Round Table Online Event
14/09/2020

SItE - Towards Lecce2021

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Natural Capital Assessment in Marine Ecosystems

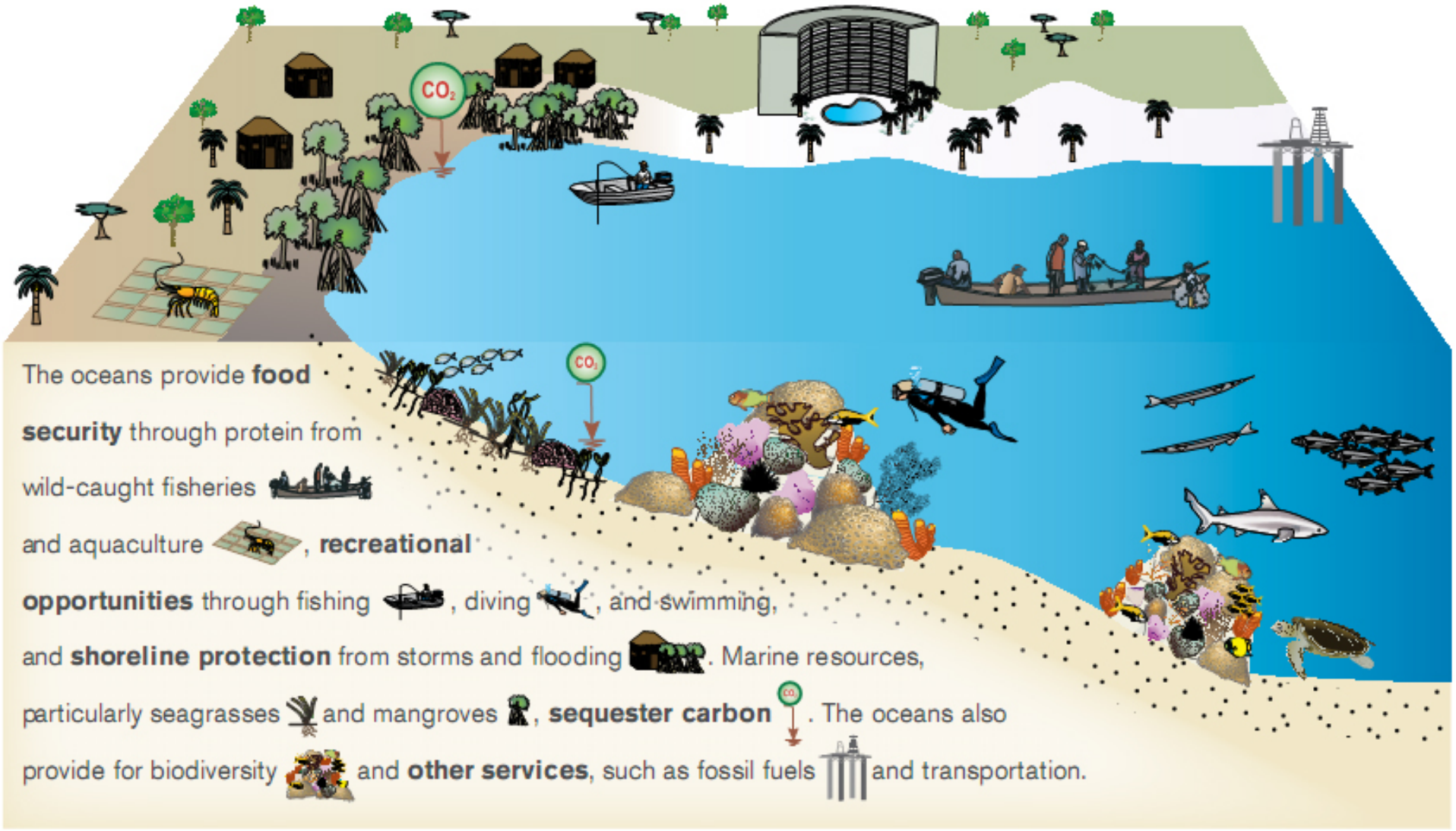
Pier Paolo Franzese, Elvira Buonocore, Giovanni F. Russo, Parthenope University of Naples

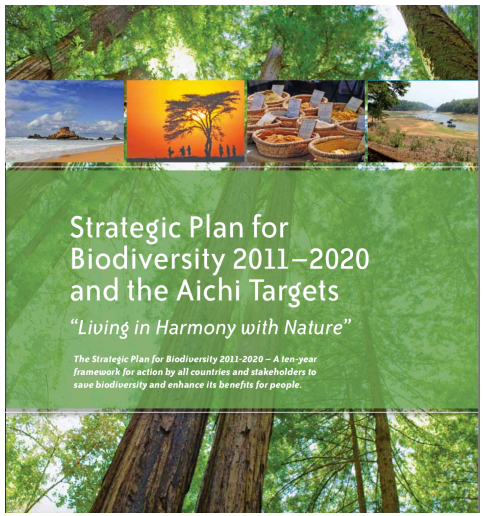
Round Table Session: Ecosystems and their services for human well-being

United Nations
Educational, Scientific and
Cultural Organization

UNESCO Chair in
Environment, Resources and Sustainable Development
Parthenope University of Naples, Italy

Ecosystem goods and services from marine ecosystems





The role of Marine Protected Areas (MPAs)

Aichi Biodiversity Target 11 of the Strategic Plan for Biodiversity 2010-2020 calls for Parties to the CBD to achieve the following: '*By 2020, at least **17 per cent of terrestrial and inland water areas** and **10 per cent of coastal and marine areas**, especially **areas of particular importance for biodiversity and ecosystem services**, are conserved through **effectively** and **equitably managed, ecologically representative** and **well-connected systems of protected areas** and **other effective area-based conservation measures**, and **integrated into the wider landscape and seascape**'.*

"By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people."

The 17 Sustainable Development Goals of the 2030 Agenda for Sustainable Development.
The online version of this report provides an interactive table with more detail on the contribution of protected areas to each SDG.

The new EU-wide Biodiversity Strategy will:

Establish protected areas for at least:

30% **of land in Europe**

30% **of sea in Europe**

With stricter protection of remaining EU primary and old-growth forests legally binding nature restoration targets in 2021.

