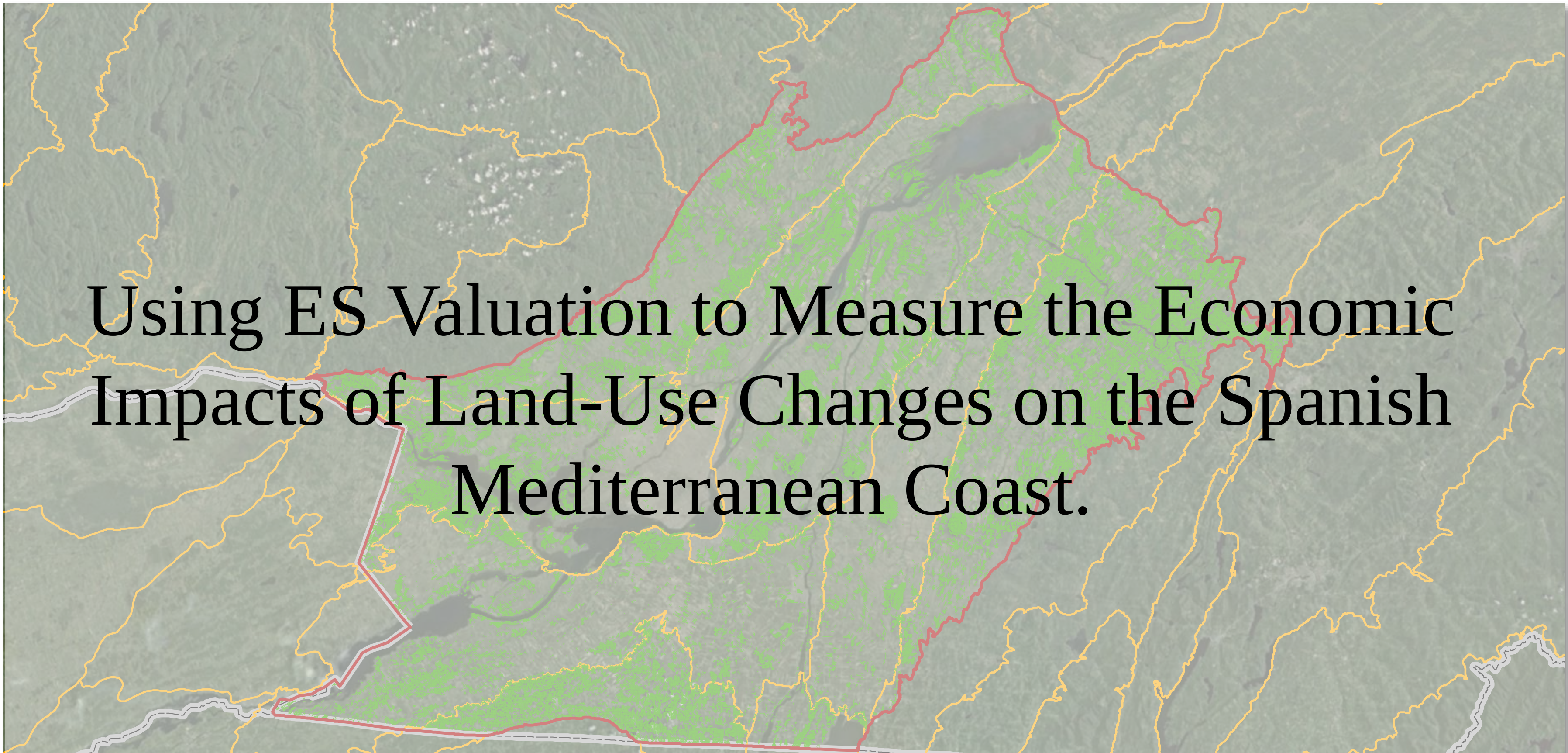
A Community on Ecosystem Services – Washington, D.C.
December 10th 2014



Using ES Valuation to Measure the Economic Impacts of Land-Use Changes on the Spanish Mediterranean Coast.

