Synoptic representation of *P.oceanica* ecosystem services in the Italian seas

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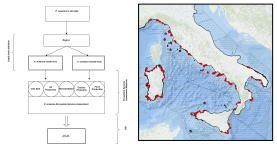
INTRODUCTION

This work analyzes and quantifies the value of ecosystem services in the *P. oceanica* meadows of the Italian seas, defining methodological approaches and creating synoptic maps through the use of GIS. Ecosystem Services can be defined as benefits provided to mankind by natural ecosystems. Their contribution is essential for human progress and of fundamental importance in the long run. The method of evaluating the ecosystem services for *P. oceanica* is derived from what reported in Costanza et al. (1997) [1] applying the specific site approach for the definition of benefits and services (Marcelli et al. 2018) [2]. The identified benefits for *P.oceanica* are carbon sequestration, oxygen production, erosion protection, bioremediation and food production. *P. oceanica* data are organized from the dataset collected by the Italian Institute for the Protection of the Environment and Research (ISPRA) for the Marine Strategy Framework Directive and include parameters such as coverage and shoots number (m2), average leaf area, leaf area index, average number of leaves, average height of the rhizomes, average foliar and rhizomes production. The data were used for the calculation of the benefits of *P. oceanica* which are represented in synoptic maps through GIS with the creation of the Atlas of the values of ecosystem services in the Italian seas.

METHODS

The dataset consists of 356 measuring stations distributed along the Italian coast. The information was collected by ISPRA from the database prepared for the mandatory Community reports relating to the definition of the Good Environmental Status (GES - Good Environmental Status). Other data were collected from COPERNICUS (wave simulations) and from the Institute of Economic Research for Fisheries and Aquaculture.



O2 PRODUCTION

The value obtained consists of two contributions: the Ob contribution relating to the supply of oxygen attributable to biomass calculated according to the following relationship:

$$O_b = [(B * M_a) * 32] * 10C$$

The Oe contribution relating to the supply of oxygen attributable to the epiphytic communities, calculated according to:

$$O_e = (M_c * 32) * 10C$$

Where B is the biomass of the meadow expressed in grams square meter year, Ma are the moles provided in a year (bibliographic data of 0.05 moles multiplied by 365 days) [4], Mc are the moles supplied in a year by the epiphytic communities (equal to 0.018 moles multiplied by 365 days), 32 is the molecular mass of O2, 10 is the conversion factor of grams in kilograms and square meters in hectares and C is the cost of industrial production per kilogram (equal to 0.05 euros) [5]
The estimate of the value of the total oxygen supply is therefore obtained from:

$$O_{tot} = O_b + O_e$$

EROSION PROTECTION

$$E = \left[\frac{1432.08 * \left(\frac{H_{rms}}{H_{rms0}} * 100\right)}{20}\right] * 5$$

Where, E is the value of the benefit in euros per hectare per year, 1432.08 euros is the cost per linear meter of a submerged barrier capable of guaranteeing wave attenuation of about 20% [2], (Hrms / Hrms0 * 100) is the percentage of attenuation obtained from the COPERNICUS model, 20 is the proportion for calculating the value relating to the submerged barrier, 5 is the conversion factor given from the ratio between an area of one hectare (100x100 meters) and the average life time of a submerged barrier (20 years).

CO2 SINK

$$C_b = (B_e * 0.33) + (B_i * 0.33)$$
$$C_L = B_L * 0.33$$
$$C_S = 21\ g$$
$$C_T = C_B + C_L + C_S$$
$$C = 0.01 * C_T * 24.7$$

Where: Cb is epiphytic CO2 sink, CL is the litter CO2 sink, Cs is the soil component CO2 sink. Be, Bi, BL the corresponding biomass productions. The value transfer is computed considering the Emission Trading Scheme (24.7 euro for 1 ton CO2). 0.33 is the organic C conversion factor for DW mass [3]

