

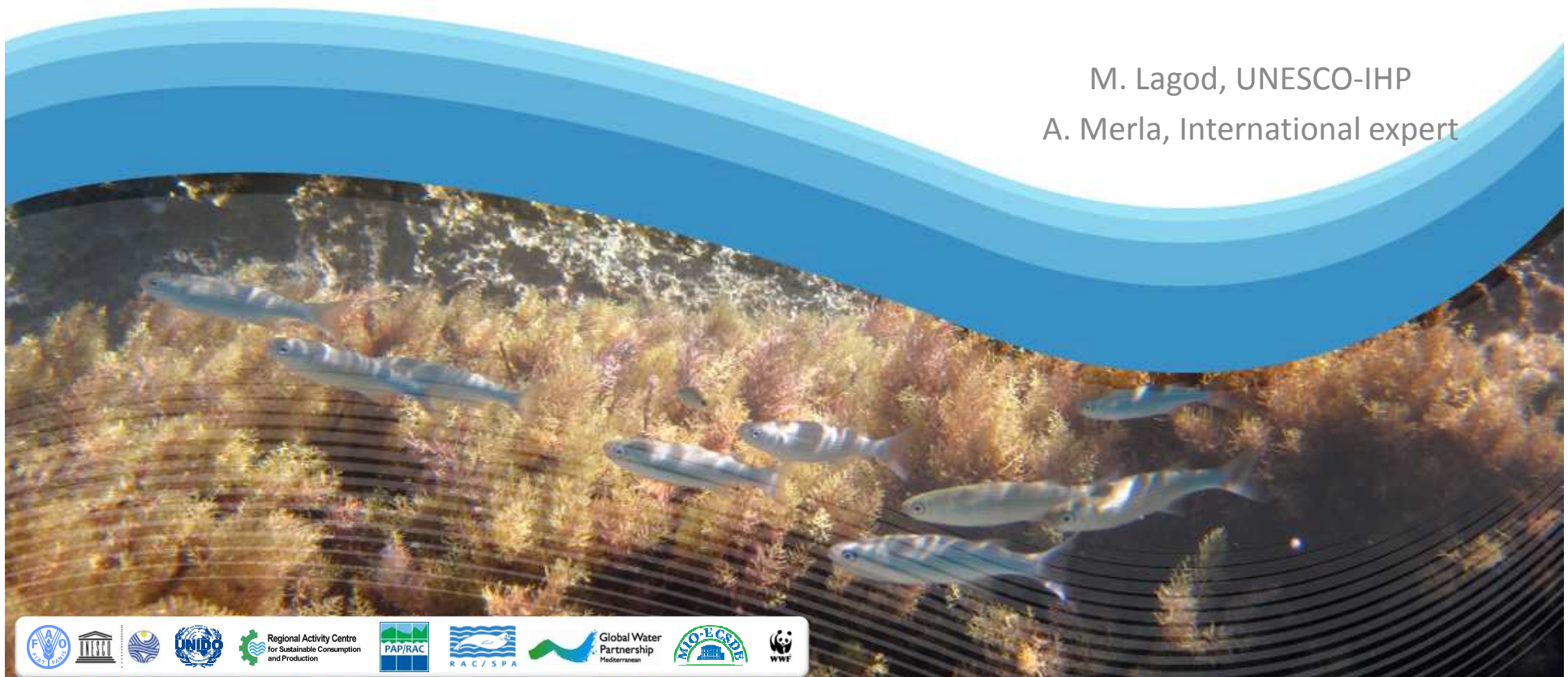


TRANSBOUNDARY IMPORTANCE OF COASTAL AQUIFERS IN THE MEDITERRANEAN

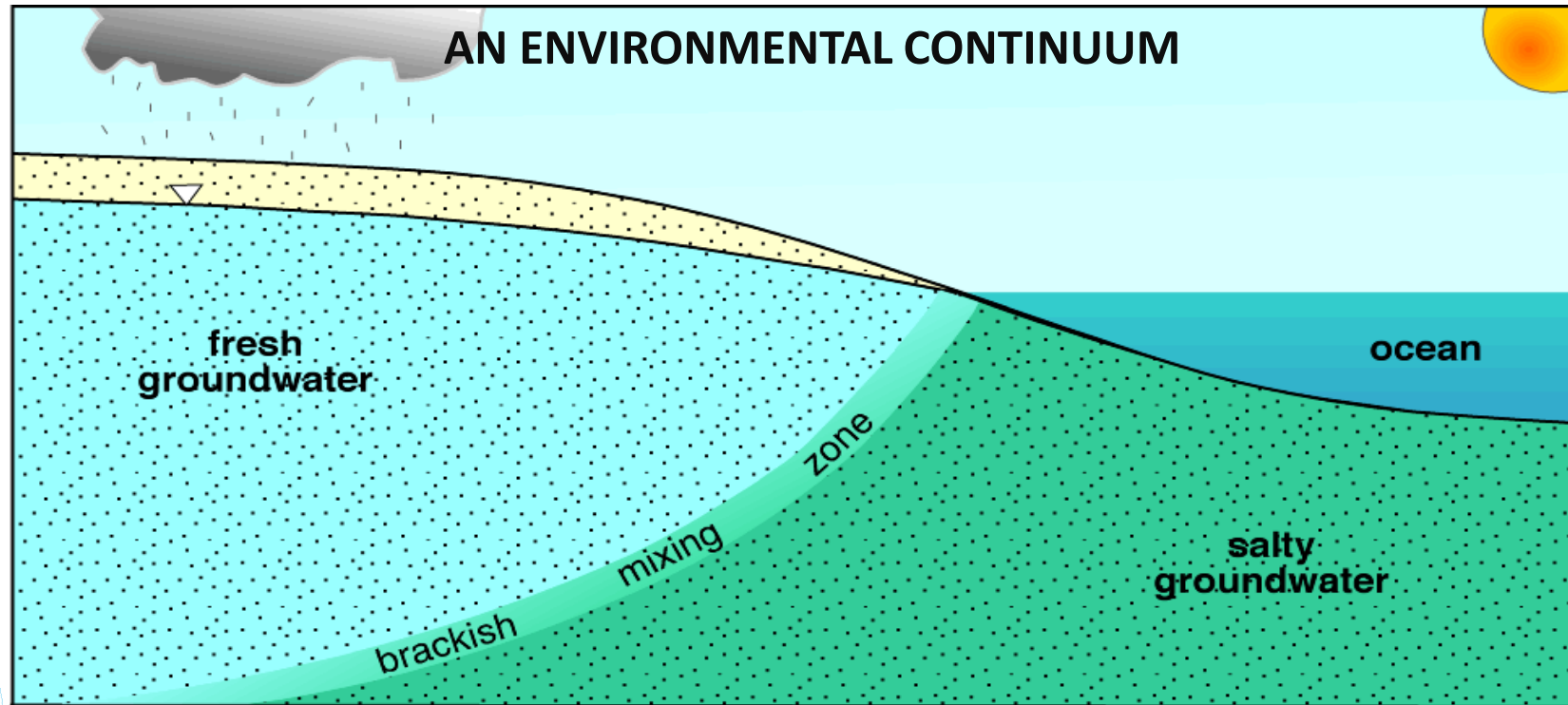


M. Lagod, UNESCO-IHP

A. Merla, International expert



**Why coastal
aquifers?**



All coastal aquifers contribute to the integrity and functioning of the coastal zone and marine ecosystems, and their degradation reflects upon, and contributes to the major transboundary issues affecting the Mediterranean Sea



Major Perceived Environmental Concerns

TDA 2005

Decline of Biodiversity

Decline in Fisheries

Decline in Sea Water Quality

Human Health Risks



COASTAL AQUIFERS AND THE HEALTH OF THE MEDITERRANEAN REGION

- Submarine groundwater discharges (SGD) have a significant influence on the environmental conditions of many near shore marine environments.
