

*Gestion et protection des zones  
humides côtières liées aux eaux  
souterraines en zone méditerranéenne :  
une approche par les services  
écosystémiques*

*Experience PHI UNESCO - MedPartnership Project)*



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# 1 FRAMEWORK: The MedPartnership Project and UNESCO-IHP

## *The GEF/UNEP-MAP Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem (MedPartnership Project)* <http://themedpartnership.org/>

- “The Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem (MedPartnership) is a collective effort of leading environmental institutions and organizations together with countries sharing the Mediterranean Sea to address the main environmental challenges that Mediterranean marine and coastal ecosystems face. “
- “The goals include: to improve environmental conditions of pollution and biodiversity hotspots and other priority areas under stress, to promote the sustainable use of marine and coastal resources through integrated approaches, to reduce pollution from land-based sources, to enhance the protection of ‘critical’ habitats and species, and to integrate climate considerations into national marine and coastal planning.”

- Partners:

United Nations Environment Programme Mediterranean Action Plan

FAO

The International Hydrological Programme

SCP/RAC (Regional Activity Centre for Sustainable Consumption and Production)

# 1 FRAMEWORK: The MedPartnership Project and UNESCO-IHP

## *The MedPartnership Project 1rst phase*

- UNESCO-IHP executed the component Management of coastal aquifers and groundwater, which included an activity on Implementation of eco-hydrogeology applications for management and protection of coastal wetlands.

Aim of the activity: *contribute o reverse degradation trends in coastal aquifers and groundwater-related coastal wetlands and enhance human wellbeing, namely by providing appropriate capacities for the integration of an ecosystem services approach into groundwater and wetlands assessment and management.*



# 1 FRAMEWORK: The Ecosystem Services Approach (EA)

## Ecosystem services (ES)

- Are defined as the benefits people obtain from ecosystems (Millennium Ecosystem Assessment, 2005).
- Categories of ecoservices:
  - ✓ Provisioning (food, water,...)
  - ✓ Supporting (soil formation, nutrient cycling,...)
  - ✓ Regulating (regulation of floods, droughts, land degradation,...)
  - ✓ Cultural (recreational, spiritual, educational...)
- Goal of EA: to generate a strategy for integrated management of land, water and living resources to promote their preservation, equitable and sustainable use.



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**Synthesis Reports**

The first set of assessment reports consists of an overall synthesis and 5 others that interpret the MA findings for specific audiences. [Learn more](#)

- Overall synthesis
- Biodiversity
- Desertification
- Business & Industry
- Wetlands and Water
- Health

**Statement of the MA Board**

The MA Board of Directors has developed an interpretation of the key messages to emerge from the assessment, entitled *Living Beyond Our Means: Natural Assets and Human Well-Being*. [Learn more](#)

- Download the Statement
- About the MA Board of Directors

**A Framework for Assessment**

In late 2003, the MA and Island Press published *Ecosystems and Human Well-being: A Framework for Assessment*. This volume lays out the assumptions, processes and parameters that were used in the MA. [Learn more](#)

**Useful Links**

- ISLANDPRESS
- Order printed reports from Island Press
- GreenFacts.org
- GreenFacts: Popularized synthesis report
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# 1 FRAMEWORK: The Ecosystem Services Approach

## Some main Ecosystem Services from wetlands

(MEA, 2005)

## List of ES from the European Environmental Agency

CICES: Common International Classification of Ecosystem Services (V5.1, 2018)

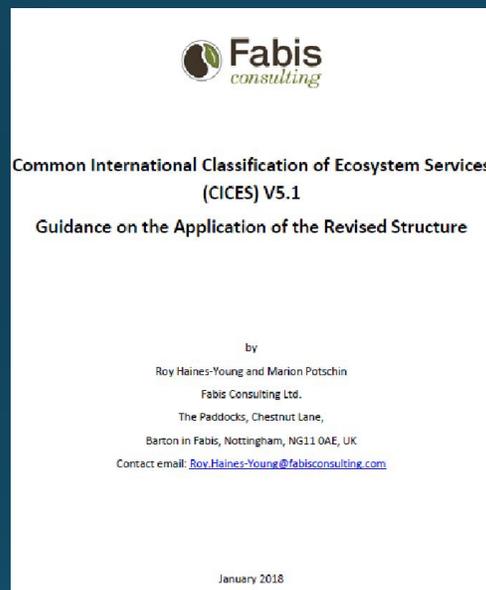
CICES is widely used for mapping, ecosystem assessment, and natural capital ecosystem accounting. It developed from the work on environmental accounting undertaken by the European Environment Agency (EEA). Contributes to the revision of the System of Environmental-Economic Accounting (SEEA) which is currently being led by the United Nations Statistical Division.

