



Ninth International Symposium



# Monitoring of Mediterranean Coastal Areas: Problems and Measurement Techniques

Livorno (Italy) 14<sup>th</sup> - 16<sup>th</sup> June 2022

edited by

Laura Bonora, Donatella Carboni,  
Matteo De Vincenzi, Giorgio Matteucci



FIRENZE  
UNIVERSITY  
PRESS

MONITORING OF MEDITERRANEAN COASTAL AREAS:  
PROBLEMS AND MEASUREMENT TECHNIQUES

- 1 -

## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

### *Director*

Fabrizio Benincasa, CNR-IBE, Institute of BioEconomy, Italy  
Laura Bonora, CNR-IBE, Institute of BioEconomy, Italy  
Donatella Carboni, University of Sassari, Italy  
Matteo De Vincenzi, CNR-IBE, Institute of BioEconomy, Italy  
Giorgio Matteucci, CNR-IBE, Institute of BioEconomy, Italy

### *Scientific Board*

Edward Anthony, CEREGE, Aix-en-Provence, France, France  
Fabrizio Antonioli, INGV, Italy  
Peter A.J. Attema, University of Groningen, Netherlands  
Rossella Bardazzi, University of Florence, Italy  
Jordi Bellmunt Chiva, Universitat Politècnica de Catalunya BarcelonaTech, Spain  
Duccio Bertoni, University of Pisa, Italy  
Giovanna Bianchi, University of Siena, Italy  
Lorenzo Cappiotti, University of Florence, Italy  
Carlo Carcasci, University of Florence, Italy  
Filippo Catani, University of Padua, Italy  
Marcantonio Catelani, University of Florence, Italy  
Carla Cesaraccio, CNR-IBE, Institute of BioEconomy, Italy  
Giulio Ciampoltrini, Soprintendenza Archeologica per la Toscana, Italy  
Corinne Corbau, University of Ferrara, Italy  
Fabio Crocetta, Anton Dohrn Zoological Station, Italy  
Giuliano Gabbani, University of Florence, Italy  
Riccardo Gori, University of Florence, Italy  
Michel Gras, Ecole Française de Rome, Italy  
Biagio Guccione, University of Florence, Italy  
Antonietta Ivona, University of Bari Aldo Moro, Italy  
Elif Koparal, Mimar Sinan Fine Arts University, Istanbul, Turkey  
Sandro Lanfranco, University of Malta, Malta  
Sabrina Lo Brutto, University of Palermo, Italy  
Ilaria Lolli, University of Pisa, Italy  
Lucrezia Lopez, University of Santiago de Compostela, Spain  
Giampaolo Manfrida, University of Florence, Italy  
Tessa Matteini, University of Florence, Italy  
Sandro Moretti, University of Florence, Italy  
Carlo Natali, University of Florence, Italy  
Marinella Pasquinucci, University of Pisa, Italy  
Kristina Pikelj, University of Zagreb, Croatia  
Donatella Privitera, University of Catania, Italy  
Anna Roselli, Museo di Storia Naturale del Mediterraneo di Livorno, Italy  
Claudio Saragosa, University of Florence, Italy  
Giovanni Sarti, University of Pisa, Italy  
Federico Selvi, University of Florence, Italy  
Stefano Soriani, University of Venice Ca' Foscari, Italy  
Roberto Tognetti, University of Molise, Italy  
Davide Travaglini, University of Florence, Italy  
Alessio Valente, University of Sannio, Italy

Ninth International Symposium  
“Monitoring of Mediterranean Coastal Areas:  
Problems and Measurement Techniques”

Livorno (Italy) 14<sup>th</sup>-16<sup>th</sup> June 2022

edited by  
Laura Bonora, Donatella Carboni,  
Matteo De Vincenzi, Giorgio Matteucci

FIRENZE UNIVERSITY PRESS

2022

Ninth International Symposium “Monitoring of Mediterranean Coastal Areas: Problems and Measurement Techniques” : Livorno (Italy) 14<sup>th</sup>-16<sup>th</sup> June 2022 / edited by Laura Bonora, Donatella Carboni, Matteo De Vincenzi, Giorgio Matteucci. Firenze – Firenze University Press, 2022.

(Monitoring of Mediterranean Coastal Areas: problems and measurement techniques; 1)

<https://books.fupress.com/isbn/9791221500301>

ISBN 979-12-215-0030-1 (PDF)

ISBN 979-12-215-0031-8 (XML)

DOI 10.36253/979-12-215-0030-1

Cover graphic design: Alberto Pizarro Fernández, Lettera Meccanica SRLs

Front cover: Port of Livorno (Italy): *Curvilinear Breakwater south end Lighthouse & lantern*, photo by Gianni Fasano

Edited by: Laura Bonora, Donatella Carboni, Matteo De Vincenzi, Giorgio Matteucci

Desktop publishing: Laura Bonora, Matteo De Vincenzi

Graphic Design: Gianni Fasano

#### *Peer Review Policy*

Peer-review is the cornerstone of the scientific evaluation of a book. All FUP's publications undergo a peer-review process by external experts under the responsibility of the Editorial Board and the Scientific Boards of each series (DOI 10.36253/fup\_best\_practice.3).


#### *Referee List*

In order to strengthen the network of researchers supporting FUP's evaluation process, and to recognise the valuable contribution of referees, a Referee List is published and constantly updated on FUP's website (DOI 10.36253/fup\_referee\_list).

#### *Firenze University Press Editorial Board*

M. Garzaniti (Editor-in-Chief), M.E. Alberti, F. Vittorio Arrigoni, E. Castellani, F. Ciampi, D. D'Andrea, A. Dolfi, R. Ferrise, A. Lambertini, R. Lanfredini, D. Lippi, G. Mari, A. Mariani, P.M. Mariano, S. Marinai, R. Minuti, P. Nanni, A. Orlandi, I. Palchetti, A. Perulli, G. Pratesi, S. Scaramuzzi, I. Stolzi.

*FUP Best Practice in Scholarly Publishing* (DOI 10.36253/fup\_best\_practice)

 The online digital edition is published in Open Access on [www.fupress.com](http://www.fupress.com).

Content license: except where otherwise noted, the present work is released under Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0: <https://creativecommons.org/licenses/by-nc-sa/4.0/>). This license allows you to share the work by any means and format, as long as appropriate credit is given to the author, the work is not modified or used for commercial purposes and a URL link is provided to the license.

Metadata license: all the metadata are released under the Public Domain Dedication license (CC0 1.0 Universal: <https://creativecommons.org/publicdomain/zero/1.0/legalcode>).

© 2022 Author(s)

Published by Firenze University Press

Firenze University Press

Università degli Studi di Firenze

via Cittadella, 7, 50144 Firenze, Italy

[www.fupress.com](http://www.fupress.com)

*This book is printed on acid-free paper*

*Printed in Italy*

## INDEX OF PAPERS

<i>Preface</i>	XIII
<i>Organizing Authorities</i>	XIV
<i>Scientific Committee</i>	XV
<i>Presentation of Proceedings</i>	XVII
<i>Introduction by Sympoarch</i>	XIX

<b>Session: Morphology and evolution of coastlines and seabeds</b>	<b>1</b>
<b>Chairperson: G. Sarti</b>	
E. Anthony	5
<i>Impacted fluvial and coastal sediment connectivity in the Mediterranean: a brief review and implications in the context of global environmental change</i>	
A. del C. Arriola Velásquez, A. Tejera, I. Alonso, W. Geibert, I. Stimac, F. Cámara, N. Miquel-Armengol, H. Alonso, J. G. Rubiano, P. Martel	16
<i>Beach sediment dynamics from natural radionuclides point of view</i>	
F. D'Ascola, M. L. Cassese, N. Lugeri, V. Pesarino, A. Salmeri	27
<i>The ISPRA geodatabase for monitoring and analysis of the state of the italian coasts: an example of its application to the Rocchette - Castiglione della Pescaia coast line</i>	
I. López, A. J. Tenza-Abril, L. Aragonés, J. I. Pagán	38
<i>Evolution of the surface roughness of a coarse sand after a beach nourishment</i>	
M. Luppichini, M. Bini, A. Berton, N. Casarosa, S. Merlino, M. Paterni	47
<i>A method based on beach profile analysis for shoreline identification</i>	
J. I. Pagán, L. Bañón; P. Ortíz, L. Aragonés, I. López	61
<i>Use of RPAS to monitor coastal dune systems and beach erosion in Guardamar Del Segura, Spain</i>	
A. Picciolo, R. Auriemma, S. Fai, L. Coluccia, A. Antonazzo, C. Buccolieri	70
<i>Use of mixed study techniques in the evaluation of coastline dynamics - the "Porto Cesareo" MPA case of study</i>	
K. Pikelj, P. Godec, B. Cvetko Tešović	83
<i>Sedimentological consequences of Posidonia Oceanica banquette removal: Sakarun beach case study (Dugi Otok, Croatia)</i>	
D. Vandarakis, I. Kourliaftis, M. Salomidi, V. Gerakaris, Y. Issaris, Ch. Agaoglou, V. Kapsimalis, I. Panagiotopoulos	93
<i>Geomorphological approaches to study Posidonia banquettes and their effects on the coastal front of Schinias - Marathon National Park</i>	

FUP Best Practice in Scholarly Publishing (DOI 10.36253/fup\_best\_practice)

Laura Bonora, Donatella Carboni, Matteo De Vincenzi, Giorgio Matteucci (edited by), *Ninth International Symposium "Monitoring of Mediterranean Coastal Areas: Problems and Measurement Techniques". Livorno (Italy) 14<sup>th</sup>-16<sup>th</sup> June 2022*, © 2022 Author(s), CC BY-NC-SA 4.0, published by Firenze University Press, ISBN 979-12-215-0030-1, DOI 10.36253/979-12-215-0030-1

<b>Session:</b>	<b>Coastline Geography and Coastal Landscapes: territorial dynamics and integrated protection</b>	<b>105</b>
<b>Chairperson:</b>	<b>D. Privitera</b>	
S. Altavilla, M. Pisconti, F. Galeano, S. Aquaro, F. Tiralongo, G. Corrente, E. Santocchini, D. Giannelli, A. Caligiore		111
<i>The development of “sustainable” surveillance and monitoring activity carried out by the Italian Coast Guard for the safeguard of the Marine Protected Areas</i>		
R. Ben Dhiab, R. Challouf, E. Derouiche, H. Ben Boubaker, W. Koched, M. Attouchi, H. Jaziri, S. Ben Ismail		122
<i>Beach macro-litter monitoring on Monastir coastal sea (Tunisia): First Findings</i>		
C. Bisci, G. Cantalamessa, S. Casavecchia, M. Tramontana, F. Spagnoli		132
<i>Coastal dunes along the Marche littoral (Adriatic side of Central Italy)</i>		
T. Bisiani		146
<i>Trieste, back to the sea. Designing sustainability and development of logistics and industrial port areas after the pandemic</i>		
J. Buoninsegni, E. Olivo, M.G. Paletta, C. Vaccaro, C. Corbau		156
<i>Marine litter surveys on Boccasette beach (Rovigo, Italy)</i>		
A.R. Candura, L. Fois, E. Poli		165
<i>The economic and environmental impact of large ships on the territory, on the coast and on the sea: the MSC cruises case study</i>		
D. Carboni, G. Messina, V. Gazale, E. Tarricone		175
<i>Fishing and territory. Status and perspectives of Sardinia artisanal fisheries. The case of traditional fishery in Asinara Island MPA</i>		
A. Cazzani, M. Peli, S. Barontini		187
<i>Analysis and survey of Lake Garda lemon houses: a tool to understand and manage a Mediterranean landscape in Lombardy</i>		
F. D’Ascola, A. L. Beck, M. L. Cassese, M. Jones, N. Lugerì, V. Pesarino, A. Salmeri, M. Amine Taji		200
<i>Monitoring of the evolution of “barene” borders and the safeguard of the Venice Lagoon morphology: a contribution from the “Coastal Change from Space” project results</i>		
J. Dorigatti, T. Peric, G. Jelic Mrcelic		211
<i>Marine protected areas and the problem of paper parks</i>		
C. Farris, D. Giaiotti, S. Miniussi, C. Sgubin, N. Tudorov		221
<i>An integrated approach for marine litter hot spots identification</i>		
L. Giordano, F. P. Buonocunto, L. Ferraro, A. Milia, C. Violante		234
<i>The environmental function analysis: a promising tool to evaluate the coastal zone conservation potential</i>		