Restore degraded ecosystems at land and sea across the whole of Europe by:

Increasing organic farming and biodiversity-rich landscape features on agricultural land

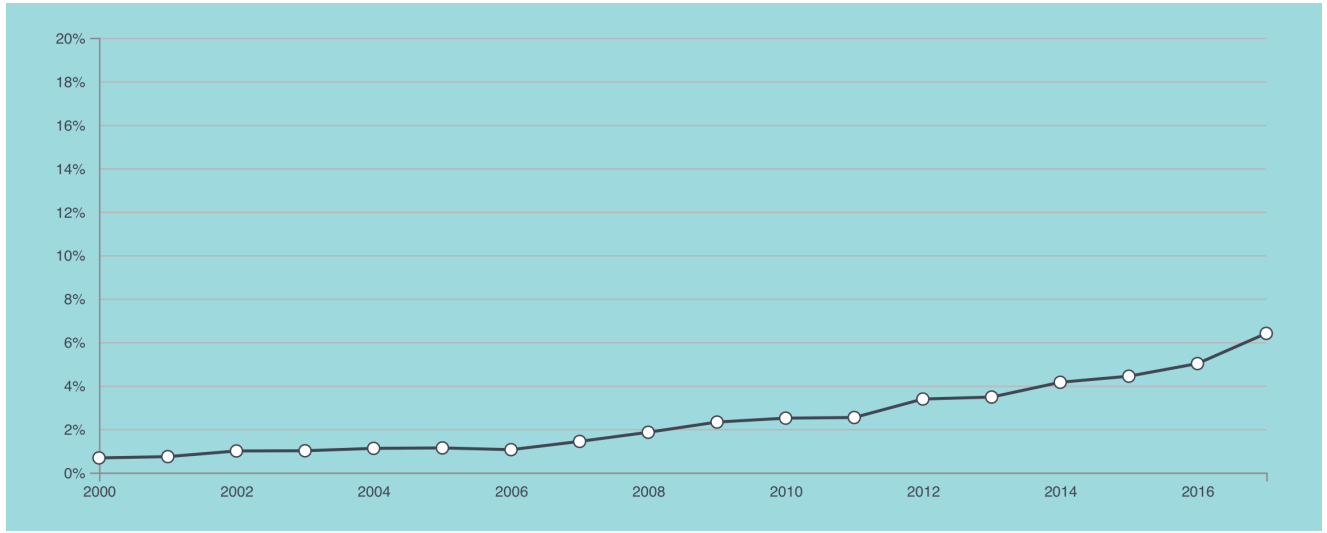
Halting and reversing the decline of pollinators

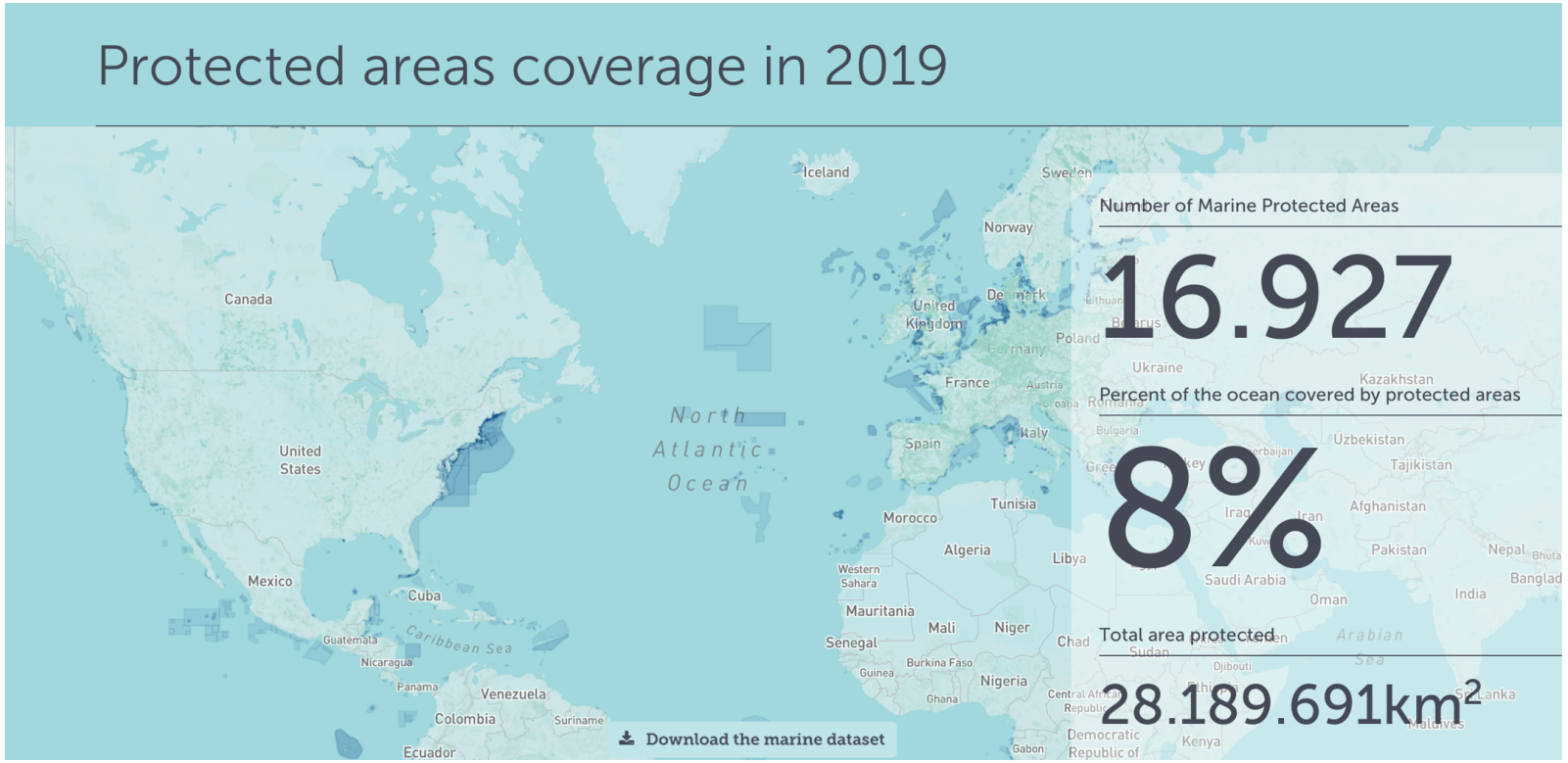
Restoring at least 25 000 km of EU rivers to a free-flowing state