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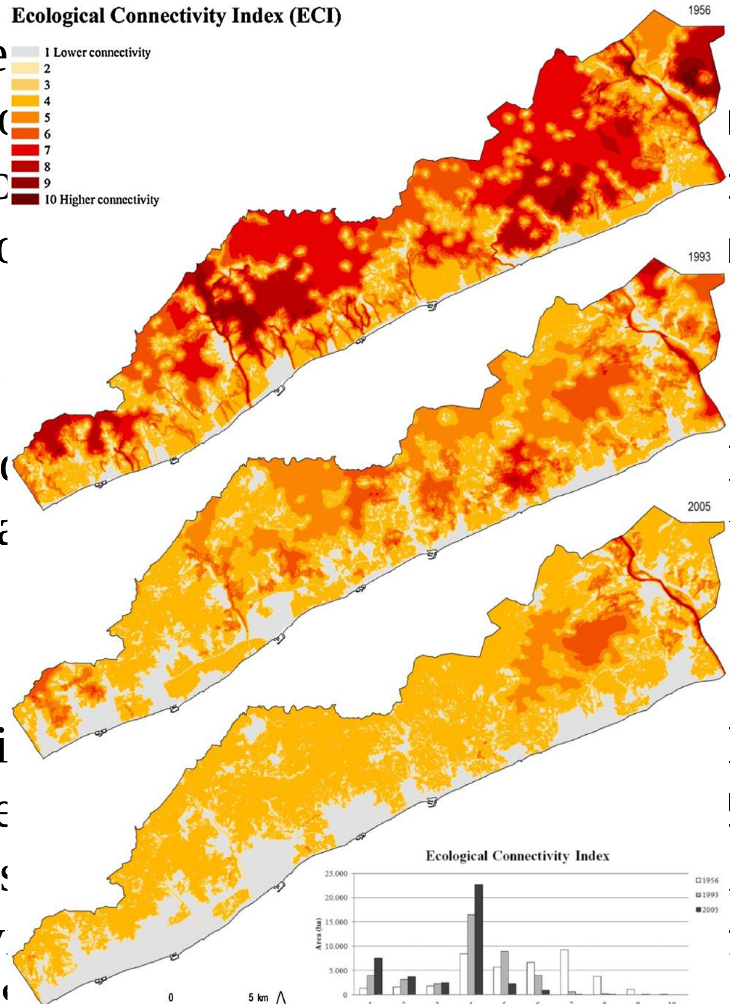
Study’s Context & Objectives

- Over the last fe areas have experienced pr ly to urban sprawl and reforestatic onal agrarian mosaics and natural resc n freshwaters.



- These changes ences on the biodiversity an The overall objective of this study wa ts of these consequences.

- By reconstructi County (Barcelona, Spain) for three 954 and 2010), we were able to as ave affected the ecosystem serv narket and market values of the E gh market prices and benefit-transfer methods.

Costanza et al., 1997: the begings of ESV cartography

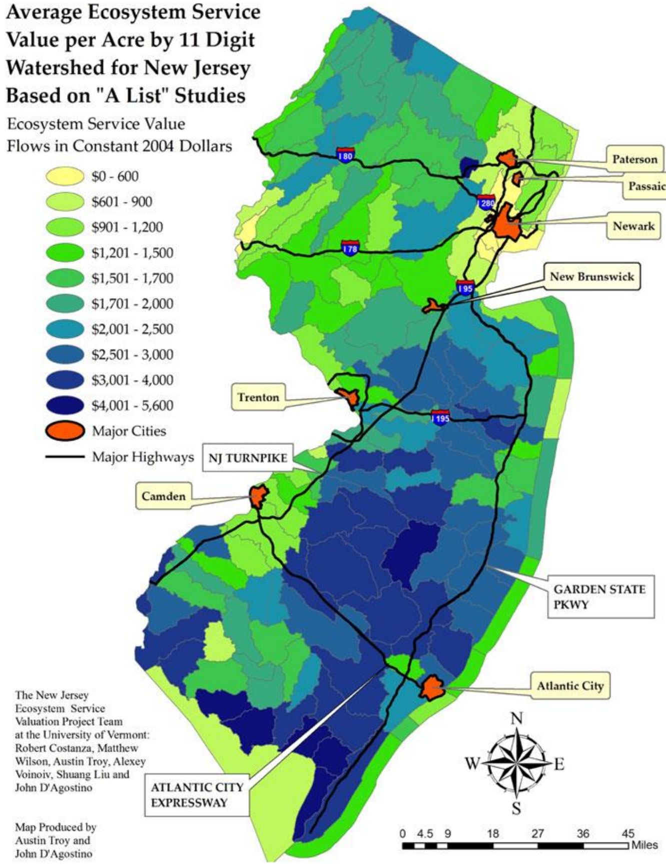
Table 2 Summary of average global value of annual ecosystem services

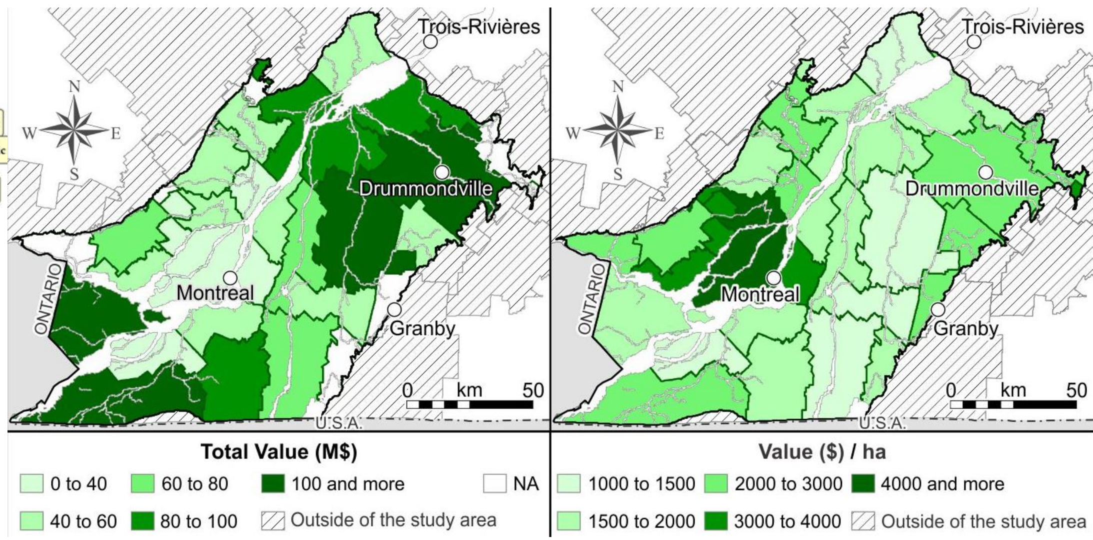
Ecosystem serivces (1994 US$ ha^{-1} yr^{-1})