A. Ivona, L. Lopez, D. Privitera	244
<i>Old landmarks and new functions. Coastal architectures redesign the geography of the coastal belts</i>	
G. Luciani	253
<i>Water, heritage, city: urbanized deltas on the line between nature and culture</i>	
M. Marras, M. Ladu	262
<i>Nature protection and local development: a study concerning a natural park located in Sardinia (Italy)</i>	
C. Montaldi, P. Fischione, D. Pasquali, F. Zullo	272
<i>Land use analysis and coastal structures: Adriatic Coast as a case study</i>	
R. Pombo, C. Coelho, P. Roebeling	283
<i>Protecting Vagueira (Portugal) waterfront: preserving natural, recreational, residential, and commercial functions</i>	
Ma. Russo	293
<i>The territorial organization of the Amalfi Coast: nature and man's intervention</i>	
C. Saragosa, M. Chiti	303
<i>Atmospheric agents and spatial planning. Case study of the Municipality of Rosignano Marittimo in Tuscany</i>	
M. Savino, C. Cesarini, F. Da Ru	312
<i>A new proposal for a strategic and resilient regeneration plan for seaside waterfronts. An Adriatic case: Riccione</i>	
M. Simeone, P. Masucci, M. Defina, G. Di Pace, C. De Vivo	322
<i>Development of a sustainable accessibility model for the Marine Protected Area Gaiola Underwater Park, in Naples, Italy</i>	
A. Sopina, B. Bojanic Obad Scitaroci	333
<i>Spatial planning prospects on changeability process of urban and natural (Land)scape relations - The dynamics of Ancona on the West and Rijeka on the East Adriatic coast</i>	
V. Spagnoli, C. Piferi	343
<i>Regeneration of historic centers in Mediterranean cities: the case study of the Venice district in Livorno</i>	
<b>Session:</b>	<b>Coastal Environmental Engineering:</b>
	<b>pollution, energy production, monitoring and economic</b>
	<b>environmental assessment, regulatory context</b>
	<b>355</b>
<b>Chairperson:</b>	<b>M. Catelani</b>
M. Bagnarol, M. Celio, S. Del Frate, D. Giaiotti, S. Martini, M. Mauro	365
<i>The ARPA FVG support to oil spill emergency response in the Gulf of Trieste</i>	



A. Ben Mefteh, V. Mesnage, S. Ben Jeddi, A. Helali, N. Zaaboub, J.-M. Barrois, W. Oueslati	378
<i>Assessment of trace metal contamination and phosphorus dynamic in sediments of Monastir Bay (Tunisia)</i>	
F. Benincasa, M. De Vincenzi, G. Fasano	390
<i>The Forgotten Nautical Astronomical instruments</i>	
F. Benincasa, M. De Vincenzi, G. Fasano	401
<i>Sea level measurements in Mediterranean coasts</i>	
C. Chouba, S. Delpoux, L. Causse, M. Marie, R. Freydier, M. Toubiana, P. Monfort, O. Pringault, C. Montigny	416
<i>Status of water quality and impact of dredging activities in four ports of the Gulf of Aigues Mortes (France)</i>	
D. Colarossi, E. Tagliolini, P. Principi	426
<i>Optimization model for a hybrid photovoltaic/cold ironing system: life cycle cost and energetic/environmental analysis</i>	
I. Dalle Mura, E. Barbone, D. Battista, C.G. Giannuzzi, S. Ranieri, G. Strippoli, An. Zito, N. Ungaro	436
<i>A first assessment of microplastics in the sea waters off the Puglia Region</i>	
P. Diviaco, M. Iurcev, R. Carbajales, A. Busato, M. Burca, A. Viola, N. Potleca, S. Zanardi, I. Cunico, N. Pino	446
<i>Citizen science based marine environmental monitoring. The MOANA60 experience</i>	
J. Droit, M. El Fadili, M. Messenger	456
<i>Assessment of the chemical quality of sediments in the maritime port of Réunion. Concentrations in trace metals and natural geochemical backgrounds</i>	
M. Esposito, M. Della Rotonda, C. Sbarra, M. Stefanelli, M. G. Aquila, A. Anastasio, P. Sarnelli, P. Gallo, Y. Cotroneo, L. Fortunato, R. Montella, L. De Maio	461
<i>Environmental investigations in the Gulf of Pozzuoli (Naples) in relation to PAHs contamination</i>	
H. Jaziri, E. Derouiche, W. Koched, H. Ben Boubaker, R. Ben Dhiab, R. Challouf, S. Ben Ismail	471
<i>First investigation of microplastic pollution in Monastir Sea surface water (Eastern Tunisia)</i>	
M. Kedzierski, M. Palazot, L. Soccalingame, M. Falcou-Préfol, G. Gorsky, F. Galgani, S. Bruzard, M. L. Pedrotti	484
<i>Chemical composition of microplastics floating on the Mediterranean Sea surface</i>	
G. Lombardini, P. Salmona, A. C. Taramasso	494
<i>Application of statistical analysis to estimate the coastal hazard. A case study in Liguria region</i>	

D. Malcangio, D. Celli, U. Fratino, M.F. Bruno, M.G. Molfetta, L. Pratola, S. Geronimo, A. M. Lotito, P. F. Garofoli, M. Di Risio	504
<i>Biodiversity smart monitoring guided by historical analysis of coastal evolution</i>	
Da. Mance, Di. Mance, D. Vukić-Lušić	515
<i>Managing water commons using mediator variables to bridge the gap between environmental factors and anthropogenic pollution indicators</i>	
Di. Mance, D. Lenac, M. Radišić, Da. Mance, J. Rubinić	525
<i>The use of <math>^2\text{H}</math> and <math>^{18}\text{O}</math> isotopes in the study of coastal karstic aquifer</i>	
A. Milia, F.P. Buonocunto, A. Di Leo, L. Ferraro, S. Giandomenico, L. Giordano, M. Mali	535
<i>Grain size, nutrients and heavy metals analysis to evaluate natural vs anthropogenic sources in the sea environment (Naples Bay, Eastern Tyrrhenian Sea)</i>	
S. F. Ozmen, B. Topcuoglu	545
<i>Determination of natural radioactivity levels of sludges collected from wastewater treatment plants of Antalya/Türkiye</i>	
F. Serafino, A. Bianco	551
<i>Analysis of the limits for the detection of small garbage island immersed in clutter radar</i>	
L. Soccalingame, M. Notheaux, M. Palazot, M. Kedzierski, S. Bruzaud	560
<i>Extraction and characterization methods for microplastics from estuarine and coastal samplings – Example of the 2019 TARA expedition</i>	
P. Ventura, M. Palmarocchi, C. Domeniconi	568
<i>New artificial reef in coastal protection reconversion and electric power production</i>	
<b>Session:</b>	
<b>Flora and Fauna of the littoral system: dynamics and protection</b>	<b>581</b>
<b>Chairperson: D. Travaglini</b>	
S. Caronni, F. Atzori, S. Citterio, V. Bracchi, N. Cadoni, R. Gentili, L. Quaglini, D. Basso	587
<i>Are caulerpa species able to settle and develop on rhodolite beds? The case study of Marine Protected Area “Capo Carbonara”</i>	
J. Castro-Fernández, J. M. Disdier-Gomez, O. Reñones, J. Moranta, I. Castejón-Silvo, J. Terrados, H. Hinz	596
<i>Using diver-operated stereo-video to monitor juvenile fish assemblages in Mediterranean coastal habitats formed by macrophytes</i>	
E. Cecchi, L. Piazzzi, M. Ria, G. Marino, A. Nicastro	606
<i>Coralligenous cliffs in Tuscany: distribution, extension of the habitat and structure of assemblages</i>	

G. Cecchi, G. Burini, A. Giglio, R. Giglio, M. Fustolo, Al. Zito, D. Asprea, E. Madeo, S. Giglio	611
<i>New reports on the presence of Callinectes sapidus (Rathbun, 1896) along the Calabrian coasts</i>	
V. Costa, R. Chemello, D. Iaciofano, S. Lo Brutto, F. Rossi	619
<i>Seagrass detritus as marine macroinvertebrates attractor</i>	
M. Cutajar, S. Lanfranco	627
<i>Spatial displacement of nearshore vegetation in response to artificial changes in coastal morphology</i>	
M. De Gioia, I. Dalle Mura, F. M. D’Onghia, G. Strippoli, G. Costantino, E. Barbone, N. Ungaro	637
<i>The role of scientific divers in the ADRIREEF project: ARPA Puglia activities</i>	
F. Drouet, J.-L. Jamet, D. Jamet, F. Miralles, M. Brochen, F. Chavanon, C. Brach-Papa	647
<i>Mercury concentrations and transfers in phyto- and zooplankton communities in a coastal mediterranean ecosystem (Bay of Toulon, France)</i>	
F. Ferraro, A. Longo, C. Ruge	656
<i>Renaturalization interventions within a regional forest complex located in a costal pine forest in the south of Italy</i>	
M. Florio Furno, D. Ferrero, A. Poli, V. Prigione, M. Tuohy, M. Oliva, C. Pretti, G. C. Varese	667
<i>Fungi from the sediments of the harbour of Livorno as potential bioremediation agents</i>	
B. Herut et IOLR Scientists	677
<i>The National Monitoring Program of Israel's Mediterranean Waters – Scientific Perspectives</i>	
M. Lapinski, M. Perrot, J. Dalle, A. Guilbert, F. Holon, P. Boissery, E. Clamagirand, P. Thievent, N. Chardin, M. Bouchoucha	685
<i>In situ rare long term observations of the dogtooth grouper Epinephelus caninus in artificial reefs recently immersed in the National park of the Calanques (North-western Mediterranean sea, France)</i>	
V. Lazzeri, A. Scartazza, F. Bretzel, R. Pini, I. Rosellini, R. Guernelli, E. Franchi, G. Petruzzelli, M. Barbafieri	693
<i>Effects of petroleum hydrocarbons on Salicornia perennans germination and growth under saline conditions</i>	
I. Lolli	700
<i>The protection of Posidonia oceanica (L.) Delile and the management of its beach-cast leaves. The italian juridical framework</i>	
G. Mancini, D. Ventura, E. Casoli, A. Belluscio, G.D. Ardizzone	719
<i>Colonization of transplanted Posidonia oceanica: understanding the spatial dynamics through high-spatial resolution underwater photomosaics</i>	

