CHAPTER 7. Annex

Annex I. Internet pages relevant to natural resource management and sustainability of the Catalan coast.

Territory, management and legal information:

- Generalitat de Catalunya (GenCat): http://www.gencat.net/
- Territorial Policy and Public Works Department (DPTOP)-GenCat: http://www.gencat.net/ptop/
- Environment and Housing Department (DMAH)-GenCat: http://mediambient.gencat.net/cat/inici.jsp
- Territorial, sectorial and directive plans-GenCat: http://www10.gencat.net/ptop/AppJava/es/plans/
- Cartographic Institute (ICC)-GenCat: http://www.icc.es/
- Spatial Data Infrastructure (IDEC)-GenCat: http://www.geoportal-idec.net/geoportal/
- Integrated coastal zone management strategy-GenCat: http://mediambient.gencat.net/cat/el_medi/egizc/inici.jsp
- Barcelona Metropolitan Area Coastal Strategic Plan: http://www.plalitoral.net/
- Sustainable Development Council (CADS)-GenCat: http://www.cat-sostenible.org/
- Agenda 21-GenCat: http://www6.gencat.net/a21cat/home_esp.htm
- Mevaplaya Project: http://lim050.upc.es/mevaplaya/
- DEDUCE-Interreg IIIC Project: http://www.gencat.net/mediamb/sosten/deduce/deduce.htm
- EUCC Mediterranean Center (The Coastal Union): http://www.eucc.nl/en/eucc/index.htm
- El Far Consortium: http://www.elfar.diba.es/
- Barcelona Province Beach Database-DIBA: http://www.diba.cat/platges/default.asp
- Barcelona Province “Espai Blau” CZM Project-DIBA: http://www.diba.es/espaiblau/indice.html
- Spanish State Ports: http://www.puertos.es/index.jsp
- Spanish Environmental Ministry: http://www.mma.es
- Ports of the Generalitat-GenCat: http://www.portsgeneralitat.org/

Environment and sustainable development:

- Water Agency (ACA)-GenCat: http://mediambient.gencat.net/aca/ca/inici.jsp
- Meteorological Service (METEOCAT)-GenCat: http://www.meteocat.com/
- Oceanographic and Meteorological Instruments Network (XIOM)-GenCat: http://lim050.upc.es/projects/xiom/
- Internacional Centre for Coastal Resources Research (CIIRC)-UPC: http://lim-ciirc.upc.es/
- European Topic Centre on Terrestrial Environment, EEA-EU: http://terrestrial.eionet.europa.eu/
- Eurosion Project-EU: http://www.eurosion.org/
- FloodSite Project-EU: http://www.floodsite.net/
- Blue Flag Programme: http://www.blueflag.org/
- Natural Heritage Defense (Depana): http://www.depana.org/
- Biodiversity Database (BIOCAT), UB-DMAH: http://biodiver.bio.ub.es/biocat/homepage.html
- World Wildlife Fund–Adena: http://www.wwf.es/
- Debate Costa Brava: http://www.debatcostabrava.org/
- Integrated Coastal Zone Management-EU: http://ec.europa.eu/environment/iczm/home.htm
- Europe Environmental Agency (EEA)-EU: http://www.eea.europa.eu/
- Plan Bleu: Regional and Activity Centre: http://www.planbleu.org/

Economic data & statistics:

- Catalan Statistics Institute (IDESCAT)-GenCat: http://www.idescat.net/
- Turistic Information-GenCat: http://www.gencat.net/turistex_nou/home.htm
- Spanish Statistics Institute (INE): http://www.ine.es/
- Eurostat-EU: http://epp.eurostat.ec.europa.eu/

Notes:

- *All links were operational at the day of publication of this document.*
- *Please send corrections and additional relevant links to: jbrennerg@gmail.com.*

Annex II. Non-market economic valuation techniques.

Method	Description
Cost-based approaches	
Avoided cost	Services allow society to avoid costs that would have been incurred in the absence of those services
Replacement coast	Services could be replaced with man-made systems
Factor income	Services provide for the enhancement of incomes
Revealed-preferences approaches	
Travel cost	Service demand may require travel, whose cost can reflect the implied value of the service. Includes the willing to pay to travel and value of their time
Hedonic prices	Service demand may be reflected in the prices people will pay for associated goods
Marginal product estimation	Service demand is generated in a dynamic modeling environment using a production function (i.e. Cobb-Douglas) to estimate the change in the value of outputs in response to a change in material inputs
Stated-preferences approaches	
Contingent valuation	Service demand may be elicited by posing hypothetical scenarios that involve some valuation of alternatives
Group valuation	Based on participatory processes and assuming that public decision-making should result, not from aggregation of separately measured individual preferences but from open public debate

Annex III. Assessed ecosystem services of the Catalan coast.

The ecosystem services that are evaluated in this study are listed below (the description has been aggregated into the following 12 services):

- ***Atmospheric gas & climate regulation****:* life on earth exists within a narrow band of chemical balance in the atmosphere and oceans, and alterations in that balance can have positive or negative impacts on natural and economic processes. Biotic and abiotic processes and components of natural and semi-natural ecosystems influence this chemical balance in many ways including the CO_2/O_2 balance, maintenance of the ozone-layer (O_3), and regulation of SO_X levels.

- ***Disturbance regulation****:* many landscapes provide a buffering function that protects humans from destructive perturbations. For example, beaches, wetlands and floodplains help mitigate the effects of storms and floods by trapping and containing storm water. Coastal island vegetation, beaches and seagrass communities can also reduce the damage of wave action and storm surges.

- ***Freshwater regulation & supply****:* the availability of fresh and clean water is essential to life, and is one of humanity's most valuable natural assets. When water supplies fail, water must be imported from elsewhere at great expense, must be more extensively treated (as in the case of low stream flows or well levels), or must be produced using more expensive means (such as desalinization). Forests and their underlying soil, and wetlands, play an important role in ensuring that rainwater is stored and released gradually, rather than allowed to immediately flow downstream as runoff.

- ***Erosion control & soil formation****:* soils provide many of the services mentioned above, including water storage and filtering, waste assimilation, and a medium for plant growth. Natural systems, terrestrial and seagrasses both create and enrich soil through weathering and decomposition and retain soil by preventing its being washed away during rainstorms.

- ***Nutrient regulation/cycling***: the proper functioning of any ecosystem is dependent on the ability of plants/algae and animals to utilize nutrients such as nitrogen, potassium and sulphur. For example, soil and water, with the assistance of certain bacteria algae (Cyanobacteria), take nitrogen in the atmosphere and fix it so that it can be readily absorbed by the roots of plants. When plants die or are consumed by animals, nitrogen is recycled into the atmosphere. Farmers apply tons of commercial fertilizers to croplands each year, in part because this natural cycle has been disrupted by hyper-intense cultivation.

