Environmental accounting of Marine Protected Area

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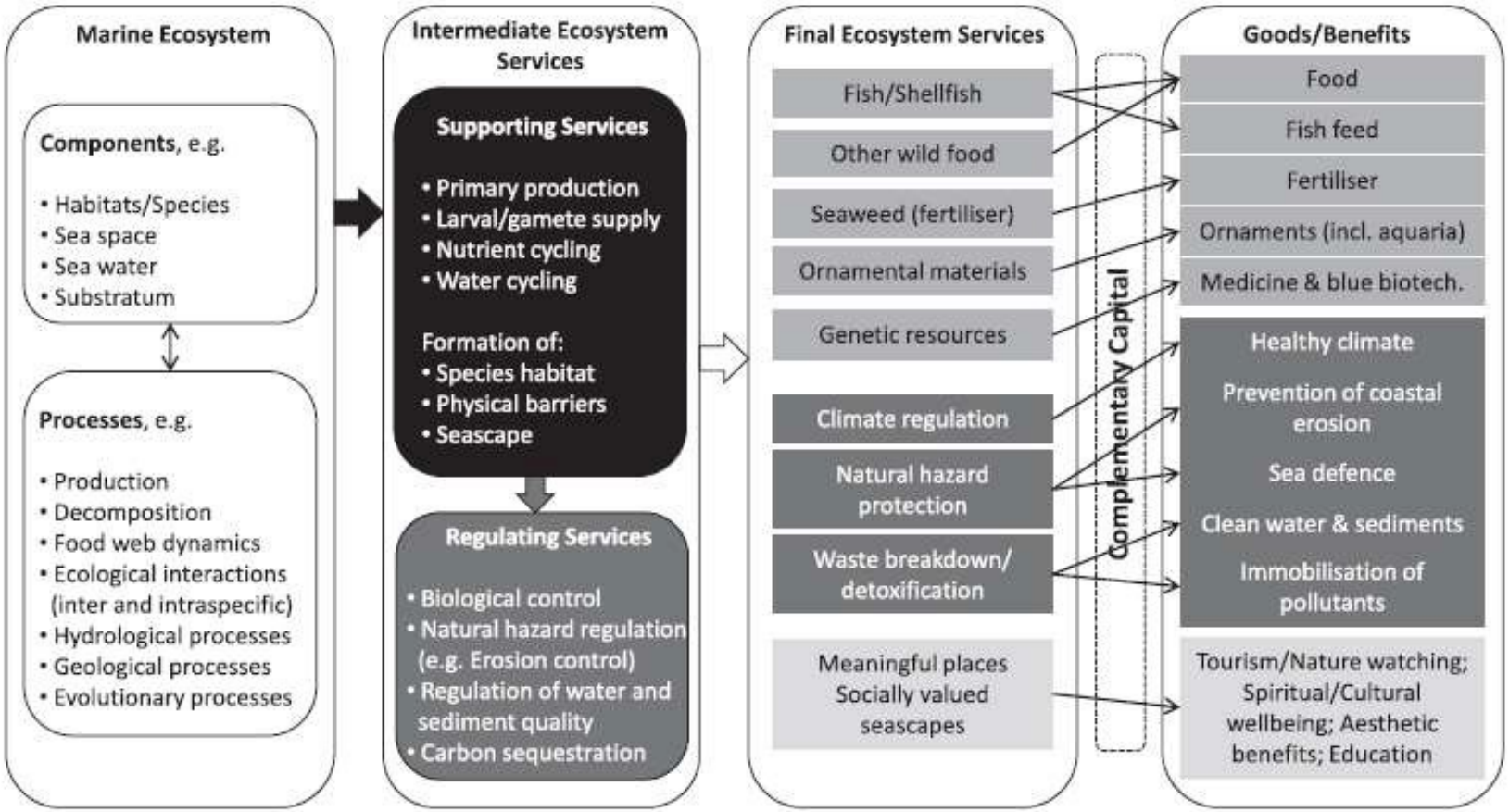
Goods and services provided by protected marine areas (benefits)

T. Potts et al. / Marine Policy 44 (2014) 139–148



Environmental accounting of Marine Protected Area

Protected Areas play a central role in adapting to various impacts of climate change such as acidification, rising sea levels, coastal erosion, increased storms, redistribution of biodiversity, decreased productivity and changes in the chemical composition of sea water.