M. Mazzetti, L. Marsili, S. Valsecchi, C. Roscioli, S. Polesello, P. Altemura, A. Voliani, C. Mancusi	729
<i>First investigation of per-and poly fluoroalkylsubstances (PFAS) in striped dolphin Stenella coeruleoalba stranded along Tuscany coast (North Western Mediterranean Sea)</i>	
A. Neri, C. Mancusi, L. Marsili, P. Sartor, A. Voliani	738
<i>Stomach contents of bottlenose dolphin Tursiops Truncatus (Montagu, 1821): first results from specimens stranded in the tuscan archipelago in the period 1990–2021</i>	
S. Risoli, S. Sarrocco, G. Terracciano, R. Baroncelli, M. A.L. Zuffi, C. Mancusi, C. Nali	747
<i>Isolation and molecular characterization of Fusarium species (Fungi, Ascomycota) from unhatched eggs of Caretta caretta in Tuscany (Italy)</i>	
S. Sahbani, R. Toujani, N. Ben M'Barek, E. Ottaviani, E. Riccomagno, E. Prampolini, H. Missaoui, B. Bejaoui,	756
<i>Effect of Climate Change and anthropogenic pressures on the European eel Anguilla anguilla from Ramsar Wetland Ichkeul Lake: Prediction from the Random Forest model</i>	
V. Tomaselli, F. Mantino, G. Albanese, C. Tarantino, M. Adamo	766
<i>Monitoring changes over a 10-year period, through vegetation maps, in a coastal site in Apulia Region (SouthEastern Italy)</i>	
D. Travaglini, C. Garosi, F. Logli, F. Parisi, I. Ursumando, C. Vettori, D. Paffetti	775
<i>Stand structure and natural regeneration in a coastal stone pine (Pinus pinea L.) forest in central Italy</i>	
E. Turicchia, C. Cerrano, M. Ghetta, F. Giannini, M. Abbiati, M. Ponti	785
<i>Ecological status of the Tuscan archipelago rocky habitats assessed by the Medsens index</i>	
<b>Session: Underwater and Coastal Cultural Heritage</b>	<b>795</b>
<b>Chairperson: Marinella Pasquinucci</b>	
M. C. Alati	801
<i>Territorial transformations, landscape and architectural features of the “Tenuta di Isola Sacra” in the reclamation of the early 1900s</i>	
B. Bertoli, Mrn. Russo, L. Marcolongo, C. Cirillo	811
<i>Massa Lubrense coast and its modifications during the twentieth century</i>	
C. Cirillo, G. Acampora, L. Scarpa, Mrn. Russo, B. Bertoli, L. Marcolongo	822
<i>The port of Neapolis: memories and traces of the coastal landscape in ancient times</i>	
F. Fratini, F. De Vita, D. Pittaluga, S. Rescic	834
<i>The building materials of “Rocca Vecchia” (Old Fortress) in the Gorgona island</i>	
G. Muscatello, C. Mitello	844
<i>Making a site otherwise inaccessible accessible: 3D laser scanner scanning of the Grotta dei Cervi di Porto Badisco in Otranto (Le)</i>	

A. Pellettieri	855
<i>...in finibus Lucaniae. Historical cartography of the Tyrrhenian coast and demographic fluctuations</i>	
E. Pribaz, I. Lotti, R. Raffalli, P. Chiavaccini	865
<i>The Torre del Marzocco and the widening of the entry channel to the industrial port of Livorno</i>	
P. Tartara	875
<i>Natural resources and coastal productive settlements in southern Puglia</i>	
M. P. Usai	887
<i>Tuna: underwater natural and cultural heritage. The Tunèa case study, a project for the re-connection between coastal community and marine ecosystem</i>	
<b><i>Index of Authors</i></b>	<b>897</b>

## Preface

The Ninth edition of the Symposium *Mediterranean Coastal Monitoring: problems and measurement techniques*, held in Livorno from 14<sup>th</sup> to 16<sup>th</sup> June 2022, addresses scholars of the coastal areas of this Mediterranean basin, as it happens once every two years. The event, organized by the Institute of BioEconomy (IBE) of the National Council Research (CNR) in collaboration with the Italian Society of Silviculture and Forest Ecology (SISEF), is divided into the following Sessions: Flora and fauna of the coastal system: dynamics and protection; Morphology and evolution of coasts and sea beds; Coastal environmental engineering: pollution, energy production, economic-environmental monitoring and evaluation, regulatory context; Coastal and underwater cultural heritage; Geography and coastal landscape: dynamics of the territory and integrated protection.

During the consolidated three days, following the tradition, The Symposium with its interdisciplinarity intends to demonstrate the importance of multidisciplinary studies, underlining the need for integrated investigation approaches. Since the coastal system represents a complex and delicate natural structure, whose evolution is the result of delicate physical, chemical and biological balances, strongly conditioned by anthropic interventions, the aim of the Symposium is to contribute to the spread of knowledge, providing notions and information on dynamics and / or on the variations of marine-coastal ecosystems, in the hope that this can be useful to increase man's respect towards the land that hosts him.

Despite the COVID 19 pandemic, the success of this edition is attested by the 170 contributions selected by the Scientific Committee from among those received. Participation involved all the thematic lines envisaged by the sessions, involving many countries bordering the shores of the Mediterranean Sea. The importance of the event is also attested by the publishing house's request to turn the Proceedings of the Symposium into a Series, of which this volume is the first issue.

A personal thank you goes, first of all, to all those, colleagues and friends, who have invested time and energy in the organization. The same gratitude goes to all the participants, who, with their presence, have shown that they believe in our initiative.

*The Editors*

FUP Best Practice in Scholarly Publishing (DOI 10.36253/fup\_best\_practice)

Laura Bonora, Donatella Carboni, Matteo De Vincenzi, Giorgio Matteucci (edited by), *Ninth International Symposium "Monitoring of Mediterranean Coastal Areas: Problems and Measurement Techniques". Livorno (Italy) 14<sup>th</sup>-16<sup>th</sup> June 2022*, © 2022 Author(s), CC BY-NC-SA 4.0, published by Firenze University Press, ISBN 979-12-215-0030-1, DOI 10.36253/979-12-215-0030-1

## ORGANIZING AUTHORITIES



National Research Council of Italy Institute of BioEconomy (CNR-IBE)  
Italian Society of Silviculture and Forest Ecology (SISEF)  
Natural History Museum of the Mediterranean

**PATRONAGE BY**  
Accademia dei Lincei

Università degli Studi di Firenze  
Regione Toscana  
Accademia dei Georgofili  
Provincia di Livorno  
Autorità di Sistema del Mar Tirreno Settentrionale  
Comune di Livorno



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE



ACCADEMIA DEI GEORGOFILII



Autorità di Sistema Portuale  
del Mar Tirreno Centro Settentrionale

PORTI DI ROMA E DEL LAZIO - CIVITAVECCHIA - FIANCINO - GAETA



COMUNE DI LIVORNO

## SCIENTIFIC COMMITTEE

### Presidency

Donatella Carboni (Symposiarch)	<i>Dept. of Humanities and Social Sciences University of Sassari</i>
Fabrizio Benincasa	<i>CNR- Institute of BioEconomy (IBE) Seat of Florence</i>
Laura Bonora	<i>CNR - Institute of BioEconomy (IBE) Seat of Florence</i>
Matteo De Vincenzi	<i>CNR - Institute of BioEconomy (IBE) Seat of Florence</i>
Giorgio Matteucci	<i>Director of CNR- Institute of BioEconomy (IBE); SISEF</i>

### Session *Morphology and evolution of coastlines and seabeds*

Giovanni Sarti	<i>Dept. of Earth Sciences University of Pisa</i>
Duccio Bertoni	<i>Dept. of Earth Sciences University of Pisa</i>
Edward Anthony	<i>CEREGE, Aix-en-Provence, France</i>
Filippo Catani	<i>Dept. of Geosciences of the University of Padua</i>
Corinne Sabine Corbau	<i>Dept. of Physics and Earth Science University of Ferrara</i>
Giuliano Gabbani	<i>Dept. of Earth Sciences University of Florence</i>
Sandro Moretti	<i>Dept. of Earth Sciences University of Florence</i>
Kristina Pikelj	<i>Dept. of Geology - University of Zagreb, Croatia</i>

### Session *Coastal Environmental Engineering: pollution, energy production, monitoring and economic environmental assessment, regulatory context*

Marcantonio Catelani	<i>Dept. of Information Engineering University of Florence</i>
Rossella Bardazzi	<i>Dept. of Economics and Management University of Florence</i>
Lorenzo Cappiotti	<i>Dept. of Civil and Environmental Engineering University of Florence</i>
Carlo Carcasci	<i>Dept. of Industrial Engineering University of Florence</i>
Giuliano Gabbani	<i>Dept. of Earth Sciences University of Florence</i>
Riccardo Gori	<i>Dept. of Civil and Environmental Engineering University of Florence</i>
Ilaria Lolli	<i>Dept. of Law University of Pisa</i>
Giampaolo Manfrida	<i>Dept. of Industrial Engineering University of Florence</i>

### Session *Flora and Fauna of the littoral system: dynamics and protection*

Davide Travaglini	<i>Dept. of Agriculture, Food, Environment and Forestry University of Florence</i>
Carla Cesaraccio	<i>CNR - Institute of BioEconomy (IBE) Seat of Sassari</i>
Fabio Crocetta	<i>Dept. Integrative Marine Ecology Zoological Station Anton Dohrn, Naples</i>
Sandro Lanfranco	<i>Dept. of Biology - University of Malta, Msida, Malta</i>
Sabrina Lo Brutto	<i>Dept. of Biological, Chemical and Pharmaceutical Sciences and Technologies - Sect. Animal Biology University of Palermo</i>
Anna Roselli	<i>Natural History Museum of the Mediterranean, Livorno</i>
Federico Selvi	<i>Dept. of Agriculture, Food, Environment and Forestry University of Florence</i>
Roberto Tognetti	<i>Dept. of Agricultural, Environmental and Food Sciences University of Molise</i>

FUP Best Practice in Scholarly Publishing (DOI 10.36253/fup\_best\_practice)

Laura Bonora, Donatella Carboni, Matteo De Vincenzi, Giorgio Matteucci (edited by), *Ninth International Symposium "Monitoring of Mediterranean Coastal Areas: Problems and Measurement Techniques". Livorno (Italy) 14<sup>th</sup>-16<sup>th</sup> June 2022*, © 2022 Author(s), CC BY-NC-SA 4.0, published by Firenze University Press, ISBN 979-12-215-0030-1, DOI 10.36253/979-12-215-0030-1



