

EUROMED COOPERATION. INLAND AND MARINE WATER CHALLENGES

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INDEX

Executive summary	pag.	5
Introduction	»	8
Scene setting	»	9
Outcomes of thematic workshops	»	12
<i>Workshop 1 – Water Resources and Land Management Impacts on Inland and Sea Water in the Mediterranean Region</i>	»	12
<i>Workshop 2 – A Mediterranean integrated ocean observing system to support sustainable coastal and marine tourism</i>	»	17
<i>Workshop 3 – Building an Ecosystem Based Approach to Fisheries and Aquaculture in the Mediterranean</i>	»	22
<i>Workshop 4 – Ecosystem Based Management in the Mediterranean Region</i>	»	27
General Recommendations	»	30
Annexes: Conference photo's, List of Acronyms, Conference Programme, List of Participants, Scientific & Organizing Committee members	»	32

EXECUTIVE SUMMARY

The *'EuroMED Cooperation. Inland and Marine Water Challenges'* Conference report aims to be a milestone in the evolving framework of international cooperation on research and innovation in the Mediterranean Region, with particular regard to the sustainable management of inland and marine water nexus and related social and economic implications.

The Mediterranean Region is facing serious social, economic, environmental, and political challenges. Population growing, with estimates of about 255 million inhabitants in 2025 in the southern and eastern parts of the Med, will trigger an increase in water demand for energy and agriculture coupled with an increasing demand for food.

Moreover, considering how strongly in this area climate change is affecting natural and human systems and aquatic resources, as reported by the Intergovernmental Panel on Climate Change (IPCC) in 2007 concern is increasing about the likely implications of climate change on poverty, economic growth, ecosystem services, livelihood opportunities and overall human development.

The situation is made further challenging by other features, including: the land use pattern, alteration of water cycle, the uneven distribution of resources, and anthropogenic pressures. Among those last degraded fisheries, loss of biological diversity, hindered aquaculture efforts, and the tourism fluxes to the coastal areas, being at the same time socio-economical hot-spots for EU and non EU Mediterranean countries and vulnerable ecosystems subject to degradation.

The combined impact of these factors with resources overexploitation and pollution of both inland and marine water, trans-boundary nature of major water resources and vague governance setup, especially in some Mediterranean countries, make the management of inland and marine water, aquatic resources and ecosystems, a primary issue for health, economy, environment and social stability. In this landscape, the Ecosystem Based Management acts as a basis for environmental safeguarding

and sustainable development of coastal communities and their interaction with resources, allowing sustainable exploitation and reduction of use conflicts.

Looking forward to enhance international cooperation between European countries and countries of the Southern Mediterranean Neighbourhood on research and innovation, it comes out that the links between inland and marine water systems, with particular regard to the impact on sustainable exploitation of key natural resources for human and economic activities like fisheries and coastal tourism, deserves further exploration. So far the tendency has been to conduct research and implement policies by looking at those systems in a separate fashion while there are many issues and above all drivers of water pollution – both in the inland and marine environment – that are often connected each other. At the same time the impacts on key economic sectors as well as ecosystems are often combined. Therefore the Conference was intended to take stock of current research, identify knowledge gaps and relate them to policy making at local, national and transnational level also in view of consistently apply the Ecosystem Based Management (EBM) approach taking into account both the commonalities and diversity of ecological and socio-economic factors in the Mediterranean region. To this end the Conference addressed in particular the following challenging themes: (i) the water resources and land management impacts on inland and sea water in the Mediterranean Region; (ii) a Mediterranean integrated Ocean observing system to support sustainable coastal and marine tourism; (iii) building an ecosystem based approach to Fishery and Aquaculture in the Mediterranean; (iv) the Ecosystem Based Management in the Mediterranean Region. Considering the framework of international and EU policies addressing the Mediterranean Region, it is recommended to build upon existing initiatives and infrastructures while favouring a joint durable strategy for the

sustainable management of inland and marine water as preliminary ways forward to a common Mediterranean integrated Policy. To this end, the following actions are fundamental.

- Fill knowledge gaps to properly assess how the coupling between riverine, marine, and coastal ecosystems like lagoons, deltas, coastal vegetation, agriculture, and their reciprocal influences the impacts of socio-economic activities like fisheries and tourism.
- Redefine water and biological resources uses, taking into account different stressors that affect their exploitation, from climate change effects at local scale to conflicts with other anthropogenic uses.
- Favour coordination among processes developed by existing initiatives (e.g. Joint Programming Initiatives *JPI-Water and JPI-Oceans*; *Partnership for Research and Innovation in the Mediterranean Area* - PRIMA Initiative), those related to policies (*Common Fishery Policy* – CFP; *Maritime Spatial Planning* – MSP) or to the implementation of directives (e.g. *Water Framework Directive* – WFD; *Marine Strategy Framework Directive* – MSFD) as well as tasks carried out by governance organisms (e.g. *Mediterranean Science*



Commission – CIESM, *General Fisheries Commission for the Mediterranean* – GFCM), pursuing a common pathway in particular for EU policies and Decisions taken by the Barcelona Convention Conference of Parties.

- Rely on research infrastructures (e.g. *Global Earth Observation System of Systems* – GEOSS; *Global Ocean Observing System* – GOOS; *Integrated Carbon Observation System* – ICOS; *European Long-Term Ecosystem Research Network* – LTER; *European e-Science infrastructure for biodiversity and ecosystem research* – LifeWatch) to provide services and support policies.
- Bridge the science-to-policy gap in order to devise long term sustainable policies in the Region, making profit of supporting tools like monitoring and services.
- Promote more organized cooperation among different stakeholders of different countries: scientists, economists, policy makers, private sector, and citizens, also by means of technology platforms.
- Make data accessible, valuing the data providers-data users interface.
- Foster partnership to link research and innovation and its uptake, enhancing human capacity.
- Involve society, increasing the awareness of the need of a more sustainable and appropriate water and coastal management.





Business as usual scenario is no longer feasible. More attention needs to be given to the social, economic, institutional and environmental aspects in inland and marine water planning and management with a long term perspective. To reach a durable sustainable development, the Mediterranean region deserves innovative strategies. A possible Strategic Research Agenda for the Med should jointly involve the EU, national and regional authorities in EU Member States and the Southern Mediterranean countries. The complexity of the Area calls for flexible long-term programme allowing mid-term actions to be timely implemented, contributing to the 'green transition' towards a Euro-Med Economic Area focused on environmental and socio-economic adaptation strategy and partnership.

INTRODUCTION

The *Naples Conference* report provides a knowledge input to the design of future research and policymaking aimed at tackling the social and economic challenges associated to the interconnection between inland and marine waters in the Mediterranean Area. This in the framework of international cooperation in research and innovation between the European Union and Southern Mediterranean countries.

This document is the main output of the Conference '*EuroMED cooperation. Inland and Marine Water Challenges*' (EuroMED-IMWC) organized by the National Research Council of Italy – Department of Earth System Science and Environmental Technology under the Italian Presidency of the European Council with support from the European Commission – Directorate General for Research and Innovation. The Conference was held in Naples on 3-4 November 2014 with the participation of researchers and policymakers from the whole Mediterranean region. The main aims of the conference were to take stock of ongoing initiatives, identify gaps and ways forward, enhance exchanges between researchers from European and the South Mediterranean countries, strengthen the links between research and policymaking.

The unique Mediterranean ecosystem has been historically accompanied by intense human activities and resources exploitation. The Region is characterized by important feedbacks between human activities and natural processes occurring in upstream river basins and those of the downstream coastal zones, where anthropic and environmental aspects are crucially related. Considering how strongly this mechanism impacts some of the key economic drivers of the Mediterranean area such as fishery, aquaculture and tourism, strategic measures have to be jointly devised and adopted for a sustainable inland and marine water management, particularly in the coastal zones.

The geo-political complexity of the area calls for policy efforts towards the efficient

connection of different priorities of the Mediterranean countries and actors. The United Nations Environment Programme Mediterranean Action Plan (UNEP/MAP) for the Barcelona Convention and the European Neighbourhood Policy (ENP) – EC COM (2011)200 and EC COM (2011)303 – recognizes the importance of cooperating at international level, as also stated in the conclusions of the Barcelona Euro-Mediterranean Conference on Research and Innovation (April 2012). The EU Framework Programme on Research and Innovation, Horizon 2020, is open to participation of entities from the whole world and the European Commission adopted a Strategy on International Cooperation that, among other features, targets the countries of the European Neighborhood for specific attention (COM(2012) 497). To effectively take advantage of the initiatives already implemented, avoid fragmentation and achieve a sustainable development of the Mediterranean region, innovative long terms initiatives are required.

At the EuroMED-IMWC Conference, four thematic workshops explored fundamental shades of the inland and marine water nexus in a Euro-Mediterranean perspective: the water resources and land management impacts on inland and sea water; an integrated ocean observing system to support sustainable coastal and marine tourism; building an ecosystem based approach to fishery and aquaculture; the Ecosystem Based Management. A general discussion followed, framing these different aspects in the scientific and policy macro context of the Euro-Mediterranean cooperation.

Looking for scientific and governance alignment to be enhanced through international cooperation, the report outlines key messages with the long term objective of building a strong area of collaboration based on shared priorities to sustainably exploit the potential of the Mediterranean environment for the benefit of its population.

SCENE SETTING

In order to identify the spatial and temporal frame laying behind the inland and marine water management issues in the Mediterranean region, this section takes advantage of the two keynotes presented at the Conference during the plenary session, 'Managing interfaces: biodiversity and ecosystems in changing Mediterranean' and 'A foresight perspective on the MED region', and of the following round table discussion on 'Integrated Med policy and science strategy for tackling the socio-economic challenges linked to the Mediterranean Inland and Marine Water'.

Inserire foto 'scene setting'

Managing the interfaces in the Mediterranean region - The historical dimension

The history of the Mediterranean Basin ecosystem is characterized by thousands years of continuously growing human population, enhanced connectivity, resource (over-)exploitation, commerce and trades, 'industrial' development, urbanization, wars and pollution.

Relevant aspects of the Mediterranean Basin ecosystem include: hotspot for biodiversity, high inland-marine connectivity, strong east-west and north-south gradients (e.g. temperature, salinity, ...), heterogeneity of abiotic factors, and biotic elements affected all along by human actions, both active like those related with water management, and passive, being vectors of alien species.

This semi-enclosed Basin is historically suffering from human pressures, and currently hosts impacting economic activities like 31% of international tourism and 30% of international maritime freight traffic¹.

¹ *The Mediterranean Sea Biodiversity: state of the ecosystems, pressures, impacts and future priorities*, United Nations Environment Programme – Mediterranean Action Plan – Regional Activity Centre for Specially Protected Areas, UNEP-MAP RAC/SPA – Tunis, 2010, Available at: http://www.rac-spa.org/sites/default/files/doc_cop/biodiversity.pdf

Increasing anthropogenic stresses to the Mediterranean ecosystem add to other threats and trends like raising water consumption, climate impacts and their related environmental effects (e.g. sea level rise, extreme events, coastal erosion, ...). During the last decade it has been indeed shown that the Mediterranean Region is particularly sensitive to these effects.