Biome	Area (ha × 10^6)	1 Gas regulation	2 Climate regulation	3 Disturbance regulation	4 Water regulation	5 Water supply	6 Erosion control	7 Soil formation	8 Nutrient cycling	9 Waste treatment	10 Pollination	11 Biological control	12 Habitat/refugia	13 Food production	14 Raw materials	15 Genetic resources	16 Recreation	17 Cultural	Total value per ha ($ ha^{-1} yr^{-1})	Total global flow value ($ yr^{-1} × 10^9)
Marine	36,302																		577	20,949
Open ocean	33,200	38							118			5		15	0			76	252	8,381
Coastal	3,102			88					3,677			38	8	93	4		82	62	4,052	12,568
Estuaries	180			567					21,100			78	131	521	25		381	29	22,832	4,110
Seagrass/algae beds	200								19,002						2				19,004	3,801
Coral reefs	62			2,750						58		5	7	220	27		3,008	1	6,075	375
Shelf	2,660								1,431			39		68	2			70	1,610	4,283
Terrestrial	15,323																		804	12,319
Forest	4,855		141	2	2	3	96	10	361	87		2		43	138	16	66	2	969	4,706
Tropical	1,900		223	5	6	8	245	10	922	87				32	315	41	112	2	2,007	3,813
Temperate/boreal	2,955		88		0			10		87		4		50	25		36	2	302	894
Grass/rangelands	3,898	7	0		3		29	1		87	25	23		67		0	2		232	906
Wetlands	330	133		4,539	15	3,800				4,177			304	256	106		574	881	14,785	4,879
Tidal marsh/mangroves	165			1,839						6,696			169	466	162		658		9,990	1,648
Swamps/floodplains	165	265		7,240	30	7,600				1,659			439	47	49		491	1,761	19,580	3,231
Lakes/rivers	200				5,445	2,117				665				41			230		8,498	1,700
Desert	1,925																			
Tundra	743																			
Ice/rock	1,640																			
Cropland	1,400										14	24		54					92	128
Urban	332																			
Total	51,625	1,341	684	1,779	1,115	1,692	576	53	17,075	2,277	117	417	124	1,386	721	79	815	3,015		33,268

Numbers in the body of the table are in $ ha^{-1} yr^{-1}. Row and column totals are in $ yr^{-1} × 10^9, column totals are the sum of the products of the per ha services in the table and the area of each biome, not the sum of the per ha services themselves. Shaded cells indicate services that do not occur or are known to be negligible. Open cells indicate lack of available information.