## **Session *Coastline Geography and Coastal Landscapes: territorial dynamics and integrated protection***

Donatella Privitera	<i>Dept. of Educational Sciences University of Catania</i>
Rossella Bardazzi	<i>Dept. of Economics and Management University of Florence</i>
Jordi Bellmunt Chiva	<i>Dept. de Urbanismo y Ordenación del Territorio Universitat Politècnica de Catalunya-BarcelonaTech, Spain</i>
Biagio Guccione	<i>Dept. of Architecture University of Florence</i>
Antonietta Ivona	<i>Dept. of Economy and Finance University of Bari</i>
Ilaria Lolli	<i>Dept. of Law University of Pisa</i>
Lucrezia Lopez	<i>Dept. de Geografia Universidade de Santiago de Compostela, Spain</i>
Tessa Matteini	<i>Dept. of Architecture University of Florence</i>
Carlo Natali	<i>Dept. of Architecture University of Florence</i>
Claudio Saragosa	<i>Dept. of Architecture University of Florence</i>
Stefano Soriani	<i>Dept. of Economics University of Venice</i>
Alessio Valente	<i>Dept. of Science and Technology University of Sannio Benevento</i>

## **Session *Underwater and Coastal Cultural Heritage***

Marinella Pasquinucci	<i>Former Full Prof. Ancient Topography University of Pisa</i>
Michel Gras	<i>President, Former Director de l'École française de Rome Emeritus CNRS, Foreign Fellow of Accademia dei Lincei</i>
Fabrizio Antonioli	<i>INGV Rome</i>
Peter A.J. Attema	<i>Faculty of Arts Classical and Mediterranean Archaeology University of Groningen, Netherlands</i>
Giovanna Bianchi	<i>Dept. of History and Cultural Heritage University of Siena</i>
Giulio Ciampoltrini	<i>former archaeologist officer Superintendence for Archaeological Heritage of Tuscany</i>
Elif Koparal	<i>Dept. Classical Archaeology Mimar Sinan Fine Arts University, Istanbul, Turkey</i>
Tessa Matteini	<i>Dept. of Architecture University of Florence</i>

## **Organizing Committee:**

Gianni Fasano	CNR – IBE Seat of Florence	<i>(Coordinator of Committee)</i>
Francesca Martelli	CNR – IBE Seat of Florence	
Davide Pellegrini	CNR – IBE Seat of Florence	
Laura Pellegrino	CNR – IBE Seat of Livorno	
Federica Zabini	CNR – IBE Seat of Florence	
Davide Travaglini	SISEF	<i>(SISEF coordinator)</i>
Gabriele Bucci	SISEF	

## **Organizing secretariat:**

CNR-IBE Area di Ricerca di Firenze  
Via Madonna del Piano 10,  
50019 Sesto Fiorentino (Florence - Italy)  
Phone +390555226557  
e-mail: [segr.org@ibe.cnr.it](mailto:segr.org@ibe.cnr.it)

## **Scientific Secretariat:**

CNR-IBE Area di Ricerca di Firenze  
Via Madonna del Piano 10,  
50019 Sesto Fiorentino (Florence - Italy)  
Phone +390555226060-6030  
e-mail: [simposio@ibe.cnr.it](mailto:simposio@ibe.cnr.it)

## Presentation of Proceedings

As described in the Preface of this Proceedings Volume, the Symposium has been confirmed as a place to present the research carried out in recent years on the monitoring of the Mediterranean Coastal Areas and therefore as a space to present new proposals and promote actions for the protection of the marine and coastal environment.

The interdisciplinary of the Symposium has been the occasion for consolidating the scientific exchanges of scholars from Mediterranean countries and also for promoting a greater diffusion of the research and related results.

It is relevant that the Symposium is considering the Mediterranean Coastal Areas in all their aspects: from morphology and evolution of coastlines and seabeds to the landscape dynamics and integrated protection; from the dynamics and protection of coastal and underwater flora and fauna to cultural heritage, considering the challenges of pollution, energy production, environmental assessment and regulatory context of coastal areas.

In this 9<sup>th</sup> edition, in fact, we had more than 100 participants from 12 countries; this is a sign of great success and willingness of being in presence in Livorno to discuss problems and propose solution for the Mediterranean coastal areas. The international scientific committee supervising the Symposium, formed by 35 renowned scientists, did a great and hard work in selecting 42 oral and 100 poster presentation among the 170 contributions received.

It is important to underline since this year, the *Proceedings* will become a Series published by Firenze University Press: another step forward that underline the scientific and political relevance of studying and managing Mediterranean Coastal Areas.

For all selected works a *double peer review* has been carried out for the inclusion of the extended papers in this Volume.

This edition has been the occasion to establish a new collaboration between CNR-IBE and Italian Society of Silviculture and Forest Ecology (SISEF) in the organization of the Symposium.

The aim of CNR-IBE and SISEF is to continue in their collaboration to organize the next edition, the 10<sup>th</sup>, of the Symposium and to involve an increasingly wide audience of scholars, supporting in this way the dissemination of scientific results obtained in the field of protection of the Mediterranean coasts.

The Director of CNR-IBE  
The Vice President of SISEF  
*Dr. Giorgio Matteucci*

## INTRODUCTION

Several agreements for the protection of the coastal and marine environment are currently effective in the Mediterranean region. However, from a historical point of view, the attention to the "health conditions" of the Mediterranean is a concept born only recently. If we wanted to indicate a precise moment, we should identify it in 1975, the year of birth of the *Mediterranean Action Plan*<sup>1</sup>. The following year it was signed the Convention for the protection of the Mediterranean Sea against pollution (definitively entered into force in 1978), the so-called Barcelona Convention<sup>2</sup>. This agreement was revised and supplemented in 1995 (Convention for the protection of the marine environment and the coastal region of the Mediterranean). The Barcelona Convention is managed by the United Nations Environment Program (UNEP) with the aim of preventing, reducing, combating, and eliminating, as far as possible, sea pollution in order to protect and improve the marine and coastal environment and thus contribute to its sustainable development. The Treaty identified seven action protocols<sup>3</sup> concerning, for example, the protection of the sea from pollution of terrestrial or marine origin (including hazardous waste, exploration and use of the continental shelf), cooperation for the prevention and control of pollution from ships and Integrated Coastal Zone Management (ICZM).

Another important regulatory instrument for the Mediterranean, is the Framework Directive on the Strategy for the Marine Environment (2008/56/EC, Marine Strategy Framework Directive, MSFD).

Characterized by greater applicability than previous instruments, it provided that each State Member should develop a strategy for achieving or maintaining Good Environmental Status (GES) by 2020. In particular, it identifies marine monitoring as the first of the operational components in an appropriate governance system (Ferraro et al., 2017; Gianoli 2013).

---

<sup>1</sup> <https://www.unep.org/unepmap/>

<sup>2</sup> <https://eur-lex.europa.eu/legal-content/IT/TXT/?uri=LEGISSUM:l28084>

<sup>3</sup> THE PROTOCOLS OF THE BARCELONA CONVENTION: 1. Dumping: Prevention of pollution due to diving operations of ships and aircrafts; 2. New Emergency Protocol: Cooperation to prevent pollution caused by ships and in emergency situations; 3. LBS (Land Based Sources): Protection from pollution of terrestrial origin; 4. SPA / BIO: Special Protection Areas and Biological Diversity; 5. Off Shore: Protection from pollution deriving from the exploration of the exploitation of the underwater continental shelf and of the subsoil (not yet entered into force); 6. Hazardous wastes: Cross-border handling of dangerous wastes and their disposal (not yet in force); 7. ICZM (Integrated Coastal Zone Management): Integrated Coastal Zone Management (defined by the Contracting Parties at the Conference of the Parties in Almeria and signed in Madrid, Spain, in January 2008).

However, today, when we talk about the Mediterranean Sea, we too often think about the millennia of history that saw it as a protagonist and about the many cultures that developed on its shores. We also consider that it was (and still is) a great source of sustenance and trade for many populations and, last but not least, we recognize the strategic role as a center of the world (at least of the western one) that this sea played for many centuries. Nevertheless, unfortunately, the Mediterranean is not always seen as an environmental entity that has been exposed, for a very long time, and particularly in recent decades, to enormous pressure on all the ecosystems that compose it: a pressure generated especially by the men who lived and still live along its coasts.

The coastline of the Mediterranean extends for a total of about 46000 km, with other 19000 km of the islands; of all coasts, almost half (46 %) is sandy and it includes important but fragile habitats and ecosystems such as beaches, dunes, lagoons, marshes, river deltas, estuaries, etc. (Gianoli 2013).

The main dangers for this complex and varied environment are represented by the fragmentation, the degradation and the loss of its habitats and landscapes. Among the various causes of degradation, population density plays a fundamental role, almost a third of the Mediterranean population (512 million in 2018, equal to 6.7 % of the world population) lives in the coastal areas and over 70 % in its cities. Nevertheless, the area demographic context is very different: Northern Mediterranean Countries (NMCs) are characterized by a low fertility rate, an aging population and a relatively low percentage of the workforce; Southern and Eastern Mediterranean Countries (SEMCs) are undergoing a demographic transition phase with a quite stronger growth, an overall younger population and therefore a larger active population (SoED 2020).

The population of the countries bordering the Mediterranean Sea was made up of about 450 million people in 1996 (EEA, 1999), it reached more than 525 million individuals in 2020 and, according to recent projections and estimates, it will reach 655 million of residents in 2050 (EEA, 2020). This steadily increasing population pressure is exacerbated by tourism. The mild climate and the natural and cultural heritage attract a large number of tourists, whose percentage, in fact, represents about one third of the world's international tourism. Moreover, tourism concentrates on a seasonal way in coastal areas, in particular on the coasts of the north-western basin (AEA, 2006). Furthermore, coastal tourism is one of the main factors associated with the production and management of waste, particularly marine litter. The strong spatial and temporal variations of tourism, mainly concentrated along the coast and with important peaks during the summer season, lead to an increase in waste production, untreated wastewater discharges and strong pressures on natural resources. Besides, the deterioration of the quality of the

environment, as well as that of water quality, can in turn have an impact on the environment and on the development of tourism, reducing the attractiveness of tourist destinations (EEA, 2020).

In addition, the intensification of urbanization (between 1965 and 2015 about three quarters of Mediterranean countries doubled or more than doubled the inhabited area in the coastal strip 1 kilometer from the coast) left less space for natural coastal ecosystems, reducing the contribution of ecosystem services and increasing the risks for biodiversity and for people living on the coast (SoED 2020).

The Mediterranean Sea is home to more than 17000 marine species (between 4 and 18 % of the known marine species in the world), but it represents only about 1 % of the global volume of the oceans. Furthermore, the Mediterranean Sea has the highest rate of endemics on a global level (from 20 to 30 % of species), for this reason it is considered a biodiversity hotspot.

Another serious threat is the chemical contamination of marine sediments and aquatic, animal, and plant bio-communities, as a result of the pollution produced by urban areas, industrial settlements, petroleum refining and air transport. Often these are substances that deplete oxygen, or heavy metals, persistent organic pollutants (POPs), hydrocarbons and nutrients in the water. Although in recent years some of these factors have seen, on average, an improvement in the situation linked to greater controls carried out on land-based activities, the risks of contamination associated with hazardous substances still remain a significant problem in many areas of the Mediterranean. Moreover, the release of nutrients into marine waters as a result of human activities is at the origin of the problem of the increase in induced eutrophication, especially in coastal areas in close proximity to large rivers and cities. Clearly, these phenomena also lead to immediate socio-economic implications, since they affect the quality and quantity of the catch, the conditions and landscape value of the coastal ecosystem, the deterioration of water quality and, consequently, also on tourism.