Reducing the use and risk of pesticides by 50% by 2030

Planting 3 billion trees by 2030

World Marine Protected Areas





Italian Marine Protected Areas

Italy, Europe

Download this dataset

The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

27 Marine Protected Areas

Area marine

8.78%

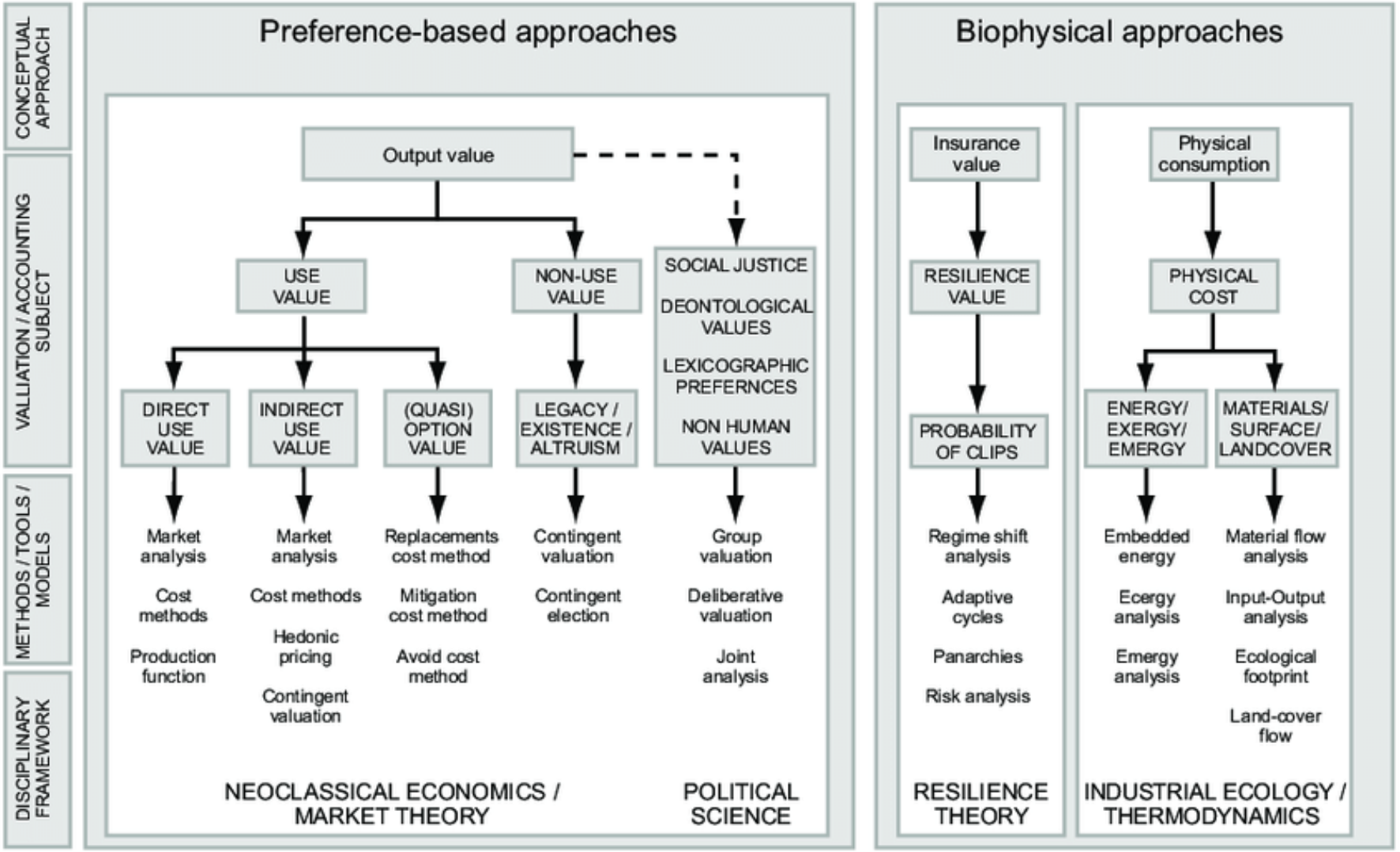
coverage

47,303 km²

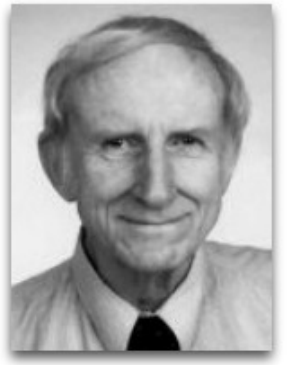
Marine Area Protected

How to calculate the value of natural capital in marine ecosystems?

Methodological approaches for natural capital and ecosystem services assessment (TEEB, 2010)



H.T. Odum Emergy Accounting



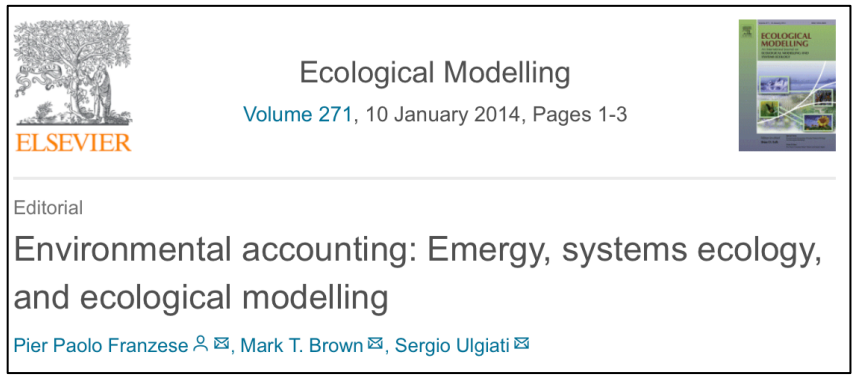
Emergy is a neologism meaning energy + memory

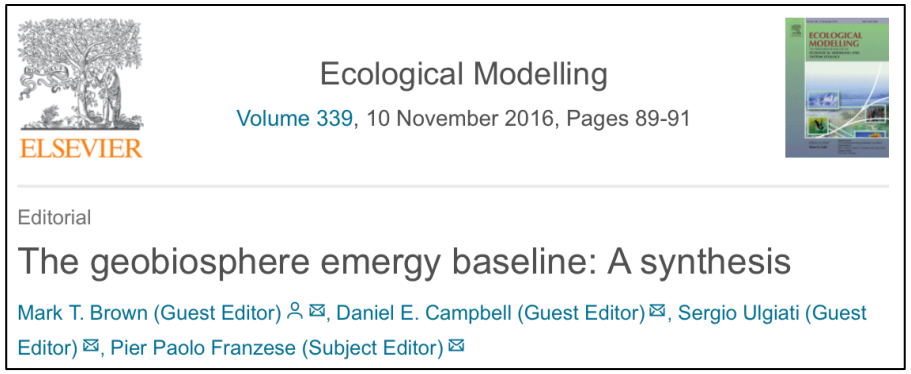
$$B_k = \sum_i Tr_i E_i$$

Solar Emergy is the total amount of solar energy directly and indirectly required to make a given product or to support a given flow (Odum, 1996).