Marine Protected Areas: *constitute a globally connected system for safeguarding biodiversity and maintaining marine ecosystem health and the supply of ecosystem services (*carbon sequestration and storage, increase the fish stocks, ricreational and cultural activities, protection by erosion..)

Environmental accounting and Marinen Protected Area

Environmental accounting is configured as *a governance tool* that allows the consistency, flows and changes of natural resources to be measured, i.e. to evaluate the impacts/effects of human actions on the environment (System of Economic-Environmental Accounts (SEEA)

Environmental accounting has also found interest in the governance of protected areas as a tool to support environmental and territorial policies aimed at measuring the *effectiveness of conservation policies in maintaining Natural Capital and ES.*

Environmental Accounting Model
Benefits (Economic and Environmental)
Costs (Economic and Environmental).

Environmental accounting

The cost-benefit analysis is a decision support tool that allows you to provide indications on the costs that the company must bear to carry out an intervention and the benefits that the company itself could benefit from

The recognition and estimation of the environmental and economic benefits offered by marine protected areas can represent a useful tool on which decision makers and stakeholders can evaluate forms of investment

	Environmental accounting	
Natural stock account	**Natural flow account**	
Quality assessment (by genius or species	Costs /expenses	Benefits /revenue
	PA expensens	PA revenue
Quantity assessment (density)	Environmental costs	Environmental benefits
	PA net benefits produced/	**consumed**

Environmental Costs (1)

Carbon Emission

The atmospheric emissions produced by small-scale artisanal fishing can be traced back to fuel consumption of the fishing fleet while those of Co.Ges. of the AMP to the consumption of: a) electricity, b) gas for heating, c) fuel for transport and nautical vehicles, d) raw materials.

1)Standard emission factor by Co.Ges. (Guideline JRC- by IPCC):

Electricity =. 0,483 t CO2/Mwhe	Annual average consumption 2,14 Mwhe	=**1,3 tCo2**
Gas 0,202 t CO2/MWh	Annual average consumption 1540 mc. = 15,40 MWh	= **2,96 tCo2**
Gasoil 0,267 t CO2/Mwh	Annual average consumption 504 l. = 6,64 MWh	= **1,78 tCo2**
Raw material (paper) 0,44 Kg Co2/KWh	Annual average consumption 161Hk = 402 KgWh	= **0,19KgCo2**

2) Emissions Co2 by regulated artisanal fishing

N. Vessels	33
Fishing days	152
Gasoil consumption	2100 l/vessel
Total cons. gasoil	69300. liter
Energetic Consumptio	637,56 MWh/year

Total emission CO2 **158,75 t CO2**

Social costs (2)

The Social Cost of Carbon method estimates the economic damage that would result from the emission of an additional ton of carbon into the atmosphere.

The methodological approaches used to determine the Social Cost of Carbon depend on various factors such as:

- the welfare function,
- the choice of discount rate,
- the choice of whether and how to take into account the potential aversion towards the impacts deriving from climate change
- the choice of time horizon

To determine this cost was taken reference is made to both the EPA data (2016) **(36$/tCO2=32,4€/tCO2)** and the new estimates (Ricke K., 2018) (417 $tCO2=379,47 €/tCO2) which push up the cost linked to the emission of carbon dioxide into the atmosphere.

Environmental and economic Costs

Environmental Costs

• Environmental costs of CoGes	€	187, 1
• Environemtnal costs of artisanal fishing	€	5143
• Total Environmental costs	€	5330,1

Economic Costs

- Services Institutional, general and of management € **€ 242.008**
  (salaries, utilities, rent….)
- Sustainable development and protection of the territory and of the Environment (investment) € **€ 475.961**
- Others € **€ 160.850**

Environmental and economic benefits

1. Wild animals and their outputs

Marine Protected Areas play an essential role in the conservation of marine biodiversity and in sustainable fisheries management (Kelleher,1999).

Sustainable fisheries management is oriented towards maintenance of fish stocks in order to ensure a constant and sustainable long-term flow of fish resource. This can be achieved through regulations governing fishing activities.

Indicators:

- Capacity indicator: fish resources: species, density (t)
- Flow indicator: capture of fish resources/crustaceans/molluscs/echinoderms (t/a) =75 T
- Flow indicator: CPUE (catch/fishing effort). = 5Kg/day
- **Benefit indicator: Market value of sale of fish resources (€/a) = 687.016 €**

Environmental and economic benefits

2. Mass stabilisation and control of erosion rates

The erosion process coastal does not seem to be attributable to "geological erosion" but rather to human action.