<https://cices.eu/resources/>

## Mapping and Assessment of Ecosystems and their Services: An EU ecosystem assessment

(European Environment Agency and others, 2020)

“The Biodiversity Strategy outlines a number of targets and precise actions to stop biodiversity loss. By mapping out and assessing the state and trends of ecosystems and their services, we can help inform the policy decisions affecting the environment.”



JRC SCIENCE FOR POLICY REPORT

### Mapping and Assessment of Ecosystems and their Services: An EU ecosystem assessment

Joachim Maas, Anne Teller, Markus Ehrend, Sophie Gondé, Sara Valledillo, José I. Barredo, María Luisa Paracchini, Daniela Abadi, Maria, Marco Trombetti, Olga Vojtek, Gracia Zúñiga, Anna M. Astorino, Bruna Grizzetti, Francesco Serrano, Andrea Ingwers, Peter Inge, Chiara Ingle, Ananya Jones, Anil Kumar, Susana Lado, Achille Mouton, Carlo Rega, Balázs Csizsik, Gábor Csécsényi, Enrica Piccini, Andrea Cristofari, Penelope De Palma, Jacopo Carraro, Michele Menoni, Giovanni Caudullo, Emanuele Lugato, Jürgen V. Sub, Jonathan Sparrow, Corrado Corbelli, Annamaria Boshup-Bills, Jesús San Miguel, Susana San Román, Peter Kristensen, Thine Christensen, Nihat Zek, Ad de Ruig, Ana Cristina Cardoso, Alberto Probst, Irene del Barrio Avelino, Konstantinos Tsamir, Eugenio Genovesi, Iván Durrán, Riccardo La Notte, Paul Abel Vries, Matteo Vizzani, Andrea Gerna, Nicolas Robert, Georgia Katsoulaki, Eduardo García Benito, Paras Panagos, Cristóbal Balboa, Simone Scarpa, Luca Montanarella, Alberto Dominguez, Chiara Ferrando, Ljiljana, Fernando Santos-Martin

Joint Research Centre, European Environment Agency, DG Environment, European Topic Centre on Biological Diversity, European Topic Centre on Urban, Land and Soil Systems

Table 1. ECOSYSTEM SERVICES PROVIDED BY OR DERIVED FROM WETLANDS

Services	Comments and Examples
<b>Provisioning</b>	
Food	production of fish, wild game, fruits, and grains
Fresh water <sup>a</sup>	storage and retention of water for domestic, industrial, and agricultural use
Fiber and fuel	production of logs, fuelwood, peat, fodder
Biochemical	extraction of medicines and other materials from biota
Genetic materials	genes for resistance to plant pathogens, ornamental species, and so on
<b>Regulating</b>	
Climate regulation	source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes
Water regulation (hydrological flows)	groundwater recharge/discharge
Water purification and waste treatment	retention, recovery, and removal of excess nutrients and other pollutants
Erosion regulation	retention of soils and sediments
Natural hazard regulation	flood control, storm protection
Pollination	habitat for pollinators
<b>Cultural</b>	
Spiritual and inspirational	source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems
Recreational	opportunities for recreational activities
Aesthetic	many people find beauty or aesthetic value in aspects of wetland ecosystems
Educational	opportunities for formal and informal education and training
<b>Supporting</b>	
	sediment retention and accumulation of organic matter
	storage, recycling, processing, and acquisition of nutrients

... was treated as a provisioning service within the MA, it is also regarded as a regulating service by various sectors.