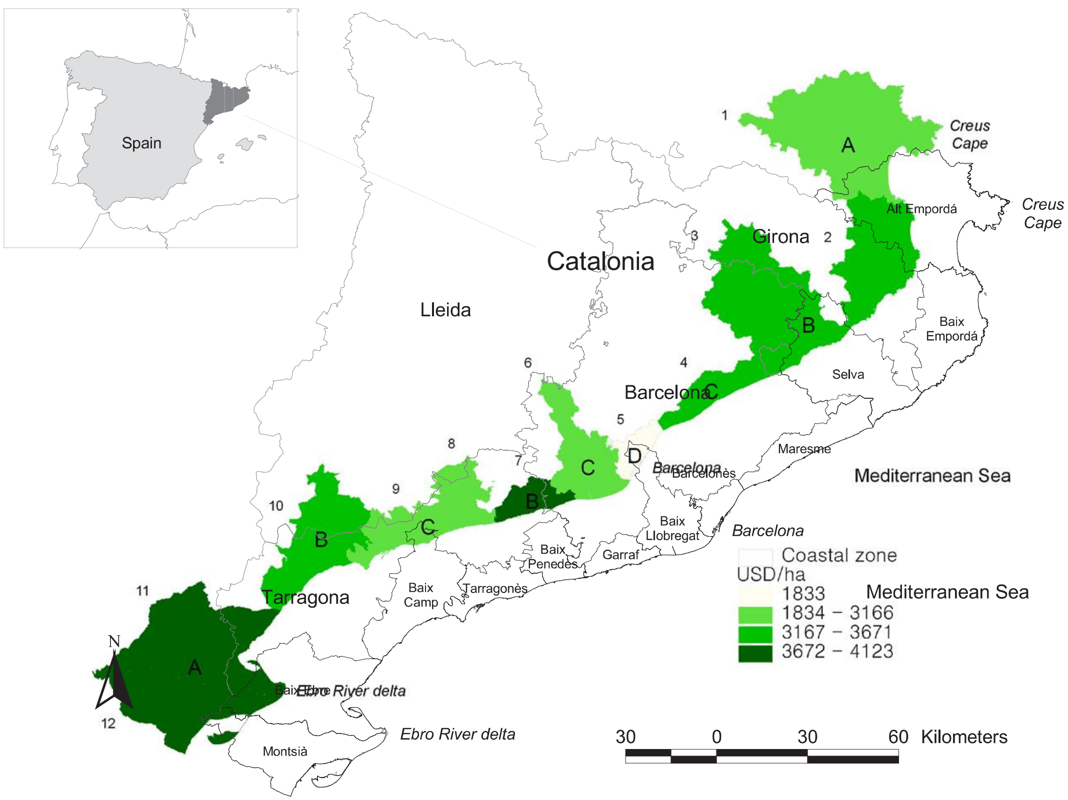
A growing literature

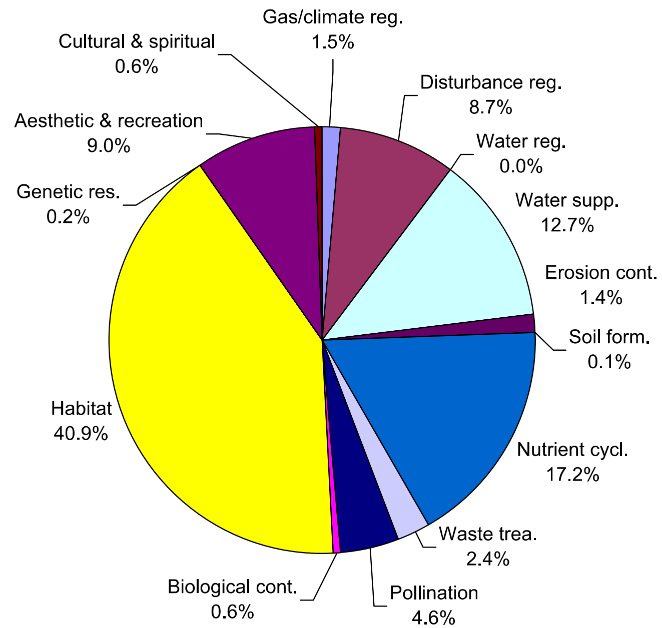




Liu et al., 2010; Dupras et al., 2014

Catalan Coast ES Value





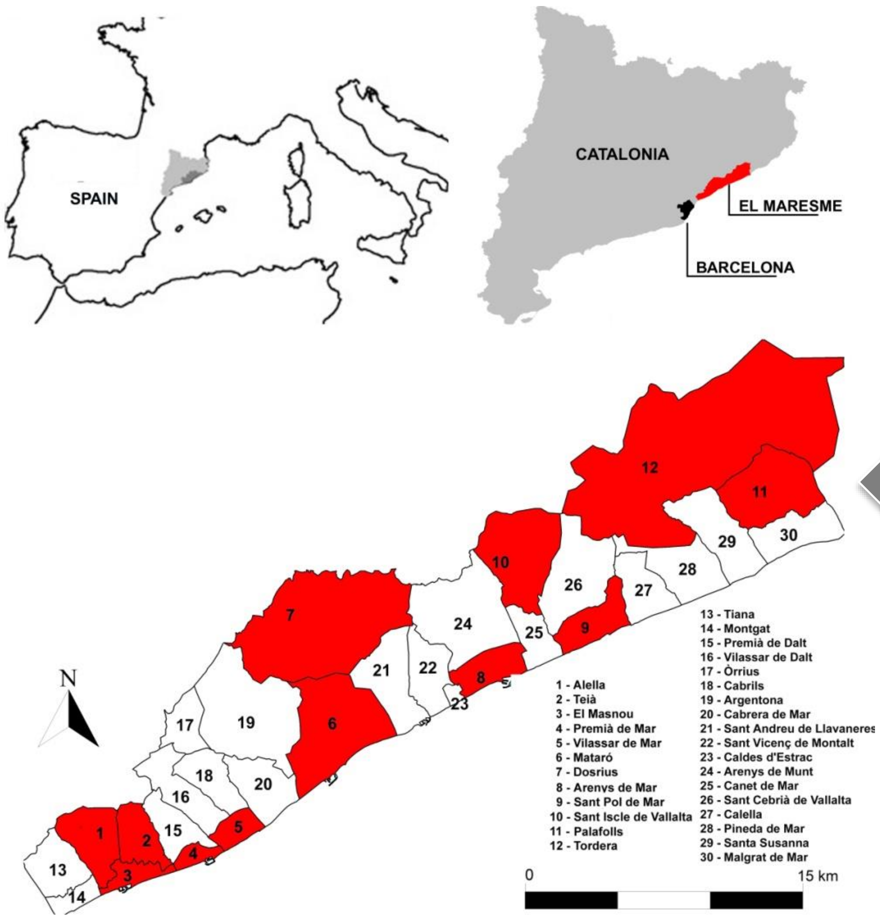
Brenner et al., 2010

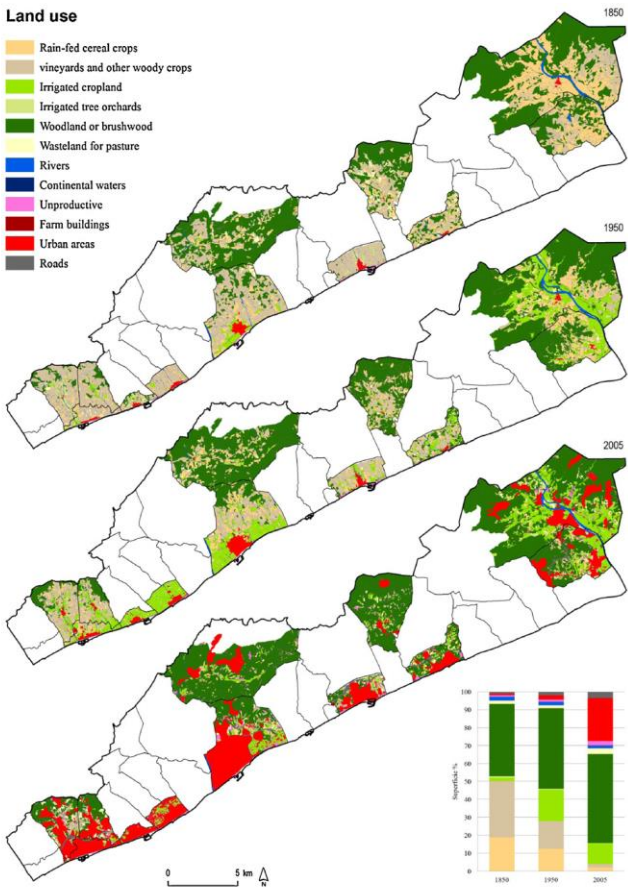
Methodology

- Step 1: Study area definition;
- Step 2: Typology development;
- Step 3: ESV Literature search and analysis;
- Step 4: Mapping;
- Step 5: Total value calculation;
- Step 6: Scenario analysis.

Troy and Wilson, 2006

Mapping El Maresme county from 1850 to 2010





Parcerisas, 2012

Land Use Matrix

	Rain-fed cereal	Irrigated cereal	Vineyard	Horticulture	Green House	Charob trees	Dry fruit trees	Irrigated fruit trees	Uncultivated	Unproductive	Forest	Urban area	Other	Total 2010 ha	Total 2010 %
Rain-fed cereal	214,0	77,2	61,3	3,1	0,0	5,7	4,6	0,5	9,6	0,0	39,9	1,5	0,1	**417,5**	**1,9**
Irrigated cereal	308,7	696,2	90,2	3,9	0,0	2,4	5,2	12,6	16,1	0,0	74,4	2,5	2,1	**1.214,3**	**5,5**
Vineyard	46,1	15,0	142,3	2,6	0,0	7,3	2,8	0,2	3,6	0,0	14,6	0,4	0,3	**235,2**	**1,1**
Horticulture	152,8	238,6	130,6	223,9	0,0	15,2	6,6	3,8	17,0	0,1	43,4	4,0	0,9	**836,9**	**3,8**