BIOREMEDIATION

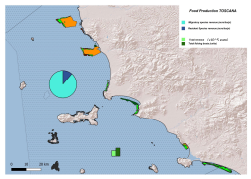
$$B = [(E * n * A)/(G * m)] * C * 10^4$$

where B is the annual average value per hectare of nitrogen or phosphorus bioremediation expressed in euros, E is the minimum required daily amount of N or P of the meadow (respectively 0.09 mg per shoot per day of N and 0.01 mg per shoot per day of P) [6], n is the number of shoots per square meter for each station, A is equal to 365 (days in a year), G is equal to 3.78 (conversion factor from gallons to liters), m is equal to 15 for N and 1.9 for P (average milligrams contained in a liter of water entering a urban treatment plant, obtained as a function of treatment efficiency) [6] and C is the cost in euros for the operation and management of an urban treatment plant, respectively 0.018 euros for N and 0.01 euros for P.[7], 10^4 is the conversion from square meters to hectares

FOOD PRODUCTION

$$P = \frac{R_r}{E_t - E_d - E_m} + \frac{R_v}{E_t}$$

Where P is the value of the benefit in euros per hectare per year, Rr is the revenue in euros of the species identified as resident, Et is the total extension in hectares of *P. oceanica*, Ed is the extension of degraded meadows, Em is the extension in hectares of the dead matte substrate, Rv is the revenue in euros of the species identified as visitors of the meadows.



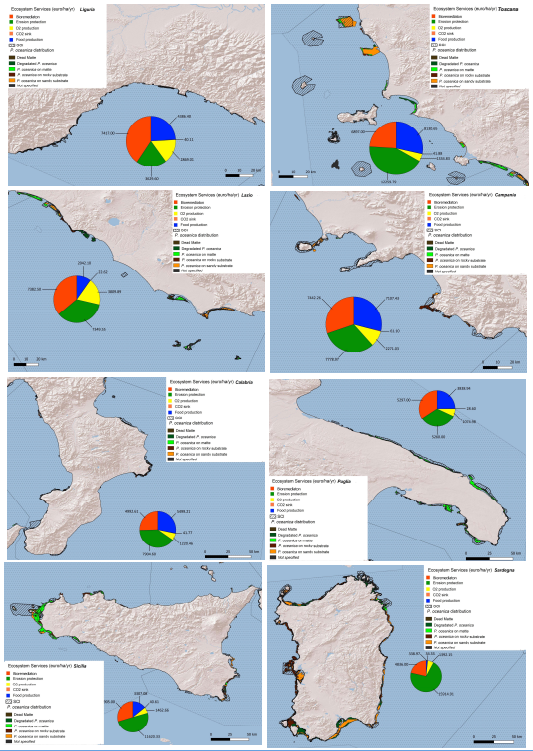
CONCLUSIONS

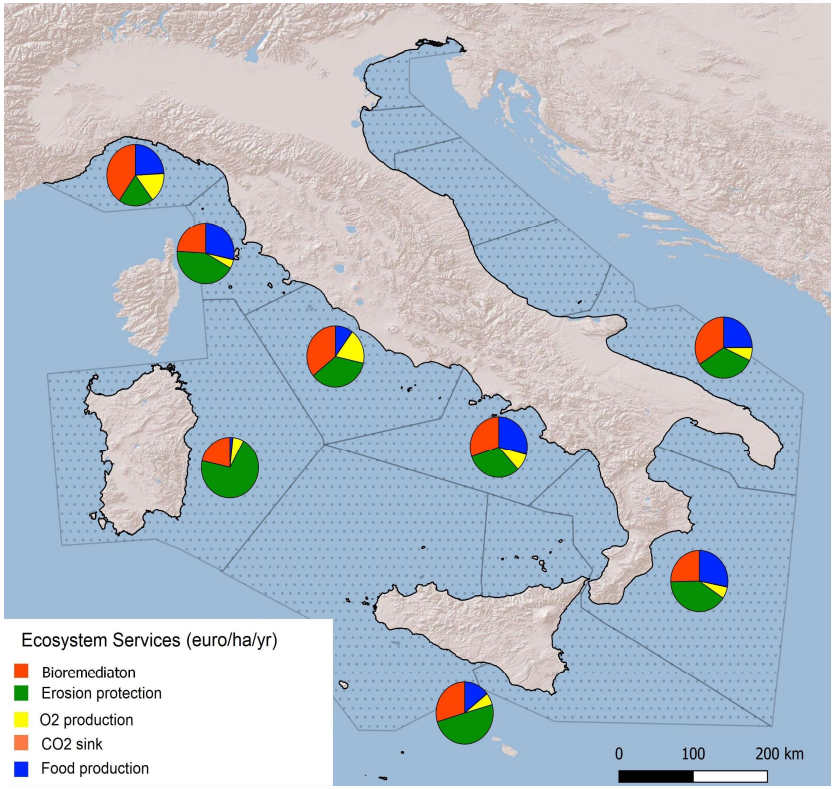
This work has provided an economic assessment of the ecosystem services of *P. oceanica meadows* on a national scale by applying a methodology based on the transfer of value and the identification of the main ecosystem services.
The study focused on five essential ecosystem services, such as carbon sink, bioremediaton, oxygen production, erosion protection and food production, and was applied to the regions of Liguria, Tuscany, Lazio , Campania, Calabria, Puglia, Sicily and Sardinia. The national average value obtained is 21660.5 € / ha / year which is in line with what is present in literature [1]. The methodology used shows that the economic evaluation of the SEs can provide an essential tool for the management of the coastal marine environment in particular if we consider the modularity of the approach.