- ***Waste treatment****:* forests, wetlands and coastal waters, specially seagrass communities, provide a natural buffer between human activities and water supplies, filtering out pathogens such as *Giardia* or *Escherichia*, nutrients such as nitrogen and phosphorous, and metals and sediments. This service benefits both humans by providing cleaner drinking water and plants and animals by reducing harmful algae blooms, increasing dissolved oxygen and reducing excessive sediment in water. Trees also improve air quality by filtering out particulates and toxic compounds from air, making it more breathable and healthy.

- ***Pollination****:* more than 87 % of the world's flowering plants, including 80 % of the world's species of food plants, rely on pollinator species for reproduction. Over

100,000 invertebrate species such as bees, moths, butterflies, beetles, and flies serve as pollinators worldwide. At least 1,035 species of vertebrates, including birds, mammals, and reptiles, also pollinate many plant species. The US Fish and Wildlife Service lists over 50 pollinators as threatened or endangered, and wild honeybee populations have dropped 25 % since 1990. Pollination is essential for many agricultural crops, and substitutes for local pollinators are increasingly expensive.

- ***Biological control:*** natural species populations are regulated by complex trophic dynamics. Those dynamics can be easily altered by the absence of keystone specie. Over harvesting or over fishing promote not only the depletion of population stocks but from other species by by-catch. In a natural ecosystem top predators will regulate prey species and prevent from over consumption of other species, such as herbivory reduction.

- ***Habitat/refugium***: contiguous patches of landscape with sufficient area to hold naturally functioning ecosystems support a diversity of plant and animal life. As patch size decreases, and as patches of habitat become more isolated from each other, population sizes can decrease below the thresholds needed to maintain genetic variation, withstand stochastic events (such as storms or droughts) and population oscillations, and meet social requirements like breeding and migration. Large contiguous habitat blocks, such as intact seagrass beds, forests or wetlands, thus function as critical population sources for plant and animal species that humans value for both aesthetic value and functional reasons.

- ***Genetic resources***: Biotic resources are sources of unique biological materials and products. Due to our limited knowledge it is not possible to account for all products that biodiversity could provide to human societies in the future. Know products are medicines, other science materials, genes for resistance of plant pathogens and crop pests and ornamental species. However, it is very likely that genetic resources constitute the most unknown services that ecosystems provide to human well-being.

- ***Aesthetic & recreation****:* intact natural ecosystems that attract people who fish, hunt, hike, canoe or kayak, bring direct economic benefits to the areas surrounding those natural areas. People's willingness to pay for local meals and lodging and to spend time and money on travel to these sites, are economic indicators of the value they place on natural areas. Real estate values, and therefore local tax revenues, often increase for houses located near protected open space. People are also often willing to pay to maintain or preserve the integrity of a natural site to protect the perceived beauty and quality of that site.

- ***Cultural & spiritual***: Landscapes are typically identified with spiritual and historic values. One of its most high expressions can be found in religions. Nature has been used as motive in books, film, painting, folklore, national symbols, architect, advertising, etc.

Annex IV. Land covers and sub-categories of the Catalan coast.

Land cover	sub-category	Area (ha)
	Coastal- marine domain	
Continental shelf (≤ 50 m)	Continental platform up to 50 m isobaths.	**191,484**
Seagrass bed	Seagrass or marine phanerogams communities (mainly Posidonia oceanica, Zostera marina and Cymodocea nodosa.	**8,568**
Beach or dune	Sand beach, rocky beach and vegetated sand dune.	**4,098**
	Vegetated dune with non nitrophil vegetation	404
	Dune with Pinus pinea, P. pinaster	911
	Sand beach with nitrophil vegetation	2,774
	Rocky beach with nitrophil vegetation	9
Saltwater wetland	Marine or hypersaline water wetlands and lagoons.	**2,494**
	Brackish or marine water wetland	1,464
	Hypersaline wetland or lagoon	39
	Industrial marine water wetland or lagoon	991
	Terrestrial domain	
Temperate forest	Mediterranean and sub-Mediterranean forest and scrubs.	**350,472**
	Oak forest	91,538
	Other deciduous forest	14,018
	Deciduous mix forest	786
	Other conifer forest	8
	Conifer mix forest	17,937
	Planifolia mix forest	1,756
	Mediterranean scrubs	112,121
	Mountainous scrubs	1,504
	Pinus uncinata forest	95,027
	Tree plantations	12,028
	Humid and riverside forest	3,751
Grassland	Prairies and rangelands.	**37,010**
	Reforested areas i.e. open mines	122
	Intensive rangelands	260
	Communities dominated by Ampelodesmos mauritanica	5,174
	Abandoned croplands	19,934
	Communities of Brachypodium phoenicoides with Euphorbia serrata	1,356
	Prairies with Aphyllanthes monspeliensis	2,652
	Prairies with Scirpus holoschoenus	11
	Dry prairies with Brachypodium retusum	3,077
	Prairies with Bromus erectus and Cirsium tuberosum	10
	Mesophil prairies with Festuca nigrescens	170

	Mountainous prairies with Arrhenatherum elatius	4
	Lowland prairies with Gaudinia fragilis	354
	Prairies with Hyparrhenia hirta	3,301
	Mesophil prairies with Agrostis capillaris	161
	Xerophil prairies with Agrostis capillaris and Seseli montanum	78
	Sub-nitrophil prairies with Aegilops geniculata	239
	Mountainous prairies with Ononis striata	7
	Prairies not associated to urban or industrial areas	102
Cropland	Dry and irrigation agricultural land.	**246,416**
	Rice fields	23,697
	Wild nut plantations	17,193
	Critics plantations	10,038
	Extensive and irrigation agricultural lands	18,058
	Dry crop extensive fields	56,038
	Vegetables and flowers	9,516
	Intensive crops i.e. cereals	11,123
	Dry land fruit and olive crops	74,201
	Irrigation fruit crops	7,607
	Vineyards	18,945
Freshwater wetland	Seasonal freshwater wetlands or lagoons.	**73**
Open freshwater	Freshwater bodies and rivers.	**5,611**
	Industrial, recreational or agricultural ponds or channels	95
	Lagoons and other water bodies	1,274
	Rivers and stream flows	4,242
Riparian buffer	Corridors along river flows with submerged vegetation.	**2,558**
	Riparian vegetation (i.e. cat tail)	2,250
	Communities dominated by Cladium mariscus	308
Urban greenspace	Large urban parks and gardens.	**1,848**
Urban	Urban and industrial areas (impervious soil).	**71,589**
Barren	Barren lands: rocks, cliffs, emerged rocks or islands.	**3,781**
Burned forest	Wildfire impacted areas (on different dates and years).	**2,778**
Mining ground	Sand, rock and mineral exploitations.	**2,681**
Total		**931,460**

Source: DMAH. 2006. Cartografia 1:50.000 dels hàbitats de Catalunya (CHC50). Departament de Medi Ambient i Habitatge. Generalitat de Catalunya [online: http://mediambient.gencat.net/cat/el_medi/habitats/habitats_cartografia.htm#cd], revised on 23 May 2006.

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Annex VI. Technical value transfer report.