<https://www.millenniumassessment.org/documents/document.358.aspx.pdf>

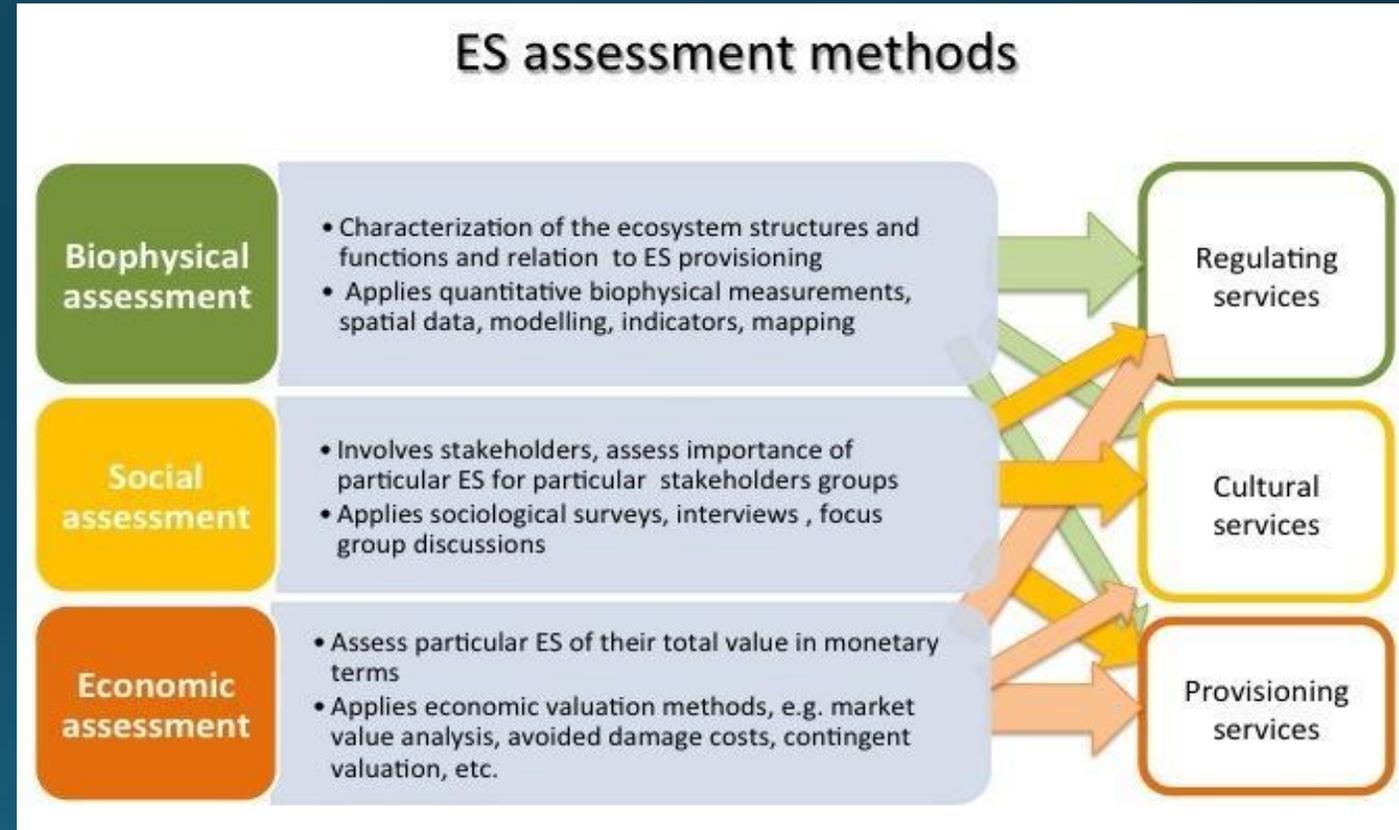
[https://ec.europa.eu/environment/nature/knowledge/ecosystem\\_assessment/index\\_en.htm](https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/index_en.htm)



# 1 FRAMEWORK: The Ecosystem Services Approach

## Ecosystem Services Assessment methods

- **MEA (2005) set a standard international methodology to assess the functionality status of particular ecosystem services and their observed/forecasted evolution trend based on INDICATORS.**
  - **Indicators are specific for each Ecosystem Service and wetland**
- + must be selected in advance depending on the data/information existing for a particular site.**