Capacity indicator: extent of emerged, sub-emerged and intertidal habitats (cover of seagrass/seaweeds (%), coastline slope and coastal geomorphology:

- ✓ Coastal habitats: sandbanks with weak permanent cover of aquamarine, mobile dunes, dunes with forests, temporary ponds (surface area Ha)

Benefit indicator: Avoided cost (€)

The economic value used of this ES is the Avoided Cost Method based on seasonal interventions was use (so annual) of nourishment of the beaches of a maintenance nature to reconstruct the existing profile of the beach following erosion phenomena.

The benefit of this SE was estimated based on the extension of the dunes (2.5 km compared to the entire 7 km coastline in which the MPA develops) of the cost of seasonal nourishment (14.77 €/m3 from Price list of the region) and the quantity of sand volume used (from 10 to 20 cubic meters per linear meter for soft nourishment).

Average cost of intervention = 574.500 €/year

Environmental and economic benefits

3.Global climate regulation by reduction of greenhouse gas concentrations

Coastal ecosystems retain large quantities of carbon called “blue carbon” and consequently they play an important role in regulating the climate:

- *Capacity indicators: C sequestration potential (gC/a), carbon stored in biomass (t/a)*
- *Flow indicators: primary productivity (gC/m2/a)*
- *Benefit indicator: market value of carbon (€)*

In the area Posidonia Oceanica is not present which performs a function not only of protection from coastal erosion, but also of absorption of carbon dioxide. For this reason the evaluation of this Service concerned only the component terrestrial referring to community habitats

1. Starting form estimation of carbon contained in Natura 2000 habitats on the Adriatic coast by the scientific literature and the surfaces occupied by the community habitats present in the AMP, the Carbon stock (t), Carbon Sink (t/year) was calculated

Benefit: carbon stock, carbon sink, CO2 sequestration

*1. Starting form estimation of carbon contained in Natura 2000 habitats on the Adriatic coast by the scientific literature (*Drius et al. 2016) *and the surfaces occupied by the community habitats present in the AMP, the Carbon stock (t), Carbon Sink (t/year) was calculated*

	Surfaces in AMP sm	Carbon stock T	Carbon Sink T/year	CO2 sequested T/Year
Embryonic mobile dunes	7500	2,355	0,0429	0,157
Mobile dunes of the coastal cordon with presence of Ammophila Arenaria	200	0,0612	0,0011	0,004
Dunes with Pinus Pinea and/or Pinus forests Pinaste	134500	416,815	7,579	27.815
Total	142200	528,841	7,623	**27,976**
Pinus Pinea e Pinus Halepensis	134500	114320	16,14	**59,23**

Social Cost of Carbon (SCS) using the value 36 $ tCO2 (EPA, 2016) (or 417$ /t CO2)

4. Experiential use of plants, animals and land/sea-scapes in different environmental settings

From an environmental and naturalistic point of view, the AMP offers visitors the opportunity to enjoy various recreational services ranging from the naturalistic observation of animal and plant species to sporting activities such as snorkelling, excursions, recreational visits etc.

Service ecosystemic was assessed with the following indicators:

- **Capacity indicator:** extension of the marine protected area **(3430 ha),** presence of iconic species (List: Fratino, Pinus …..)
- **Flow indicator:** number of tourists (arrivals) registered in the municipalities of the MPA, number and typology of tourists (arrivals) estimated in the AMP, number of snorkelers, number of visitors to the visitor center (eg. Museum), number of visitors per guided tour guides. Activities,
- **Benefit indicator:** willingness to pay (contigent evaluation): consumers express their preferences, choosing to pay/accept a certain thing or not amount to protect or renounce the benefits provided by natural capital