- Seawater intrusion is the movement of seawater into fresh water aquifers due to natural processes or human activities. Seawater intrusion is caused by decreases in groundwater levels or by rises in seawater levels. Intrusion affects the quality of water and the health of groundwater dependent ecosystems.
- Nutrients such as nitrates and phosphates in coastal aquifers are a serious concern in certain parts of the Mediterranean. Excess nutrients in water have lead to water quality problems such as algal blooms, eutrophication in a number of surface water bodies, affecting living marine resources and human health.

Assessment of coastal aquifers and their interactions with the coastal environment

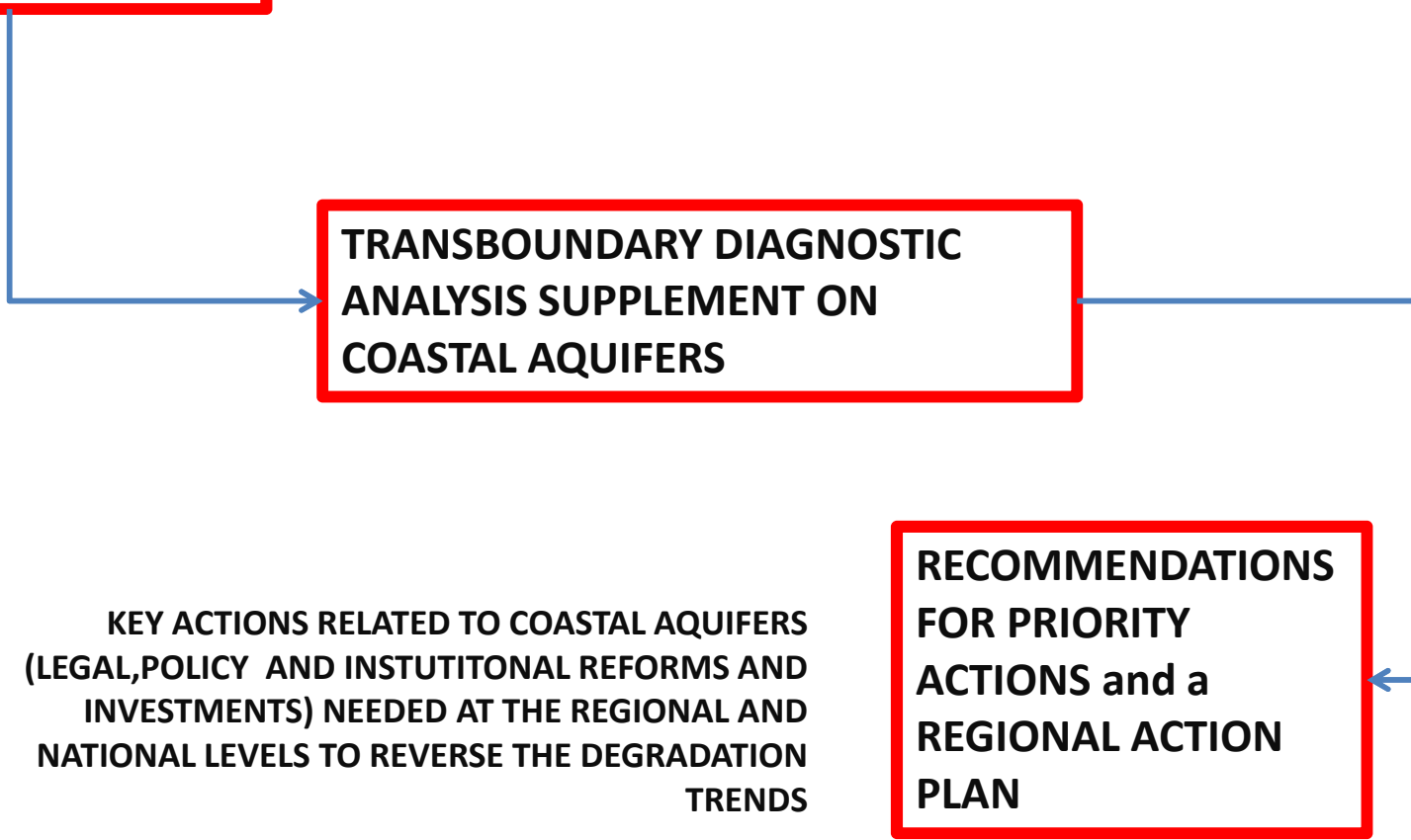
**CHARACTERIZATION OF
COASTAL AQUIFERS**

**THE CHARACTERIZATION AND CURRENT STATE OF THE MEDITERRANEAN
COASTAL AQUIFERS AND OF GROUNDWATER DEPENDENT COASTAL
ECOSYSTEMS (WETLANDS)**