When addressing such a complex system where multiple feedbacks occur among different ecosystems and with human activities, the management of interfaces at different level emerges as one of the key points.

- Inland-marine interface. Transitional water (TW) systems like lagoons and river mouths represent a dense area of key ecosystem functions and services to human communities (e.g. water, fish and birds as part of ecosystems renewal and provision of food, recreation and other services) as well as rich energy suppliers. Considering the increasing loss of TW surface, the interconnection between inland and marine water needs therefore to be monitored, managed, and mitigated.
- Data providers-data users interface. Despite the huge amount of data collected through the observing systems from in situ observatories to remote sensing, a major effort is needed to assemble all this information, better connecting satellite with in situ data, looking at the ecological interfaces, decoding patterns into mechanisms. In this way it would be possible to fill the gap of understanding the processes affecting water management, being able to implement new descriptors, for example to assess species behavior in relation with the food webs.
- Fields of knowledge interface. Considering the number of disciplines involved in the water management issue, a trans-disciplinary approach is required in order to reduce fragmentation and extend the strategy of the Ecosystem Approach and the Ecosystem Based Management.

Managing interfaces in the Mediterranean region - Forward looking dimension

Setting the horizon to 2030, how shall the future of Euro Mediterranean Cooperation be envisaged on the interface management with particular regard to the water issue?

Recognizing applied research as key driver of an inclusive and sustainable socio-economic development, it is important for scientific research to have a solid social and economic approach in order to effectively enhance cooperation on key topics among Mediterranean regions. To define appropriate long term actions, moving from the business as usual approach to a sustainable co-development, it is important to build scenarios on socio-economic complementarities and synergies. These need to take into account relevant constraints like the exploitation of energy and water resources and demographic change as well as long term challenges like climate change pressures, then complementing the scenario with the assessment of security and political constraints.

According to the scenario analysis carried out by the 'Mediterranean Prospects'² (MEDPRO) project for Southern and Eastern Mediterranean countries (SEM), a long term Roadmap for Sustainable Water Use includes:

- a vision combining technical, economic, social, and institutional factors
- dual water supply-enhancing and demand-management measures considering innovative sources and irrigation networks/technologies
- improved water management efficiency and institutional management towards a more collaborative approach including relevant stakeholders
- planning strategies integrating climate change impacts.

Going beyond the water issue, and including economic and other financial aspects, the projection of an economic development at

² www.medpro-foresight.eu & <http://euromed-economists.org/>

today rhythm asks for urgent political action to avoid a 'red scenario' of a Euro-Mediterranean area under significant threats and move towards a 'green scenario' of a sustainable development of the Euro-Mediterranean area, adaptation strategies and the development of a common market and frameworks of action on key topics such as research and innovation (R&I), migration, trade, energy and water would be necessary.

Euro-Mediterranean cooperation - Ongoing initiatives

Can a sustainable inland and marine water management be tackled building on the ongoing initiatives?

The implementation process of relevant EU Directives and International Agreements constitute a valuable opportunity for tackling the inland and marine water challenge, including by addressing governance issues related to the management of natural resources at local, national, European and international levels.

The results of research projects conducted under the previous EU Research Framework Programme, achievements of relevant science policy events, ongoing public-public and public-private partnerships (e.g. JPIs), as well as capacity building programs can provide inputs to new actions geared towards linking research and innovation and enhancing international cooperation in the Mediterranean region.

Moreover, existing research infrastructures (RIs) including e-RIs (e.g. GEOSS, GOOS, ICOS, LTER, LifeWatch) can play an important role to enhance the competitiveness of the region strengthening international cooperation and reinforcing human capital. For example, the possibility to integrate satellite data offered by Copernicus satellite Programme can help to build up a much more robust knowledge about the MED Region functioning and thus address the water systems.

Looking at the present landscape, some relevant ongoing initiatives at EU level do not address sufficiently the inland & marine water topic or the international cooperation

dimension, except for dedicated international and EC Programmes/projects for the Mediterranean area. The following table

accounts for the initiatives that have been represented during the round table discussion of the plenary session of the conference.

Initiative	Inland-marine water issue	International cooperation
JPI Water www.waterjpi.eu/	Tackled in the Strategic Research and Innovation Agenda (SRIA) and partially as topic of the pilot call on emerging contaminants	Not implemented so far
JPI OCEANS www.jpi-oceans.eu/	Scientific inter-calibration exercise on the Water Framework Directive + Interoperability in sediments study	While strategic cross-border cooperation to implement joint actions is at the base of JPI-Oceans functioning, cooperation with non-EU Mediterranean countries has not been implemented so far.
WssTP - Water supply and sanitation technology platform – www.wsstp.eu/ (ongoing)	Water sector coordination with a vision approach on what there could be in 2030, but the link inland-marine is not yet explored.	Open in principle
PRIMA – Partnership for Research and Innovation in the Mediterranean Area (submitted)	Among the goals is the link between food production and water provision in order to support an inclusive well-being while the link between inland and marine water is indirectly addressed.	This is a Euro-Mediterranean cooperation initiative de facto submitted by a number of EU Member States and South Mediterranean Partner Countries
H2020 - Depollution of the MED Sea Programme - www.h2020.net/	Inland and marine interfaces addressed while not prominently (e.g. industries have been asked to help in monitoring pollution...)	Fully Euro-Mediterranean Programme with equal power to EU and non-EU countries, and a key link with the investor.

Based on the above mentioned historical and forward looking perspectives and stock-taking of ongoing initiatives, some more detailed analysis of the issues at stake was developed in the thematic workshops.

OUTCOMES OF THEMATIC WORKSHOPS

For each theme of the workshops, once the driver is defined, the known and unknown aspects are presented to achieve proposals on how to move forward.

Workshop 1 – Water Resources and Land Management Impacts on Inland and Sea Water in the Mediterranean Region

Challenge definition (driver)

The Mediterranean Basin in general and the southern and eastern parts in particular are facing serious social, economic, environmental and political challenges. Among the most critical challenges are the increasing water scarcity and increasing water demand resulting mainly from rapid population growth. Currently, the basin is home to 468 Million people (nearly 7.4% of World's population). The population is growing rapidly especially in the southern and eastern parts where it will reach about 255 million inhabitants in 2025 as reported by United Nations in 2006³. This will trigger an increase in water demand by 25% in the southern and eastern parts of the basin during the same period.

In addition, the IPCC predicts that, for the southern and eastern Mediterranean, warming over the 21st century will be larger than global annual mean warming – between 2.2-5.1°C according to a realistic emissions scenario (Scenario A1B). In the same period of time annual precipitation rates are likely to decrease 10 per cent by 2020 and 20 per cent by 2050 (IPCC, 2007). The report also provides a comprehensive analysis of how climate change is affecting natural and human systems. Concern is increasing about the likely implications of climate change on poverty, economic growth, ecosystem services, livelihood opportunities and overall human development.

³ United Nations' Department of Economic and Social Affairs Population Division (2007) "World Population Prospects - The 2006 Revision Highlights", New York – USA

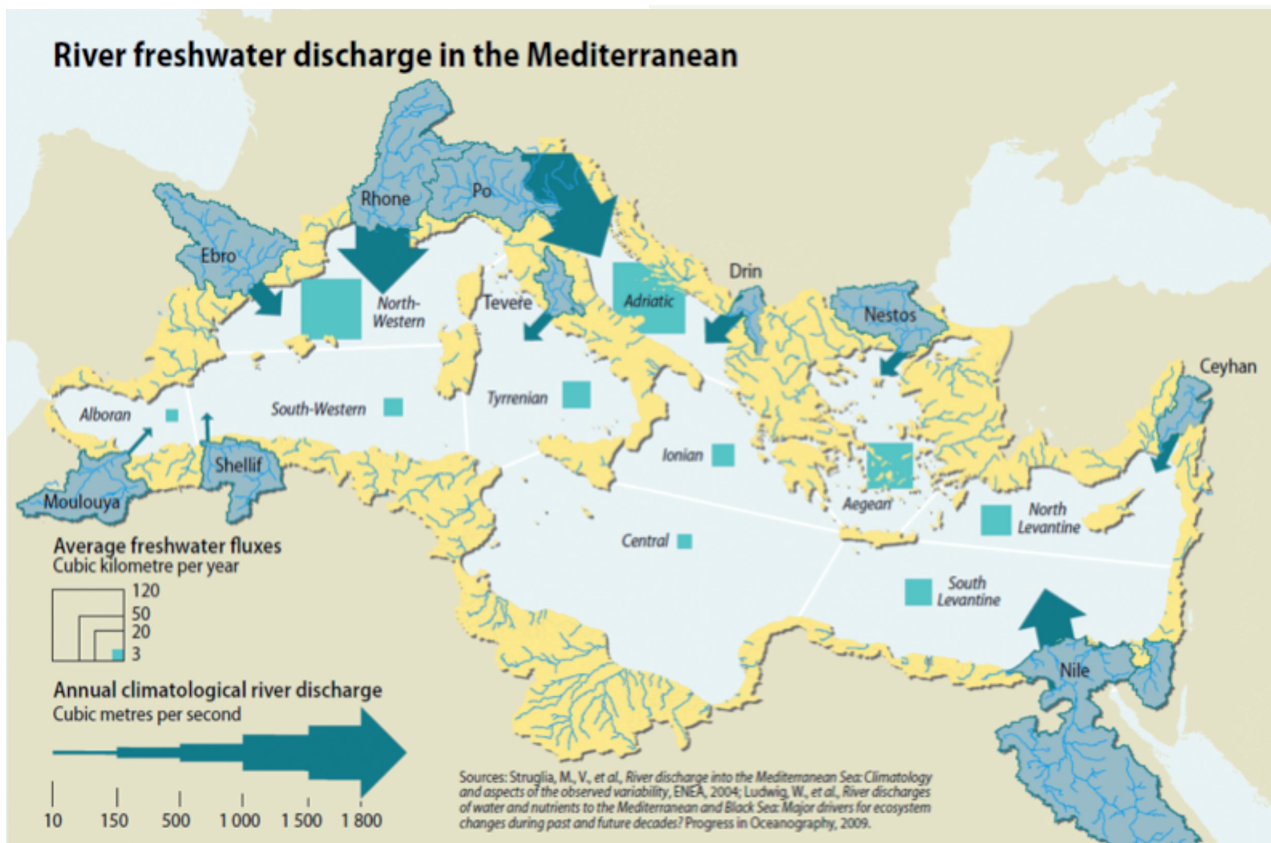
The land use pattern, alteration of water cycle, overexploiting both surface and groundwater resources, the tourism fluxes to the coastal areas (170 million tourists per year visiting the Mediterranean coast while its population is 150 Million people), and the uneven distribution of fresh water resources within the Basin -84% of the resources (1060 km³) occurs in the northern part while only 16% occurs in the southern and eastern parts -further complicates the situation.

The combined impact of these factors coupled with overexploitation and pollution of both inland and marine water, trans-boundary nature of major water resources and not well defined or functioning governance setup, especially in some Mediterranean countries, make the management of both inland and marine water a primary issue for health, economy, environment and social stability.