The amount of emergy that it takes to make a unit of output flow or product is termed solar transformity (sej/Joule).

Emergy is a donor-side approach. Value is in the environmental work supporting a product or a service.





The Italian National project for Environmental Accounting in MPAs

The Italian Ministry of the Environment has financed a research programme for the implementation of an environmental accounting system for all the Italian MPAs.

The main goal of such a system is the calculation of the ecological and economic value of the MPAs, with particular reference to natural capital and the ecosystem services generated in each protected area.

Journal of Environmental Accounting and Management 3(4) (2015) 324-332

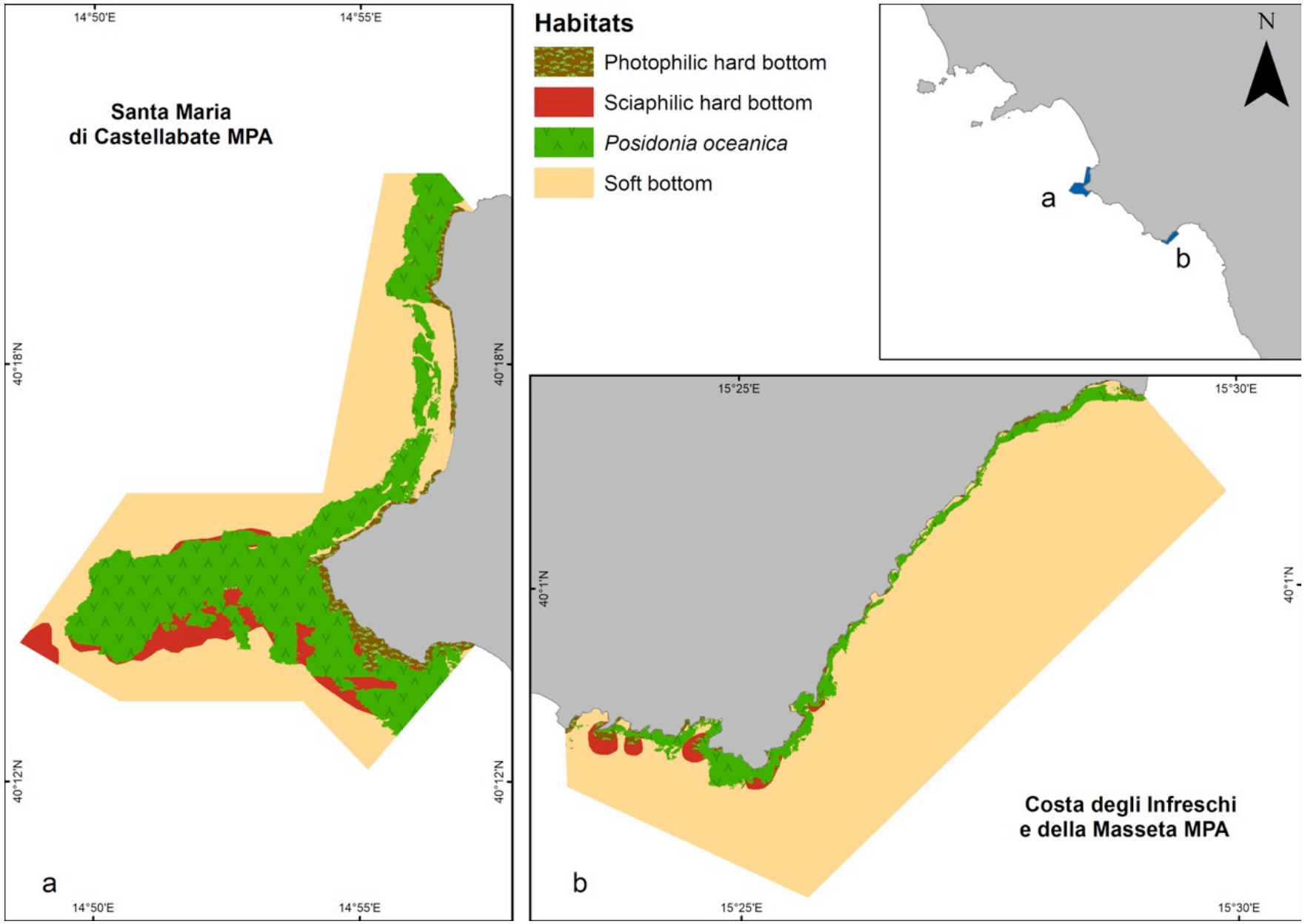
Journal of Environmental Accounting and Management

https://lhscientificpublishing.com/Journals/JEAM-Default.aspx

Environmental **A**ccounting in **M**arine **P**rotected **A**reas: the EAMPA Project

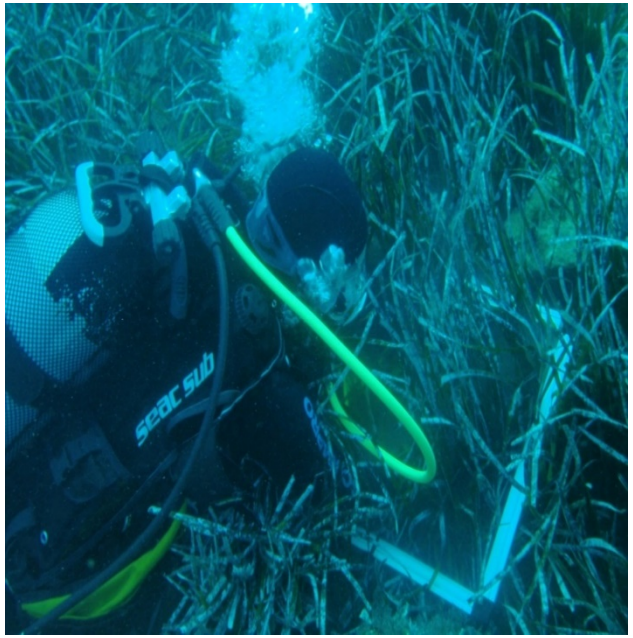
Pier Paolo Franzese[1,†], Elvira Buonocore[1], Chiara Paoli[2], Francesco Massa[2], Donati Stefano[3], Giorgio Fanciulli[4], Antonino Miccio[5], Emanuele Mollica[6], Augusto Navone[7], Giovanni F. Russo[1], Paolo Povero[2], Paolo Vassallo[2]