Another threat for the Mediterranean ecosystems, often linked to the change of the water conditions (such as temperature, excessive presence of nutrients, etc.), is the invasion of non-indigenous species. In recent years this is a worryingly increasing phenomenon, especially in the easternmost part of the Mediterranean where its impact on biodiversity, on predation habits, on alteration of the chain and, in general, on habitat modification, has been documented. All that has had repercussions on fishing, aquaculture, tourism, and human health. Furthermore, the problem of over-exploitation of fish resources is very widespread, often well beyond the limits of sustainability. The macroscopic result is the change in biodiversity between species, especially in terms of endangered or threatened species due to intensive and indiscriminate fishing techniques.

Paradoxically, even the development of fish farming (recorded especially since the 1990s) has not alleviated the problem of overfishing but, on the contrary, has ended up adding further pressures to the marine ecosystem due to the release of nutrients, organic pollutants and sometimes antibiotics for livestock into the sea. There is also a conflict with the tourism industry over the use of small natural bays and a degradation of the habitats near the cages (AEA, 2006). Other problems relate to the impact of noise caused by marine biological communities from intense maritime traffic (especially in the western Mediterranean basin) and from industrial installations or offshore military activities in specific areas. Underwater noise is a problem of growing concern in important cetacean habitats such as the Pelagos Sanctuary (the sanctuary is between France, Côte d'Azur and Corsica), the Principality of Monaco and Italy (Liguria, Tuscany and northern Sardinia) or the Strait of Sicily. Besides, it is important to point out the integrity of the seabed, threatened by deep fishing, dredging or other drilling and excavation activities, which have the effect of increasing the suspended particulate matter, together with sediments. Consequently, this modifies the habitats of numerous species in the medium / long term. But above all, it remains the key problem: the risks for biodiversity. As a matter of fact, this is the element on which all the other pressure factors affecting the Mediterranean (Gianoli 2013) group together. The Mediterranean Sea is also one of the areas in the world most affected by marine litter. More than 730 tons of plastic enter the Mediterranean Sea every day; these represent 95 to 100 % of floating marine litter and more than 50 % of seabed litter. Single-use plastic accounts for over 60 % of the total marine litter found on Mediterranean beaches, waste normally produced by recreational beach activities. The main causes of plastic pollution include: an increase in its use, unsustainable consumption patterns and inefficient waste management practices. In fact, less than a third of the plastic produced each year in the Mediterranean countries is recycled. Even wastewater represents an important way of entry of waste into the sea of waste hitherto, less than 8 % of wastewater is subjected to tertiary treatment. Other important sources of marine litter are fishing, tourism, and shipping. Litter affects marine organisms primarily through strangulation and ingestion, but also through colonization and buoyancy. They also have important socio-economic effects through the costs of decontamination, as well as the potential loss of income and tourism jobs, and reduction in the value of land and recreational and fishing activities (SoED 2020).

Therefore, in order to "*prevent, reduce, fight and, as far as possible, eliminate sea pollution and in order to protect and improve the marine and coastal environment and thus contribute to its sustainable development*", as stated by the Convention of Barcelona, it is indispensable an integrated approach based on the knowledge about the different ecosystems and landscapes of the Mediterranean Sea.

Furthermore, in order to better protect the environment, it would be appropriate: to fill the gaps in terms of knowledge; to perfect management practices; to increase the socio-economic capacity for environmental management; to strengthen Integrated Coastal Zone Management (ICZM); to decentralize actions, so as to take into account the specific contexts as well as the specific pressures, impacts and particular needs of each country or area that persists in its waters; to improve monitoring and evaluation plans, in order to ensure informed and adequate policies. And the environmental monitoring is precisely the key theme of this 9<sup>th</sup> Symposium.

Environmental monitoring defined by the European Environment Agency (EEA) as "*Periodic and/or continued measuring, evaluating, and determining environmental parameters and/or pollution levels in order to prevent negative and damaging effects to the environment*" becomes the fil rouge of the Symposium with the aim of considering both the environmental quality and the effectiveness of the management of the *Mare Nostrum*, with an Integrated and multidisciplinary Ecosystem Approach given the complexity and the dimensions of the phenomenon to be examined.

With these premises, it is possible to achieve a resilient and sustainable future of the Mediterranean Sea only through a holistic and integrated approach and this new edition of the Symposium will be able to provide new knowledge, new tools, new case studies useful for good governance processes and for stakeholders, contributing to identify those cause-effect phenomena that link particular human activities to documented environmental effects and, consequently, to provide information that allows policy makers to adopt policies and strategies able to avoid, or at least reduce, negative effects on the environment.

*The Symposiarch*  
*Donatella Carboni*

*Department of Humanities and Social Sciences*  
*University of Sassari*

## References

- [1] AEA (Agenzia Europea Ambiente) (2006) - *Problemi prioritari per l'ambiente mediterraneo*, n.4, AEA, Copenhagen
- [2] AEA (Agenzia Europea Ambiente) (1999) - *Stato e pressioni sull'ambiente marino e costiero del Mediterraneo*, in E. Papathanassiou e G. P. Gabrielidis (Eds.) *Agenzia europea dell'ambiente*, Environmental assessment series, n. 5, 1999. ([http://reports.eea.eu.int/ ENVSERIES05/en/envissue05.pdf](http://reports.eea.eu.int/ENVSERIES05/en/envissue05.pdf)).



- [3] European Environment Agency (EEA) (2020) - *Towards a cleaner Mediterranean: a decade of progress. Monitoring Horizon 2020 regional initiative*, Report n. 7/2020 Joint EEA-UNEP/MAP Report, © EEA, Luxembourg DOI: 10.2800/623712
- [4] European Environment Agency (EEA) (2021) - *Technical assessment of progress towards a cleaner Mediterranean. Monitoring and reporting results for Horizon 2020 regional initiative*, Report n. 8/2020, Joint EEA-UNEP/MAP Report, © EEA, Luxembourg DOI: 10.2800/898759
- [5] Ferraro L., Giordano L., Bonomo S., Cascella A., Di Martino G., Innangi S., Gherardi S., Tamburrino S., Alberico I., Budillon F., Di Fiore V., Punzo M., Tarallo D., Anzalone E., Capodanno M., Cavuoto G., Evangelista L., Ferraro R., Iavarone M., Iengo A., Lirer F., Marsella E., Migliaccio R., Molisso F., Pelosi N., Rumolo P., Scotto di Vettimo P., Tonielli R., Vallefucio M. (2017) - *Monitoraggio integrato di un'area marino-costiera: la foce del Fiume Volturno (Mar Tirreno centrale)*, Quaderni di Geofisica, n. 146.
- [6] Gianoli R. (2013) - *La salute del Mare Nostrum*, Micron/Scenari, n. 25, pp. 38-43.
- [7] United Nations Environment Programme/Mediterranean Action Plan and Plan Bleu (2020) - *SoED 2020, State of the Environment and Development in the Mediterranean - Summary for Decision Makers*, United Nations Environment Programme.

# TRIESTE, BACK TO THE SEA. DESIGNING SUSTAINABILITY AND DEVELOPMENT OF LOGISTICS AND INDUSTRIAL PORT AREAS AFTER THE PANDEMIC

Thomas Bisiani

Università degli Studi di Trieste, piazzale Europa 1 - 34127 Trieste (Italy),  
phone 329 2824827, e-mail: [tbisiani@units.it](mailto:tbisiani@units.it),

**Abstract** – This work traces the stages of a long process of safety and industrial reconversion of an iron and steel industry polluted area, a typical “brownfield” [1], within the port of Trieste. Since 2014, a series of phases have followed one another, implementing an articulated and complex process. In recent years, this process has had to deal with events and scenarios on a global scale that have significantly affected the port system of the site, with the logistical and geopolitical aspects, demonstrating the adaptability and dynamism of various subjects in knowing how to combine development and environmental protection. The interest in the case of Trieste, provided for by the 2006 Environmental Code (Codice dell’Ambiente), is the first completed application of this law in Italy. The results obtained include the completion of the environmental safety program, the renewal of the existing industrial plant, the increment in logistics activities and the maintenance of occupational levels. Following these encouraging results, the activation of a new second agreement, currently in progress, demonstrates the effectiveness and repeatability of the procedure.

## Introduction

On January 30th, 2014, the Program Agreement (*Accordo di Programma*) of the “Program Agreement for the re-development of industrial and port activities and environmental recovery in the complex industrial crisis area of Trieste” was signed [6]. The aim was to implement an integrated project of safety, industrial reconversion and economic development in a Polluted Site of National Interest (SIN) in order to reuse these areas in conditions of health and environmental safety. Subsequently, on November 21st, 2014, a more specific Program Agreement was signed “for the implementation of the integrated project for safety, industrial reconversion and economic production development in the *Ferriera di Servola* (Servola Ironworks site)” [5].

The significance of this initiative - in addition to its specific contents - lies in the fact that it was the first application of the procedure contained in art. 252-bis “National polluted sites of preeminent public interest for industrial conversion” (*Siti inquinati nazionali di preminente interesse pubblico per la riconversione industriale*) of the Environmental Code. A complex process that saw, among others, the Minister of the Environment and Protection of Land and Sea and the Minister of Economic Development, with the Minister of Labour and Social Policies, in agreement with the Friuli Venezia Giulia Region and the Port Authority of Trieste, enter into an agreement with the Arvedi Group, concessionaire of a large contaminated industrial area of over 270 000m<sup>2</sup> within the Port of Trieste, that has allowed the re-employment of 400 workers.

Referee List (DOI 10.36253/fup\_referee\_list)

FUP Best Practice in Scholarly Publishing (DOI 10.36253/fup\_best\_practice)

Thomas Bisiani, *Trieste, back to the sea. Designing sustainability and development of logistics and industrial port areas after the pandemic.*, pp. 146-155 © 2022 Author(s), CC BY-NC-SA 4.0, 10.36253/979-12-215-0030-1.13

From a historical point of view, the iron and steel plant of the Ferriera was born in the last years of the nineteenth century with the purpose of supplying cast iron and ferroalloys to the Austro-Hungarian Empire. From 1913 onwards, there was a progressive expansion of the plant with the construction of new blast furnaces and foundry areas with gradual implementations up to the second half of the twentieth century. After several decades of stagnation at the end of the 1990s, the plants that had been shut down over the years were restarted: the existing structures were strengthened through the refurbishing of the steel plant, a coke battery was built to replace the existing ones, along with the thermoelectric plant. The first workings on the sea landfill, refer to 1897, but many others followed, including the expansion of the quay (1907), the enlargement of the area adjacent to the *Scalo Legnami* (1931) and the conquest of a further 200 000 square meters of the sea (1960). At the date of the Program Agreement, the steel plant was spread over a total area of 500 000 square meters, partly under state concession as the areas were subject to the administration of the Port Authority System of the Eastern Adriatic Sea (*Autorità di Sistema Portuale del Mare Adriatico Orientale*). The excavations carried out over the years have been achieved with demolition materials from disused activities and with process waste (discards from blast furnaces), often improperly used as aggregates in the past. The “quality” of the waste used to create the landfill is linked to the process line that generated these aggregates. Therefore, the deeper layers that correspond to the older layers are the most polluted ones, as the production process and the quality of materials and additives have improved over time. Hence, it can be deduced that in the more superficial layers it is possible to find presence of a homogeneous mixture of earth and waste, while in the deeper layers, it is possible to find presence of heaps and waste, deposited as is.