Taking stocks (what we know)

The level of knowledge which is currently available on the magnitude of the challenges that are facing the Basin as well as the opportunities to overcome these challenges, is undoubtedly better than that of two decades ago. Moreover the type of the challenge varies substantially across the Basin and may range from political, natural, technological, socio-economic-cultural to institutional and governance issues. They can be described as follows:

- *Natural*
 - Water scarcity is increasing as a result of spatial and temporal changes in climate. The increase in the extreme events is yet adding another complication.
 - Population is rapidly growing especially in the south and so does water demand to meet various developmental needs, expected to increase by 25% toward 2025.
 - Increased scarcity and shared nature of main water resources are creating more sectorial as well as other types of conflicts.
 - Problems related to environmental flows of major rivers, no longer discharging to



■ **Figure 1** – River freshwater discharge in the Mediterranean. Sources: Struglia, M., V., et al., River discharge into the Mediterranean Sea: Climatology and aspects of the observed variability, ENEA, 2004; Ludwig, W., et al., River discharges of water and nutrients to the Mediterranean and Black Sea: Major drivers for ecosystem changes during past and future decades? Progress in Oceanography, 2009

Mediterranean Sea sufficient quantities of water and sediments which resulted in cost line shrinkage and nutrient losses.

■ Political

- Human activities, current land use and development patterns at both catchment up streams and coastal areas is posing a major threat to both inland and marine water quality and quantity.
- Water Management is highly influenced by politics and decisions are often taken in a mostly sectorial way and favoring economically stronger sectors. Environment is thus not properly represented within the plans.
- Societal priorities and needs (e.g. fair and efficient access to water resources for different users –from agriculture and households to transport and tourism) are

sometimes not well addressed in water management plans.

- Water pricing is often based on political preferences rather than on a reliable reflection of the actual cost in several parts of the Mediterranean Basin.

■ Social - Economic - Cultural

- Low awareness of the acuteness of the water scarcity problem at public as well as decision makers' level.
- Water use efficiency is low especially in irrigation, while irrigation is the largest 'water consumer' in the Mediterranean area.
- The difficult economic situation, especially in the Southern Mediterranean, is considered a major barrier to develop and adopt advanced and high-cost technological solutions

for the water problems; this calls for affordable, 'frugal' innovation.

- › Social and cultural acceptability of some water management aspects, especially reuse, is still a major issue of concern in some countries.
 - › Solving water problems has been realized by increasing the supply through exploiting existing fresh water resources (e.g., more dams, more wells) as a first relatively lower cost choice. This has however caused overexploitation of inland waters (both surface and groundwater), altered their quality, influenced the water cycle and affected ecosystems services.
- *Institutional and Governance*
- › Existing Scientific Knowledge and data is not communicated well to both public as well as decision makers.
 - › More harmonized action plans at the Basin level are needed (e.g. endorsement of the action plan of the Mediterranean Water Strategy)
 - › Stakeholder participation in planning and management of resources are not well established in many parts of the Basin and the current institutional setup needs further attention and reforms.
- *Technological*
- › The advances in technology have promising future concerning the further development of non-conventional water resources and releasing the pressure over the conventional water resources.
 - › New water savings devices, flow control measures, water leakage detection and repair technologies in municipal water networks and efficient irrigation systems of low-rate applicators (e.g., drip irrigation) are emerging. Scientists are getting more involved – while not enough – in the start-up companies.
 - › Energy costs of seawater desalination have considerably dropped in the last

decade. Yet knowledge is still lacking as for the environmental impact of massive desalination along the Mediterranean coasts on the sea ecology.

Gaps (*what we do not know*)

Despite of all the above mentioned knowledge, there are still several gaps that need to be better understood in order to ensure a more sustainable and integrated water resources management. For example:

- The implications and uncertainties related to "hot" issues (e.g. infiltration of nano-particles and pharmaceuticals substances into receiving water bodies) on human health impacts and the environment need to be investigated more.
- The exact climate behavior and more precise downscaling to better understand the occurrence of extreme hydrologic events and their impacts on local as well as freshwater and Med-Sea ecosystems needs further studies and analysis.
- Low level of knowledge and best practices that exists in other relevant research fields (e.g. nutrient recovery) and also in other countries of the Basin and worldwide, thus interdisciplinary knowledge gap needs to be bridged.
- How national plans can influence (positively or negatively) the overall water and marine environment in the Basin is not documented and not harmonized.
- The capacity (technical, economic, social) and willingness of various countries in the Basin to cooperate to address the various challenges ahead needs further encouragement.
- The magnitude and shapes of inland and marine water interaction and reciprocal influence needs further analysis.
- We do not fully understand the coupling between the rivers and the sea and the importance in fisheries or for conservation of some rare species as well as some birds.

Ways forward

To address these gaps it is necessary to undertake several revisions to the conventional ways of how the water planning have been made and what shifts are needed to address these gaps properly in the Basin. In this respect, it is important to reiterate the following:

- Business as usual scenario is no longer possible. More participatory, scientifically based and lower politically influenced water planning is needed. More attention needs to be given to the social and environmental aspects in water planning and management.
- To improve inter-disciplinary cooperation and create new platforms for knowledge sharing.
- Defining the most prominent and successful practices and cooperation which has real contribution to solve the problems, ensure its further development and up scaling.
- Diversify the technology to address various challenges. Start with low cost and small scale technology and bottom-up, affordable innovation.
- Capacity building of water practitioners as well as mid-level managers is needed to ensure better adaptation and mitigation. This includes further informal exchange of knowledge at users and practitioners at local, national and international levels as well as formal capacity building programs.
- To raise decision makers awareness and to bridge the gap between science and policy.
- There is a crucial need to better understand the implications of food – water – energy-land-use nexus. It is important to improve efficiency and reduce costs, for example in agriculture.
- To review the standards and norms currently in use to match the new emerging reality under climate and global changes.
- To ensure better water integrity and encourage voluntary reforms that can support the development of more sustainable water and marine environments.
- New approaches and new definitions of water budgets and the water cycle need to be studied in the light of the increased water scarcity and deteriorated quality. A holistic view looking at integrated solutions and their sustainability should be adopted. This includes the redefinition of water uses and prioritizing such uses taking into account social and ecological realities and needs.
- It is important to reverse the current pollution level of Med Sea before it reaches an irreversible situation. More harmonized regulation and more investment in cleanups is urgently needed.
- It is important to further investigate the coupling between the rivers and the sea and their importance to fisheries as well as for conservation of some rare species and some birds.



Workshop 2 – A Mediterranean integrated ocean observing system to support sustainable coastal and marine tourism

Challenge definition (driver)

Coastal regions are socio-economical hot-spots for EU and non EU Mediterranean countries. These areas contain more than half the planet's population, natural and man-made wealth in the form of buildings, infrastructure and machinery, human social capital and the natural ecosystems that provide food. About 35% of Mediterranean Partner Countries (MPC) population lives in the coastal zone and the average coastal population density grew of 49% in 30 years until 2000 (UNEP/MAP)⁴. Consequently, built-up areas within 1 km from the shoreline result to be 25% more than in the hinterland (with a peak of 45% in the most developed countries). From an economical prospective maritime regions account for over 40 % of Europe's GDP and attract almost a third of the world's international tourists. Coastal and maritime tourism is indeed a driver and vehicle for economic development in the whole Mediterranean. In 2011, coastal tourism generated more than a quarter of international tourism receipts which is estimated to contribute about 10 % of GDP and employment (Eurostat database). Moreover, the tourism sector in North Africa (+4,6 % a year of international tourist arrivals), the Middle East (+4,5 %) and the emerging economies of Europe (+4,1 %) is expected to significantly outgrow the

⁴ UNEP/MAP/PAP. 2001. *White Paper: Coastal Zone Management in the Mediterranean*. MARKOVIC, M., SATTI, A., SKARICIC, Z., & TRUMBIC, I. (2011). *Sustainable coastal tourism/an integrated planning and management approach*. United Nations Environment Programme, Division of Technology, Industry and Economics (UNEP-DTIE) "Practical Manuals on Sustainable Tourism" publication series.
Source: http://www.unep.org/pdf/DTIE_PDFS/DTIx1091xPA-SustainableCoastalTourism-Planning.pdf. Accessed, 2.

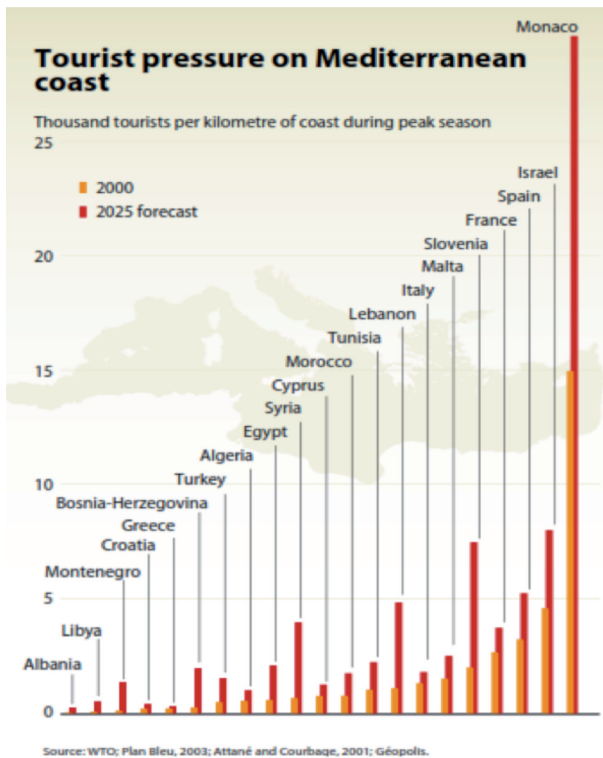
advanced economies of Europe (+1,6 %) (UNWTO, 2012)⁵.

On the other hand, coastal and marine ecosystems have been experiencing rapid rates of degradation over the last hundred years, largely as a consequence of modification of natural habitats and market-driven exploitation of natural resources. While coastal and maritime tourism brings to objective benefits for national economies and local populations (e.g., infrastructure improvement, increase of investments, reinforcement of economic activities), it also stresses coastal areas, which are inevitably subjected to environmental and social pressures. These regions are particularly vulnerable to future climate change, natural and man-made hazards, marine and inland water pollution, biodiversity decline, and habitat degradation.

It results, therefore, that coastal and marine tourist industry is a very fragile system that depends on political, economic, and social changes. Unsustainable tourism may easily bring to urban sprawl, alteration of landscapes, over-exploitation of natural resources, and negative social impacts. The marine environmental status preservation and coastal landscape preservation are therefore pre-requisite to continue to attract tourists and maintain both integrity and balance of these delicate ecosystems.

The World Tourism Organization (UNWTO) defines the sustainable tourism as: "Tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities". This aim can be achieved by means of specific EU policies such as the Integrated Coastal Management (ICM), which can be envisioned as a dynamic process for the sustainable management and use of coastal zones. Such an approach takes into account the fragility of coastal ecosystems and landscapes, the diversity of activities and uses, their interactions, the maritime

⁵ UNWTO (2012). *UNWTO Tourism Highlights, 2012 Edition*. United Nations World Tourism Organization, Geneva, Switzerland.