			2004 USD/ha·yr		
Land cover	**Ecosystem service**	**Method**	**Single value**	**Mean**	**Source**
			Coastal - Marine		
Continental shelf	Water supply	CV		798	Soderqvist and Scharin 2000
		CV	1,278	1,278	Nunes and van den Bergh 2004
		CRS	1,787	1,789	Hanley, Bell and Alvarez-Farizo 2003
				1,287	
	Biological control	VT	49	49	Costanza and others 1997
				49	
	Nutrient regulation	VT	1,787	1,787	Costanza and others 1997
				1,787	
	Cultural & Spiritual	VT	86	86	Costanza and others 1997
				86	
				3,210	
Seagrass bed	Nutrient regulation	CV		24,228	Costanza and others 1997
				24,228	
				24,228	
Beach or dune	Disturbance prevention	HP	83,368	83,368	Pompe and Rinehart 1995
		HP	51,432	51,432	Parsons and Powell 2001
				67,400	
	Aesthetic & Recreational	HP		1,791	Taylor and Smith 2000
		CV	51,101	51,101	Silberman, Gerlowski and Williams 1992
		TC		93,536	Kline and Swallow 1998
		HP	324	324	Edwards and Gable 1991
				36,687	
	Cultural & Spiritual	HP	59	59	Taylor and Smith 2000
				59	
				104,146	
Saltwater wetland	Disturbance prevention	AC		2	Farber 1987
		AC	2	2	Farber and Costanza 1987
		VT		2,296	Costanza and others 1997
				766	
	Waste treatment	VT		8,357	Costanza and others 1997
		AC	40,920	40,920	Breaux, Farber and Day 1995
		AC		269	Breaux, Farber and Day 1995
		AC		3,951	Breaux, Farber and Day 1995
				13,376	
	Habitat	ME	2	2	Lynne, Conroy and Prochaska 1981
		ME	2	2	Farber and Costanza 1987
		VT		210	Costanza and others 1997
		FI		1,357	Bell 1997
		ME		914	Batie and Wilson 1978
				497	

	Aesthetic & Recreational	TC		22	Farber 1988
		CV	35	35	Bergstrom and others 1990
		HP		136	Anderson and Edwards 1986
				64	
	Cultural & Spiritual	CV		445	Anderson and Edwards 1986
				445	
				15,147	
			Terrestrial		
Temperate forest	Gas & climate regulation	VT	27	27	Reyes and Mates 2004
		AC	32	32	Pimentel and others 1997
		MP	141	141	Tol 1999
		MP	746	746	Tol 1999
		MP	64	64	Tol and Downing 2000
		MP	40	40	Tol and Downing 2000
		MP	183	183	Tol and Downing 2000
		MP	49	49	Tol and Downing 2000
		MP	193	193	Tol and Downing 2000
		MP	2	2	Tol and Downing 2000
		MP	57	57	Schauer 1995
		MP	786	786	Schauer 1995
		MP	96	96	Roughgarden and Schneider 1999
		MP	121	121	Reilly and Richards 1993
		MP	104	104	Reilly and Richards 1993
		MP	49	49	Reilly and Richards 1993
		MP	35	35	Reilly and Richards 1993
		MP	49	49	Plambeck and Hope 1996
		MP	1,035	1,035	Plambeck and Hope 1996
		MP	27	27	Nordhaus and Popp 1997
		MP	15	15	Nordhaus and Popp 1997
		MP	15	15	Nordhaus and Yang 1996
		MP	12	12	Nordhaus 1993
		MP	82	82	Nordhaus 1993
		MP	17	17	Nordhaus 1993
		MP	2	2	Nordhaus 1993
		MP		54	Newell and Pizer 2003
		MP		37	Newell and Pizer 2003
		MP	40	40	Maddison 1995
		MP	69	69	Hope and Maul 1996
		MP	47	47	Fankhauser 1994
		MP	99	99	Fankhauser 1994
		MP	42	42	Fankhauser 1994
		MP		109	Costanza and others 1997
		MP	499	499	Azar and Sterner 1996
		MP	25	25	Azar and Sterner 1996
		MP	74	74	Azar and Sterner 1996
		MP	163	163	Azar and Sterner 1996
				133	
	Soil formation	VT		12	Costanza and others 1997
				12	

	Erosion control	CV		122	Costanza and others 1997
				122	
	Waste treatment	VT		109	Costanza and others 1997
				109	
	Pollination	RC		400	Hougner *in press*
				400	
	Biological control	VT		5	Costanza and others 1997
				5	
	Habitat	CV	7	7	Shafer and others 1993
		CV	1,053	1,053	Kenyon and Nevin 2001
	.	CV		10	Haener and Adamowicz 2000
		CV		8,011	Garrod and Willis 1997
		CV	37	37	Garrod and Willis 1997
		CV		4,720	Garrod and Willis 1997
		CV		326	Amigues and others 2002
		CV		4,075	Amigues and others 2002
				2,281	
	Genetic resources	CV		20	Costanza and others 1997
				20	
	Aesthetic & Recreational	TC		2	Willis 1991
		TC		69	Willis 1991
		TC		30	Willis 1991
		TC		12	Willis 1991
		TC		311	Willis 1991
		TC	10	10	Willis and Garrod 1991
		CV	1,134	1,134	Shafer and others 1993
		CV		2	Prince and Ahmed 1989
		CV	25	25	Maxwell 1994
		VT		44	Costanza and others 1997
		CV	1,342	1,342	Bishop 1992
		CV	1,198	1,198	Bishop 1992
	.	CV	356	356	Bennett and others 1995
		CV	0	0	Haener and Adamowicz 2000
		TC	0	0	Boxall, McFarlane and Gartrell 1996
				301	
	Cultural & Spiritual	VT		2	Costanza and others 1997
				2	
	Water supply	RC		781	NJEPA 2005
		TC		22	Loomis 1988
				403	
				3,789	
Grassland	Gas & Climate regulation	VT		10	Costanza and others 1997
		VT	0	0	Costanza and others 1997
		MP	12	12	Sala and Paruelo 1997
				7	
	Water regulation	VT		5	Costanza and others 1997
				5	
	Erosion control	CV		37	Costanza and others 1997
				37	
	Soil formation	DM	15	15	Pimentel and others 1997