Green House	14,4	42,6	31,4	106,1	0,0	3,1	0,0	1,1	1,8	0,0	3,6	0,9	0,0	**205,0**	**0,9**
Charob trees	2,5	0,5	13,4	1,0	0,0	24,3	0,9	0,0	0,2	0,0	4,0	0,1	0,0	**46,9**	**0,2**
Dry fruit trees	17,7	10,0	18,1	3,5	0,0	1,3	13,6	2,6	3,2	0,0	5,9	0,4	0,0	**76,3**	**0,3**
Irrigated fruit trees	13,9	45,0	5,8	2,0	0,0	0,3	0,4	4,8	1,6	0,0	3,2	0,1	0,1	**77,2**	**0,3**
Uncultivated	143,0	116,8	171,0	19,9	0,0	10,3	13,4	2,3	39,8	0,0	116,7	6,0	2,3	**641,5**	**2,9**
Unproductive	79,1	68,6	66,5	54,5	0,0	13,1	4,8	3,7	35,9	0,3	96,2	15,3	10,0	**448,0**	**2,0**
Forest	717,9	326,4	903,2	18,3	0,0	94,2	163,6	16,1	165,6	0,0	9.975,5	27,1	9,3	**12.417,2**	**56,0**
Urban area	675,5	481,7	721,9	655,8	0,0	168,0	31,0	19,5	96,2	4,4	1.304,1	915,4	114,1	**5.187,6**	**23,4**
Other	3,2	7,9	3,0	3,2	0,0	0,1	0,4	0,0	1,2	0,0	6,7	4,8	339,8	**370,3**	**1,7**
Total 1954 ha	**2.388,8**	**2.126,5**	**2.358,7**	**1.097,8**	**0,0**	**345,3**	**247,3**	**67,2**	**391,8**	**4,8**	**11.688,2**	**978,5**	**479,0**	**22.173,9**	**100,0**
Total 1954 %	**10,8**	**9,6**	**10,6**	**5,0**	**0,0**	**1,6**	**1,1**	**0,3**	**1,8**	**0,0**	**52,7**	**4,4**	**2,2**	**100,0**	