■ **Figure 2a** - Tourist pressure on Mediterranean coasts. The main issue of coastal tourism is the conflict between the benefits tourism provides for the economy and society and its heavy impact on the physical environment. This plot enlightens the significant pressure due to coastal tourism that some middle east and east European countries are expected to face in the next future. Source: WTO; Plan Bleu, 2003; Attané and Courbage, 2001; Géopolis.

orientation of certain activities and uses, and their impact on both the marine and land parts. The ICM is therefore an interdisciplinary and comprehensive strategy based on the best available science to be implemented. Its prime goal is to overcome sectorial and intergovernmental fragmentation that exist in today's coastal management efforts. In view of all this, enacting, enforcing, optimizing, and abiding to MPC regulations - which for member states derive from the European Directives - the use of coastal areas in a sustainable development framework shall rely on monitoring tools of the ecological status of coasts and shorelines. The strategic goal is therefore the provision of data and information needed for rapid detection and timely anticipation of the effects of the major drivers of change on coastal and maritime ecosystems.

Taking stocks (what we know)

The main issue of coastal tourism is the conflict between the benefits tourism provides for the economy and society and its heavy

impact on the physical environment. Specific social impacts have been monitored since the last decades, allowing for the identification of trends and syndromes (Newton et al., 2012)⁶. In addition to those, the coastal physical environments themselves show changes that potentially affect or/and are affected by the tourism-induced stressors. Integrated river basin analysis and coastal geomorphology studies are enlightening the main impacts on coastal sustainability in terms of river runoffs, and marine processes (e.g., sea level rise). Scientists are also providing indicator parameters for Biological and Hydro-morphological Quality Elements. The assessment of the ecological quality of water bodies already showed that transitional and coastal waters have low ecological status and they are affected by more pressures and impacts compared to the coastal waters. To make a synthesis of these information, and to connect the dots between land-ocean

⁶ NEWTON, A., CARRUTHERS, T.J., & ICELY, J. (2012). The coastal syndromes and hotspots on the coast. *Estuarine, Coastal and Shelf Science*, 96, 39-47.

characteristics in a synoptic fashion, the scientific community has been developing systemic approaches for coastal and marine areas based on observing and modelling systems for operational applications and downstream services (e.g., the 'MyOcean-Copernicus' Pan-European fully Integrated System and Service as well as the 'Emodnet' portals).

More specifically, the Mediterranean Operational Network for the Global Ocean Observing System (i.e., MONGOOS, a GOOS regional alliance for Operational Oceanography in the Med Sea) has the objective of fostering operational oceanography in the Mediterranean Sea and promoting collaboration. MONGOOS partners have established during the last decade a robust network of observation and forecasting systems spanning from regional to coastal scales, in order to offer a wide range of products to the different users. Within this framework the Mediterranean regional forecasting system (i.e., one of the components of the European Copernicus marine service operated by MyOcean project) developed sub-regional and coastal components operated at national level. A further, complementary component of MyOcean is represented by satellite and in situ observations: the Ocean Colour and the In-situ Thematic Assembly Centers give information from satellite and in situ measurements, respectively, on types and concentration of bio-geochemical and sedimentologic tracers, as well as physical properties of marine and coastal waters (e.g., sea surface temperature and currents), also providing indicators (e.g., eutrophication) and trends at different spatial and temporal scales.

Observation and forecasting systems cover a wide range of products (wave, sea level, temperature, salinity, sea surface height, currents and biogeochemical parameters) and are engaged in activities related to the production and use of operational oceanography services and promote the visibility and recognition of the services with governmental agencies and private companies, and encourage their integration at national, regional, European and global levels. MONGOOS is recently focusing on

the involvement of the non-EU countries, in seeking to reinforce the Mediterranean cooperation, also addressing the development of downstream services that are aimed to support decision systems for sustainable use of coastal and, in particular, touristic areas. This kind of coastal and marine environment monitoring services, which pairs observations with numerical modelling, have been providing regular and systematic reference information on the physical state and dynamics of the ocean and marine ecosystems for the European regional seas and the global ocean. This capacity encompasses the description of the current situation (analysis), the prediction of the situation a few days ahead (forecast), and the provision of consistent retrospective data records for recent years (re-analysis), and it is therefore at the base of any service to support sustainable coastal and marine tourism.

Gaps (what we do not know)

The main challenge is to develop coastal tourism patterns that will not reduce benefits to tourists and local populations, and preserve the quality of the natural resources for tourism. Specific needs for socio-economic strategies should, for instance, respond to the changing tourism market, minimize risks for and from tourism, secure more diversified and balanced use of coastal zones. From an environmental perspective, the use of coastal areas in a sustainable development framework shall rely on monitoring and predicting tools for the ecological status of coasts and shorelines. This requires the analysis of physical and socio-economic factors based on past "experience" as well as some downscaling in order to address local (beach wise) issues such as flooding, over exploitation of water and marine resources, degradation of coastal zones, loss of biodiversity in terrestrial and marine ecosystems, and increasing in sea temperature. The key missing factors for these characteristics are indeed represented by temporal gaps and spatial gaps. Moreover, some crucial environmental parameters are not yet standardised and thus they are not available in the main Marine Environment

Monitoring Services. Another limiting factor is represented by the long term commitments, which are nowadays reduced by the fact that the majority of scientific efforts are based on research funding.

Similar gaps can be found (policy wise) for the ICM, which is highly sensitive to funding and implementation of policies, and is weakened by lack of clear strategies, lack of public participation in developing plans, limited enforcement of environmental laws and practices, fragmented regulations and sectorial approach in coastal zones. Moreover, most MPCs' projects are designed on ICM experiences developed in other EU countries, without taking into account the specific culture issues of the SE Mediterranean countries related to authority and government. For instance, central authority in South Mediterranean countries plays a much more prominent role in shaping the future development policies than in European countries and power is often concentrated in a single body (Governorate or relevant Ministry). This exposes the environmental projects to discontinuity (e.g. change of Governor) and lack of confrontation.

Ways forward (how to move forward)

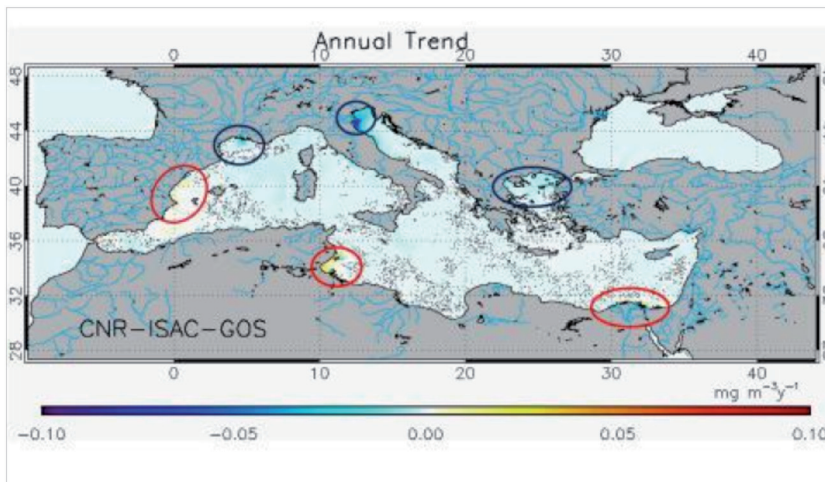
The discussion enlightened the need of a Mediterranean integrated coastal-ocean observing system and service to support European Policies (e.g., Integrated Coastal Zone Management, Water Framework Directive, Bathing Water Directive, etc.) for a sustainable exploitation of coastal and marine tourism. Such a "One-System for Several-Purposes" should reduce overlaps and maximize synergies and benefits in order to (i) improve the safety and efficiency of marine operations; (ii) improve security in the Mediterranean Sea; (iii) mitigate effects of natural hazards more effectively; (iv) improve predictions of climate change and their effects; (v) minimize public health risks; (vi) protect and restore healthy coastal marine ecosystems; (vii) sustain living marine resource.

Designing a coastal and marine sustainable tourism means to reduce cost and risk of

economical efforts and to reduce impact on the natural environment in coastal areas. Combining physical and socio-economic information is therefore the pathway to assess projection of social and economic conditions and to find "green" solutions for re-establishing natural coastal-geomorphologic processes.

A crucial push is represented by a Mediterranean ICM Protocol that would promote the restriction of linear extension of urban development as well as the restriction for land vehicles and marine vessels in fragile natural areas on land and sea in order to preserve coastal ecosystems, natural resources, cultural heritages, and landscapes. Such a specific protocol should also promote ad hoc forms of coastal tourism, including cultural, rural and ecotourism by taking into account the traditions of local populations. This is at the base of planning a sustainable use of coastal resources and promoting stakeholders' awareness. The potential of this kind of management is also to solve overlapping mandates at central level and to address inadequate competition between institutions by establishing better communication with local level and designing/enforcing a proper decentralization.

Data availability/accessibility/sharing is therefore crucial for the development of such a plan. Relevant organization (possibly public) that have direct experience with the collection and analysis of these data should define (and calculate values of) strategic indicators such as human-induced eutrophication and coastal geomorphic indexes based on biogeochemical and sedimentologic trends, respectively. The development of ultra-high resolution satellite and modeling products (from km to m and from daily to hourly resolution) is needed to resolve the necessary spatial and temporal scales of coastal dynamics. These improved datasets will produce reanalysis, reprocessing products, environmental indicators, and forecast products for coastal applications, in order to monitor the evolution of the coastal and marine status. A particular need is, finally, an international support to the maintenance and upgrade of national in situ observation



■ **Figure 2b** - Human-induced eutrophication index based on Chlorophyll concentration trends. These satellite-based measurements enlighten (circles) the coastal areas affected by strong mean surface productivity. Red circles indicate positive trends, which can be related to eutrophic areas; blue circles indicate negative trends (i.e., a marker for hypoxic areas)

networks, which are crucial for product calibrations and validations. The ongoing monitoring network related to the Water Framework Directive (WFD) will constitute the basis for the future monitoring system useful for the Marine Strategy Framework Directive (MSFD). The establishment of such a programme at the end of 2014, and a new definition of the Good Environmental Status in 20015-2017, will design the next monitoring network, stressing the efficiency (and the need) of a Mediterranean monitoring system, and linking monitoring and scientific results to management plans (e.g., the Integrated Regional monitoring Implementation Strategy in the South European Seas IRISSES, Emodnet MedSea portal) in order to develop coastal and maritime tourism downstream services. The capacity building for the development of such monitoring and forecasting system can take advantage from experiences like the EuroGOOS and MONGOOS. The link with GOOS-Africa will also help the implementation of monitoring and forecasting systems along the south Mediterranean coast, where in situ observations need to be increased. Technological help for supporting these goals is represented by satellite products for coastal management (i.e., high resolution images that can be used to detect environmental problem). The launch of the

Sentinel missions by the European Space Agency (ESA) will constitute a significant advance in this regard: Sentinel-2 satellites will provide high resolution data at low frequency; Sentinel-3 satellites will provide daily data on our coastal environment.