**TRANSBOUNDARY DIAGNOSTIC
ANALYSIS SUPPLEMENT ON
COASTAL AQUIFERS**

**KEY ACTIONS RELATED TO COASTAL AQUIFERS
(LEGAL,POLICY AND INSTUTIONAL REFORMS AND
INVESTMENTS) NEEDED AT THE REGIONAL AND
NATIONAL LEVELS TO REVERSE THE DEGRADATION
TRENDS**

**RECOMMENDATIONS
FOR PRIORITY
ACTIONS and a
REGIONAL ACTION
PLAN**



AQUIFER CHARACTERIZATION

- Making coastal aquifer “visible” and recognized by the countries, and by their users and land/water administrators.
- Collecting, to the extent feasible, for each transboundary aquifer a set of data that combined give a first description of its present hydro-geological, environmental, socio-economic, and governance conditions, and of its interactions with adjoining water-bodies and ecosystems.

NATIONAL REPORTS ON
HYDROGEOLOGY AND
LEGAL ASPECTS



COASTAL AQUIFERS
ONLINE DATABASE



OVERVIEW OF
COASTAL
WETLANDS



CROATIA

The coastal aquifers in Croatia are primarily karstic in nature, with significant discharges of fresh groundwater to the Adriatic Sea. The total average annual fresh water runoff in the Adriatic Sea is 886 m³/s, of which a major portion is groundwater. The average annual precipitation in Croatia ranges from 650 mm in eastern Slavonia to 3500 mm or more in Gorski Kotar (Lividraga, 3800 mm). The continental part of Croatia is characterized by maximum levels of precipitation in summer and minimum in winter, the transitional area between the continental and the Mediterranean climate is characterized by maximum levels of precipitation in November and minimum levels in February, while the coastal area and the mountainous hinterland (recharge area of coastal aquifers) is characterized by maximum levels of precipitation in winter and minimum levels in summer.



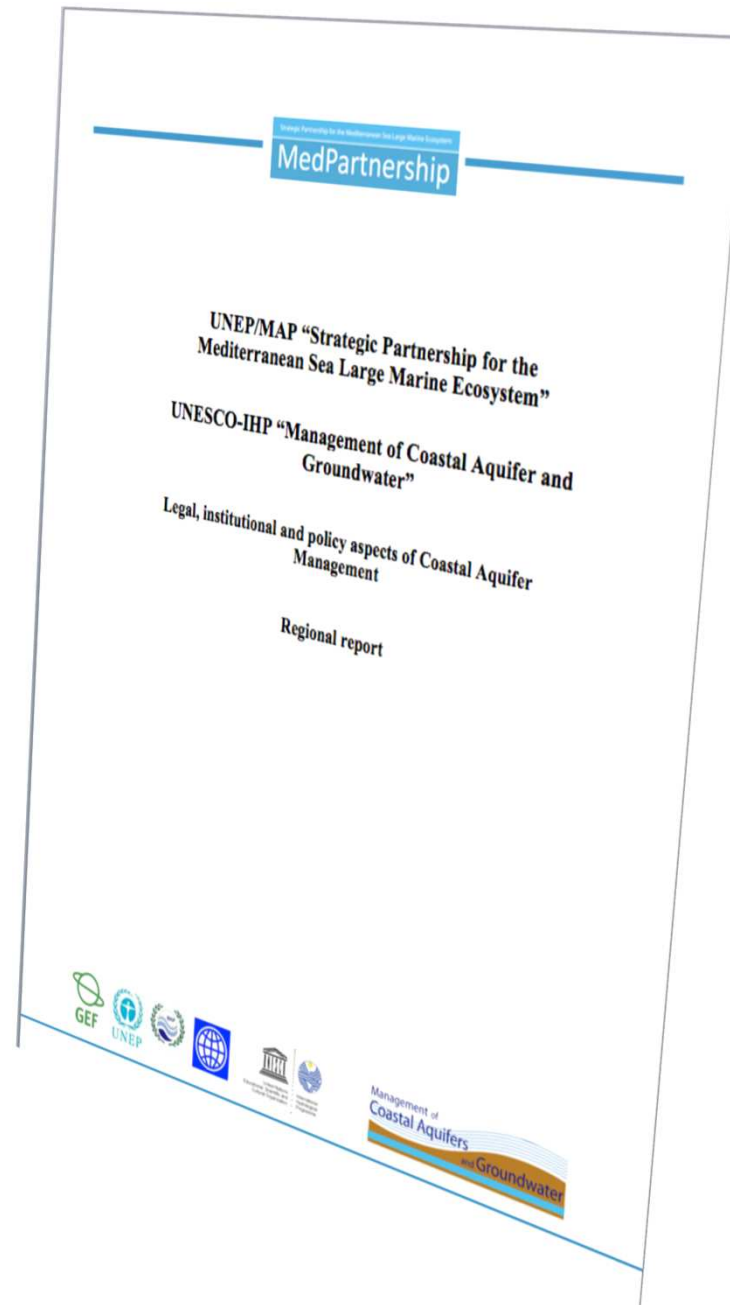
In the Neretva, Ravni Kotari and Istra coastal aquifers, the most important pressure is the intensive use of water for irrigation (mainly by an unknown number of unregistered wells that are pumping water). In the proximity of the Šibenik-Rogoznica coastal aquifer, however, there are fewer suitable areas for agriculture and consequently less pressure on this aquifer from irrigation activities, compared with the other aquifers studied in Croatia.