		VT		2	Costanza and others 1997
				7	
	Waste treatment	VT		109	Costanza and others 1997
				109	
	Pollination	VT		32	Costanza and others 1997
				32	
	Biological control	VT		30	Costanza and others 1997
				30	
	Aesthetic & Recreational	VT	2	2	Costanza and others 1997
		CV	2	2	Alvarez-Farizo and others 1999
				2	
				230	
Cropland	Pollination	DM		12	Southwick and Southwick 1992
		AC	27	27	Robinson, Nowogrodzki and Morse 1989
				20	
	Biological control	VT		30	Costanza and others 1997
				30	
	Habitat	CV	3,069	3,069	Christie and others 2004
		CV	1,035	1,035	Christie and others 2004
				2,053	
	Aesthetic & Recreational	CV	64	64	Bergstrom, Dillman and Stoll 1985
		CV	10	10	Alvarez-Farizo and others 1999
				37	
				2,140	
Freshwater wetland	Gas & Climate regulation	VT		331	Costanza and others 1997
				331	
	Disturbance prevention	VT		9,037	Costanza and others 1997
				9,037	
	Water regulation	AC	14,720	14,720	Thibodeau and Ostro 1981
		VT		37	Costanza and others 1997
				7,378	
	Water supply	CV	7,576	7,576	Pate and Loomis 1997
		CV	420	420	Lant and Tobin 1989
		CV	4,616	4,616	Lant and Tobin 1989
		CV	0	0	Lant and Tobin 1989
		CV		3,462	Hayes, Tyrrell, and Anderson 1992
		TC	1,142	1,142	Creel and Loomis 1992
		VT		9,486	Costanza and others 1997
				3,815	
	Waste treatment	VT		2,071	Costanza and others 1997
				2,071	
	Habitat	CV	12	12	Vankooten and Schmitz 1992
		VT		549	Costanza and others 1997
				279	
	Aesthetic & Recreational	CV		3,311	Whitehead 1990
		CV	1,381	1,381	Thibodeau and Ostro 1981
		TC		138	Thibodeau and Ostro 1981
		TC	74	74	Mahan, Polasky and Adams 2000
		CV		3,716	Hayes, Tyrrell and Anderson 1992

		TC	9,741	9,741	Doss and Taff 1996
		TC	8,817	8,817	Doss and Taff 1996
		VT		613	Costanza and others 1997
				3,474	
	Cultural & Spiritual	VT		2,199	Costanza and others 1997
				2,199	
				28,585	
Open freshwater	Water supply	TC		1,589	Ribaudo and Epp 1984
		CV	69	69	Piper 1997
		CV	904	904	Henry, Ley and Welle 1988
		CV	1,191	1,191	Croke, Fabian and Brenniman 1986
		TC	1,300	1,300	Bouwes and Scheider 1979
				1,011	
	Aesthetic & Recreational	HP	173	173	Young and Shortle 1989
		TC		2,041	Ward, Roach and Henderson 1996
		TC	2,318	2,318	Shafer and others 1993
		TC	1,161	1,161	Shafer and others 1993
		CV	205	205	Shafer and others 1993
		TC	507	507	Piper 1997
		TC		30	Patrick and others 1991
		TC	381	381	Kreutzwiser 1981
		TC	27	27	Kealy and Bishop 1986
	.	CV		442	Cordell and Bergstrom 1993
		CV		1,038	Cordell and Bergstrom 1993
		CV		1,142	Cordell and Bergstrom 1993
		CV		1,898	Cordell and Bergstrom 1993
		TC	971	971	Burt and Brewer 1971
				880	
				1,890	
Riparian buffer	Disturbance prevention	AC		131	Rein 1999
		AC		304	Rein 1999
				217	
	Water supply	HP	10	10	Rich and Moffitt 1982
		AC		240	Rein 1999
	.	CV	32	32	Oster 1977
		CRS	27,401	27,401	Mathews, Homans and Easter 2002
		CV	465	465	Gramlich 1977
		CV	10,119	10,119	Danielson and others 1995
		CV	4,433	4,433	Berrens, Ganderton and Silva 1996
		TC		15	Kahn and Buerger 1994
		TC	0	0	Kahn and Buerger 1994
				4,747	
	Aesthetic & Recreational	CV	4,836	4,836	Sanders, Walsh and Loomis 1990
		DM		171	Rein 1999
		TC	810	810	Mullen and Menz 1985
		HP	106	106	Kulshreshtha and Gillies 1993
		CV	17	17	Greenley, Walsh and Young 1981
		CV	3,104	3,104	Duffield, Neher and Brown 1992
		CV	2,197	2,197	Duffield, Neher and Brown 1992

	.	TC		15,837	Bowker, English and Donovan 1996
				3,385	
	Cultural & Spiritual	CV	10	10	Greenley, Walsh and Young 1981
				10	
				8,359	
Urban greenspace	Gas & Climate regulation	DM	62	62	McPherson, Scott and Simpson 1998
		AC	405	405	McPherson 1992
		AC	2,026	2,026	McPherson 1992
				830	
	Water regulation	AC	15	15	McPherson 1992
				15	
	Aesthetic & Recreational	CV	8,562	8,562	Tyrvainen 2001
		CV	2,921	2,921	Tyrvainen 2001
		CV	4,312	4,312	Tyrvainen 2001
				5,266	
				6,111	

Notes:

Code	***Valuation method***
DM	*Direct market valuation*
AC	*Avoided cost*
RC	*Replacement cost*
FI	*Factor income*
TC	*Travel cost*
HP	*Hedonic pricing*
CV	*Contingent valuation*
GV	*Group valuation*
MD	*Multiattribute decision analysis*
EA	*Energy analysis*
MP	*Marginal product estimation*
CRS	*Combined Revealed and Stated Preference*
MA	*Meta-analysis*
VT	*Value transfer*

Annex VII. Area of *comarca* by land use type in Hectares.

Comarca	Alt Empordà	Baix Empordà	Selva	Maresme	Barcelonès	Baix Llobregat	Garraf	Baix Penedès	Tarragonès	Baix Camp	Baix Ebre	Montsià
Shelf (≤ 50 m)	14,801.1	8,061.3	3,891.0	22,057.8	6,111.6	7,684.3	22,478.4	5,445.5	10,841.0	11,140.1	23,586.6	55,385.8
Seagrass bed	180.5	174.5	73.0	975.0	100.1	0.0	2,174.5	211.0	426.7	2,697.9	1,555.3	0.0
Beach or dune	253.3	994.4	38.4	245.7	45.8	164.2	76.3	99.3	123.3	110.0	627.8	1,319.4
Saltwater wetland	54.1	3.6				38.0		1.1		10.0	346.6	2,040.1
Total coastal	**15,289.1**	**9,233.8**	**4,002.4**	**23,278.5**	**6,257.5**	**7,886.6**	**24,729.1**	**5,756.9**	**11,391.0**	**13,958.0**	**26,116.3**	**58,745.4**
Temperate forest	76,157.1	33,010.5	75,881.8	20,851.2	1,846.8	18,685.5	7,474.6	13,772.5	7,503.2	32,984.7	41,503.3	20,801.1
Grassland	4,627.7	900.1	1,286.3	2,407.7	808.8	4,604.3	3,678.9	1,094.1	4,231.7	6,301.4	4,893.7	2,175.2
Cropland	46,467.5	27,727.8	13,935.2	6,623.9	87.8	9,413.7	2,965.4	9,695.8	12,788.5	25,762.9	47,216.5	43,731.3
Freshwater wetland	46.0		27.0									
Open freshwater	908.1	242.6	775.8	163.1	119.8	452.3	32.9	47.2	318.4	430.7	1,562.4	557.4
Riparian buffer	438.6	135.2	11.0	5.5	33.5	370.0	1.5	30.9	219.0	58.6	244.1	1,010.1
Urban greenspace	208.4	277.4	141.4	107.1	494.0	157.1	78.5	49.0	152.0	130.7	52.0	
Urban	4,859.2	5,225.8	6,347.7	9,186.7	10,986.9	13,203.0	3,838.9	4,724.0	6,357.2	3,470.8	2,330.2	1,058.1
Barren	1,167.4	4.5	34.5			591.1	81.5	16.0	41.5	147.6	1,211.7	485.5
Burned forest	156.5	1,357.7	925.7	224.9			2.2		26.8	24.6		59.3
Mining ground	251.9	208.8	153.2	48.1	33.6	975.2	242.0	104.4	84.0	166.4	222.1	191.1
Urban/barren/burned/mining	**6,435.0**	**6,796.8**	**7,461.1**	**9,459.7**	**11,020.5**	**14,769.3**	**4,164.6**	**4,844.5**	**6,509.5**	**3,809.4**	**3,764.0**	**1,794.1**
Total terrestrial	**135,288.5**	**69,090.4**	**99,519.5**	**39,618.2**	**14,411.3**	**48,452.3**	**18,396.3**	**29,533.9**	**31,722.4**	**69,478.4**	**99,236.0**	**70,069.2**
Total	**150,578**	**78,324**	**103,522**	**62,897**	**20,669**	**56,339**	**43,125**	**35,291**	**43,113**	**83,436**	**125,352**	**128,815**