The methodological approach



Data collection

Four main benthic macro-habitats were identified through the analysis of the bionomic maps of the MPAs: 1) Sciaphilic hard bottom (**SHB**), 2) Photophilic hard bottom (**PHB**), 3) Posidonia oceanica seagrass bed **(PSB**), 4) Soft bottom (**SB**).



Macro-Benthos

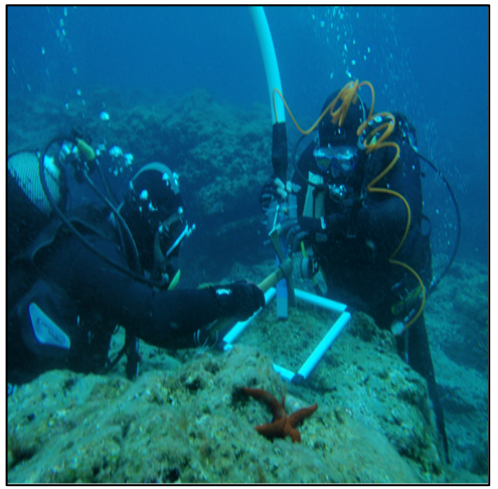
Data were gathered from ad hoc samplings performed on the four habitats in the study area. Species identified in each sample were clustered in main taxonomic groups and dry weights for all groups were calculated.

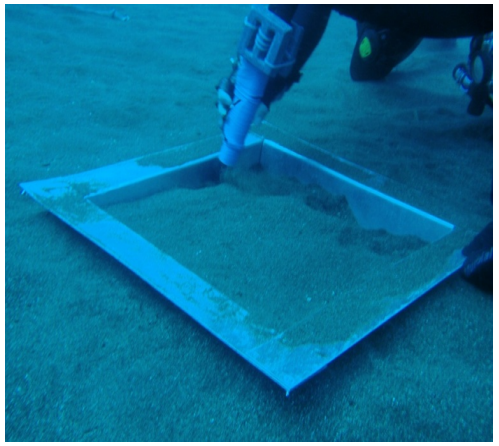
Fishes

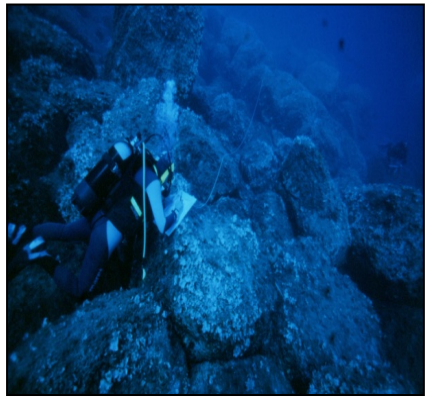
Fish biomass was calculated from visual census sampling technique.

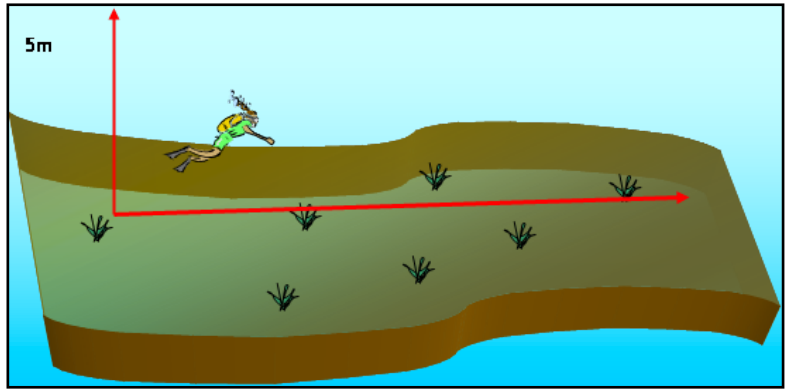
Biomass density of selected taxonomic groups

	Biomass (g_{AFDW} m^{-2})			
Groups	**SHB**	**PHB**	**SB**	**PSB**
Algae	18.64	47.50	0.00	1.54
Epiphytes	0.00	17.98	0.00	2.90
Microphytobenthos	55.37	55.37	55.37	55.37
Phytoplancton	1.51	1.51	1.51	1.51
Posidonia	0.00	0.00	0.00	475.11
Annelida	8.88	0.80	4.38	1.02
Ascidiacea	0.04	0.00	0.00	0.00
Bryozoa	5.26	0.47	0.17	0.96
Cnidaria	5.94	2.82	0.00	0.00
Crustacea	0.99	0.53	0.07	0.13
Porifera	12.81	29.83	0.00	0.00
Echinodermata	0.29	0.00	0.79	0.08
Fishes	39.40	15.54	0.24	4.69
Mollusca	27.36	5.33	3.84	2.75