Finally, it was recognized that consultation and encouragement of stakeholders, as well as education and environmental information that can increase the awareness of the need of a more sustainable coastal tourism and an appropriate coastal management. Coastal tourism is not only highly dependent on environmental quality but environmental quality is also highly vulnerable to tourism development. The challenge is to exploit the potential of coastal and marine tourism sustainably in order to offer healthy destinations and attractive jobs to its people. To make tourism as a sustainable industry protecting the natural environment is not enough. The real need is to ensure that tourism development is supported by an adequate public (scientific and socio-economic) infrastructure. The ultimate aim is indeed to develop coastal tourism patterns that preserve the quality of the natural resources for tourism without reducing benefits to tourists and local populations. Integration as well as bridging science and decision-making is the key for reaching these targets.

Workshop 3 – Building an Ecosystem Based Approach to Fisheries and Aquaculture in the Mediterranean

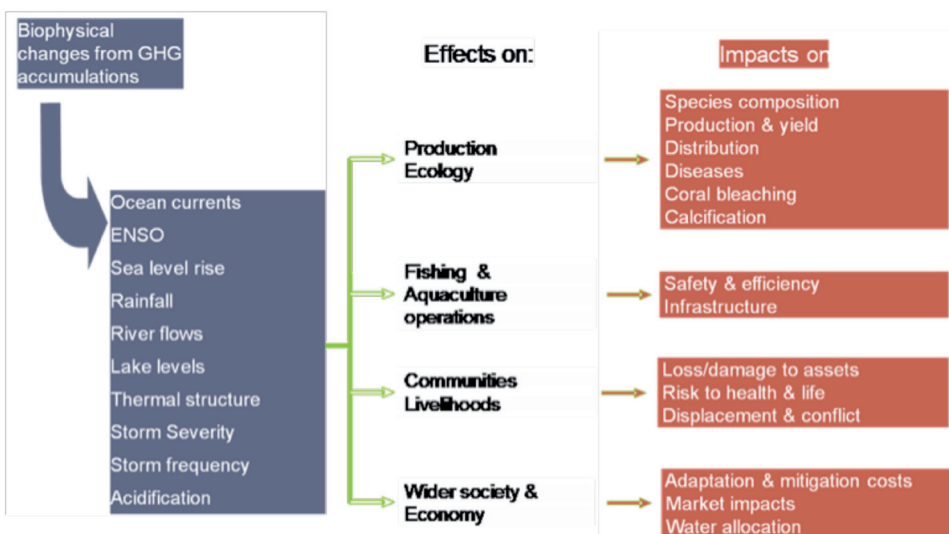
Challenge definition (driver)

The world will need to accommodate about 9 billion people by 2050 (Food and Agriculture Organization of the United Nations - FAO 2014). This may not be sustainable with increasing challenges and likely impacts of environmental change such as: 1) changing environmental and anthropogenic pressures (degraded fisheries, loss of biological diversity, hindered aquaculture efforts) and increases in climate change associated stressors (high temperature, pH); 2) increasing human population and subsequent need for water resources for energy (e.g. electricity) and agriculture use coupled with an increased demand for food. This will require more effective management of aquatic resources and ecosystems, allowing sustainable exploitation and reduction of use conflicts. Ecosystem Approach to Fishery and to Aquaculture (EAFA) takes into account of the ecological, economic, social and institutional aspects of the sustainable exploitation renewable aquatic resources. Among the identified challenges: lack of knowledge of all possible impacts of changing environments; difficulty of

integrating large number of parameters into one management system; inadequate communication among the scientific community, decision makers and stakeholders; protection of coastal habitat and biodiversity conservation issues. Due to importance of climate as main driver in affecting aquatic biological resource dynamics, the workshop was mainly focused on influence of climate change in future scenarios of capture and aquaculture fisheries in the Mediterranean area, which is expected to be affected more than other areas of the world.

Overall the following key questions shall be answered.

- How are fisheries and aquaculture likely to respond to ongoing climate change, increasing urbanization and general anthropogenic pressures?
- How can science provide information necessary to help society prepare for these changes?
- Which actions will be possible to bring scientists, stakeholders and policy makers of Euro Mediterranean countries together to enhance effective communication and collaboration and suggest a tailored strategy to plan coordinated Ecosystem Based Biological Resource Management Program?



■ **Figure 3** - Potential impact pathways of global warming on fisheries and aquaculture. From M.C. Badjeck, E.H. Allison, A.S. Halls and N.K. Dulvy (2010). Impacts of climate variability and change on fishery-based livelihoods. *Marine Policy* 34: 375-383.

Taking stocks (what we know)

There is considerable evidence that inland and marine waters have been affected by climate change during the past 40 years. For instance the increase of water temperature produced changes in species composition with a growing occurrence of thermophilic species, coming both from the Southern Atlantic Ocean and the Red Sea or introduced by humans. Climate change and its consequences to biodiversity, species boundaries, etc., are well known and the effects of climate change on life cycles of marine and freshwater species and ecosystems have been investigated by many researchers. The impacts of climate change on marine and freshwater organisms are due to a variety of direct and indirect effects of physical and chemical factors, including temperature, winds, vertical mixing, salinity, oxygen, pH and others. Environmental change directly affects the physiology, development rates, reproduction, behavior and survival of individuals. Indirect effects include ecosystem and community-level processes such as species interactions, changes in the production of food, or changes in the abundance of competitors, predators and pathogens. However it is clear that climate change is not the only driver of the impacts on fisheries and aquaculture. Pollution, increasing urbanization, general anthropogenic pressure, overfishing and habitat destruction also cause significant impacts.

The main negative issues regarding fisheries management in the Mediterranean area include: Illegal, Unreported and Unregulated Fishing (IUU), ghost fishing, high discards and unreported by-catch including for instance cetaceans, sea turtles, seabirds and sharks and in general large predators, depletion of fishing stocks, destruction of the benthic ecosystem, touristy activities, coastal urbanization, difficulties in involving stakeholders in management, high complexity of Mediterranean fisheries in terms of multi-species and multi-gears, fragmentation of responsibility and authority of fresh water inland fisheries, difficulties in producing an agreed legal context among Mediterranean

countries due to the very different socio-economic context.

Due to the multispecies and multigear characteristics of most of fisheries in Mediterranean areas, some of the most valuable tools for an ecosystem approach to fisheries management are fisheries restrictions and establishment of protected areas. However the identification of proper spatial scale of protection remains a very critical point in their implementation.

Aquaculture is one of the fastest growing food sectors worldwide. If developed in a sustainable way, it can be considered as a good candidate to reduce future ecological impacts of fisheries. However monoculture is not recommended because of reduced resilience and greater vulnerability to multiple stressors. Culturing of carnivorous species is particularly problematic due to stress on other species targeted for use as fish feed. In contrast, an integrated multi-trophic aquaculture (IMTA) appears to be a viable solution for mitigation and adaptation to climate change stressors. This due to the fact that IMTA increases efficiency of energy recovery, reduces pathogens, increases economic diversity, improves social acceptability, reduces potential environmental impacts, enhances environmental mitigation of existing impacts, accelerates growth of co-cultured species and increases economic diversity and return.

Moreover, aquaculture is one the most heavily regulated food production sectors in Europe due to fear of environmental impact which might not be the case in southern Mediterranean countries. An Ecosystem Approach to Aquaculture (EAA) could develop aquaculture in a sustainable way and provide alternative food sources in the light of declining fisheries in the Euro-Mediterranean region. EAA can be identified as a strategy for the integration of the activity within wider ecosystem such that it promotes sustainable development, equity, and resilience of interlinked social ecological systems. The EAA normally starts by a scoping and definition/ agreement on the boundaries of the system to be managed and can be implemented at any scale from local level such as farm or cluster

of farms to national level. Its implementation can be best achieved in designed aquaculture management areas (AMA) where farms are sharing a common relevant water body or source and that may benefit of a common management system and where there is a need to integrate and build positive synergies with other users of the coastal zone, e.g. fisheries, tourism. The spatial planning of aquaculture is an essential tool in the implementation of EAA and in the design of AMAs.

The following urgent priorities for improving sustainable fisheries and aquaculture are thus recognized:

- connection of inland and marine water management;
- tackling different problems using specialized committees such as Socioeconomic, Aquaculture (marketing, site selection, etc.) and Fisheries (stock evaluation, environmental issues, manage marine protected areas);
- international cooperation to prevent IUU and zero tolerance to IUU fishing;
- discard management;
- national fleet management;
- Marine Protected and Fishery restricted areas as a main tool for EBM;
- benthic habitats conservation;
- co- and adaptive management;
- involving stakeholders in management and enforcement of an effective monitoring, control and surveillance system and considering humans as an integral component of the system.

Gaps (what we do not know)

Today it is globally consolidated and accepted that climate change is affecting and will continue to affect aquatic ecosystems. However, there is a high level of uncertainty on possible local and regional impacts. Therefore, the expected impacts can be too complex to be predicted and quantified with high levels of certainty. Biological, environmental and socio-economic processes that come into play and interact are difficult to reconcile. However, knowledge of how changes in the environment affect biological

processes can provide valuable insights into where problems are most likely to occur. This recalls the importance of identifying the “right” scale in measuring and modeling ecological processes. Specifically, the use of climate change models to predict the future scenario must be adopted with caution because space for time substitution cannot always be assumed under novel ecological conditions. Moreover, biological impacts of climate change at the scale of ecosystems are emergent properties of how organisms interact with their environment and with each other at small spatial and temporal scales. Although climate change is a global process, its impacts and possible successful solutions are local due to species-specific responses and high heterogeneity in environmental conditions. Some species will be “winners” and others “losers” based on their physiological properties and the environments in which they live. Coupled physical and biological models can help to categorize these species and to identify priority areas.

Another high level of uncertainty is related to the possible local and regional impacts of climate change due to the impacts of other drivers such as increased temperature, sea acidification and hypoxia due to eutrophication. Therefore, improving knowledge on the possible actual effects of climate variability, and particularly of multiple stressors, will reduce uncertainties and help to address these challenges. This suggests a downscaling approach to study effect of climate change to predict patterns at scales relative to organisms and populations that can then be scaled back up to local, regional or global scales.

Ways forward (how to move forward)

Differences in facing challenges in climate changing and implementation of EAFA exist between EU states and southern Mediterranean countries. This is partially due to more enforced rules in EU states, more skilled personnel and interconnection among stakeholders, scientists and policy makers. Another relevant point is the difference in levels of data collection and availability that

exist between EU and developing countries. Therefore there is need for collaboration between EU states and non-EU countries for better management of fisheries and aquaculture in Mediterranean areas as preliminary step towards a common Med policy.