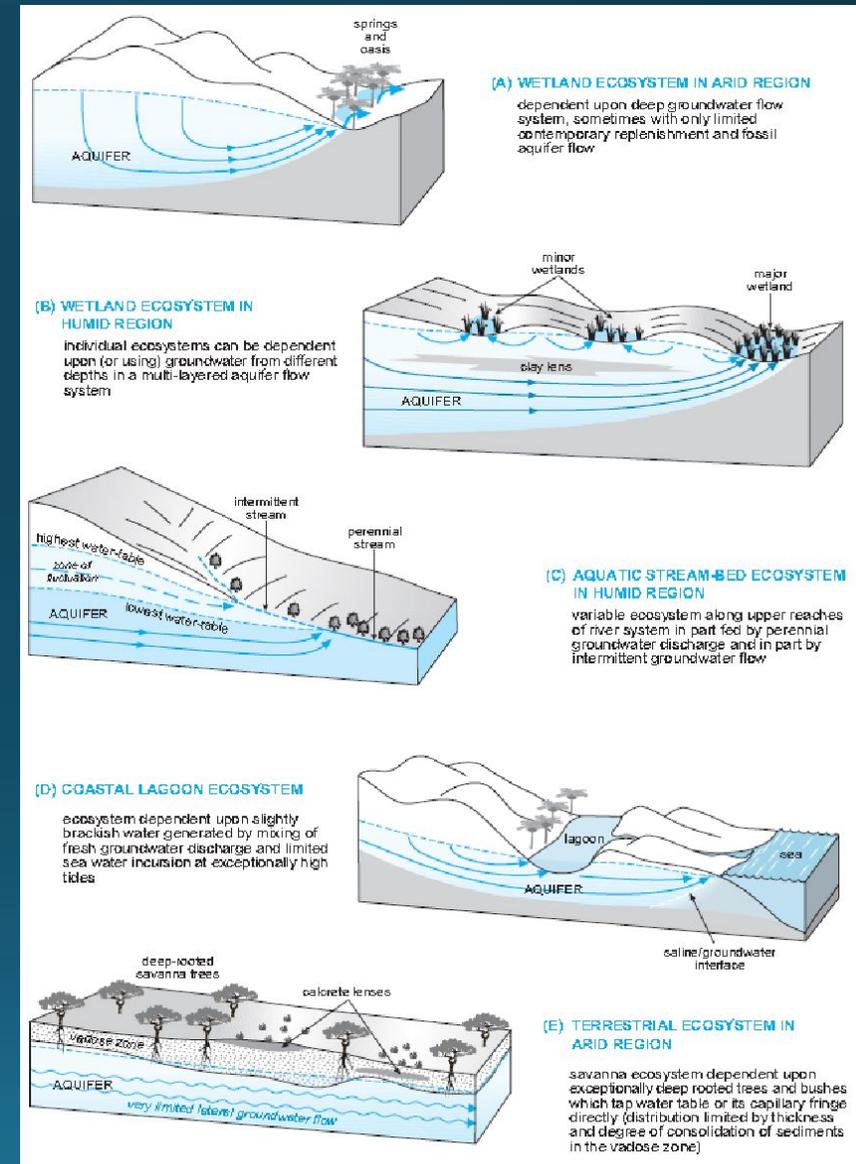


<https://vivagrass.eu/ecosystem-services/valuation-of-ecosystem-services/>

# 1 FRAMEWORK: Wetlands, groundwater and the Ecosystem Approach

## Role of groundwater in wetlands

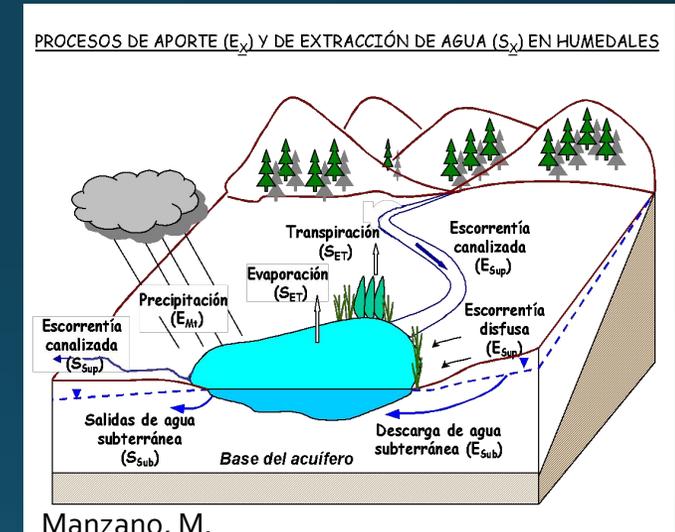
- Wetlands-groundwater relationships: wide typology.
- Many ES from groundwater-related wetlands depend on the type of wetland-groundwater relationship.
- Groundwater can be a minor component on the wetland balance but play a relevant role on wetland functioning.
- Groundwater in wetlands can contribute to regulate the presence and lasting of water; improve the water quality; supply nutrients; regulate the temperature; regulate the flow of water and solutes;
- ...