The scientific interest of the specific case of Trieste, developed on the basis of a procedure foreseen by the 2006 Environmental Code, is due to the fact that this is the first application of the law completed in Italy. The objectives to be achieved concern environmental safety, the renewal of the industry plant, the increase in port logistics activity and the maintenance of employment. The verification of the achievement of these goals, can verify the effectiveness and repeatability of the procedure in other contexts.

## **Materials and Methods**

This study intends to retrace the main stages of the process that has guided the transformation of the area since 2014, which is still currently ongoing. The meaning of the analysed procedure refers to the requirements of the Environmental Code, as a repeatable process. The sectoral literature does not appear to be particularly up to date, the most complete studies refer at the European level to the CLARINET [4] (Contaminated Land Rehabilitation Network for Environmental Technologies) project concluded in 2001, and to the Proposal for “Guidelines for Environmental Recovery and Economic Enhancement of Brownfields” [2], of the Agency for the Protection of the Environmental and for Technical Services of 2006. However, these guidelines refer to the previous regulatory context regulated mainly by Ministerial Decree 25.10.1999, n. 471, testifying to the need for new, updated insights. The basic materials analysed are the Program Agreements and the related attached documentation. These materials allowed the reconstruction of an administrative and procedural, but also operational path, of transformations and tangible investments.

Furthermore, an integration was added, an enhancement of the latest developments of the project born around the growth actions being applied in Italy in the post-pandemic phase.

## **An Unprecedented Plan**

An annex contained in the Program Agreement of November 2014 illustrates the “intervention strategies” relating to the “Integrated project for environmental safety and reindustrialization” [8]. It is a fundamental document that has acted as a compass during all the phases of the long process, which is still under development today. Starting from the geological and hydrogeological characterization of the area, the project has identified the forms of contamination of both the soil and the aquifer. A risk analysis was carried out on the basis of this data, which made it possible to identify the operational solutions to be applied. In particular, the project has identified: the ways of disposing the so called “historical” heap and other Hot Spots identified in the area, the management plan of the waste present in the area today and of that produced at the time, the safety of the land, both in ownership and in concession, through sanitary prevention measures (capping), and the treatment of discharged groundwater, intended as a link intervention pending the construction of the water treatment plant.

This initial start-up phase was followed on November 2nd, 2015 by the international decree (Ministry of the Environment and Protection of the Sea, Ministry of Economic Development) approving the “Integrated project for safety, industrial reconversion and development economic and productive area of the Ferriera di Servola “pursuant to art.252bis DLGS n.152/2006 [9]. The Decree detailed some aspects of the project in terms of prevention measures, risk analysis, intervention phases, monitoring plans of environmental matrices, even focusing on very minute technical details, such as the methods of connection between the safety floorings, the so-called surface capping, and the foundation structures of the new industrial buildings.

## **The Technical Solution of “Capping”**

The capping solution made it possible to physically isolate the contaminated soil from the external environment in such a way as to eliminate the health risk for users of the area. Furthermore, this solution minimizes the infiltration of rainwater and process water into the polluted soils, it minimizes the consequent washout and the decrease in quality of groundwater, and, in addition to the erosion of the polluted soil itself and the dispersion of contaminants, the new flooring also facilitates cleaning and collection of the materials used on the site. It is an industrial floor, a reinforced concrete hood with a reinforcement mesh, enhanced by a layer of geotextile on the intrados. A form of physical delimitation that, together with the barrier on the seaside, captures polluted soils, preventing the exchange of contaminating elements with the environment. An effective solution, but “hard” and necessary, to respond to the extension of the area and the stages of reuse, which consequently does not leave room for further ecological and landscape integrations (the area is located within a Coastal Territory, protected by law pursuant to rt.142 C.1 letter a) of the Code of Cultural Heritage and Landscape). In fact, in order to ensure the safety of a

heavily polluted industrial area, it was necessary to give up the permeability of the soils and the possibility of using mitigation elements such as tree plantings. The large squares also contribute to the formation of a “heat island” effect, typical of urbanized areas. In terms of land consumption, on the other hand, given that the soil was already compromised by pollution, the balance was unchanged from the execution of the clapping.

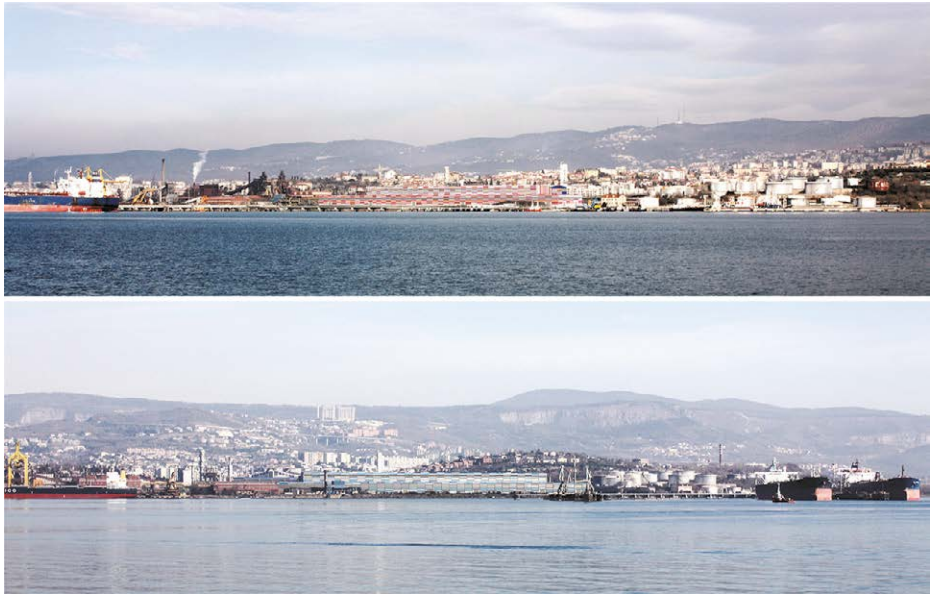


Figure 1 – Camouflage studies of the volumes of the Cold Area for the purpose of landscape mitigation (elaboration by the author, 2015).

## **Results Achieved**

On the 18th of July 2019, the Autonomous Region of Friuli Venezia Giulia verified how the environmental activities in the field at the Arvedi Group had been complied with (over 100 activities are mapped with reference to the Program Agreement and the Authorization Decree in the report of the General Management Environment and Energy [10]). The renewal activities of the industrial plant were also put in place, restarting the production of cast iron in accord with what is indicated in the Integrated Environmental Authorization, setting up a new production unit called Cold Area for the pickling and rolling of steel coils from Arvedi plants in Cremona and increasing the railway logistics activity of the Port of Trieste for a total investment of 254 million euros. All while safeguarding the employment levels of the establishment.

## A Renewed Plan

Six years later, the aims of the agreement have been achieved, and in June 2020 a new document was signed to give incentive to further transformations in terms of development and sustainability for a total of 100 million euros. The incentive comes from the Region's proposal for the closure of the so-called Hot Area, the production part of the plant that has the most impact from an environmental point of view. It is a large area characterized in particular by blast furnaces, the coking plant and two large size open-air carbon fossil and iron ore parks of a total of 54 000 square meters that the previous agreement envisaged to cover.



Figure 2 – Study of the roof of the fossil and mineral park of the Hot Area (elaboration by the author, 2018).

This is followed by an ambitious industrial plan by the Arvedi Group which provides for the decarbonization and conversion of the Hot Area on the principles of circularity, starting with the production of flat rolled carbon steel (the only European manufacturer) from an electric oven (therefore with lower operating temperatures) based on post-consumer scraps, rather than non-renewable raw materials. The project foresees a line of research and development aimed at reducing to zero the 29 % of cast iron produced at the Trieste site, which is still necessary to integrate 71 % of the waste used in the production processes. The decommissioning of the Hot Area also makes it possible to reconvert the Trieste power plant into a high-efficiency cogeneration (CAR) plant. Where the iron and steel process gases have been substituted by methane gas, with lowered consumption and high environmental performance. Consequently, the strengthening of the Cold Area was envisioned, with a new galvanizing and painting production line along with the relocation of the Hot Area workers.



Figure 3 - The hot area of the Servola ironworks undergoing demolition (author's photo, April 2021).

## **The First Executed Activities**

The Hot Area shutdown procedure was consequently started in April 2020, and a new Program Agreement was signed on June 26, 2020, which aims to convert the part of the decommissioned production site into a logistics area and upgrade the remaining plants [7]. This phase also has a circular nature, the ferrous waste from demolitions will become the material at the base of the steel production cycle of the Arvedi Group, while the aggregates will be reused for the construction of the infrastructures of what will be the expansion of the new logistics platform by a new subject involved, I.CO.P., a group operating in the road construction sector, and special works. The so-called Hot Area with the old blast furnaces will make way for the expansion of the logistics activities of the Port of Trieste. The new cold rolling mill built in 2015, the core of the previous industrial reconversion project, will be doubled.

## **Planning**

To obtain this result, it becomes necessary to reorganize the areas throughout a system of exchanges of lands, both privately owned and under state concession. Also necessary is a remodeling of the planning structures, currently in progress, which presuppose the development of industrial areas owned by the Municipality of Trieste as part of the General Town Plan of the Municipality of Trieste, while the areas under concession will be subject to the regime of the Port Town Plan.



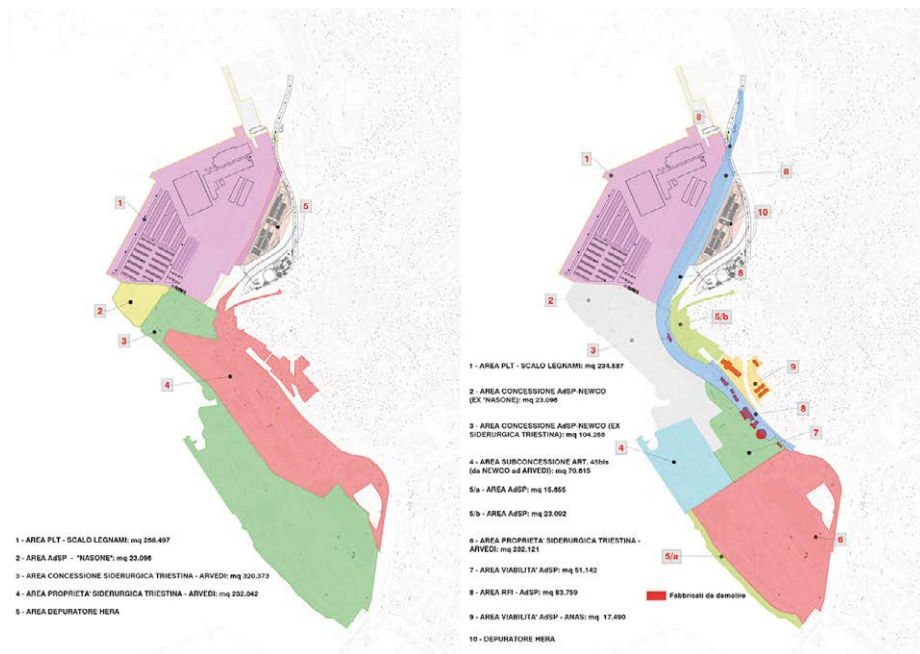


Figure 4 – The current and proposed layout of the areas (Annex 6 [11] to the Program Agreement). Legend on the left: 1) PTL Area – Timbers Shed; 2) AdSP area- “NASONE”; 3) Concession area of Siderurgica Triestina- ARVEDI; 4) Privately owned area by Siderurgica Triestina – AVREDI; 5) Hera depurator area. Legend on the Right: 1) PTL Area – Timbers Shed; 2) Concession area AdSP-NEWCO; 3) Concession area AdSP-NEWCO; 4) Sub-concession area; 5/a) Area AdSP; 5/b) Area AdSP; 6) Privately owned area by Siderurgica Triestina – AVREDI; 7) Viability AdSP area; 8) RF1 area – AdSP; 9) Viability AdSP area - ANAS; 10) Hera depurator.