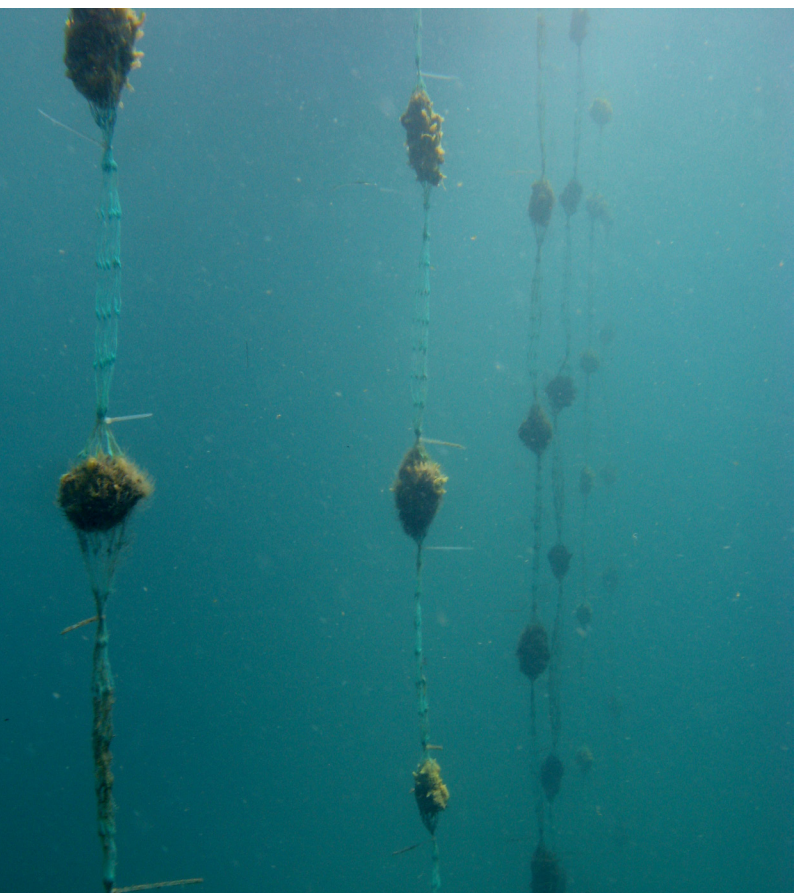
There are many steps that need to be done to plan coordinated EAFA in the Mediterranean. These include but are not limited to: prediction of ecological responses to climate change and anthropogenic pressures; identification of research priorities needed for proper management and future collaboration; development of strategies for management and sustainable growth; implementation of EAFA in the wider framework of the Ecosystem Based Management (EBM); integration in a multi-sectorial management approach of different activities (fisheries, tourism, transportation, wind farm, industries, mining, etc.); consideration of humans in the Ecosystem Approach to Fishery and Aquaculture and involvement of different stakeholders from EU and non-EU countries; involvement of scientists, policy makers and public and private research institutions as well as research and innovation-driven enterprises; focusing on the management of the main target species; increasing the capacity for implementation of research to produce agreed vision based on scientific knowledge (Research – advice – management decision); enforcement of Common Fisheries Policy (CFP); consideration of the other EU policies and directives involving fisheries and aquaculture (MSFD, MSP, ...); application of the opportunities offered by the European maritime and fisheries fund (EMFF).

There is strong agreement that European and Mediterranean countries need to work together to face future challenges. A collaboration agenda supporting this agreement shall involve the EU and non-EU States, taking into consideration the differences in culture and state of development. Particularly it is recognized that:

- stakeholders must be treated as partners in the decision-making process rather



- than as persons who take orders from policy makers, allowing a more effective compliance of regulations
- there is a need to increase capacity building for non-European countries for implementing research needed for planning ecosystem based approach as there is gap in knowledge and in funding sources between the two big societies as drivers of development
- there is a need to improve the scientific basis of decision making, and to increase the mobility of researchers among partners
- step-by-step solutions are appropriate to tackle the complicated, long-term problems of ecosystem based management of aquatic biological resources towards the identification of realistic targets and objectives for the fishing sector
- flexibility in the technical measures and management is needed to adapt to local conditions (regionalization)
- cooperation with third countries has to be extended, making profit of the General Fisheries Commission for the Mediterranean (GFCM) and FAO regional



projects to produce cooperative research and to contribute to an agreed vision of stock status and fishery management and aquaculture in the Mediterranean

- fisheries and aquaculture should be integrated with other human activities within a framework of spatial planning of sustainable use of inland and marine aquatic resources.

Workshop 4 – Ecosystem Based Management in the Mediterranean Region

Challenge definition (driver)

ECO systems are subject to increasing anthropogenic pressures, and thus call for an improved management of the coastal and marine space. The Ecosystem Based Management (EBM) is an approach that has become the overarching principle of EU and International policies on water resources, the marine environments, their resources and sustainable uses.

EBM recognizes the full array of interaction within marine ecosystems, with the goal of maintain marine ecosystems in a healthy, productive and resilient condition so that they can sustain human uses of the sea and provide goods and services. Its main features are to:

- Recognize the inter-connections between marine (either coastal and off-shore, shallow and deep) and terrestrial systems (as well as between ecosystems and human societies);
- Reduce the impacts of various activities affecting an ecosystem and recover/restore damaged habitats;
- Manage multiple and conflicting uses of marine space and resources, with the objective of preserving the biodiversity and ecosystem services;
- Adopting mitigation and policies of adaptation throughout the management process.

Taking stocks (what we know)

EBM is a basis for environmental safeguarding and sustainable development of coastal communities and their interaction with marine resources. It explicitly addresses the protection of the environment but is also a tool (through ecosystem services) for sustainable development. EBM has important regional and local implementation implications since it is always focused on a specific ecosystems and the range of human activities affecting them. Unavoidable and

often challenging is the need of prioritization of choices and ecosystem services and their socio-economic impacts. Sometimes priorities are clear, while in many cases they have to be discussed, ranked, balanced and agreed.

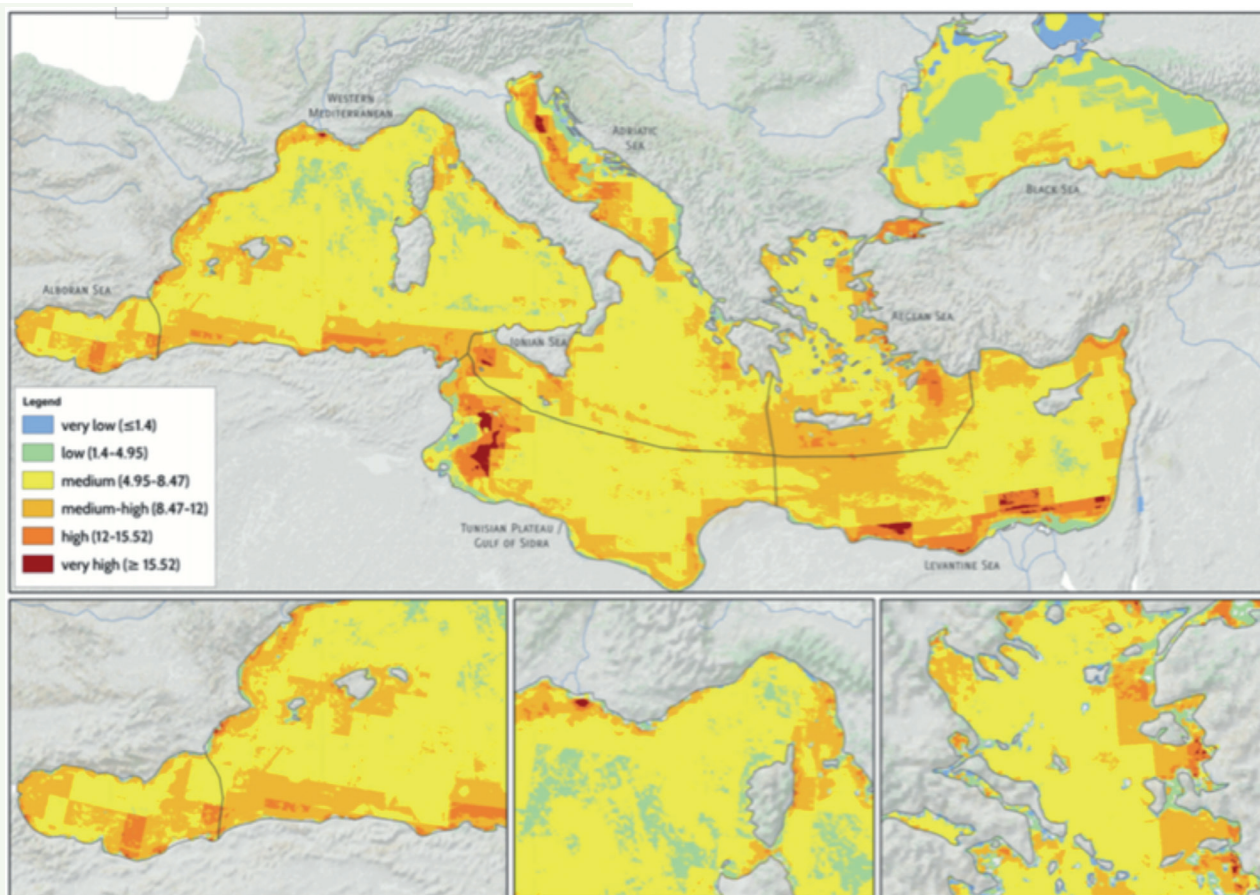
Integrated Coastal Management (ICM) and Maritime Spatial Planning (MSP) are essential tools for EBM and provide the template on which it can be effectively implemented. Their aim is analysing and allocating spatial and temporal distribution of human activities in coastal and marine areas to achieve ecological, economic and social objectives by means of a more rational and scientifically-based organization of the use of ocean and land space, defined through a political process, in which stakeholders involvement and transparency are important components.

The Mediterranean area is as yet the best case study available to test the effects of the EBM in order to extend the practice to other seas in the world. Regarding knowledge of structure and processes regulating the ecosystem functioning, the Mediterranean is one of the best known systems to date, with special emphasis on the way biodiversity is distributed in some subregions (e. g. Adriatic) and the way climate changes is affecting the water mass circulation.

This important knowledge must be fully integrated with the “models” of co-management based on the ecosystems.

Gaps (what we do not know)

EBM must be based on the best knowledge available on ecosystems status, functioning and services. Moreover, R&I is crucial for improving the understanding of cause-effect relationships and for developing and promoting the use of the best technologies and solutions. In most cases, EBM is knowledge limited rather than data limited. However, data are unevenly distributed in time and space, and some countries do actually need more data in order to be able to efficiently implement EBM. Furthermore EBM is often limited by the access to existing data, since the Mediterranean region is generally suffering



■ **Figure 4** - Spatial distribution of cumulative impacts to marine ecosystems of the Mediterranean and Black Sea. Source: Micheli F, Halpern BS, Walbridge S, Ciriaco S, Ferretti F, et al. (2013). 'Cumulative Human Impacts on Mediterranean and Black Sea Marine Ecosystems: Assessing Current Pressures and Opportunities'. PLoS ONE 8(12): e79889. doi:10.1371/journal.pone.0079889

from the problem of data ownership and accessibility.

The main identified gaps in knowledge include: dynamics and resilience of populations, communities and ecosystems, multiple stressors and cumulative impacts, in line also with the gap analysis recently performed by the Med EU Member States together with the EC within the Initiative for Blue Jobs and Growth in the Mediterranean (BLUEMED).

It is also apparent that there are gaps in knowledge on effects of global climate change on all other relevant impacts, since most of the activities are destined to be influenced by climate change. Climate change effects are one of the reasons why management plans have to be updated on a periodic base to assess changes due to climate change.

Ways forward (how to move forward)

During the past ten years several attempts have been made to map human pressure on ecosystems. ICM and MSP are the frameworks to explicitly integrate the management of multiple human activities. There are many approaches to develop ICM/MSP, but the consideration of the distribution of multiple stressors characterized them all. Multiple stressors can have additive, multiplicative (synergic) and compensating effects, while knowledge gaps on them are still relevant. Among them, there are issues on data quality, resolution, and homogeneity in time/space. Especially in coastal and areas, EBM needs to account for land-sea connections. Fundamentally there is a need for an interoperable, integrated observing and knowledge capability to support the

conservation of biodiversity and ecosystem service contributing to EBM.

