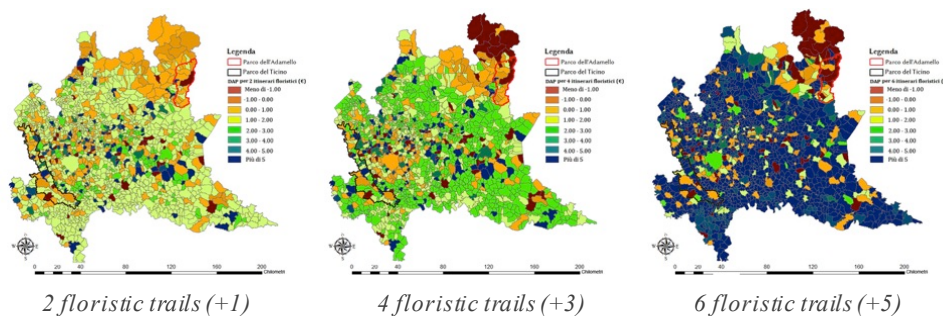
d. Benefit transfer (2/3)

About **60 variables** considered:

- (13) Socio-demographic per respondent (*e.g. age, gender, education, n. family members, annual income...*)
- (28) Socio-demographic for all municipalities in Lombardy (*e.g. total population, population density, education levels, employed people, income levels...*)
- (14) Geographic and territorial for all municipalities in Lombardy (GIS-based) (*e.g. land cover, log distance from the 2 Parks, log distance from the closest protected area, log distance from the closest urban green area...*)

d. Benefit transfer (3/3) Preliminary results

An example: BFT for Adamello Park, Floristic trails



Outline

Background information

- a. Literature review
 - b. Summary matrix
 - c. Choice experiment
 - d. Benefit transfer
 - e. Assessment of market products and services**
- Final considerations

e. Assessment of market products and services

Analysis at 3 scales:

- All the Region
- Protected areas
- Natura 2000 sites

	Consumed production	Total production	Notes
Industrial wood	Removals * unit market prices	NAI * unit prices	2 separate evaluations: standing prices and roadside prices
Fuelwood			
Forage (pasture)	No heads * days * daily consumption * price feed unit	-	
Chestnut	-	Land cover * production * price	
Mushroom	No. permits * 2 kg * price daily permit	-	Use of a factor to consider free riders and locals
Carbon sink	-	NAI * BEF * price C	Two evaluations made with two prices
Water	-	No. springs * flow rate * water tariff	

Outline

Background information

- a. Literature review
- b. Summary matrix
- c. Choice experiment
- d. Benefit transfer
- e. Assessment of market products and services

Final considerations

Take home message

- **Large no. of ES**, still not a common understanding of their components → **need of ES ranking and defining priorities** (almost impossible to calculate the TEV)
- **Scale** is a variable of **fundamental importance** (ES at which scale? value for whom?)
- **High variability of preferences** by respondents
- BFT: **a powerful tool** to be used carefully. Preliminary results but further research needed → (i) variables influencing WTP, (ii) spatial econometrics
- Market values: attention to the **place of reference along the value chain** (standing trees, roadside, final market), to **potential vs. real use** → mistakes in **data aggregation**
- Inputs for policy makers: **connect the value of ES** (non-market + market) to a systematic **cost accounting system** → investment in ES conservation (no regret policies, cost of inaction)