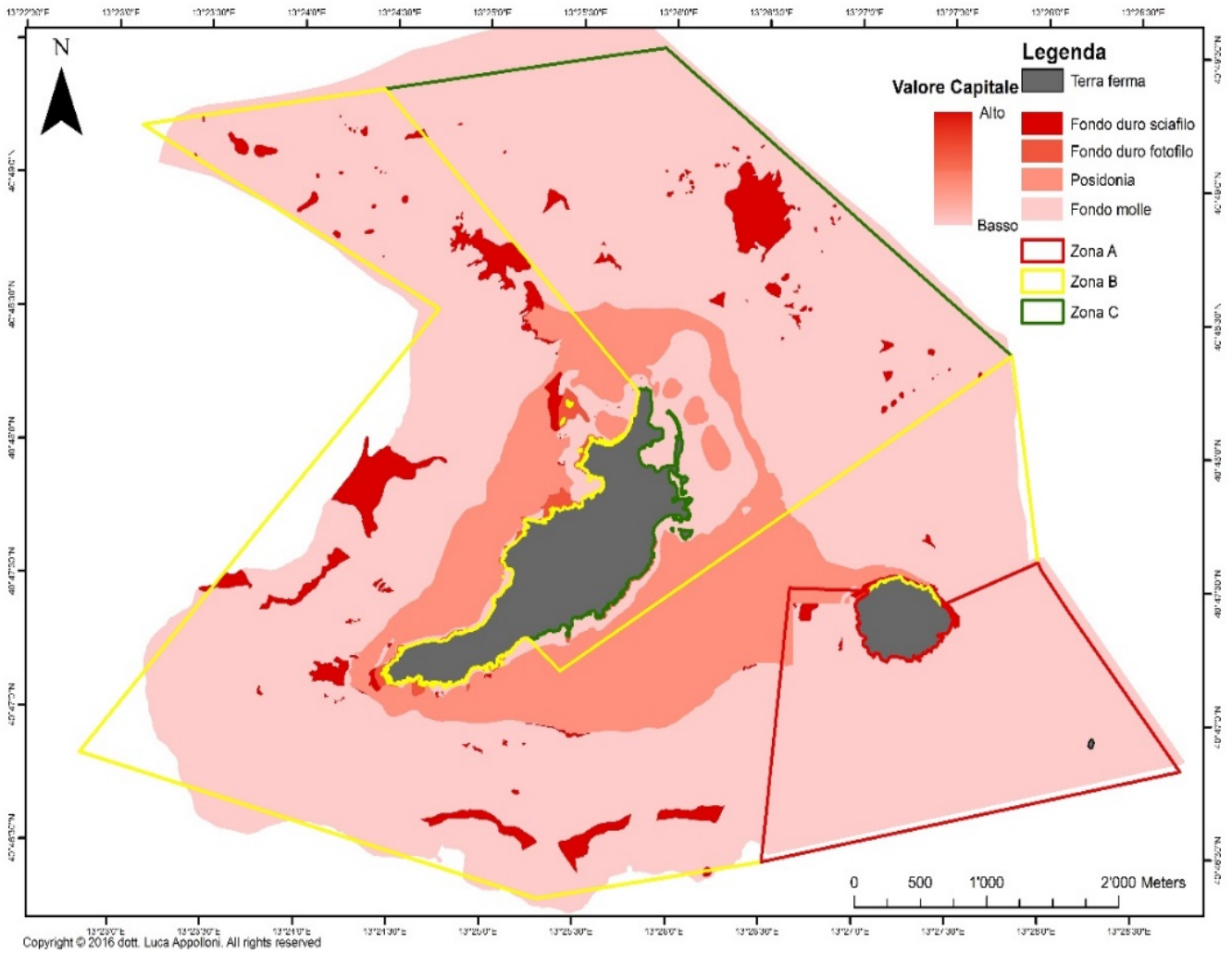




Biophysical value of natural capital stocks

INPUT	Emergy (sej)			
	SHB	**PHB**	**SB**	**PSB**
Solar radiation	3.03E+17	1.77E+16	5.60E+16	3.65E+16
Rain	8.11E+17	4.74E+16	1.50E+17	9.75E+16
Wind	1.18E+17	6.90E+15	2.18E+16	1.42E+16
Geothermal flow	2.46E+17	1.44E+16	4.53E+16	2.95E+16
Tides	1.31E+17	7.66E+15	2.42E+16	1.58E+16
Currents	1.83E+14	1.07E+13	3.38E+13	2.20E+13
Runoff	8.50E+17	4.97E+16	1.57E+17	1.02E+17
C	3.70E+17	2.16E+16	6.83E+16	4.45E+16
N	4.57E+18	2.67E+17	8.43E+17	5.49E+17
P	2.52E+18	1.47E+17	4.66E+17	3.03E+17
Total emergy (sej)	6.61E+18	3.86E+17	1.22E+18	7.94E+17
Emergy density (sej m^{-2})	4.81E+12	2.06E+12	9.75E+10	5.55E+11

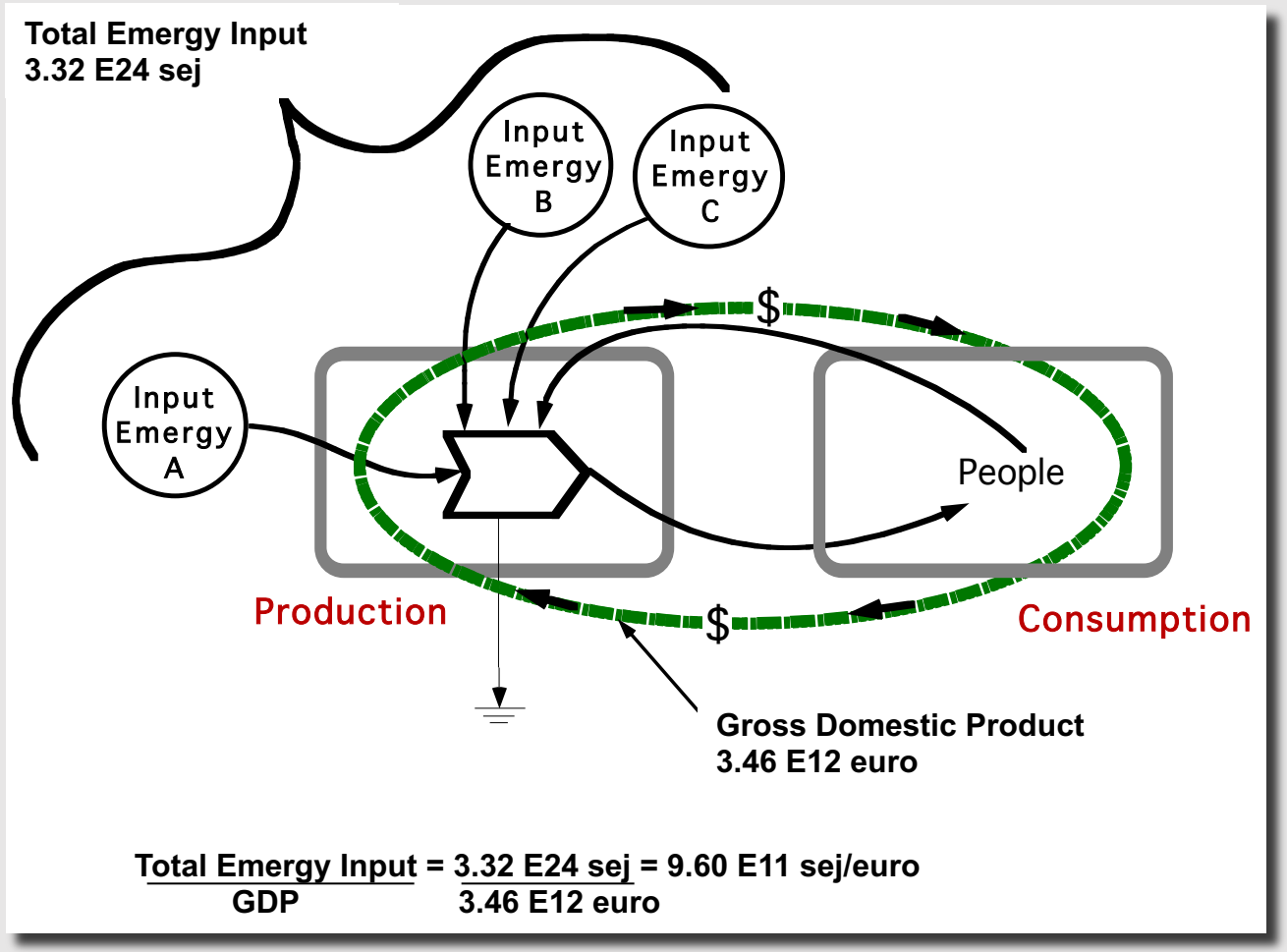
Spatial distribution of natural capital value for improving conservation management options