Source:

- *DARP. 2002. Zones de protecció de les praderies de fanerògames marines, 1:50,000. Departament d'Agricultura, Ramaderia i Pesca, Generalitat de Catalunya [online: http://www.gencat.net/darp/c/pescamar/sigpesca/csig14.htm], revised on May 2004.*
- *DARP. 2000. Corbes de batimetria del litoral català, fins a una profunditat de 1000 m, 1:50,000. Departament d'Agricultura, Ramaderia i Pesca, Generalitat de Catalunya [online: http://www.gencat.net/darp/c/pescamar/sigpesca/csig09.htm], revised on May 2004.*
- *DMAH. 2006. Cartografia 1:50.000 dels hàbitats de Catalunya (CHC50). Departament de Medi Ambient i Habitatge. Generalitat de Catalunya [online: http://mediambient.gencat.net/cat/el_medi/habitats/habitats_cartografia.htm#cd], revised on 23 May 2006.*

Annex VIII. Annual flow of ecosystem services by land used type and *comarca* (USD/ha·yr).

	Alt Empordà	Baix Empordà	Selva	Maresme	Barcelonès	Baix Llobregat	Garraf	Baix Penedès	Tarragonès	Baix Camp	Baix Ebre	Montsià	Total	%
Shelf (≤ 50 m)	47,509,542	25,875,715	12,489,524	70,802,453	19,617,346	24,665,554	72,152,509	17,479,255	34,798,072	35,758,280	75,709,738	177,780,837	**614,638,825**	**19.2**
Seagrass bed	4,374,123	4,228,174	1,769,783	23,623,003	2,425,392	0	52,682,914	5,112,108	10,338,427	65,365,278	37,682,172	0	**207,601,373**	**6.5**
Beach or dune	26,381,529	103,564,414	3,995,888	25,589,808	4,766,259	17,104,065	7,947,202	10,341,840	12,839,166	11,454,228	65,385,183	137,415,529	**426,785,111**	**13.4**
Saltwater wetland	819,883	54,137	0	0	0	576,252	0	16,223	0	151,201	5,250,360	30,902,689	**37,770,746**	**1.2**
Total coastal	**79,085,077**	**133,722,439**	**18,255,196**	**120,015,263**	**26,808,998**	**42,345,871**	**132,782,625**	**32,949,426**	**57,975,665**	**112,728,988**	**184,027,453**	**346,099,055**	**1,286,796,055**	**40.3**
Temperate forest	288,577,404	125,084,614	287,534,056	79,010,151	6,998,022	70,803,840	28,323,051	52,187,388	28,431,389	124,986,712	157,265,756	78,820,352	**1,328,022,735**	**41.6**
Grassland	1,063,171	206,791	295,516	553,156	185,823	1,057,790	845,186	251,351	972,201	1,447,678	1,124,282	499,722	**8,502,667**	**0.3**
Cropland	99,436,243	59,334,963	29,819,991	14,174,611	187,878	20,144,505	6,345,752	20,748,165	27,366,285	55,130,300	101,039,018	93,581,123	**527,308,834**	**16.5**
Freshwater wetland	1,314,931	0	771,133	0	0	0	0	0	0	0	0	0	**2,086,065**	**0.1**
Open freshwater	1,716,574	458,544	1,466,587	308,268	226,494	855,069	62,175	89,201	601,970	814,207	2,953,483	1,053,720	**10,606,294**	**0.3**
Riparian buffer	3,666,094	1,129,784	91,971	46,019	280,093	3,093,068	12,347	258,024	1,830,961	489,924	2,040,860	8,443,882	**21,383,028**	**0.7**
Urban greenspace	1,273,740	1,695,394	864,129	654,185	3,019,017	960,106	479,506	299,224	928,837	798,395	317,556	0	**11,290,089**	**0.4**
Total terrestrial	**397,048,157**	**187,910,091**	**320,843,384**	**94,746,390**	**10,897,327**	**96,914,378**	**36,068,018**	**73,833,352**	**60,131,643**	**183,667,216**	**264,740,956**	**182,398,800**	**1,909,199,712**	**59.7**
Total	**476,133,234**	**321,632,530**	**339,098,579**	**214,761,653**	**37,706,324**	**139,260,250**	**168,850,642**	**106,782,779**	**118,107,308**	**296,396,204**	**448,768,409**	**528,497,855**	**3,195,995,767**	**100**
%	**14.9**	**10.1**	**10.6**	**6.7**	**1.2**	**4.4**	**5.3**	**3.3**	**3.7**	**9.3**	**14.0**	**16.5**	**100**	

Annex IX. Population, GDP and available family income by *comarca* in USD for 2004.