Economic Indicators

Land-use	Incomes	Total exp
Cereal – irrigated land	5,881	
Cereal – rain fed land	1,700	
Wine	3,061	
Horticulture	19,705	1
Flowers	68,057	5
Irrigated fruit trees	7,113	
Olive trees	1,352	
Rain fed fruit trees	3,980	
Carob and Chesnut trees	748	
Forest	126	
Meadows	784	

Source: Idescat; XCAC (2010a); C

Land-use cover	Non - market Value	Market Value	Total Value
Rain fed cereal crops	2,158	892	3,050
Irrigated cereal	2,158	4,344	6,502
Orchards	2,158	9,230	11,388
Flower cropping	2,158	14,569	16,727
Vineyards	2,158	575	2,733
Irrigated fruit trees	2,158	2,490	4,648
Olive tress	2,158	462	2,620
Rain fed trees	2,158	996	3,154
Carob and chestnut	2,158	174	2,332
Woodlands	3,312	89	3,401
Pastures	2,408	259	2,667
Beach or dune	97,143	0	97,143
Open freshwater	1,123	0	1,123
Urban green space	3,896	0	3,896
Urban build-up	0	0	0
Unproductive	0	0	0

Values expressed in 2013EUR/ha/year

Non Market ES Value Matrix

	Cropland	Woodlands	Pastures	Beach or dune	Open freshwater	Urban area	Unproductive	Var. 1954 - 2010
Cropland	*0,0*	-218,1	-13,3	0,0	1,1	21,4	0,2	-11.888,4
Woodlands	2.584,6	*0,0*	149,7	0,0	14,2	89,8	0,0	2.418,4
Pastures	119,2	-105,5	*0,0*	0,0	0,0	14,4	0,0	598,6
Beach or dune	0,0	0,0	0,0	*0,0*	0,0	58,3	0,0	-3.215,4
Open water	-2,2	-5,9	0,0	0,0	*0,0*	3,3	0,0	-85,9
Urban area	-5.941,8	-4.319,2	-231,6	-2.661,7	-84,2	*0,0*	0,0	0,0
Unproductive	-626,5	-318,6	-86,4	-612,0	-1,8	0,0	*0,0*	0,0
Total 1954	18.593,1	38.698,1	940,6	8.626,3	409,3	0,0	0,0	*-12.172,7*

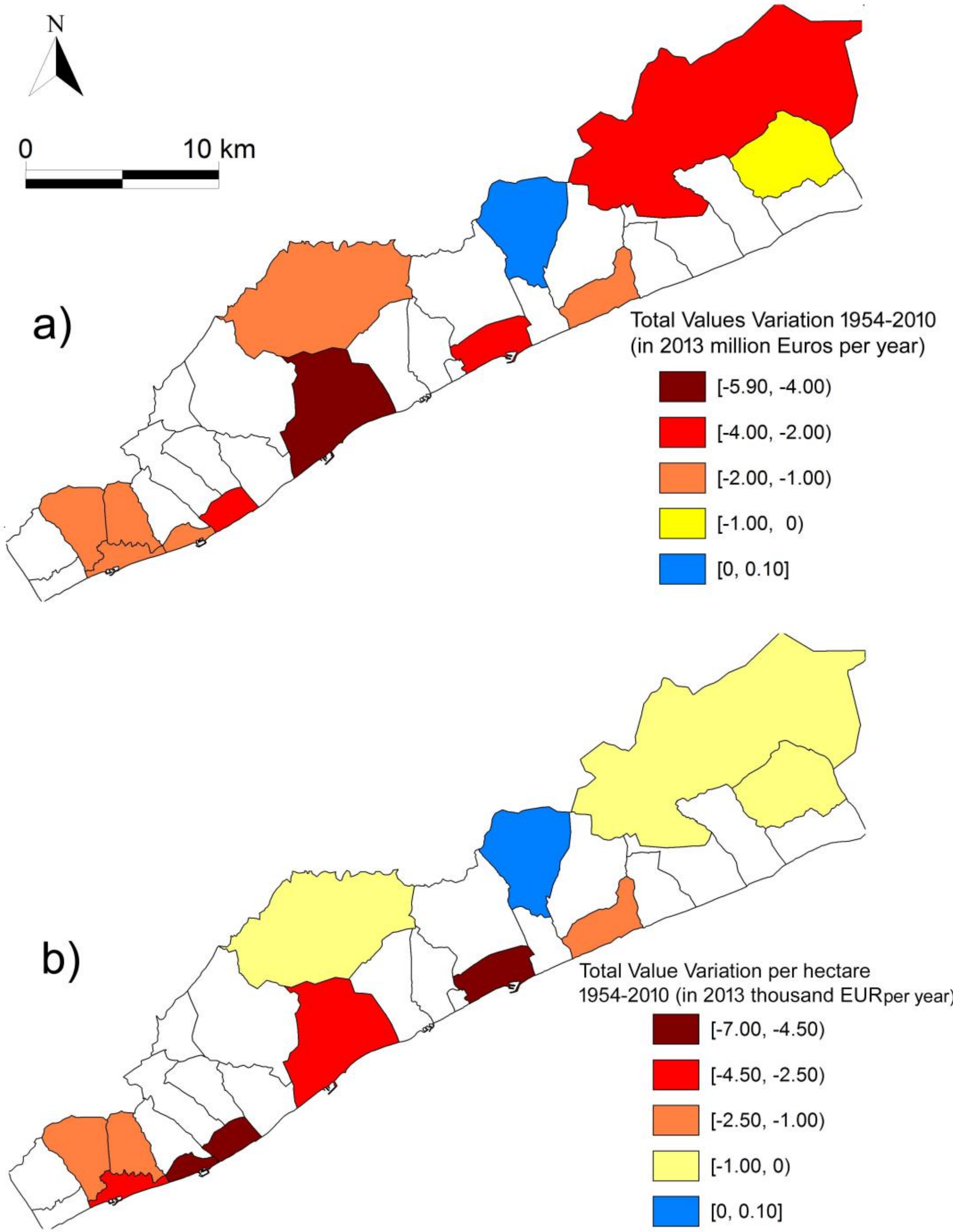
Note: The row "Total 1954" indicates the total Non-Market Value in 1954. The rest of the cells indicate the variation between 1954 and 2010.