Issues of concern: The greatest pressure on most coastal aquifers is the uncontrolled abstraction of groundwater for irrigation from unregistered wells, which leads to seawater intrusion in many areas. The ever-growing demand for water from the public water supply system further intensifies this problem. Most coastal aquifers are also naturally influenced by salinization to some degree, from changes in sea levels during the last geological period. Apart from salinization, the quality of groundwater in coastal aquifers is also negatively impacted by pollution from the intensive use of fertilizers and pesticides in agriculture as well as the release of untreated wastewaters from numerous settlements. In the southernmost area of the peninsula Istra, in and around Pula, industry and industrial wastewater discharges also exert an important pressure on water quality in the coastal aquifer.

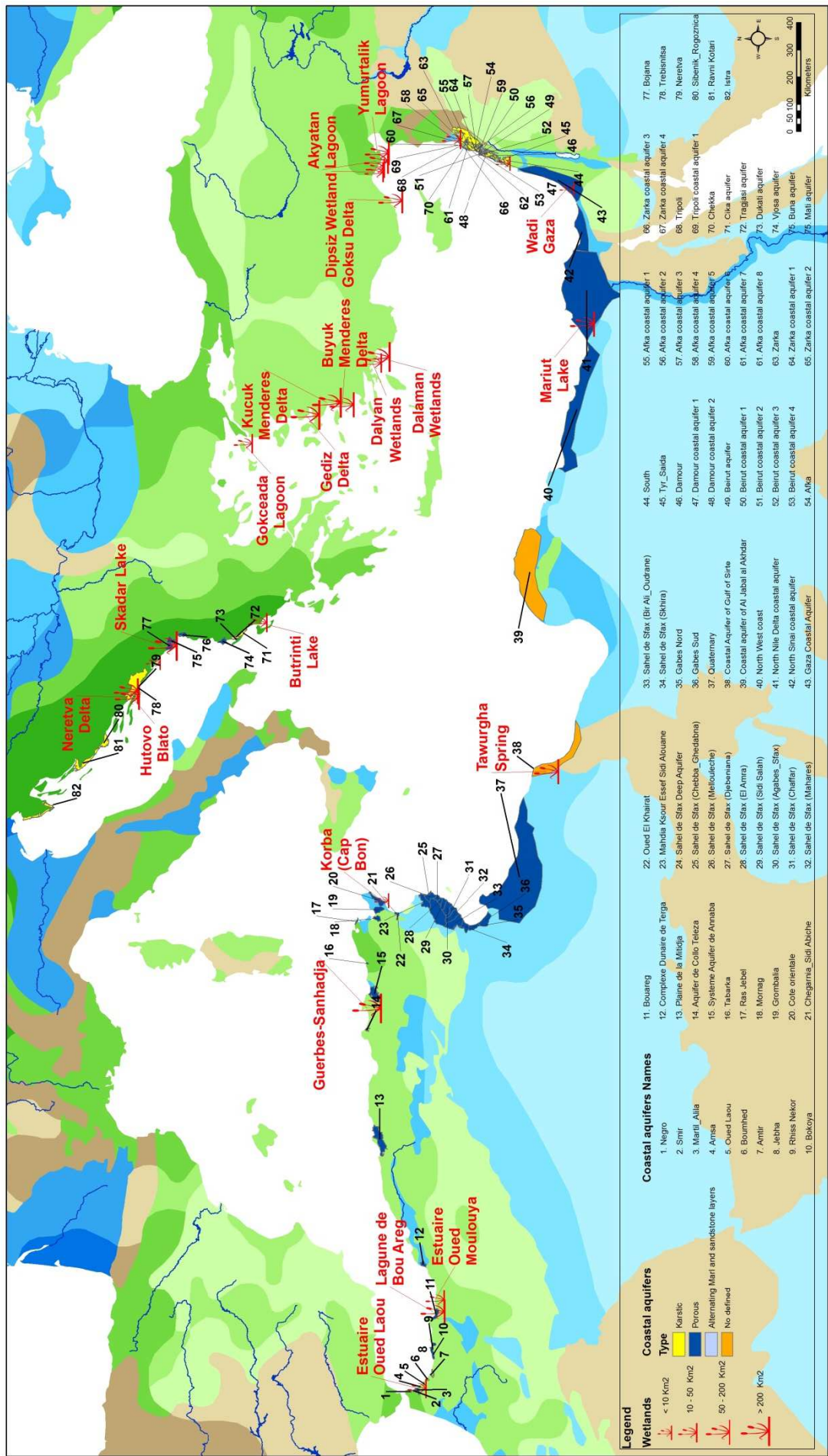
Aquifer name	Hydrogeology	Extent	Salinity	Main uses	Entity responsible for management	Recharge (Mm ³ /yr)	Abstraction (Mm ³ /yr)
Istra	Karstic	584.9 km ²	Widespread and severe salinization	Irrigation, livestock and industry. Monitored for water levels, nitrogen, salinity, heavy metals, pesticides and industrial organic compounds.	Croatian Waters	Not known	Not known
Neretva	Karstic	215.8 km ²	Local and moderate salinization	Domestic supply, irrigation and livestock. Monitored for water levels and salinity.	Croatian Waters	Not known	Not known
Ravni Kotari	Karstic	616.9 km ²	Local and moderate salinization	Domestic supply, irrigation, livestock and industry. Monitored for nitrogen, salinity, heavy metals, pesticides and industrial organic compounds.	Croatian Waters	Not known	Not known
Šibenik-Rogoznica	Karstic	523.3 km ²	Local and moderate salinization	Domestic supply, irrigation and livestock. No monitoring of groundwater levels or quality.	Croatian Waters	Not known	Not known