		Available family income			*Gross domestic product*		
Comarca	**Population**	**Per capita**	**Total**	**%**	**Per capita**	**Total**	**%**
Alt Empordà	112,439	17,681	1,988,003,535	2.7	22,824	2,566,296,597	2.2
Baix Empordà	115,566	17,542	2,027,257,259	2.7	20,929	2,418,723,474	2.1
Selva	136,738	16,641	2,275,427,886	3.1	24,769	3,386,803,157	3.0
Maresme	386,573	16,633	6,429,797,639	8.6	16,037	6,199,546,868	5.4
Barcelonès	2,193,380	17,704	38,830,740,420	52.2	30,605	67,128,061,869	58.5
Baix Llobregat	741,024	14,971	11,094,077,988	14.9	22,265	16,498,675,072	14.4
Garraf	122,229	15,461	1,889,828,367	2.5	15,997	1,955,343,870	1.7
Baix Penedès	73,665	16,511	1,216,308,649	1.6	16,647	1,226,332,646	1.1
Tarragonès	202,662	17,737	3,594,655,502	4.8	30,926	6,267,430,504	5.5
Baix Camp	161,090	17,404	2,803,585,140	3.8	26,979	4,346,028,452	3.8
Baix Ebre	71,708	16,946	1,215,186,758	1.6	22,288	1,598,216,914	1.4
Montsià	61,989	16,311	1,011,085,676	1.4	19,593	1,214,526,796	1.1
Total	4,379,063	201,542	74,375,954,819	100	269,858	114,805,986,220	100
Catalonia	6,813,319	16,949	115,476,225,578		21,757	148,238,940,421	

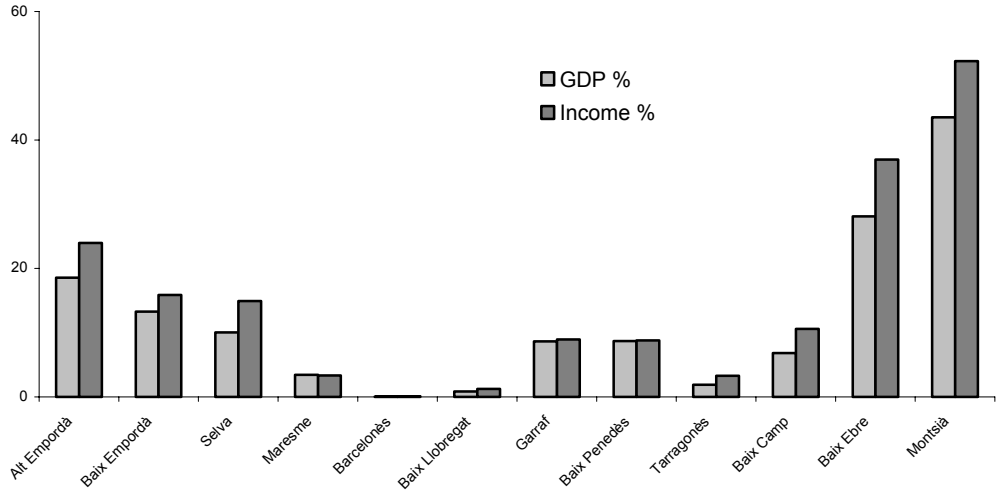
Source:

- *Population & income: IDESCAT. 2006. Anuari Estadístic 2005. Institut d'Estadística de Catalunya [online: http://www.idescat.net/], revised on 22 July 2006.*
- *GDP: Caixa Catalunya. 2005. Anuari Econòmic Comarcal 2005. Caixa Catalunya, Barcelona, Spain, 139 pp.*

Annex X. Contribution of *comarca's* and HEMU's ESV flow to its GDP and income.

Comarca:

Comarca	ESV Flow (USD/ha·yr)	GDP %	Income %
Alt Empordà	476,133,234	18.6	24.0
Baix Empordà	321,632,530	13.3	15.9
Selva	339,098,579	10.0	14.9
Maresme	214,761,653	3.5	3.3
Barcelonès	37,706,324	0.1	0.1
Baix Llobregat	139,260,250	0.8	1.3
Garraf	168,850,642	8.6	8.9
Baix Penedès	106,782,779	8.7	8.8
Tarragonès	118,107,308	1.9	3.3
Baix Camp	296,396,204	6.8	10.6
Baix Ebre	448,768,409	28.1	36.9
Montsià	528,497,855	43.5	52.3



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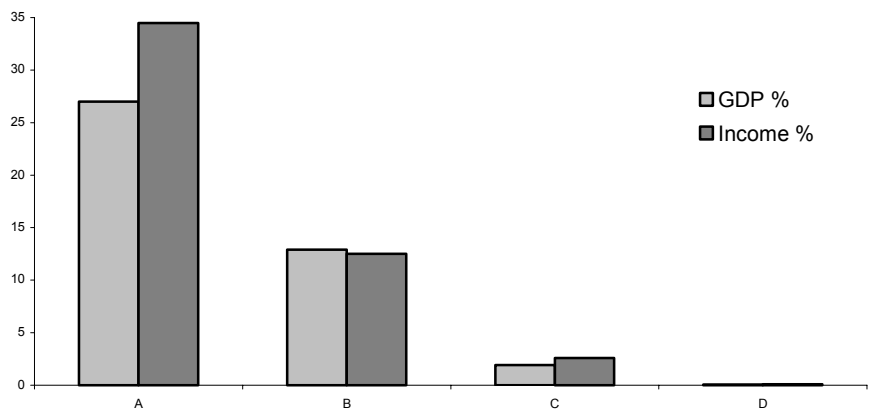


Annex XI. Descriptive statistics of sub-indicators of the Ecological Index of the Catalan coast.

	N	Min.	Max.	Mean	Std. Dev.	Variance	Skewness	Kurtosis
Veg. richness	50,289	1	4	2.08	0.62	0.38	0.40	0.81
Veg. rarity	50,289	1	4	1.31	0.59	0.35	1.93	3.55
Implantation area	50,289	1	4	2.35	0.61	0.37	-0.01	-0.33
Succession stage	50,289	1	4	2.07	1.19	1.42	0.56	-1.28
Biogeographic rep.	50,289	1	4	1.56	0.67	0.45	0.92	0.23

Annex XII. Descriptive statistics of sub-indicators of the Human Influence Index of the Catalan coast.

	N	Min.	Max.	Mean	Std. Dev.	Variance	Skewness	Kurtosis
Tourism	29,257	0	3	0.65	0.72	0.52	0.97	0.69
Land cover	29,257	0	18	8.72	5.84	34.09	-0.16	-1.06
Population density	29,257	1	10	2.11	1.85	3.42	2.33	5.59
Access	29,257	0	4	2.88	1.80	3.22	-0.98	-1.04
Heavy industry	29,257	0	8	0.15	0.47	0.22	8.50	127.71
Erosion	29,257	0	8	0.02	0.41	0.17	19.23	369.21

Note: N of 29,257 represents the resampled 500 x 500 m grid using bilinear interpolation of the original N of 22,848,540 of the 50 x 50 m grid for statistical data management purposes.

Annex XIII. Summary of the Human Influence Index scores by land cover.

Domain	Land cover	Area (ha)	Min.	Max.	Average	SD
Coastal-marine	Shelf (≤ 50 m)	191,484	0	32	6.70	6.40
	Seagrass bed	8,568	1	25	14.09	4.89
	Beach or dune	4,098	6	38	18.04	7.20
	Saltwater wetland	2,494	1	27	7.15	5.36
Terrestrial	Temperate forest	350,472	1	36	9.24	6.33
	Grassland	37,010	1	38	12.94	6.50
	Cropland	246,416	1	36	18.33	5.14
	Freshwater wetland	73	1	14	12.21	4.30
	Open freshwater	5,611	1	36	13.42	4.73
	Riparian buffer	2,558	1	34	12.49	5.96
	Urban greenspace	1,848	7	38	23.66	5.96
	Urban	71,589	11	51	27.94	4.25
	Barren	3,781	1	22	6.85	6.20
	Burned forest	2,778	9	26	20.07	5.61
	Mining ground	2,681	2	36	22.15	5.31

Annex XIV. Summary of PEIN areas' ESV flow and indexes in the Catalan coast.