Values expressed in million 2013EUR/year

Total Economic Variation

	1850			1954			2010			Δ TV 1850-1954	Δ TV 1954-2010
	NMV	**MV**	**TV**	**NMV**	**MV**	**TV**	**NMV**	**MV**	**TV**		
Alella	2,1	0,7	2,8	2,2	1,3	3,5	1,6	0,5	2,1	0,7	-1,4
Dosrius	11,6	1,4	13	12,2	1,2	13,4	10,8	1	11,8	0,4	-1,6
Palafolls	4,2	0,9	5,1	4,2	2	6,2	3,2	2,5	5,7	1,1	-0,5
Sant Iscle de V.	4,8	0,7	5,5	5	0,8	5,8	5,1	0,8	5,9	0,3	0,1
Teià	1,5	0,7	2,2	1,6	1,5	3,1	1,2	0,7	1,9	0,9	-1,2
Tordera	23,1	3,5	26,6	24,5	6,7	31,2	22,7	6,1	28,8	4,6	-2,4
Mountain municipalities	***47,3***	***7,9***	***55,2***	***49,7***	***13,5***	***63,2***	***44,6***	***11,6***	***56,2***	***8,0***	***-7,0***
Arenys de Mar	3,4	0,5	3,9	3,6	1,3	4,9	0,7	0,6	1,3	1,0	-3,6
Masnou, el	1,8	0,3	2,1	1,7	1,2	2,9	1,3	0,1	1,4	0,8	-1,5
Mataró	7,1	2	9,1	6,2	6,9	13,1	4,4	2,8	7,2	4,0	-5,9
Premià de Mar	1,1	0,1	1,2	1	1,5	2,5	0,8	0,1	0,9	1,3	-1,6
Sant Pol de Mar	3,2	0,4	3,6	3,1	1,1	4,2	1,9	1,1	3	0,6	-1,2
Vilassar de Mar	2,1	0,3	2,4	2	4,3	6,3	1,6	1,9	3,5	3,9	-2,8
Coastal municipalities	***18,7***	***3,6***	***22,3***	***17,6***	***16,3***	***33,9***	***10,7***	***6,6***	***17,3***	***11,6***	***-16,6***
TOTAL	**66,0**	**11,5**	**77,5**	**67,3**	**29,8**	**97,1**	**55,3**	**18,2**	**73,5**	**19,6**	**-23,6**

Values expressed in million 2013EUR/year


N
0
10 km
a)
Total Values Variation 1954-2010
(in 2013 million Euros per year)
[-5.90, -4.00)
[-4.00, -2.00)
[-2.00, -1.00)
[-1.00, 0)
[0, 0.10]
b)
Total Value Variation per hectare
1954-2010 (in 2013 thousand EURper year)
[-7.00, -4.50)
[-4.50, -2.50)
[-2.50, -1.00)
[-1.00, 0)
[0, 0.10]

Discussion

- The overall net loss has been estimated at 23.6 million 2013 Euros per year. This loss can be attributed to urban sprawl, which has invaded former natural areas such as croplands, woodlands, pastures, beach zones, and waterways, and their associated ES;

- This phenomenon has been especially significant in coastal areas, where urban sprawl has been particularly aggressive since the arrival of Franco's dictatorship, forming a continuous line all along the coast;

- A recent problem threatening to remain structural is the lack of sand in the El Maresme beaches. This problem, which has a negative impact on the ecological state of the territory and on the ecosystem services provided by beaches and tourism, is due to two factors, worsened by typical annual autumn storms.