Based on extensive Hydrogeological Country Reports, for each country a Country Aquifer Card has been prepared, summarizing key features of each coastal aquifer

Legal, Institutional and Policy aspects related to coastal aquifer have been assessed in each country, and summarized in a Regional Report, and in Country Matrixes



Main Mediterranean coastal aquifers and representative wetlands assessed by UNESCO-IHP for the MedPartnership



Groundwater resources and recharge (mm/year) (Source: WHYMAP)



Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem

MedPartnership

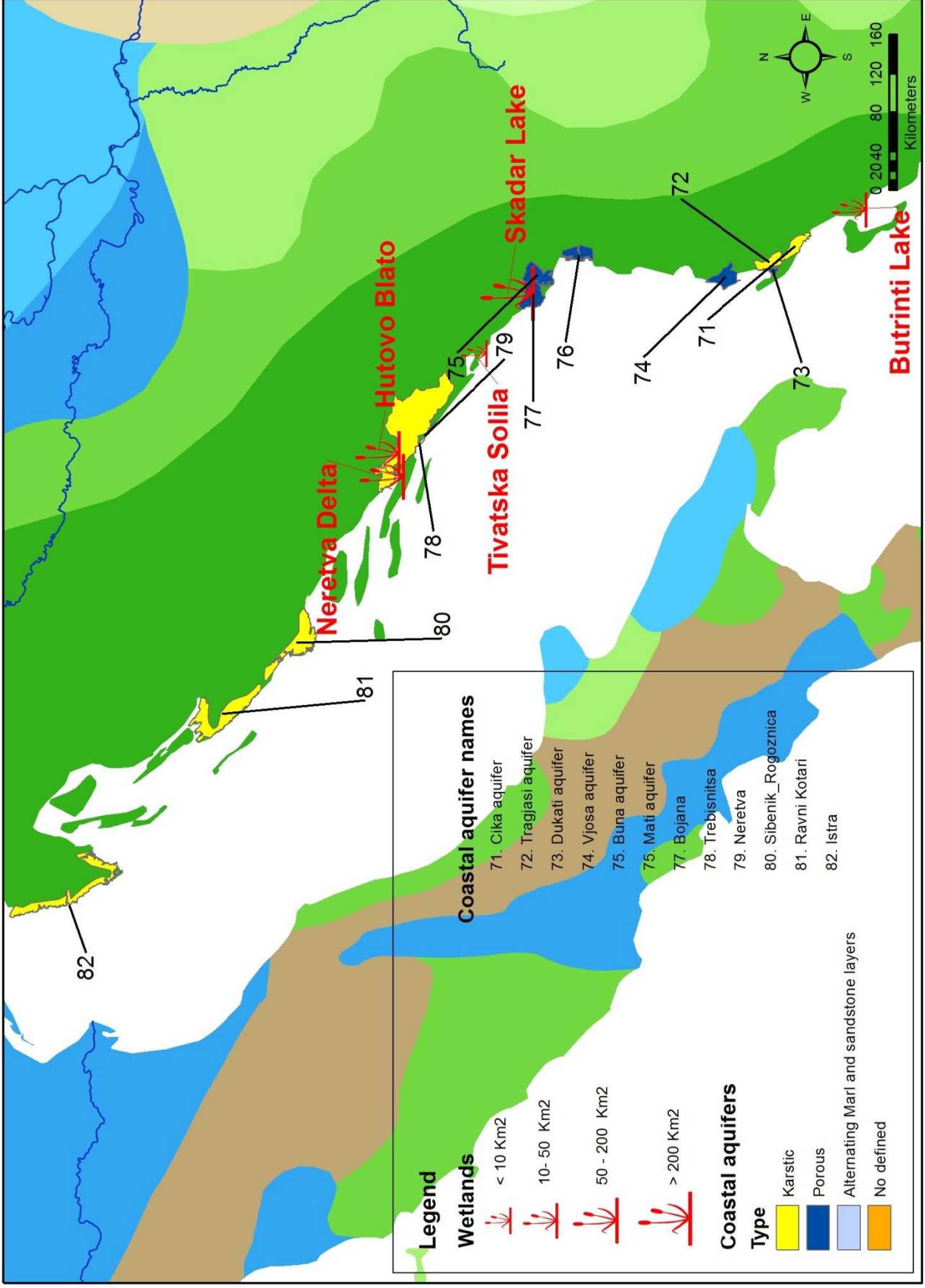
Together for the Mediterranean Sea



United Nations
Educational, Scientific and
Cultural Organization



International
Hydrological
Programme



Adriatic Basin

PILOT DEMONSTRATIONS

aimed at testing new integrated management approaches and assessment technologies

Coastal aquifer vulnerability mapping in different hydrogeologic environments

- 1) Tunisia: Estuarine – flood plain environment
- 2) Croatia: karst environments

Consideration of coastal aquifers in integrated management plans

- 1) Buna/Bojana Transboundary Integrated Management Plan
- 2) Integrative Methodological Framework
- 3) ICZM Strategy in Algeria/ICZM Plan for Reghaia



COASTAL ZONE USE CAPABILITY with RESPECT TO COASTAL AQUIFERS INTEGRITY

VULNERABILITY MAP UNITS			ACTIVITIES									
LAND UNIT	GEOLOGY	COMPREHENSIVE VULNERABILITY OF COASTAL AQUIFERS	Fish Farming	Solid waste disposal	Surface disposal of untreated liquid wastes	Heavy construction	Excavation, and extraction of natural materials	Devegetation	Use of herbicides, pesticides, insecticides	Irrigation	Cemeteries	Groundwater abstraction
Northern slopes	Permeable lands & calcarenites	MEDIUM		0	0	0		X	X		0	
	Impermeable Marls and clays	LOW										
Coastal Plain	Recent alluvial deposits and beach sands	HIGH		0	0	0	0	0	X		X	X
Estuary	Deltaic deposits at sea level	VERY HIGH	X	XX	XX	XX	XX	X	XX		XX	XX
Coastal wetlands	Salt water marsh			X								