EBM requires transparent, participative and coherent trans-boundary planning efforts in coastal and marine areas. This implies the progressive improvement and implementation of harmonized and legally binding policies and legal frameworks. EU countries have adopted EBM as base principle of several directives and policies, while at the Mediterranean level the Conference of parties (COP) of the Barcelona Convention has recently adopted a Decision on the Ecosystem Approach (EcAp). A common pathway for EU policies (Common Implementation Strategy of Marine Strategy Framework Directive) and Decisions taken by the Barcelona Convention Conference of Parties (BC COP Decisions) on EcAp is underway, through the definition of a common set of descriptors and quantitative indicators and common ecological objectives, common rules and procedures for monitoring plans and a shared work-plan for implementation in the coming years.. In addition, the close cooperation among different initiatives (investments, infrastructures, policies, management choices) under the EBM principle is a priority, in order to guarantee that they are all coherent with shared and agreed strategic goals.

Reducing the differences between countries in terms of knowledge, policies and management plans, promoting initiatives of capacity building, training, education, common projects, permanent networking, raising awareness among citizens, through dedicated funding schemes and frameworks, is essential to a successful EBM implementation for the Mediterranean area. On training specifically, the ambition should be to train a new generation of scientists, managers, and operators that are able to tackle complex ecological, economic and societal problems from a holistic perspective, while ensuring learning, tertiary education and the transfer of knowledge and technologies.

A closer collaboration within and among countries shall include sharing of data and knowledge; in fact, the accessibility to data (i.e. for pollution, habitats and bottom morpho-bathymetry) remains a key limiting factor.



Science is required to provide its fundamental contribution, embedding the EBM within a possible new Strategic Research Agenda for the Mediterranean based on existing knowledge (i.e. recent and ongoing research projects), involving public research and industry of the marine and maritime sectors, and integrating and focusing funding strategies at regional, national, EU and international level. Mapping habitats and their functioning and resources, and assessing related ecosystem services in the Mediterranean area (EU and non-EU countries) shall allow to demonstrate how nature-based solutions address societal challenges and contribute to sustainable growth.

The science-to-policy dialogue remains a key issue and a challenge that needs to be tackled with a combination of tools and efforts, starting from the best capitalization of the knowledge available.

The Mediterranean area and its basin are also a great opportunity to test new socio-economy models based on new approaches to handle the access and benefit sharing, according to the very recent directive adopted by the EU (e.g. Marine biotechnologies)⁷.

⁷ Regulation (eu) No 511/2014 of the European Parliament and of the Council of 16 April 2014 on compliance measures for users from the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization in the Union (<http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014R0511&from=EN>)



From: Sustainable Coastal Tourism - An integrated planning and management approach United Nations Environment Programme, 2009

GENERAL RECOMMENDATIONS

The nexus between inland and marine waters is a challenging theme requiring further exploration. Coastal zones well represent critical features of this interface, where mutual environmental feedbacks are also perturbed by economic activities fundamental for the society development. The Ecosystem Based Management, with its specific approaches for fisheries and aquaculture, applies as an overarching principle to tackle this interconnection, particularly in the Mediterranean Region, characterized by ecological, social, institutional and economic complexities.

Knowledge gaps still need to be filled to properly assess how the coupling between the rivers and the sea, coastal ecosystems

(including lagoons, coastal vegetation) and agriculture, and their reciprocal influences and impacts on activities such as fisheries and tourism. Water and biological resources uses need to be redefined accordingly, taking into account different stressors that affect their exploitation, from climate change impacts at local and regional scale to conflicts with other anthropogenic uses, and aiming at preserving the quality of the natural resources for the benefit of local populations.

At governance level it has to be considered that many policies (e.g. CFP, MSP) and directives (e.g. WFD, MSFD) as well as organisms (e.g. GFCM) are in place and can act as umbrella, offering an opportunity to consistently design future strategies with management measures based on scientific results. In particular, the definition of a common pathway for EU policies and Decisions taken by the Barcelona Convention Conference of Parties on EcAp is underway.

At the same time, although a further assessment of research and innovation capacities and technological developments in the region – especially in some Southern Mediterranean countries – is still needed, the existing infrastructure potential can serve policy, for example a Mediterranean integrated coastal-ocean-environmental observing system could support EU policies devoted to a sustainable exploitation of inland, coastal and maritime activities, also taking into account the inherited links among those.

Considering the opportunity of strengthening the Mediterranean Basin approach, and the fact that many initiatives have already been supported while the fragmentation is still high, the sustainable inland and marine water management can be tackled building on present possibilities by:

- accompanying the setup of innovative initiatives with the mapping of existing ones, in order to address real needs, identifying best practices to be further developed and upscaled, and avoid duplications
- favouring stronger interactions with relevant actions for the Area like the PRIMA initiative

for public-public partnership possibly based on Art.185 of the EU Treaty and joint programming initiatives like the JPI-Water and JPI-Oceans

- extending the existing and relevant RIs to the Euro-Mediterranean scale promoting more organized cooperation among different stakeholders of different countries: scientists, economists, policy makers, private sector, and citizens, also by means of social and technology platforms.

To implement a common Euro-Mediterranean strategy on inland and water management, the following transversal actions are also fundamental:

- promote a holistic conceptual approach, organizing disciplines in clusters and building up around their core, with the aim of tackling the socio-economic and ecological challenges in the region, help creating jobs (including by investing in young researchers, also given the large youth population in the Southern Mediterranean countries) and fostering citizen participation
- bridge science and decision-making, increasing the science-to-policy dialogue and capitalizing on the best available knowledge. In order to devise long term sustainable policies in the Mediterranean Region more integrated political and socioeconomic scientific research is needed to explore the drivers of sustainable and inclusive growth and development
- make data accessible, valuing the data providers-data users interface
- use infrastructures and services for supporting human activities and policy, deploying existing monitoring systems
- enhance innovation, technology sharing and transfer, human capital and capacity building, including training that can be also supported by RIs, to enhance the skills of water practitioners as well as mid-level managers in the public and private sectors at various territorial levels
- increase the public awareness of the need for a more sustainable management of coastal zones and of inland as well as marine water resources.

A business as usual scenario is no longer feasible: continuing the current trends would bring towards a scenario of increasing the already significant ecological and socio-economic threats in the region. More attention needs to be given to the social and environmental aspects in inland and marine water planning and management with a long term perspective. To reach a sustainable development, the Mediterranean region requires innovative strategies to be jointly agreed. Whether endorsing the action plan of the Mediterranean Water Strategy, implementing a Mediterranean ICM protocol, or including the EBM principle in a Strategic Research Agenda for the Med also as part of broader initiatives, any common initiative should involve the relevant authorities and stakeholders in the EU and the Southern Mediterranean countries, taking into consideration the shared challenges as well as the diversity of socio-economic conditions, cultures and ecosystems. The complexity and strategic importance of the Area calls for flexible long-term initiatives allowing mid-term actions to be timely implemented, contributing to the 'green transition' towards a sustainable Euro-Mediterranean Area.

ANNEXES:

- Conference photos,
- List of Acronyms,
- Conference Programme,
- List of Participants,
- Scientific & Organizing Committee members.

CONFERENCE PHOTOS



LIST OF ACRONYMS

- CFP = Common Fisheries Policy
- CIESM = Mediterranean Science Commission
- EAA = Ecosystem Approach to Aquaculture
- EAFA = Ecosystem Approach to Fishery and to Aquaculture
- EBM = Ecosystem Based Management
- EcAp = Ecosystem Approach (EcAp)
- EMFF = European maritime and fisheries fund
- ENP = European Neighbourhood Policy
- ESA = European Space Agency
- EuroMED-IMWC = EuroMED cooperation. Inland and Marine Water Challenges
- FAO = Food and Agriculture Organization of the United Nations
- GEOSS = Global Earth Observation System of Systems
- GFCM = General Fisheries Commission for the Mediterranean
- GOOS = Global Ocean Observing System
- ICM = Integrated Coastal Management
- ICOS = Integrated Carbon Observation System
- IMTA = Integrated Multi-Trophic Aquaculture
- IPCC = Intergovernmental Panel on Climate Change
- IRIS-SES = Integrated Regional monitoring Implementation Strategy in the South European Seas
- IUU = Illegal, Unreported and Unregulated Fishing
- JPI = Joint Programming Initiative
- LifeWatch= European e-Science infrastructure for biodiversity and ecosystem research
- LTER = European Long-Term Ecosystem Research Network
- MEDPRO = Mediterranean Prospects project
- MONGOOS = Mediterranean Operational Network for the Global Ocean Observing System
- MPC = Mediterranean Partner Countries
- MSFD = Marine Strategy Framework Directive
- MSP = Maritime Spatial Planning
- PRIMA - Partnership for Research and Innovation in the Mediterranean Area
- RI = Research Infrastructure
- R&I = Research and Innovation
- SEMc = Southern and Eastern Mediterranean countries
- SRIA = Strategic Research and Innovation Agenda
- TW = Transitional water
- UNEP/MAP = United Nations Environment Programme/Mediterranean Action Plan
- UNWTO = United Nations - World Tourism Organization
- WFD = Water Framework Directive
- WssTP = Water supply and sanitation technology platform

EUROMED COOPERATION. INLAND AND MARINE WATER CHALLENGES

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#EuroMED _IMWC

Naples, Stazione Marittima, 3-4 November 2014

A unique opportunity to discuss urgent challenges related to the proper management of the inland and marine waters, with emphasis to their link, and the impacts on society and sustainable growth. A strong objective of enhancing the Euro Mediterranean international cooperation on research and innovation.