PEIN code	Original flow (USD/yr)	Aver. EI	Aver. HFI	Aver. FI	Aver. ESPCI	Integrated flow (USD/yr)
AAE	26,947,783	5.3	38.1	2.5	3.0	35,983,258
ABE	4,859,845	5.1	43.4	2.3	2.5	6,343,537
ALB	34,245,949	6.7	25.7	2.0	5.3	54,882,024
ALG	37,365,746	7.7	24.7	2.1	6.3	64,052,983
ARB	339,395	5.1	34.3	1.7	3.5	446,430
BGM	2,016,335	5.5	48.8	2.0	3.1	2,742,736
CCR	34,456,796	5.8	38.5	1.8	4.0	50,197,619
CEL	10,517,874	5.6	42.8	1.9	3.5	14,907,399
CLR	12,659,247	5.2	53.2	1.9	2.7	16,159,047
CLS	8,778,284	7.0	33.5	2.0	5.2	14,113,137
CRD	22,743,508	6.3	16.3	1.9	5.6	37,790,804
CSC	127,845	4.9	51.9	1.9	2.4	151,936
CSD	322,605	5.3	42.0	1.7	3.3	449,854
CTC	1,817,848	5.8	40.9	1.9	3.9	2,686,394
CTI	1,869	6.0	25.0	2.0	5.0	2,804
CTM	19,444,588	6.4	44.9	2.0	4.0	30,504,231
DEB	256,323,132	5.8	31.3	2.7	3.8	380,624,550
DLL	3,815,531	5.1	57.2	2.6	1.3	4,456,543
EBI	107,126	5.0	41.0	2.7	2.2	128,824
GAI	43,647	2.7	68.9	1.8	-0.6	57,738
GAV	61,260,439	5.9	33.7	2.0	4.1	94,006,243
GIL	31,608,645	5.9	24.1	2.0	4.6	49,333,137
GRF	16,810,553	5.6	36.3	1.9	3.8	24,708,160
JOE	394,617	6.3	48.4	2.4	3.2	408,476
LCJ	5,210,157	5.5	11.6	2.0	4.9	8,466,130
MAR	153,739	6.3	12.4	2.0	5.6	247,138
MCS	21,223,292	5.5	28.8	1.9	4.1	33,287,432
MCT	310,042	5.8	50.6	1.9	3.3	485,613
MGI	18,690,224	5.4	42.8	2.0	3.2	26,649,903
MIA	12,731,600	5.5	15.3	2.0	4.7	21,101,502
MML	5,123,724	5.6	39.9	1.8	3.8	7,905,864
MPS	1,321,724	6.4	15.5	2.4	5.5	2,279,077
MSY	21,570,642	6.4	25.1	2.0	4.9	34,845,889
MTS	2,919,411	6.2	32.9	2.0	4.5	4,586,618
OLD	305,779	6.2	46.2	1.9	3.9	444,786
ORD	7,476,143	5.7	34.0	1.8	4.1	11,124,693
PRA	21,668,476	5.9	26.8	2.0	4.4	34,062,685
PRO	313,216	4.1	45.2	1.8	2.3	394,168
PSD	452,285	6.5	13.6	2.0	5.7	736,233
PTT	86,091,649	6.2	19.9	2.0	5.2	143,286,180
RJP	1,609,785	5.5	53.4	1.7	3.1	2,253,390
SCR	191,775	4.1	34.9	1.7	2.5	246,492
SIE	1,952,959	4.6	47.9	1.9	2.2	1,966,745
SJP	961,177	5.3	45.2	2.0	3.1	1,362,896
SLB	357,270	5.1	40.9	1.8	3.1	500,122
SLS	15,582,611	6.5	32.4	2.3	4.5	24,941,544
SSM	109,708	4.9	51.3	2.5	1.7	119,961
TBP	2,153,040	7.2	59.2	3.6	1.8	1,796,766
TDS	147,324	4.7	43.7	2.0	2.5	184,740

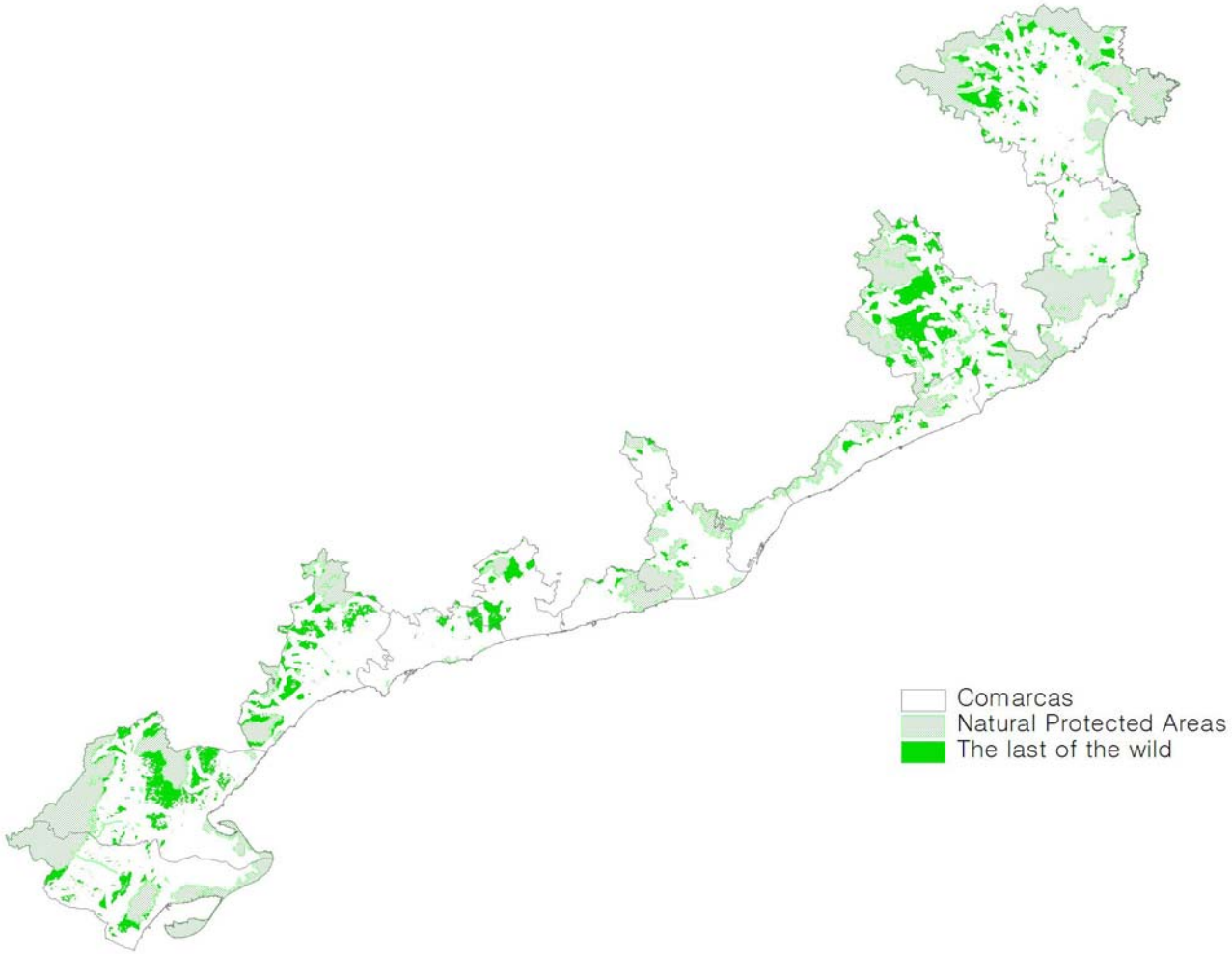
TPM	316,432	5.1	67.6	1.9	1.6	384,139
TRD	121,284	5.5	41.3	1.8	3.4	178,637
TVM	10,401,720	6.5	4.5	2.0	6.5	17,360,144
Total	826,476,394					1,266,337,351
Min.	1,869	2.7	4.5	1.7	-0.6	2,804
Max.	256,323,132	7.7	68.9	3.6	6.5	380,624,550
Average	15,893,777	5.7	37.1	2.0	3.7	24,352,641
Median	3,367,471	5.6	39.2	2.0	3.8	4,521,581