SIGNIFICANT PROBLEMS UNLIKELY



UNDESIRABLE: PROBLEMS LIKELY

X

UNDESIRABLE: SIGNIFICANT PROBLEMS LIKELY

XX

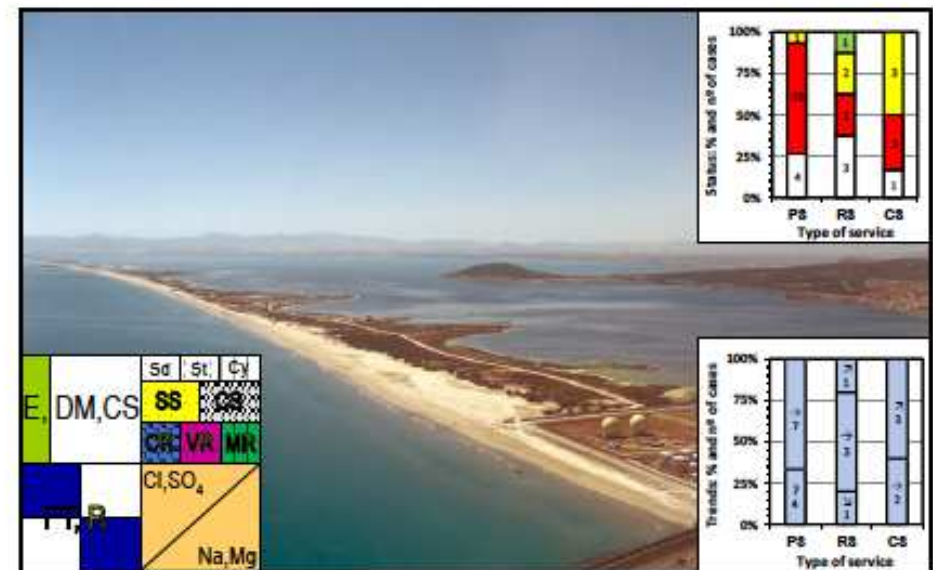
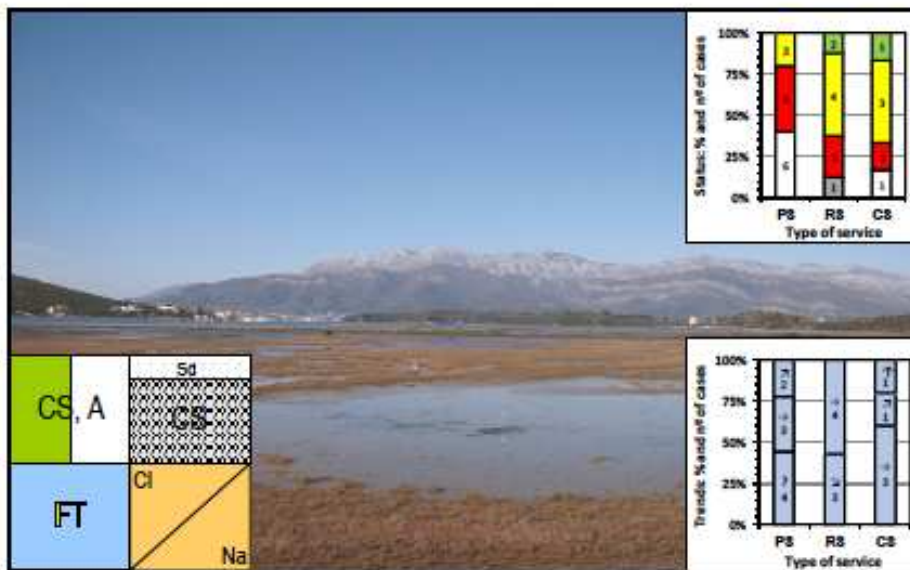
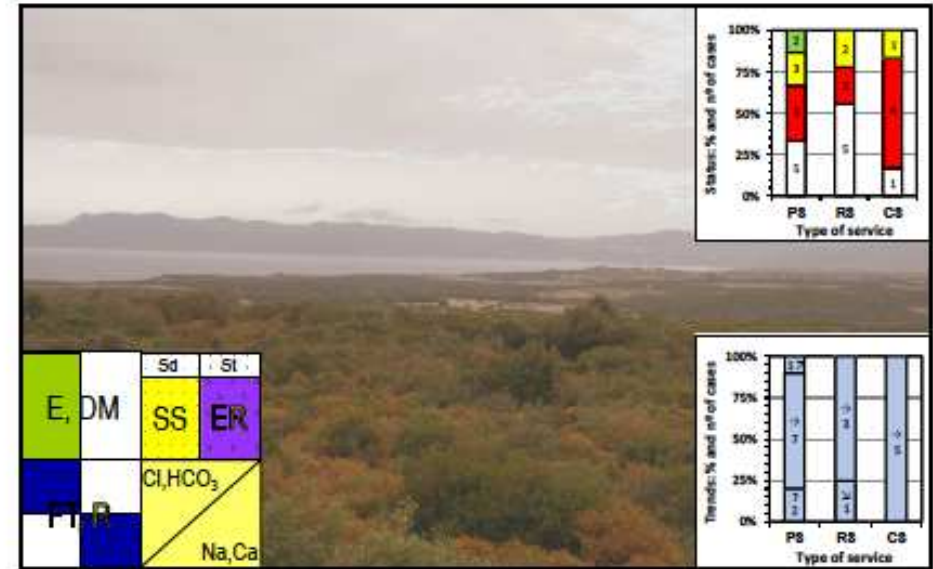
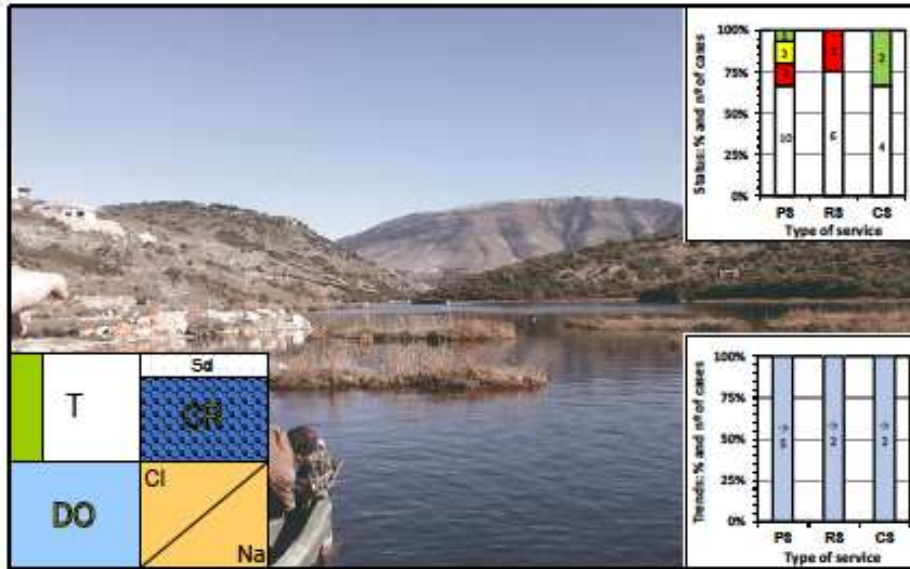
POSSIBLE PROBLEMS