Natural capital value in Italian MPAs

Natural capital value (sej/m^2)	Punta Campanella	Isole Ventotene e S. Stefano	S. Maria di Castellabate	Costa degli Infreschi	Capo Rizzuto	Isole Tremiti	Isole Egadi	Regno di Nettuno	Porto Cesareo	Torre Guaceto
Sciaphilic hard bottom	4.94E+12	2.85E+12	2.61E+12	9.15E+11	1.50E+12	1.49E+12	2.38E+12	2.72E+12	4.74E+12	2.35E+12
Photophilic hard bottom	2.22E+12	7.43E+11	1.96E+12	1.27E+12	2.23E+12	2.28E+12	2.46E+12	2.45E+12	3.43E+12	2.16E+12
Soft bottom	2.18E+11	1.03E+11	2.50E+11	2.92E+11	1.08E+11	2.33E+11	9.85E+11	2.79E+11	5.90E+11	2.92E+11
Podidonia o. seagrass beds	1.10E+12	6.00E+11	1.00E+12	1.22E+12	9.20E+11	4.87E+11	2.35E+12	1.26E+12	1.23E+12	1.91E+12

From biophysical to non-market monetary value

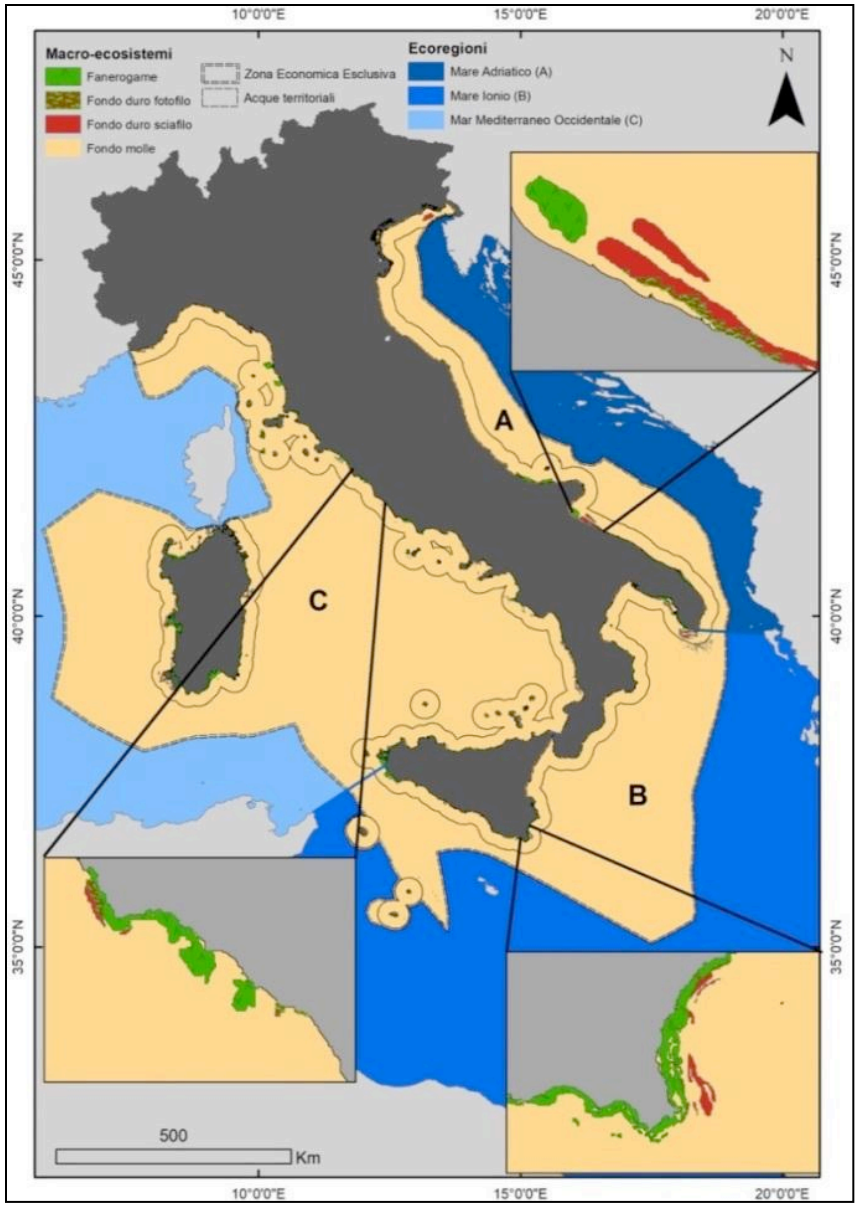


$$\frac{\text{Total Emergy Input}}{\text{GDP}} = \frac{3.32\ \text{E24 sej}}{3.46\ \text{E12 euro}} = 9.60\ \text{E11 sej/euro}$$

Natural capital value at national level: a first assessment

Distribution of marine habitats from maps available on the European Marine Observation and Data Network (EMODNET) platform.