## 2 INTRODUCING THE EA INTO THE MEDPARTNERSHIP PROJECT. Basis

### *Basis for the incorporation of EA to the MedPartnership activity on coastal wetlands*

- **RATIONALE.** Groundwater-related coastal wetlands of arid and semi-arid areas provide humans with especially valuable services: water, food, fiber, medicines, minerals, construction materials, improvement of water quality, regulation of climate, generation of tourism, economic resources, cultural values,...
- **RAISE AWARENESS ON VALUE AND TRENDS.** Despite the irreplaceable contribution to human wellbeing, many Mediterranean coastal wetlands have been destroyed or irreversibly damaged, and even at present they are subject to many pressures, which cause significant economic, social and environmental losses, and qualitative and quantitative impairment of water resources.
- **ROLE OF KNOWLEDGE.** Preservation of Mediterranean groundwater-related coastal wetlands requires understanding of wetlands origin and functioning, their relationship to surface water and groundwater systems and to the management of water, land and other resources at basin scale, and the list, status and trends of the services they provide.



# 2 INTRODUCING THE EA INTO THE MEDPARTNERSHIP PROJECT. Work developed

## Country Report to be complimented by National Experts for each wetland

### Part of the compliment Key

#### Key for compliment of the Country Reports

Superscripted numbers<sup>(x)</sup> in the "Template for Country Reports.doc" file refer to the numbers in this legend chart. To fill in the template please select one option (or more, when necessary) from the lists below (when indicated) or write the required information.

#### GROUNDWATER RELATED WETLANDS GENERAL DATA

<sup>(1)</sup> **Name of wetland** (this subject does not have choices)

<sup>(2)</sup> **Wetland type** (please combine one number and one letter):

- 1 Isolated wetland
- 2 Wetland complex
- 3 Isolated within a wetland complex
- A Fresh/brackish coastal lagoon/lake
- B Salt lake
- C Salt pan
- D Natural, concentrated spring or outflow ("cyc")
- E Fresh water marsh

#### MAIN DIRECT DRIVERS OF CHANGE IN THE GROUNDWATER RELATED WETLAND

<sup>(19)</sup> **Resource exploitation** (please select one or more):

- Water abstraction
- Biological exploitation
- Mineral exploitation

<sup>(20)</sup> **Changes in land use** (please select one or more):

- Deforestation
- Reforestation
- Forest management
- Replacement of species
- Extensive agriculture
- Extensive cattle rising
- Urbanization
- Roads
- Others (if you select this option, please indicate which type/s of change/s)

#### WETLAND SERVICES GLOBAL ASSESSMENT OF STATUS AND TRENDS

<sup>(26)</sup> **Provisioning services:**

- Natural production of food:
  - Cropping
  - Livestock
  - Fishing
  - Fruits collection
  - Hunting
  - Other (specify)
- Artificial production of food:
  - Aquaculture
  - Agriculture
  - Other

#### GROUNDWATER RELATED WETLAND GENERAL DATA

<sup>(x)</sup> Refers to the numbers in the legend chart provided. Please select one option (or more, when necessary)

- |  |  |   |
|--|--|---|
| 1. Name of wetland <sup>(1)</sup> :                    | Wetland general type <sup>(2)</sup> :    |   |
| 2. Municipality, Country:                              | Coordinates: (geographical)              |   |
| 3. Wetland surface (km <sup>2</sup> ) <sup>(3)</sup> : | Elevation (m):                           | Average depth / length / width (m) <sup>(3)</sup> : |
| 4. Contributing surface area (km <sup>2</sup> ):       |  |   |
| 5. Contributing aquifer area (km <sup>2</sup> ):       | Aquifer type <sup>(4)</sup> :            |   |
| 6. Mean rainfall (mm/y) <sup>(5)</sup> :               | Mean T (°C) <sup>(5)</sup> :             | Mean ET (mm/y) <sup>(5)</sup> :                     |
| 7. Underlying lithology <sup>(6)</sup> :               |  |   |
| 8. Wetland genesis <sup>(7)</sup> :                    |  |   |
| 9. Wetland sediments <sup>(8)</sup> :                  |  |   |
| 10. Water source <sup>(9)</sup> :                      |  |   |
| 11. Groundwater flow type <sup>(10)</sup> :            | Groundwater dependence <sup>(11)</sup> : |   |
| 12. Hydroperiod <sup>(12)</sup> :                      |  |   |
| 13. Hydrochemistry <sup>(13)</sup> :                   |  |   |
| 14. Dominant vegetation <sup>(14)</sup> :              |  |   |
| 15. Trophic state <sup>(15)</sup> :                    |  |   |
| 16. Functionality <sup>(16)</sup> :                    |  |   |
| 17. State of knowledge <sup>(17)</sup> :               |  |   |
| 18. Management status <sup>(18)</sup> :                |  |   |

