Summary of the case study on valuation of the forest ecosystem services

Title of the valuation study: **The conservation against development paradigm in protected areas: Valuation of ecosystem services in the Doñana social–ecological system (southwestern Spain).**

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Objectives of the study

As provision services are fostered strongly by governments, other ecosystem services are in danger of undergoing serious degradation. This trend appeared mainly because of a lack of awareness and of existing data about monetary values of ecosystem services.

To assess the conservation effectiveness of the Doñana Protected Area (PA), the study valued the most important ecosystem services through a market-based approach, revealed-preference and stated-preference methods. Furthermore, the spatial distribution of the ecosystem services beneficiaries and the scale of their related markets with consideration of existing human activities in the surrounding lands were analysed. The main purpose of the report was to explore the socio-economic mechanisms underlying land use management outside and inside PAs that influence the capability to provide ecosystem services. The authors (1) identified the main services provided by the ecosystems of the Doñana social–ecological system; (2) estimated the monetary value of these ecosystem services; (3) analysed the spatial scale at which these ecosystem services were used; and (4) explored the relationship between ecosystem service values and the management strategy used.

Scope of the study

The ecosystem services valuated in the study were cultural services (recreation, spiritual), provisioning services (fishery, forestry, agriculture, and livestock), regulating services (climate, water, erosion) and habitat services (lifecycle maintenance, biodiversity). A regional geographical scope was covered.

The Doñana region is a cultural landscape of 220 070 ha located at the end of the Guadalquivir watershed in Andalusia, Spain. Its´ biophysical system consists of four ecodistricts: marshes, aeolian sheets, the coastal system, and the Guadalquivir Estuary (Fig. 1). It is one of the most significant wetlands in Europe to migrational bird species and contains several endemic flagship species (Iberian lynx, Imperial eagle). The socio-cultural system persists of 16 municipalities with 213,839 inhabitants, whose activities are mainly devoted to tourism and agriculture. The area was declared as National Park, Natural Park, Biosphere Reserve, and Ramsar Wetland.

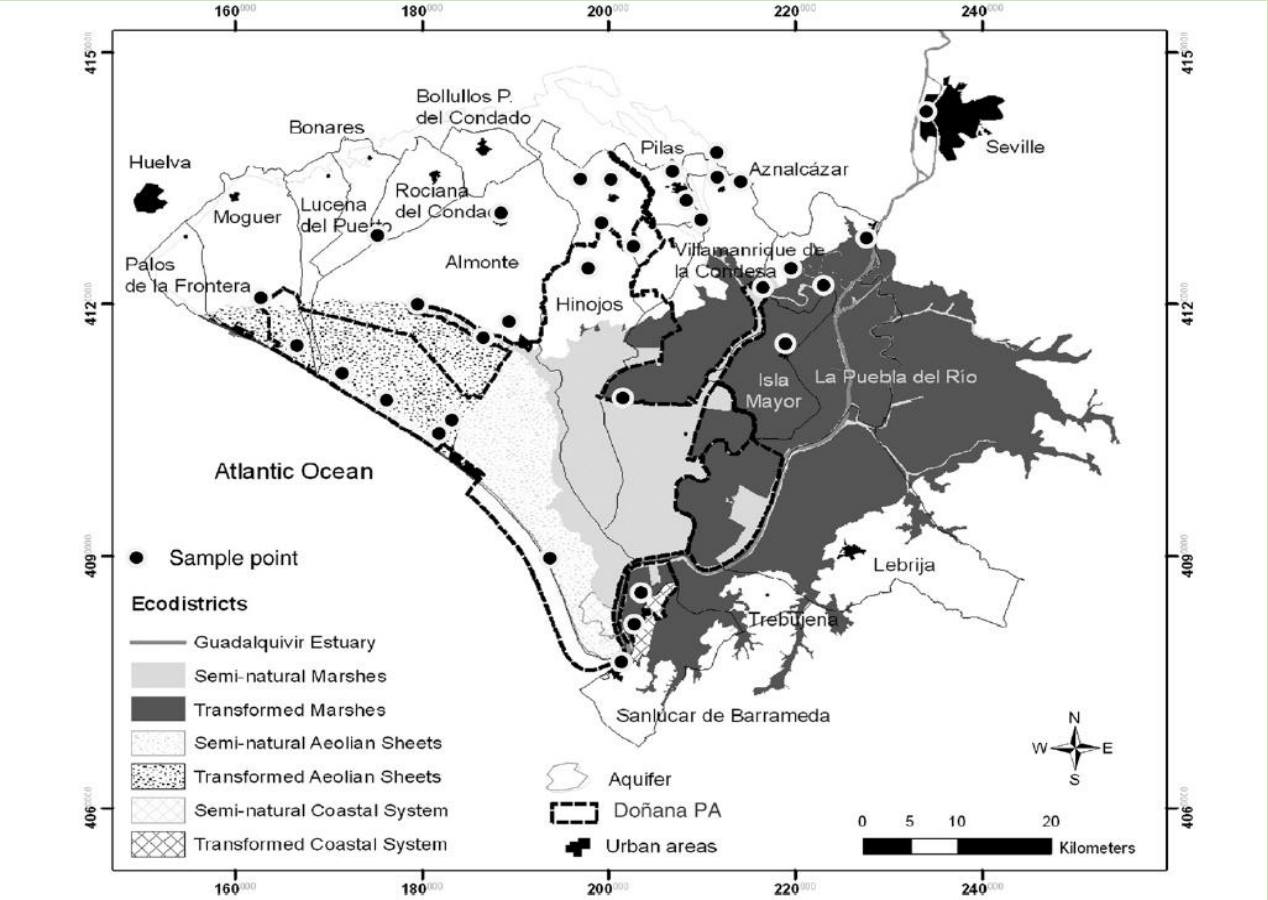

Fig. 1. Map of the Doñana social–ecological system showing the location of the sampling points. The ecodistricts represent the biophysical limits of Doñana (i.e., the service providers); the municipalities correspond to the limits of the main ecosystem services users; and the limits of the Doñana PA represent the conservation administrative limits.