Estimate of the Total Economic Value (VET) attributed by visitors to the AMP

Median value = 35€ * annual visitors 36000 = 767712 €/year

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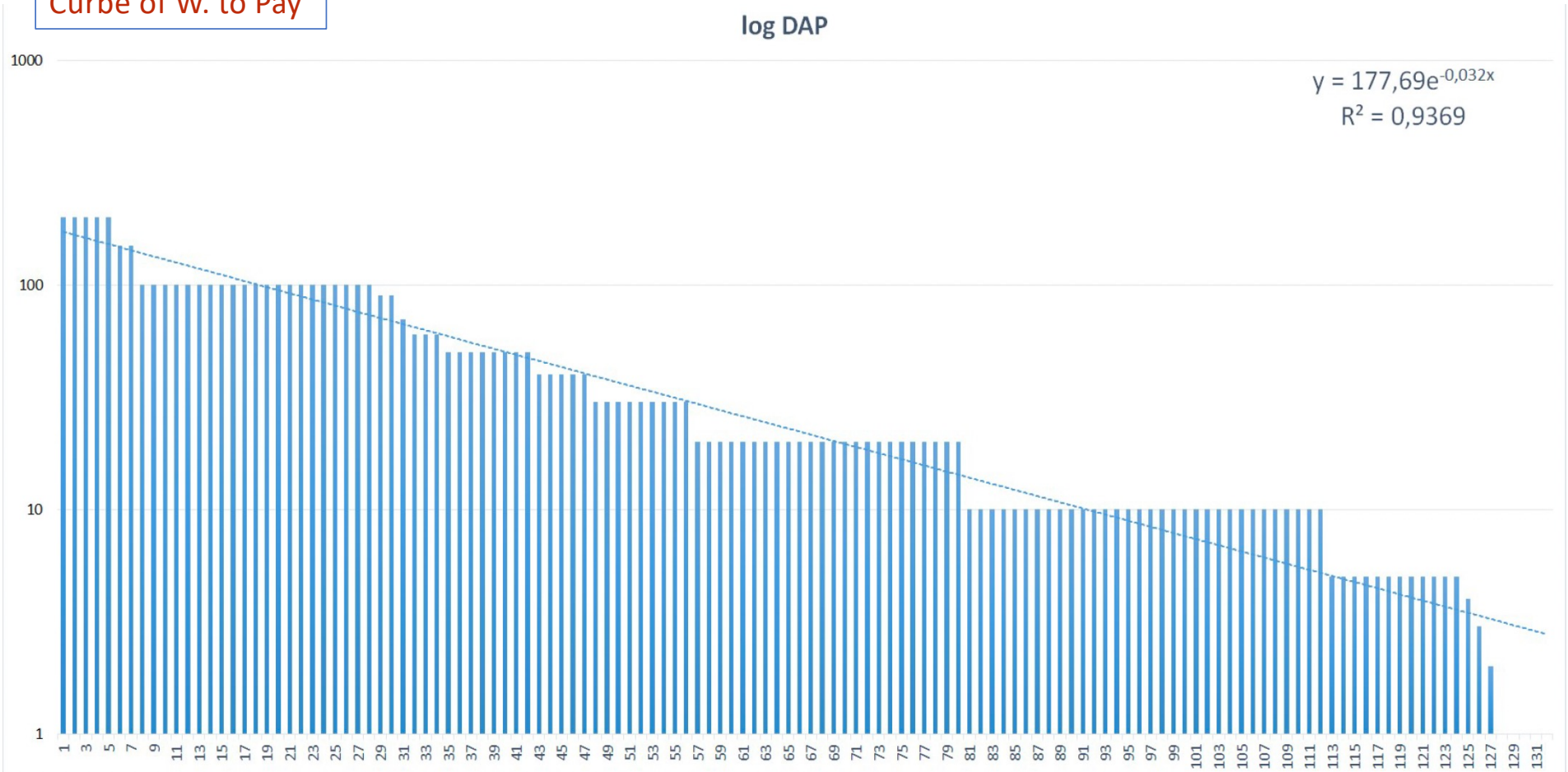

5. Educational benefits

Depending on the characteristics and activities carried out by the AMP in the education sector environmental, the following indicators were calculated:

- Capacity indicators: didactic-educational publications (number)
- Flow indicator: guided tours (number) school visits (number), workshop
- Benefit indicators: guided tours (Budget) School visits (budget): these estimates refer to revenue resulting from the guided tours and reception at AMP and the environmental education/workshop activities educational, ex. 22649 €

Economic benefit

Financial resources consist of current transfers (from the state or region), non-tax revenues, capital receipts (extraordinary resources from public organization)

Average: 877.000 €

Account of environmental flows and balance sheet of the AMP

Cost-benefit analysis (CBA) is a decision support tool which allows us to provide indications on the costs that the company must bear to create a intervention/ project and the benefits that the company itself will be able to benefit from

	average
Environmental costs	5330
Economic Costs	838281
Environmental Benefits	41545773
Economic Benefits	877294
Environmental Solde	41540443
Economic Solde	39133
Net Benefit	**41.579.456**