Discussion

- With respect to spatial analysis, benefit transfer function assumes a meta-evaluation that ensures that the variance in the economic evaluation of ES can be explained by biophysical and socio-economic characteristics that are homogenous in time and space. These generalization errors limit the interpretation of results ;

- A study on the robustness of spatial analysis based on substitutes (proxies) (Eigenbrod et al. 2010) shows that this methodology is indeed a poor reflection of the actual distribution of ES. To solve these problems, methods are evolving to incorporate spatial heterogeneity into the construction of statistical models based on GIS data;

- Finally, we should put into perspective the historical analysis performed. Value systems of societies change and evolve over time. Thus, it is illusory to believe that the social, cultural, and economic values of ES are homogeneous in time, especially over the long period that we cover in this study. The results and conclusions should only be interpreted from a contemporary perspective.

Conclusions

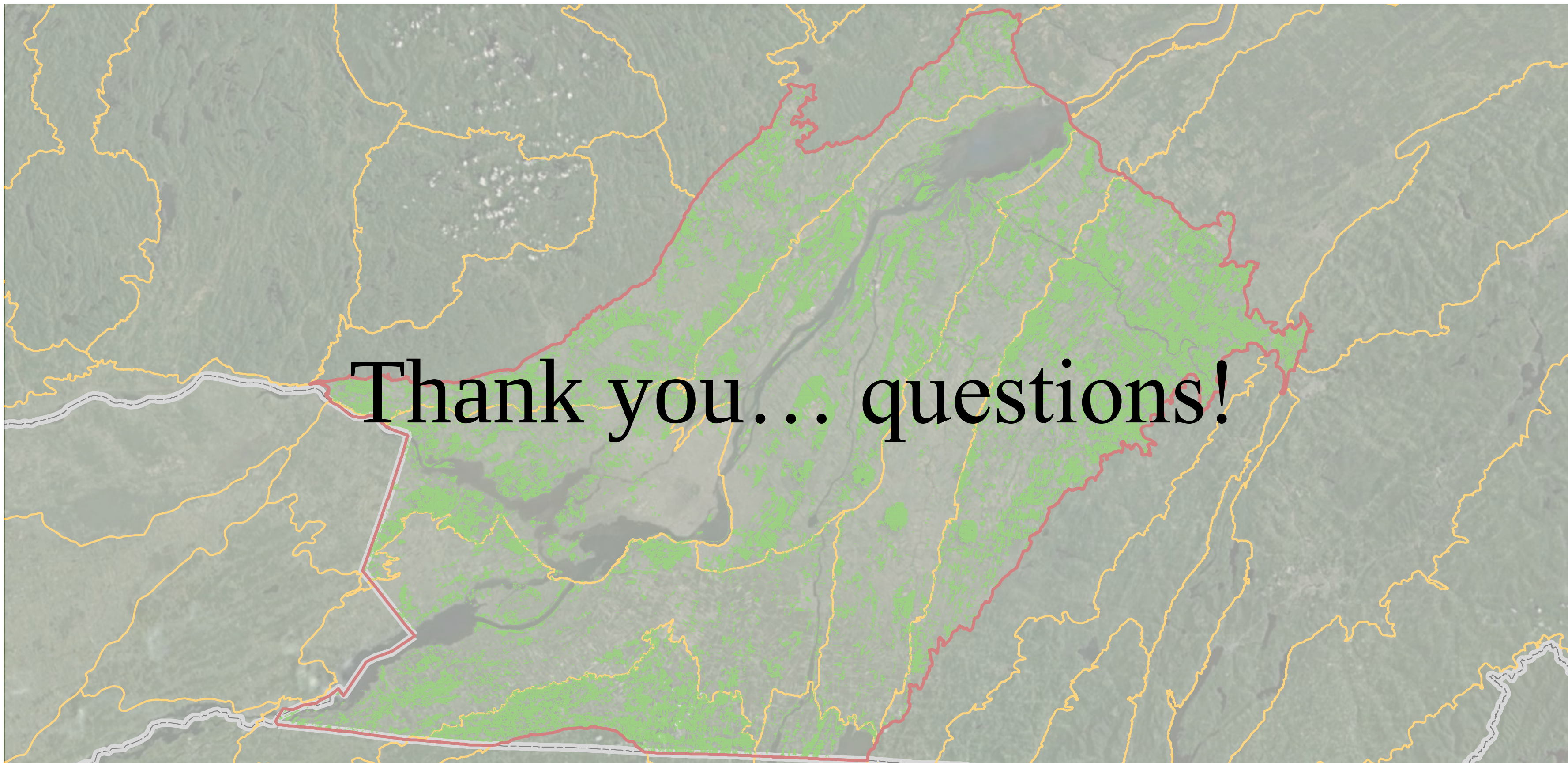
- Change in land use may seem economically profitable, but the loss of non-market ES can cause substantial economic losses.

- Coastal ecosystems produce highly economically valuable services that are associated with beaches, such as disturbance regulation, aesthetics, and recreational activities.

- The economic losses attributable to losses in ES in coastal municipalities between 1954 and 2010 are more than two times higher than those observed for municipalities located inland (16.6 vs 7.0 million 2013 Euros per year).

- A more extensive study should compare these results with the region economic growth in that period and compare with other socio-economics indicators. Weaknesses in the cartography of ES.

- With this in mind, spatial planning policies should consider and incorporate both the concept of ES and non-market values to reflect the actual contribution of natural and semi-natural quality of life of human communities, particularly for coastal ecosystems.



Thank you… questions!