0

NOT APPLICABLE



By A. Merla



TDA SUPPLEMENT

- **THE ROLE AND IMPACT OF COASTAL AQUIFERS ON THE ISSUES OF TRANSBOUNDARY CONCERN IDENTIFIED BY THE MED TDA**
- **THE EFFECTIVENESS OF THE LEGAL, POLICY AND INSTITUTIONAL SETTINGS AS THEY RELATE TO THE PROTECTION OF THE INTEGRITY OF COASTAL AQUIFERS AND THEIR FUNCTIONS**

CONCLUSIONS

The importance of Coastal Aquifers in the Mediterranean

Coastal aquifers are a major water resource all along the Mediterranean coastline and often represent the main source of drinking water for the growing littoral population,

Submarine groundwater discharges are large (>25%), and in places superior to surface water inflows. Hence coastal aquifers contribute to, and sustain shallow marine water quality and ecosystems

Coastal wetlands, lagoons, humid zones and coastal habitats, providing very valuable services and contributing to coastal livelihoods, are all in part or totally dependent on groundwater regimes.

In spite of all this, the regional picture that emerges from the assessment of the current state of these critically important resources is one of generalized neglect and progressive degradation. Findings in fact show that:

- The Mediterranean Sea TDA Coastal Aquifer Supplement has recognized the contribution of coastal groundwater degradation to exacerbating issues of transboundary concern at the LME level, such as nutrient pollution, habitat and coastal freshwater dependent ecosystems degradation.
- Expert opinions and the existing quantitative data indicate a regionally preponderant medium to high level of contamination from nutrients, and other hazardous substances.
- Medium to high salinization is locally present in about 70% of the aquifers and often attributed to seawater intrusion.

- As a consequence, management frameworks for coastal groundwater are absent, and these resources are not formally recognized as critical for the sustainability of coastal developments, and as being highly vulnerable.
- Unregulated exploitation is common, and no quality-quantity safeguards exist or are applied. Conflicts among uses (agriculture, domestic, tourism, environment, energy...) are common and potentially disruptive.
- In spite of the abundant scientific information on Mediterranean wetlands, and of the frequent existence of some kind of protection scheme, most of the wetlands are reported as having their functionality altered in different degrees. Half of the wetlands are moderately altered, and the other half is highly to very highly altered.

- Scientific knowledge and public awareness on coastal aquifers is scanty or non-existent in most countries. Monitoring is occasional at best, lacks modern technologies and strategic, multi-purpose design.
- No specific laws or policies exist in the vast majority of the countries protecting and regulating the use of coastal groundwater, taking into account its strategic value, its high vulnerability to contamination, and its interactions with the sea. General water laws apply, normally with little or no discrimination between surface and groundwater. The same is true for the institutional settings.
- The present ICZM Protocol includes very limited consideration of coastal groundwater.

KEY FINDINGS

Growing pressure on coastal groundwater supplies, seawater intrusion and salinization, nutrient and contaminant transport, are the major issues of transboundary concern affecting most if not all Mediterranean coastal aquifers. They are ultimately attributable to the lack of policy and sustainable legal and institutional frameworks for coastal aquifer management.