The new plant will give an ambitious response in terms of eco-sustainable production, aiming at complete decarbonization and low-impact industrial production of the steel plant. Compared to the original contents of the Program Agreement, the energy will also be produced by a hydrogen plant whose electrolysis will be fuelled by the photovoltaic roof of over 95 000 square meters, house of the Cold Area plans building.

## The Adriagateway Project

This further integration, the result of an initiative of the Arvedi Group, is in turn integrated with the Adriagateway project of the Port Authority System (*Autorità di Sistema Portuale*) [3]. Added to this scenario is the Port Authority's project: Adriagateway. A strategic plan of coordinated investments for the logistic/industrial relaunch of the port system of the Eastern Adriatic Sea in outlook of green and digital transition (2020-2026).





Figure 5 – Summary graph of the "Adriagateway Project" (AdSP, September 2020).

The Adriagateway Project, developed during the summer of 2020, defines a system of 57 potential actions (project components) to be implemented in the Port System, divided into 6 macro-categories and financed for 385 million Euros by the National Plan for Recovery and Resilience. For example, the electrification of the docks (cold ironing), which will reduce the impact of the generators of moored ships, which remain active during loading and unloading operations, as well as the strengthening of railway logistics, considered in terms of greater sustainability.

## Conclusion

The scientific interest for the specific case of Trieste, developed on the basis of a procedure provided for by the 2006 Environmental Code, is due to the fact that it is the first completed application of this law in Italy. The results obtained include the completion of 100 environmental activities, the renewal of the existing industrial plant with a new production unit, the increase of port logistics activity and the maintenance of employment levels. Following these encouraging results, the activation of a second agreement, currently in progress, demonstrates the effectiveness and repeatability of the procedure. Furthermore, the new agreement introduces, compared to the previous one, new principles of “circular

economy”, both with regard to the disposal of existing buildings and plants, and with regard to the new production cycle, which is the subject of a specific research and development activity.

Industrial innovation, logistical implementation, environmental and landscape requirements, social protection and job opportunities, quality of life, ecological transition, are overlapping themes that outline a complex interdisciplinary scenario. The success of these operations is partly due to this holistic character, transversal to the convergence of actions carried out in different areas towards a single objective. What derives from this is also the value of a strategy based on the enhancement of relationships, connections, between different interests that no longer operate separate from each other. The ability to define development projects that also become environmental improvers is a complex vision, in a way, it could also be defined as creative. Time also plays a fundamental role; the effects of these transformations are measured on the passage of years. The process started in 2014, although many consequences are already appreciated, it has not yet been completed in its entirety, it continues to develop, it is progressively integrated. It has a dynamic, adaptable character.

“Bringing industry back to the sea” is a formula that has a precise and extensive strategic and planning significance. Today, logistics chains are getting shorter. This is a reduction of the excesses of globalisation. The pandemic in 2020, the blocking of the Suez Canal in the spring of 2021, and the Ukrainian war of 2022, have demonstrated the need to create regional buffers capable of absorbing interruptions in the distribution of goods and processing them while also creating added value. The case of the Port of Trieste can be a model to be studied in order to understand how to effectively govern these transformations, moving from the global logistics of the “Just in Time” to the more resilient structures that respond to the “Just in Case” logic, where the reuse and optimization of resources ensure achievement of outcomes on several fronts.

## Acknowledgements

Thanks to: Research and didactic unit: Integrated Design and Architecture Laboratory, Department of Engineering and Architecture, University of Trieste (IT). Coordinator and scientific manager: Giovanni Fraziano (DIA – UNITS). Team of researchers: Adriano Venudo, Claudio Meninno, Luigi Di Dato (DIA – UNITS). 2020 graduates who have collaborated on my research on ports and development: Matteo Savron, author of the thesis “Trieste: nuovi scenari per uno sviluppo tra infrastruttura e innovazione” and Vittoria Umani, translator and reviewer.

## References

- [1] Agenzia per la protezione dell’ambiente e per i servizi tecnici (2005) - *Annuario dei dati ambientali*, edizione 2004, IGER, Roma.
- [2] Agenzia per la protezione dell’ambiente e per i servizi tecnici (2006) - *Proposta di linee guida per il recupero ambientale e la valorizzazione economica dei brownfields*, IGER, Roma.

- [3] Autorità di Sistema Portuale del Mare Adriatico Orientale (2020) - *Piano Operativo Triennale*, [https://www.porto.trieste.it/wp-content/uploads/2021/04/POT\\_REVISIONE\\_N.3\\_2020.pdf](https://www.porto.trieste.it/wp-content/uploads/2021/04/POT_REVISIONE_N.3_2020.pdf), site consulted on 7.6.2022.
- [4] Contaminated Land Rehabilitation Network for Environmental Technologies (2002) - *Brownfields and Redevelopment of Urban Areas*, Federal Environment Agency, Wien.
- [5] Ministero dell'Ambiente e della tutela del Territorio e del Mare (2014) - *Accordo di Programma per l'attuazione del progetto integrato di messa in sicurezza, riconversione industriale e sviluppo economico produttivo nell'area della Ferriera di Servola*, [http://commissario.ferriera.fvg.it/fileadmin/user\\_crferriera/allegati/ADP\\_21\\_novembre\\_2014.pdf](http://commissario.ferriera.fvg.it/fileadmin/user_crferriera/allegati/ADP_21_novembre_2014.pdf), site consulted on 7.6.2022.
- [6] Ministero dello Sviluppo Economico (2014) - *Accordo di Programma per la disciplina degli interventi relativi alla riqualificazione delle attività industriali e portuali e del recupero ambientale nell'area di crisi industriale complessa di Trieste*, [http://commissario.ferriera.fvg.it/fileadmin/user\\_crferriera/allegati/ADP\\_30\\_gennaio\\_2014.pdf](http://commissario.ferriera.fvg.it/fileadmin/user_crferriera/allegati/ADP_30_gennaio_2014.pdf), site consulted on 7.6.2022.
- [7] Ministero dello Sviluppo Economico (2020) - *Accordo di Programma per l'attuazione del progetto integrato di messa in sicurezza, riconversione industriale e sviluppo economico produttivo nell'area della Ferriera di Servola*, [https://www.mise.gov.it/images/stories/documenti/Accordo\\_di\\_Programma\\_Ferriera\\_di\\_Servola.pdf](https://www.mise.gov.it/images/stories/documenti/Accordo_di_Programma_Ferriera_di_Servola.pdf), site consulted on 7.6.2022.
- [8] Ministero dello Sviluppo Economico (2020) - *Accordo di Programma per l'attuazione del progetto integrato di messa in sicurezza, riconversione industriale e sviluppo economico produttivo nell'area della Ferriera di Servola, Allegato 1*, [https://www.mise.gov.it/images/stories/documenti/Allegato\\_1\\_ferriera\\_di\\_servola.pdf](https://www.mise.gov.it/images/stories/documenti/Allegato_1_ferriera_di_servola.pdf), site consulted on 7.6.2022.
- [9] Ministero dello Sviluppo Economico (2020) - *Accordo di Programma per l'attuazione del progetto integrato di messa in sicurezza, riconversione industriale e sviluppo economico produttivo nell'area della Ferriera di Servola, Allegato 1.1*, [https://www.mise.gov.it/images/stories/documenti/Allegato\\_1\\_1\\_ferriera\\_di\\_servola.pdf](https://www.mise.gov.it/images/stories/documenti/Allegato_1_1_ferriera_di_servola.pdf), site consulted on 7.6.2022.
- [10] Ministero dello Sviluppo Economico (2020) - *Accordo di Programma per l'attuazione del progetto integrato di messa in sicurezza, riconversione industriale e sviluppo economico produttivo nell'area della Ferriera di Servola, Allegato 2*, [https://www.mise.gov.it/images/stories/documenti/Allegato\\_2\\_ferriera\\_di\\_servola.pdf](https://www.mise.gov.it/images/stories/documenti/Allegato_2_ferriera_di_servola.pdf), site consulted on 7.6.2022.
- [11] Ministero dello Sviluppo Economico (2020) - *Accordo di Programma per l'attuazione del progetto integrato di messa in sicurezza, riconversione industriale e sviluppo economico produttivo nell'area della Ferriera di Servola, Allegato 6*, [https://www.mise.gov.it/images/stories/documenti/Allegato\\_6\\_Accordo\\_Programma\\_Aree\\_Intervento.pdf](https://www.mise.gov.it/images/stories/documenti/Allegato_6_Accordo_Programma_Aree_Intervento.pdf), site consulted on 7.6.2022.