P. Oceanica ECOSYSTEM SERVICES ATLAS

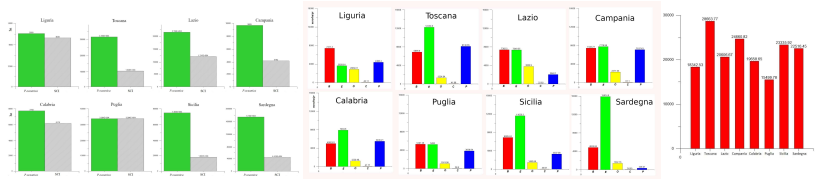
Ecosystem Services values (euro)

Region	CO2 sink	O2 production	Bioremediaton	Erosion protection	Food production
Liguria	40.10	2848.01	7417.40	3429.61	4386.40
Toscana	41.88	1334.84	6896.60	12259.80	8130.65
Lazio	22.60	3809.90	7382.50	7349.55	2042.10
Campania	61.10	2271.04	7442.27	7778.98	7107.43
Calabria	41.77	1220.46	4092.61	7904.60	5499.21
Puglia	28.60	1074.98	5297.26	5260.00	3838.94
Sicilia	40.60	1442.66	6905.24	11620.33	3307.08
Sardegna	34.50	1392.16	4835.85	15914.92	338.97





On national scale, the total value is equal to about 8 billion euros. SCIs coverage protect about 2.8 billion in value.



References

[1] Costanza, R., d'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., ... & Raskin, R. G. (1997). The value of the world's ecosystem services and natural capital. nature, 387(6630), 253-260.
[2] Marcelli, M., Scanu, S., Frattarelli, F. M., Mancini, E., & Carli, F. M. (2018). A benthic zonation system as a fundamental tool for natural capital assessment in a marine environment: A case study in the Northern Tyrrhenian Sea, Italy. Sustainability, 10(10), 3786.
[3] Duarte, C.M.. Marine Ecol. Prog. Ser. 67, 201-207 (1990)
[4] Gazeau, F., Duarte, C. M., Gattuso, J. P., Barrón, C., Navarro, N., Ruiz, S., ... & Borges, A. V. (2005). Whole-system metabolism and CO2 fluxes in a Mediterranean Bay dominated by seagrass beds (Palma Bay, NW Mediterranean).
[5] Li, J., Ren, Z., & Zhou, Z. (2006). Ecosystem services and their values: a case study in the Qinba mountains of China. Ecological Research, 21(4), 597-604.
[6] Gobert, S., Lejeune, P., Lepoint, G., & Bouquegneau, J. M. (2005). C, N, P concentrations and requirements of flowering Posidonia oceanica. Hydrobiologia, 533(1-3), 253.
[7] EPA report 820-F-15-096 (2015).