Source of PEIN area name and description:

- *DMAH. 2006. Cartografia 1:25,000 del Pla d'Espais d'Interès Natural de Catalunya. Departament de Medi Ambient i Habitatge. Generalitat de Catalunya [online: http://mediambient.gencat.net/cat/el_departament/cartografia/fitxes/pein.jsp?ComponentID=5469&SourcePageID=6463#1], revised on 1 October 2006.*

PEIN code	Name	PEIN code	Name
AAE	Aiguamolls de l'Alt Empordà	MCS	Serres de Montnegre-el Corredor
ABE	Aiguamolls del Baix Empordà	MCT	Turons de Maçanet
ALB	Massís de l'Albera	MGI	el Montgrí
ALG	l'Alta Garrotxa	MIA	Serra de Montsià
ARB	Riera d'Arb·cies	MML	el Montmell
BGM	Muntanyes de Begur	MPS	Penya-segats de la Muga
CCR	Cap de Creus	MSY	Massís del Montseny
CEL	la Conreria-Sant Mateu-Céllecs	MTS	Montserrat
CLR	Serra de Collserola	OLD	Olèrdola
CLS	Collsacabra	ORD	Muntanyes de l'Ordal
CRD	Serres de Cardó-el Boix	PRA	Muntanyes de Prades
CSC	Cap de Santes Creus	PRO	Pinya de Rosa
CSD	Volcà de la Crosa	PSD	Serres de Pradell-l'Argentera
CTC	Castell-Cap Roig	PTT	els Ports
CTI	Illa de Canet	RJP	la Rojala-Platja del Torn
CTM	Massís de les Cadiretes	SCR	Riera de Santa Coloma
DEB	Delta de l'Ebre	SIE	Estany de Sils
DLL	Delta del Llobregat	SJP	la Plana de Sant Jordi
EBI	Illes de l'Ebre	SLB	Barrancs de Sant Antoni-Lloret-la Galera
GAI	Desembocadura del Riu Gaià	SLS	Massís de les Salines
GAV	les Gavarres	SSM	Sèquia Major
GIL	les Guilleries	TBP	Platja de Torredembarra i Creixell
GRF	Massís del Garraf	TDS	Estanys de Tordera
JOE	Estanys de la Jonquera	TPM	Tamarit-Punta de la Mora
LCJ	Serra de Llaberia	TRD	Roureda de Tordera
MAR	Mare de Déu de la Roca	TVM	Muntanyes de Tivissa-Vandellòs

Annex XV. The last of the wild of the coast *comarcas* in Catalonia.



Publications and participation in symposia

- Valuation study indexed in: Nature Valuation and Financing Network – Case Study Database (http://www.naturevaluation.org).

- Spatial data layers metadata indexed in: Conservation GeoPortal – Conservation Commons Initiative (http://www.conservationmaps.org):

    - Homogeneous Environmental Management Units (HEMU)
    - Ecosystem Services Value flow (ESV)
    - Ecological Index (EI)
    - Human Footprint Index (HFI)
    - Ecosystem Services' Provision Capacity Index (ESPCI)

    Note: use "catalan" keyword in search

- Research appointment:

    - Visiting scholar, Ecoinformatics Collaboratory, Gund Institute for Ecological Economics, University of Vermont, Burlington, Vermont, USA, July 2006.

- Publications in peer-reviewed journals, book chapters & symposia proceedings:

Brenner, J., J.A. Jiménez, A. Garola, and R. Sardá. in preparation. Ecosystem services value of the coastal zone in Catalonia, Spain [to be sent to Ocean and Coastal Management].

Brenner, J. J.A. Jiménez, A. Garola, and R. Sardá. 2007. Spatial valuation of ecosystem services in the Catalan coast. Proceedings of the CoastGIS 07 Conference, Santander. October 8-10 [accepted].

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Brenner, J., J.A. Jiménez, and R. Sardá, 2006. Definition of environmental Homogeneous management units for the Catalonian coastal zone. Environmental Management 38: 993-1005 [online: http://dx.doi.org/10.1007/s00267-005-0210-6].

Brenner, J., J.A. Jiménez, and R. Sardá. 2006. Interacting processes and functions that determine the environmental health and change of the coastal socio-ecological system. Pages 205-212 in M. Forkiewicz (Ed.) Proceedings of Littoral 2006 Conference: Integrated Coastal Zone Management – Theory and Practice, Gdansk, Poland, September 18-20.

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Brenner, J., J.A. Jiménez, and R. Sardá. submitted. Environmental indicators system: application to the Catalan coast. In D. Green (Ed.) Coastal and Marine Geospatial Technologies, Coastal Systems and Continental Margins Book Series, Springer, New York.

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Brenner, J., J.A. Jimenez, and R. Sarda. 2005. Environmental indicators GIS of the Catalonian coast. In Proceedings of the CoastGIS 2005 International Conference, D. Green (Ed.), Aberdeen, July 21-23.

Brenner, J., and J.A. Jimenez. 2004. Evaluation of human pressure on ichthyofauna in Catalonian coastal waters. In Proceedings of the 37th International Conference of the Mediterranean Science Commission (CIESM), Barcelona, June 7-11.