## INDEX OF AUTHORS

Abbiati M.	785	Barontini S.	187
Acampora G.	822	Barrois J.-M.	378
Adamo M.	766	Basso D.	587
Agaoglou Ch.	93	Battista D.	436
Alati M. C.	801	Beck A. L.	200
Albanese G.	766	Bejaoui B.	756
Alonso H.	16	Belluscio A.	719
Alonso I.	16	Ben Boubaker H.	122, 471
Altavilla S.	111	Ben Dhiab R.	122, 471
Altemura P.	729	Ben Ismail S.	122, 471
Amine Taji M.	200	Ben Jeddi S.	378
Anastasio A.	461	Ben M'Barek N.	756
Anthony E.	5	Ben Mefteh A.	378
Antonazzo A.	70	Benincasa F.	390, 401
Aquaro S.	111	Bertoli B.	811, 822
Aquila M. G.	461	Berton A.	47
Aragonés L.	38, 61	Bianco A.	551
Ardizzone G.D.	719	Bini M.	47
Arriola Velásquez A. del C.	16	Bisci C.	132
Asprea D.	611	Bisiani T.	146
Attouchi M.	122	Boissery P.	685
Atzori F.	587	Bojanic Obad Scitaroci B.	333
Auremma R.	70	Bouchoucha M.	685
Bagnarol M.	365	Bracchi V.	587
Bañón L.	61	Brach-Papa C.	647
Barbafieri M.	693	Bretzel F.	693
Barbone E.	436, 637	Brochen M.	647
Baroncelli R.	747	Bruno M.F.	504

Bruzaud S.	484, 560	Chiti M.	303
Buccolieri C.	70	Chouba C.	412
Buoninsegni, J.	156	Cirillo C.	811, 822
Buonocunto F. P.	234, 535	Citterio S.	587
Burca M.	446	Clamagirand E.	685
Burini G.	611	Coelho C.	283
Busato A.	446	Colarossi D.	426
Cadoni N.	587	Coluccia L.	70
Caligiore A.	111	Corbau C.	156
Cámara F.	16	Corrente G.	111
Candura A.R.	165	Costa V.	619
Cantalamessa G.	132	Costantino G.	637
Carbajales R.	446	Cotroneo Y.	461
Carboni D.	175	Cunico I.	446
Caronni S.	587	Cutajar M.	627
Casarosa N.	47	Cvetko Tešović B.	83
Casavecchia S.	132	D'Ascola F.	27, 200
Casoli E.	719	D'Onghia F. M.	637
Cassese M. L.	27, 200	Da Ru F.	312
Castejón-Silvo I.	596	Dalle J.	685
Castro-Fernández J.	596	Dalle Mura I.	436, 637
Causse L.	412	De Gioia M.	637
Cazzani A.	187	De Maio L.	461
Cecchi E.	606	De Vincenzi M.	390, 401
Cecchi G.	611	De Vita F.	834
Celio M.	365	De Vivo C.	322
Celli D.	504	Defina M.	322
Cerrano C.	785	Del Frate S.	365
Cesarini C.	312	Della Rotonda M.	461
Challouf R.	122, 471	Delpoux S.	412
Chardin N.	685	Derouiche E.	122, 471
Chavanon F.	647	Di Leo A.	535
Chemello R.	619	Di Pace G.	322
Chiavaccini P.	865	Di Risio M.	504

Disdier-Gomez J. M.	596	Ghetta M.	785
Diviaco P.	446	Giaiotti D.	221, 365
Domeniconi C.	568	Giandomenico S.	535
Dorigatti J.	211	Giannelli D.	111
Droit J.	456	Giannini F.	785
Drouet F.	647	Giannuzzi C.G.	436
El Fadili M.	456	Giglio A.	611
Esposito M.	461	Giglio R.	611
Fai S.	70	Giglio S.	611
Falcou-Préfol M.	484	Giordano L.	234, 535
Farris C.	221	Godec P.	83
Fasano G.	390, 401	Gorsky G.	484
Ferraro F.	656	Guernelli R.	693
Ferraro L.	234, 535	Guilbert A.	685
Ferrero D.	667	Helali A.	378
Fischione P.	272	Herut B.	677
Florio Furno M.	667	Hinz H.	596
Fois L.	165	Holon F.	685
Fortunato L.	461	Iaciofano D.	619
Franchi E.	693	IOLR Scientists	677
Fratini F.	834	Issaris Y.	93
Fratino U.	504	Iurcev M.	446
Freydier R.	412	Ivona A.	244
Fustolo M.	611	Jamet D.	647
Galeano F.	111	Jamet J.-L.	647
Galgani F.	484	Jaziri, H.	122, 471
Gallo P.	461	Jelic Mrcelic G.	211
Garofoli, P. F.	504	Jones M.	200
Garosi C.	775	Kapsimalis V.	93
Gazale V.	175	Kedzierski M.	484, 560
Geibert W.	16	Koched W.	122, 471
Gentili R.	587	Kourliaftis I.	93
Gerakaris V.	93	Ladu M.	262
Geronimo S.	504	Lanfranco S.	627

Lapinski M.	685	Mesnager V.	378
Lazzeri V.	693	Messenger M.	456
Lenac D.	525	Messina G.	175
Lo Brutto S.	619	Milia A.	234, 535
Logli F.	775	Miquel-Armengol N.	16
Lolli I.	700	Miralles F.	647
Lombardini G.	494	Missaooui H.	756
Longo A.	656	Mitello C.	844
López I.	38, 61	Molfetta M.G.	504
Lopez L.	244	Monfort P.	412
Lotito A. M.	504	Montaldi C.	272
Lotti I.	865	Montella R.	461
Luciani G.	253	Montigny C.	412
Lugeri N.	27, 200	Moranta J.	596
Luppichini M.	47	Muscatello G.	844
Madeo E.	611	Nali C.	747
Malcangio D.	504	Neri A.	738
Mali M.	535	Nicastro A.	606
Mance Da.	515, 525	Notheaux M.	560
Mance Di.	515, 525	Oliva M.	667
Mancini G.	719	Olivo E.	156
Mancusi C.	729, 738, 747	Ortíz P.	61
Mantino F.	766	Ottaviani E.	756
Marcolongo L.	811, 822	Oueslati W.	378
Marie M.	412	Ozmen S. F.	545
Marino G.	606	Paffetti D.	775
Marras M.	262	Pagán J. I.	38, 61
Marsili L.	729, 738	Palazot M.	484, 560
Martel P.	16	Paletta M.G.	156
Martini S.	365	Palmarocchi M.	568
Masucci P.	322	Panagiotopoulos I.	93
Mauro M.	365	Parisi F.	775
Mazzetti M.	729	Pasquali D.	272
Merlino S.	47	Paterni M.	47



Pedrotti M. L.	484	Rescic S.	834
Peli M.	187	Ria M.	606
Pellettieri A.	855	Riccomagno E.	756
Peric T.	211	Risoli S.	747
Perrot M.	685	Roebeling P.	283
Pesarino V.	27, 200	Roscioli C.	729
Petruzzelli G.	693	Rosellini I.	693
Piazzì L.	606	Rossi F.	619
Picciolo A.	70	Rubiano J. G.	16
Piferi C.	343	Rubinić J.	525
Pikelj K.	83	Rugge C.	656
Pini R.	693	Russo Ma.	293
Pino N.	446	Russo Mrn.	811, 822
Pisconti M.	111	Sahbani S.	756
Pittaluga D.	834	Salmeri A.	27, 200
Polesello S.	729	Salmona P.	494
Poli A.	667	Salomidi M.	93
Poli E.	165	Santocchini E.	111
Pombo R.	283	Saragosa C.	303
Ponti M.	785	Sarnelli P.	461
Potleca N.	446	Sarrocco, S.	747
Prampolini E.	756	Sartor P.	738
Pratola L.	504	Savino M.	312
Pretti C.	667	Sbarra C.	461
Pribaz E.	865	Scarpa L.	822
Prigione V.	667	Scartazza A.	693
Principi P.	426	Serafino F.	551
Pringault O.	416	Sgubin C.	221
Privitera D.	244	Simeone M.	322
Quaglini L.	587	Soccalingame L.	484, 560
Radišić M.	525	Sopina A.	333
Raffalli R.	865	Spagnoli F.	132
Ranieri S.	436	Spagnoli V.	343
Reñones O.	596	Stefanelli M.	461

Stimac I.	16	Turicchia E.	785
Strippoli G.	436, 637	Ungaro N.	436, 637
Tagliolini E.	426	Ursumando I.	775
Taramasso A. C.	494	Usai M. P.	887
Tarantino C.	766	Vaccaro C.	156
Tarricone E.	175	Valsecchi S.	729
Tartara P.	875	Vandarakis D.	93
Tejera A.	16	Varese G. C.	667
Tenza-Abril J.	38	Ventura D.	719
Terracciano G.	747	Ventura P.	568
Terrados J.	596	Vettori C.	775
Thievent P.	685	Viola A.	446
Tiralongo F.	111	Violante C.	234
Tomaselli V.	766	Voliani A.	729, 738
Topcuoglu B.	545	Vukić-Lušić D.	515
Toubiana M.	412	Zaaboub N.	378
Toujani R.	756	Zanardi S.	446
Tramontana M.	132	Zito Al.	611
Travaglini D.	775	Zito An.	436
Tudorov N.	221	Zuffi M. A. L.	747
Tuohy M.	667	Zullo F.	272

MONITORING OF MEDITERRANEAN COASTAL AREAS:  
PROBLEMS AND MEASUREMENT TECHNIQUES

PUBLISHED BOOK

1. Laura Bonora, Donatella Carboni, Matteo De Vincenzi, Giorgio Matteucci (edited by), *Ninth International Symposium "Monitoring of Mediterranean Coastal Areas: Problems and Measurement Techniques". Livorno (Italy) 14<sup>th</sup>-16<sup>th</sup> June 2022, 2022*

FROM OTHER SERIES

Claudio Conese (edited by), *Sixth International Symposium "Monitoring of Mediterranean Coastal Areas: Problems and Measurement Techniques". Livorno (Italy) 28-29 September, 2016, 2017*

Fabrizio Benincasa (edited by), *Seventh International Symposium "Monitoring of Mediterranean Coastal Areas: Problems and Measurement Techniques". Livorno (Italy) 19-20-21 June 2018, 2018*

Laura Bonora, Donatella Carboni, Matteo De Vincenzi (edited by), *Eighth International Symposium "Monitoring of Mediterranean Coastal Areas: Problems and Measurement Techniques". Livorno (Italy) June 2020, 2020*



## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

---

The 9<sup>th</sup> International Symposium *Monitoring of Mediterranean Coastal Areas: Problems and Measurements Techniques* was organized by CNR-IBE in collaboration with *Italian Society of Silviculture and Forest Ecology*, and *Natural History Museum of the Mediterranean* and under the patronage of *University of Florence*, *Accademia dei Lincei*, *Accademia dei Georgofili*, *Tuscany Region*, *The North Tyrrhenian Sea Ports System Authority*, *Livorno Municipality* and *Livorno Province*. In the Symposium Scholars had illustrated their activities and exchanged innovative proposals, with common aims to promote actions to preserve coastal marine environment. Despite the COVID 19 pandemic, the success of this edition is attested by the 170 contributions selected by the Scientific Committee from among those received. Participation involved all the thematic lines envisaged by the sessions, involving many countries of the Mediterranean Sea. A big endeavor for a coastal environment of paramount importance but threatened by global changes. The importance of this Proceedings is attested by the fact that this volume is the first issue of a new FUP Series.

**Laura Bonora** is researcher at Institute of BioEconomy - National Research Council (CNR-IBE) of Italy. Her main research activities are concerned Natural Resources Management, environmental risk analysis, ecosystems biodiversity and Remote Sensing.

**Donatella Carboni** is a professor of Human Geography at the University of Sassari. She carries out investigations about land use, processes and its dynamics. In recent years she has been interested in the Integrated Coastal Zone Management of the beaches and she was involved in the management process of the coasts.

**Matteo De Vincenzi** is researcher in Institute of BioEconomy - National Research Council (CNR-IBE) of Italy. His main research activities concern the development of analysis methodologies based on artificial neural networks and analytical and statistical techniques applied to environmental-physical phenomena.

**Giorgio Matteucci** Director of the Institute of BioEconomy - National Research Council (CNR-IBE) of Italy. Main research areas: effects of climate change on forests, carbon cycle in ecosystems, direct measurement of carbon uptake / emission in terrestrial ecosystems. Other research activities: forest monitoring, Long Term Ecological Research, research on biodiversity.

ISBN 979-12-215-0030-1 (PDF)  
ISBN 979-12-215-0031-8 (XML)  
DOI 10.36253/979-12-215-0030-1

[www.fupress.com](http://www.fupress.com)