Valuation method(s) applied

The Doñana region was concepted as coupled human and natural system, where both the protected area (PA) and the territorial matrix outside are embedded in complex socio-economic systems (SES). The value of ecosystem services provided was estimated as the sum of: (1) the direct consumptive use value, (2) the direct non-consumptive use value, (3) the indirect use value, and (4) the existence value. Table 1 shows the methods used for the estimations.

Tab. 1: The ecosystem services provided by the Doñana social-ecological system (SES), their type of value, and the methodology used for their estimation (ES: ecosystem service).

ES type	Type of value	Ecosystem service	Estimation method	Year assessed	Source
Provisioning	Consumptive direct use value	Agriculture Fishing (estuary and marshes)	Market based	2001-2008	▪ Agriculture and Fisheries Statistics Yearbook of Andalusia ▪ Interviews
		Cattle	Market based	2004-2008	▪ Annual Reports of Activities of the Doñana PA
		Coastal shell-fishing		2001-2008	▪ Interviews
		Forest resources		2001-2008	
		Crayfish	Market based	1999-2006	▪ CAP (2001) ▪ Interviews
Regulating	Indirect use value	Soil fertility Erosion control Water quality Hydrological regulation Micro-climatic regulation	Contingent Valuation (WTP)	2008	▪ Questionnaire survey from July 2008 to March 2009
Cultural	Non-consumptive direct use value	Tourism	Travel cost method	2004	▪ Questionnaire survey (Martín-López et al., 2009a)
		Religious tourism (spiritual values)	Travel cost method	2004	▪ Questionnaire survey (Martín-López et al., 2009a)
		Research	Research budget	2003-2008	▪ Martín-López et al. (2009b) ▪ The Doñana Biological Station Reports
		Environmental education	Environmental education budget	2006-2008	▪ Annual Reports of Activities of the Doñana PA
	Existence value	Moral satisfaction for conserving biodiversity	Contingent valuation (WTP)	2004	▪ Questionnaire survey (Martín-López et al., 2007b)

Consumptive use values were derived through **semi-structured interviews** of key informants and landowners in **a snowball sampling**.

Indirect-use values (regulating services) were estimated through a pre-tested **contingent valuation study** (CV) through willingness to pay (WTP) estimations (n= 404). For the analysis, the authors used the **Heckman model** and the best combination of variables was chosen guided by **Akaike information criterion** statistics. Finally, **ANOVA tests** determined statistical differences among specific regulating services.

Non-Consumptive Use and Existence Values (touristic and religious values) were estimated by using the **individual travel cost method** on a basis of 672 questionnaires representing 3965 visitors. The values of research and environmental education services were obtained from **annual budgets**, and the values related to the satisfaction for conserving biodiversity were calculated through the **contingent valuation method**.

Analysis of Trade-Offs among Beneficiaries and Spatial Scales were carried out by classifying the ecosystem services observed on the scale at which the beneficiaries used. A subdivision was done to assign ecosystem services to the local markets or the global markets. Furthermore, the services were classified based on their biophysical provider (ecodistricts; inside/outside PA). **Student's t tests** and **ANOVA tests** were used to compare the values of services provided. The **Shapiro–Wilk test** was used to check normality and a **redundancy analysis** (RDA) examined relations to economic values (ecosystem service provider, management strategy, spatial scale of beneficiaries, scale of markets). Additionally, a **hierarchical cluster analysis** (HCA) and a **Monte Carlo permutation test** were carried out.

Key results

- There was a clear trade-off between the local and global market values of ecosystem services. For example, landscape management outside of the Doñana Protected Area promotes the provision of ecosystem services associated with international markets.

- The highest valued regulating services in the CVM were water quality and climate control. The estimated economic value of regulating services was approximately 62 Mio. €/year. Local people showed higher WTP for biodiversity conservation and maintenance of soil fertility compared to people from somewhere else.

- The average consumer surplus for nature, 'sun and beach', cultural, and religious tourists was 36.8 €, 35.7 €, 14.2 €, and 86.3 € per annum, respectively, resulting in a total estimation of 126 million €.

- More than 65% of the users felt satisfaction related to conserving biodiversity and were willing to pay 36.04 € per annum for species protection. The WTP is higher for the conservation of charismatic and endemic species. The WTP declined with the geographical distance between the user's place of residence and the Doñana.

- Doñana is a perfect example for a conservation against development model. Unsustainable use of land areas surrounding the Doñana PA affects the ecosystem's potential to provide other ecosystem services and the beneficiaries at lower organisational scales negatively.