KEY FINDINGS

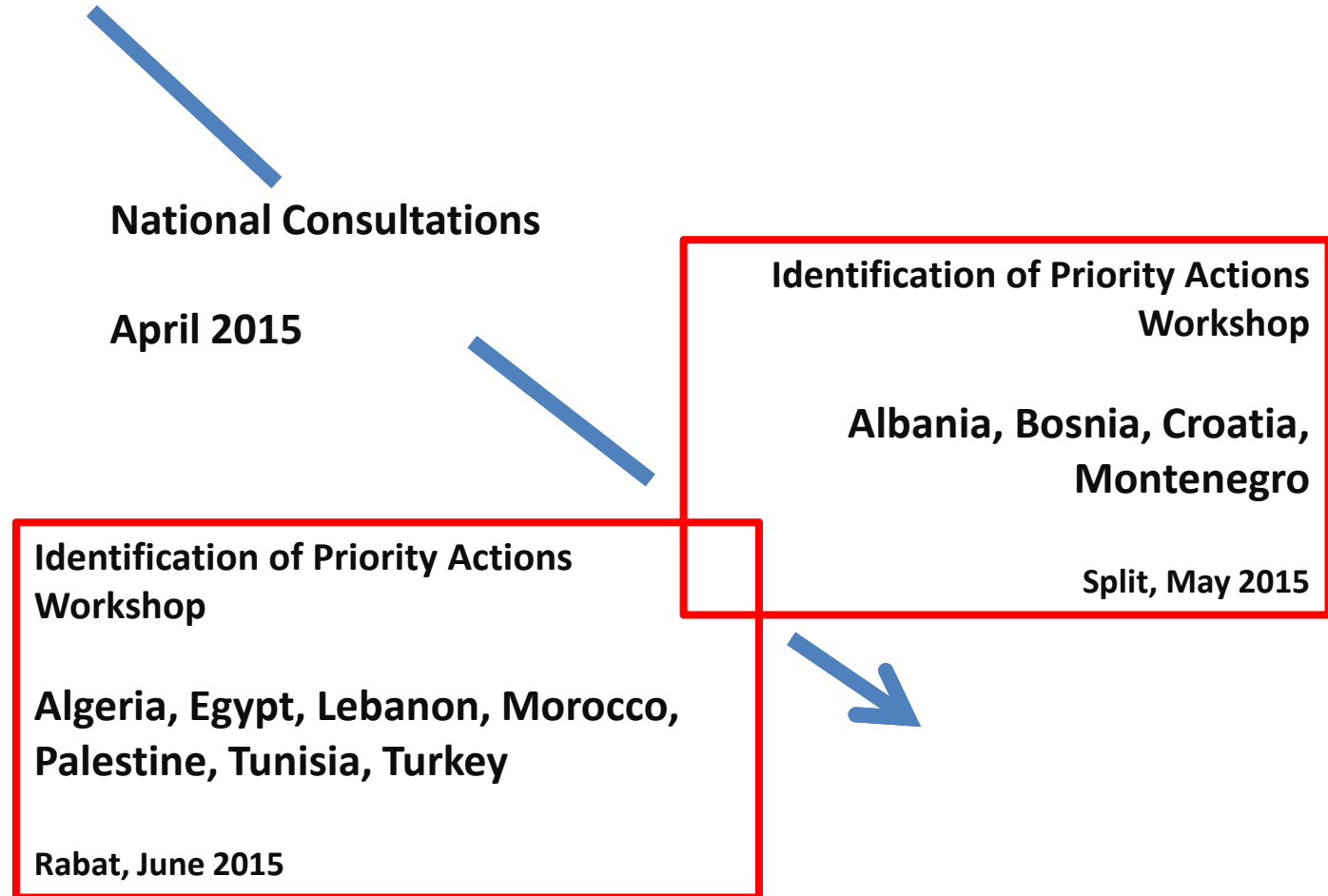
The results of the Mediterranean Wetland Assessment carried out as part of the Coastal Aquifers Component of MedPartnership, shows that for 15 of the 26 main Mediterranean wetlands, are affected by alarmingly growing pressures due in particular to groundwater extraction, urbanization, diffuse pollution from agriculture.

KEY FINDINGS

The degradation of coastal aquifers and coastal freshwater ecosystems along large sections of the Mediterranean coastline is an indicator of the growing level of environmental stress affecting the coastal zone and shallow marine ecosystems.

**Issues of concern identified
in the Coastal Aquifers TDA
Supplement, and Pilot
demonstrations experiences**

TDA FINDINGS, PILOTS & CONSULTATION PROCESS



**Establishing an
action plan for
coastal aquifers of
the Adriatic Basin**

LINES OF ACTION: NATIONAL LEVEL

A. Strengthening knowledge as a necessary basis for coastal aquifer and coastal zone management, as a first step for high *priority aquifers* only:

- (i) The systematic mapping of groundwater vulnerability to pollution and salinization in the coastal zone, including from human-induced seawater intrusion, and defining local land uses and human activities compatible with the various classes of vulnerability. Proposed areas for future interventions: Buna/Bojana Delta, the Neretva Delta and the catchment area of springs in the Dubrovnik coastal zone,
- (ii) The identification of major submarine groundwater discharge zones, and assessment of flows and contaminant loads.
- (iii) The design and testing on the ground of modern multi-purpose monitoring networks.

LINES OF ACTION: NATIONAL LEVEL

B. Building effective institutions

- (i) Incorporate consideration of coastal aquifers and groundwater in evolving water and other relevant legislation and policy instruments.
- (ii) Seek solutions to groundwater management challenges with a transboundary aspect (example of sanitary protection zones governed by requirements from different countries).
- (iii) Consider systematic stakeholder participation as a cornerstone of water resources management, including coastal aquifers
- (iv) Establish water user groups in coastal areas to encourage the strategic, equitable use of water resources in the context of competing water uses and users

LINES OF ACTION: REGIONAL LEVEL

- (i) Encourage the concerned countries to deposit their instruments of ratification, acceptance, approval or accession of/to the ICZM Protocol;
- (ii) Consider the findings and the recommendations of the TDA Coastal Aquifer Supplement in future actions in the region, and pursue the adoption of the present Action Plan under the UNEP/MAP processes
- (iii) Uptake of the Integrative Methodological Framework - developed in the context of MedPartnership and tested in the Buna-Bojana area - and its consideration of coastal aquifers in ICZM guidelines and policies.
- (iv) Create a mechanism for the exchange of knowledge, data and technologies between countries in the region adapted for coastal aquifers.
- (v) Raise awareness on the importance of coastal aquifers to human livelihoods, ecosystem health and economic development, through the organization of events that inform and educate policy makers and actors from other sectors (tourism, agriculture, ...) on the role of coastal aquifers in the wider development agenda of the region.



Thank you for your attention

Merci pour votre attention