CONFERENCE PROGRAMME

Monday, 3 November 2014

12:30 - 13:30	Registration, poster session & welcome snack
13:30 - 14:00	Opening and institutional welcomes - Chair: <i>Enrico Brugnoli, Director CNR-DTA (National Research Council, Department of Earth System Science and Environmental Technologies - Italy)</i> <ul style="list-style-type: none"> • <i>Stefania Giannini, Minister, MIUR (Ministry of Education, University and Research - Italy)</i> • <i>Cristina Russo, Director, International Cooperation - EC (European Commission, DG Research and Innovation)</i> • Welcome address by the Authorities
14:00 - 14:15	Introduction to the workshops <i>Enrico Brugnoli, Director CNR-DTA</i>
14:15 - 18:30	Parallel Workshops
20:00 - 22:30	Conference social dinner (Ristorante Regina Margherita, Via Partenope 19 - 25 min walk)

Monday, 3 November 2014

Workshop 1 – Water resources and land management impacts on inland and sea water in the Mediterranean Region

- | | |
|---------------|---|
| 14:15 - 15:00 | Key note: Integrated water resources management from catchment to coastal zone <i>Narcis Prat, UB (University of Barcelona – Spain)</i> |
| 15:00 - 15:25 | Water resources: quantity and quality
<i>Laila Mandi, UCA (University Cadi Ayyad of Marrakech – Morocco)</i> |
| 15:25 - 15:50 | Non-conventional water resources: water reuse and desalination <i>Avner Adin, HUJI (The Hebrew University of Jerusalem – Israel)</i> |
| 15:50 - 16:15 | Land and water resources management including Water Use efficiency
<i>Cosimo Lacirignola, CIHEAM (International Centre for Advanced Mediterranean Agronomie Studies - Italy)</i> |
| 16:15 - 16:40 | Hydrologic extremes impact on coastal zones
<i>Maria Mimikou, NTUA (National Technical University of Athens – Greece)</i> |
| 16:40 - 17:05 | Water Resources: policy and socio-economie issues
<i>Mohammud Abu Zeid, A WC (Arab Water Council – Egypt)</i> |
| 17:05 - 17:25 | Coffee break |
| 17:25 - 18:20 | Round table discussion. Chair: <i>Manuel Sapiano, Water Director (Sustainable Energy and Water Conservation Unit Ministry for Energy and Health - Malta)</i> .
Panel: <i>Antoni Munné, ACA; Narcis Prat, UB; Laila Mandi, UCA; Cosimo Lacirignola, C/HEAM; Maria Mimikou, NTUA; Mohammud Abu Zeid, AWC</i> |
| 18:20 - 18:30 | Wrap-up and conclusions |

Rapporteurs: Ayman Rabi, PHG (Palestinian Hydrology Group – Palestine) & Michiel Blind, Deltares (The Netherlands)

Monday, 3 November 2014**Workshop 2 – A Mediterranean integrated ocean observing system to support sustainable coastal and marine tourism**

- 14:15 - 14:30 Introduction to the WS and overview on sustainable coastal tourism
Maria Snoussi, UM5A (Mohamed V-Agdal University – Morocco)
- 14:30 - 15:00 Key Note: Integrated Coastal Zone Management (ICZM) and Strategie Tourism Development Planning
Željka Skaricic PAP/RAC (Priority Actions Programme/Regional Activity Centre – Croatia)
- 15:00 - 15:25 A vision for a coordinated international effort on delta sustainability
Agustin S. Arcilla LIM/UPC (Laboratory of Maritime Engineers, Polytechnic University of Catalonia – Spain)
- 15:25 - 15:50 The role of remote sensing and coastal operational oceanography/
Monitoring of the coastal environment
Francis Gohin, Ifremer (French Research Institute for Exploitation of the Sea – France)
- 15:50 - 16:15 Urbanization, tourism development and risk of beach erosion in the Mediterranean: examples from Morocco, Tunisia and Egypt
Ameur Oueslati, UTUNIS (University of Tunis – Tunisia)
- 16:15 - 16:40 Coastal zone management in the South Mediterranean
Suzan Kholeif, NIOF (National Institute of Oceanography and Fisheries – Egypt)
- 16:40 - 17:05 State of MSFD monitoring in the Mediterranean. A focus on coastal and transitional water bodies, *Sofia Reizopolou, HCMR (Hellenic Centre for Marine Research – Greece)*
- 17:05 - 17:25 Coffee break
- 17:25 - 17:50 Mediterranean monitoring and forecasting system to support sustainable coastal and marine tourism
Rosalía Santoleri, CNR-ISAC (National Research Council, Institute of Atmospheric Sciences and Climate-Italy) & Marina Tonani GNOO/INGV (National Group of Operational Oceanography/ National Institute of Geophysics and Volcanology – Italy)
- 17:50 -18:20 Round table discussion. Chair: *Mohamed Said, NIOF*. Panel: *Željka Skaricic, PAP/RAC; Maria Snoussi, UM5A; Alessio Satta, SCP/RAC (Regional Activity Centre for Sustainable Consumption and Production); Erik Buch, EuroGOOS AISBL (European Global Ocean Observing System – Denmark); Rosalía Santoleri, CNR-ISAC; Suzan Kholeif, NIOF*
- 18:20 - 18:30 Wrap-up and conclusions

Rapporteurs: Erik Buch, EuroGOOS AISBL & Federico Falcini, CNR-ISAC

Monday, 3 November 2014

Workshop 3 – Building Ecosystem based approach to Fishery and Aquaculture in the Mediterranean

- 14:15 - 14:25 Introduction to the Workshop
Stefano Cataudella, GFCM-FAO (General Fisheries Commission for the Mediterranean-Food and Agriculture Organization)
- 14:25 - 15:10 Key Note: Building Ecosystem based approach to Fishery and Aquaculture management in the Mediterranean Region
Konstantinos Stergiou, HCMR (Hellenic Centre for Marine Research – Greece)
- 15:10 - 15:35 Knowns, unknowns, and unknown unknowns: tools for predicting impacts of climate change on marine resources
Brian Helmuth, Northeastern University (Boston, USA)
- 15:35 - 16:00 Addressing the challenge of Climate change and fisheries in the Mediterranean Region
Gabriella Bianchi, FAO-FIRF (Food and Agriculture Organization-Marine and Inland Fisheries Service)
- 16:00 - 16:25 Is the aquaculture able to cope with future challenges? IMTA as a solution in a context of climate change
Gianluca Sarà (University of Palermo, Italy)
- 16:25 - 17:00 Implementing the Ecosystem Approach to Aquaculture to increase fish production and opportunities for sustainable development in inland and marine waters
Doris Soto, FAO-FIRA (Food and Agriculture Organization-Fisheries and Aquaculture Department, Aquaculture Branch)
- 17:00 - 17:20 Coffee break
- 17:20 - 17:45 Towards a spatial based approach to fisheries management in the Mediterranean: the Moroccan case
Mohammed Malouli Idrissi, INRH (National Institute of Fisheries Research – Morocco)
- 17:45 - 18:20 Round table discussion 'Fishery and aquaculture prospects in a changing Mediterranean' Moderator: *Othman Iarboui, INSTM (National Institute of Marine Sciences and Technologies – Tunisia)*. Panel: *Iordi Leonart ICM-CSIC (Institute of Marine Science, The Spanish National Research Council - Spain)*; *Pietro Volta, CNR-ISE (National Research Council-Institute for Ecosystems Study, Verbania Pallanza – Italy)*; *Giampaolo Buonfiglio, MEDAC (Regional Advisory Council for the Mediterranean)*; *Abdellah Srour, GFCM-FAO*; *Bayram Ozturk (University of Istanbul - Turkey)*; *Riccardo Rigillo, MIPAAF – Director General of Maritime Fisheries and Aquaculture (Italian Ministry of Agriculture, Food and Forestry Policy – Italy)*
- 18:20 - 18:30 Wrap-up and conclusions

Rapporteur: Eman El-Wazzan (National Institute of Oceanography and Fisheries – Egypt)

Monday, 3 November 2014

Workshop 4 – Ecosystem-Based Management (EBM) in the Mediterranean Region

- 14:15 - 14:25 Introduction to the Workshop
Roberto Danovaro, SZN (Stazione Zoologica Anthon Dorn Italy)
- 14:25 - 14:55 Key note: Ecosystem-Based Management approach: theory and practical implementation, *Habib El-Habr, UNEP/MAP (United Nations Environment Programme/Mediterranean Action Plan)*
- 14:55 - 15:20 Cumulative anthropogenic impacts in the Mediterranean in the perspective of EBM *Simona Frascchetti, UNISALENTO (University of Salento, Lecce – Italy)*
- 15:20 - 15:45 Mapping Mediterranean Ecosystems and their Services (EU Biodiversity Strategy to 2020)
Joachim Maes, EC-IRC (European Commission - Joint Research Centre, Institute for Environment and Sustainability)
- 15:45 - 16:10 Fate, effects and management of emerging contaminants in Mediterranean river catchment under water scarcity
Damia Barcelo Culleres, IDAEA-CSIC (Institute of Environmental Assessment and Water Research, The Spanish National Research Council – Spain)
- 16:10 - 16:35 Modelling tools and satellite data for the ecosystem based management of the Lagoon of Nador (Morocco)
Driss Nachite, UAE (Abdelmalek Essaïdi University, Tétouan, Morocco)
- 16:35 - 17:00 Socio-economic relevance of EBM: limitation vs opportunity
Ina Kruger, Ecologie Institute (Germany)
- 17:00 - 17:20 Coffee break
- 17:20 - 17:45 EBM as a basis for Integrated Coastal Management and Maritime Spatial Planning, *Vassiliki Celia Vassilopoulou, HCMR (Hellenic Centre for Marine Research - Greece)*
- 17:45 - 18:20 Round table discussion ‘EBM & Sustainable Development in the Mediterranean’,
Moderator: *Maria Betti, EC-IRC*. Panel: *Fabrizio Donatella, EC, DG-MARE (European Commission – Director General for Maritime Affairs and Fisheries); Habib El-Habr, UNEP/MAP; Laura Giuliano, CNR-IAMC (National Research Council, Institute for the Marine and Coastal Environment, Italy); Driss Nachite, UAE; Angelo Tursi, CONISMA (Inter-University Consortium for Marine Sciences, Italy)*
- 18:20 - 18:30 Wrap-up and conclusions

Rapporteur: Katrin Schroeder CNR-ISMAR/RITMARE (National Research Council, Institute of Marine Sciences, Italy)

Tuesday, 4 November 2014

Plenary Session – EuroMED Cooperation. Inland and Marine Water Challenges

09:30 - 10:00	Registration and poster session
10:00 - 10:15	Welcome and general objectives of the conference <i>Cristina Russo, Director, International Cooperation – EC (European Commission, DG Research and Innovation)</i> <i>Luigi Nicolais, President, CNR (National Research Council – Italy)</i>
10:15 - 10:45	Key note 1 – A foresight perspective on the MED region <i>Rym Ayadi, MEDPRO (Mediterranean Prospects Project)</i>
10:45 - 11:15	Key note 2 – Managing interfaces: biodiversity and ecosystems in changing Mediterranean <i>Alberto Basset, UNISALENTO (University of Salento, Lecce – Italy)</i>
11:15 - 12:35	Results of the four parallel workshops presented by the rapporteurs
12:35 - 13:00	Questions and answers
13:00 - 14:00	Networking lunch
14:00 - 15:30	Round table discussion ‘Integrated Med policy and science strategy for tackling the socioeconomic challenges linked to the Mediterranean Inland and Marine Water’ Chair: <i>Angela Liberatore, International Cooperation - EC (European Commission, DG Research and Innovation)</i> . Panel: <ul style="list-style-type: none"> • <i>Giuseppina Monacelli, JPI- Water (Joint Programming Initiative Water challenges for a changing world),</i> • <i>Wendy Bonne, JPI-Oceans (Joint Programming Initiative Healthy and Productive Seas and Oceans)</i> • <i>Michael Scoullas, Horizon2020 - Depollution of the Med Sea Programme</i> • <i>Angelo Riccaboni, PR.I.M.A Initiative (Partnership for Research and Innovation in the Mediterranean Area)</i> • <i>Durk Krol, WssTP (European Technology Platform for Water)</i>
15:30 - 16:00	Concluding remarks <i>Enrico Brugnoli, Director CNR-DTA (National Research Council, Department of Earth System Science and Environmental Technologies – Italy)</i> <i>Angela Liberatore, International Cooperation – EC (European Commission, DG Research and Innovation)</i>

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