Spatial distribution of macro-ecosystems in the three Italian marine eco-regions (Adriatic, Ionian and West Mediterranean) within **Territorial Waters** (TW) (12 miles, 234,000 km^2) and the **Zone of Ecological Protection** (ZEP) (906,000 km^2).



Natural capital value in the Italian marine eco-regions

Macro-ecosystems	Adriatic Sea		Ionian Sea		West Mediterranean Sea	
	TW	ZEP	TW	ZEP	TW	ZEP
Seagrass	1.05E+21	1.05E+21	1.57E+21	1.57E+21	6.28E+21	6.28E+21
Photophilic hard bottom	4.83E+20	4.83E+20	5.13E+20	5.13E+20	1.02E+21	1.02E+21
Sciaphilic hard bottom	2.32E+21	2.32E+21	1.66E+21	1.84E+21	3.33E+21	3.33E+21
Soft bottom	1.37E+22	3.54E+22	1.51E+22	7.86E+22	4.07E+22	1.66E+23
Total (sej)	**1.76E+22**	**3.92E+22**	**1.88E+22**	**8.25E+22**	**5.13E+22**	**1.76E+23**

Total value at national scale (TW) = 91 Billion euros

Total value at national scale (ZEP) = 310 Billion euros

Macro-ecosystems	Adriatic Sea		Ionian Sea		West Mediterranean Sea	
	TW	ZEP	TW	ZEP	TW	ZEP
Seagrass	1.10	1.10	1.64	1.64	6.54	6.54
Photophilic hard bottom	0.50	0.50	0.53	0.53	1.06	1.06
Sciaphilic hard bottom	2.42	2.42	1.73	1.92	3.47	3.47
Soft bottom	14.31	36.84	15.68	81.84	42.39	172.48
Total (Billion euros)	**18.33**	**40.86**	**19.59**	**85.93**	**53.46**	**183.55**

Selected publications

Ecological Modelling 355 (2017) 12–17

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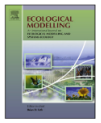

Assessing the value of natural capital in marine protected areas: A biophysical and trophodynamic environmental accounting model

P. Vassallo[a,c], C. Paoli[a,c,*], E. Buonocore[b,c], P.P. Franzese[b,c], G.F. Russo[b,c], P. Povero[a,c]

Ecological Modelling 392 (2019) 137–146

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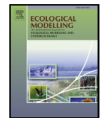

Modeling matter and energy flows in marine ecosystems using emergy and eco-exergy methods to account for natural capital value

Elvira Buonocore[a,b], Flavio Picone[a,b], Luigia Donnarumma[a,b], Giovanni F. Russo[a,b], Pier Paolo Franzese[a,b,*]

Ecological Modelling 360 (2017) 290–299

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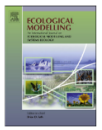

Natural capital accounting in marine protected areas: The case of the Islands of Ventotene and S. Stefano (Central Italy)

Pier Paolo Franzese[a,b], Elvira Buonocore[a,b,*], Luigia Donnarumma[a,b], Giovanni F. Russo[a,b]

Ecological Modelling 424 (2020) 109029

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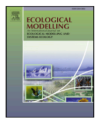

Marine natural capital and ecosystem services: An environmental accounting model

Elvira Buonocore[a,b,*], Luigia Donnarumma[a,b], Luca Appolloni[a,b], Antonino Miccio[c], Giovanni F. Russo[a,b], Pier Paolo Franzese[a,b,*]

Ecological Modelling 361 (2017) 1–13

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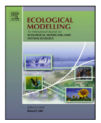

Integrating natural capital assessment and marine spatial planning: A case study in the Mediterranean sea

F. Picone[a,c], E. Buonocore[a,c], R. D'Agostaro[b,c], S. Donati[d], R. Chemello[b,c], P.P. Franzese[a,c,*]

Ecological Modelling 419 (2020) 108958

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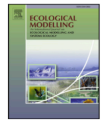
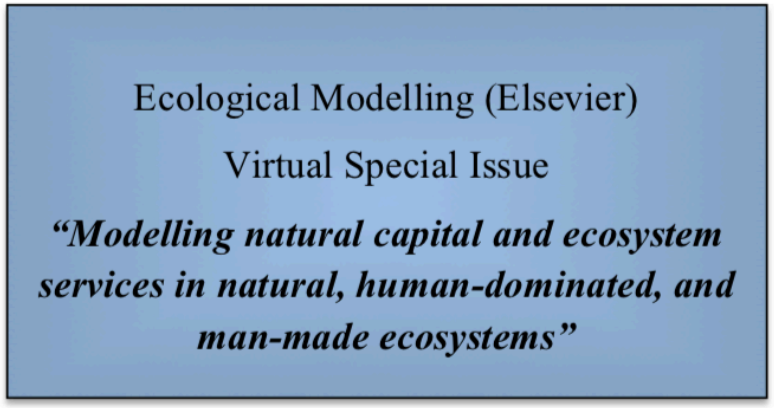


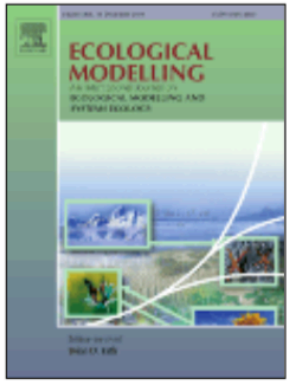
Assessing natural capital value in marine ecosystems through an environmental accounting model: A case study in Southern Italy

Elvira Buonocore[a,b], Luca Appolloni[a,b], Giovanni F. Russo[a,b], Pier Paolo Franzese[a,b,*]

Ecological Modelling (Elsevier)

Special issue "Modelling natural capital and ecosystem services in natural, human-dominated, and man-made ecosystems"





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Scope and goal of the special issue

Natural capital can be defined as the stock of natural resources generating a "natural income" in terms of valuable flows of ecosystem goods and services. Natural capital is irreplaceable with manufactured capital and it ensures a life support system vital for human well-being.

Socio-economic systems are highly dependent on the ecological systems in which they are embedded and from which they gain several goods and services: food, fibers, fresh water, clean air, pollination, climate regulation, among many others. Healthy ecosystems are capable of maintaining their structures and functions while generating several ecosystem services.


Thank you
for your attention!
Photos by Guido Villani