#### MAIN DIRECT DRIVERS OF CHANGE IN THE GROUNDWATER RELATED WETLAND

19. Resource exploitation<sup>(19)</sup>:
20. Changes in land use<sup>(20)</sup>:
21. Modification of hydrological cycle<sup>(21)</sup>:
22. Pollution<sup>(22)</sup>:
23. Alteration of biological communities structures and ecosystems functioning<sup>(23)</sup>:
24. Effects associated with changes<sup>(24)</sup>:
25. Global and climate changes<sup>(25)</sup>:

#### WETLAND SERVICES GLOBAL ASSESSMENT OF STATUS AND TRENDS

26. Provisioning services<sup>(26)</sup>:

26a. Natural production of food:

26b. Artificial production of food:

26c. Others:

27. Regulating services<sup>(27)</sup>:

28. Cultural services<sup>(28)</sup>:

#### ADDITIONAL INFORMATION / COMMENTS

- Please write here whatever additional information or comments related to items 1 to 31 above that you think may be useful for understanding wetland behavior and/or for wetland management. Pictures, maps, and schemes are accepted.
- Also write here the complete references of reports, papers, legal texts, management plans, webs, etc. contributing relevant information about the wetland.

Country Report

# 2 INTRODUCING THE EA INTO THE MEDPARTNERSHIP PROJECT. Work developed

## Ecosystem Services Form

**MEDITERRANEAN GROUNDWATER RELATED COASTAL WETLANDS INVENTORIED**  
Wetland services contributing to human well-being. Global assessment of status and trends

*Ecosystem Services include Provisioning Services, such as food and water; Regulating and Supporting Services, such as regulation of floods, droughts, land degradation, and diseases, soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious, and other nonmaterial benefits. These three categories can also be subdivided into other subgroups.*

Inventory number	Name of wetland, Country	Type	PROVISIONING SERVICES													REGULATING SERVICES						CULTURAL SERVICES													
			Natural production of food						Artificial production of food			Supply of good quality water	Water supply for different uses	Production of biological source materials	Production of mineral source materials	Genetic pool and biotechnology	Energy production	Natural species of medicinal interest	Hydrological regimes (floods, drought)	Water purification	Morpho-sedimentary regulation	Biological control	C sink and global regulation	Air quality regulation	Local climate regulation	Tourism	Educational and scientific knowledge	Local knowledge and good practices	Landscape and aesthetic	Cultural identity and sense of belonging	Religious and spiritual				
			Cropping	Livestock	Fishing	Fruits collection	Hunting	Other	Aquaculture	Agriculture	Other																								
1	Butrinti, Albania	2H		→	→				→			→	→				→			→				→				→							
2	Guerbes, Algeria	2HKN	↗	→	→		?	?		→		→	→	→			→	↘	→	→				→	→	→	→	→	→	→	→				
25	Gediz Delta, Turkey	2AIP	→	↘	→	→	→		→	↗		↘	↘	↘	↘	↘	↘	↘	→	↘		↗		→	→	↗	↗	↗	↗	→	→	→			
26	Gökçeada Lagoon, Turkey	1AHI	→	↘		→	→		→		→	→	↘	↘	↘	↘	↘	↘	→	→		→		→	→	→	→	→	→	→	→	→	→		

Services Assessment Code

Service's status		Service's trends	
High	↑	Very rapidly increasing	
Moderate	↗	Moderately increasing	
Low	→	Continuing	
Non-existent	↘	Moderately decreasing	
Unknown	↓	Very rapidly decreasing	

The list of Services to be assessed was defined for this work (29 Services, grouped in 3 main categories)

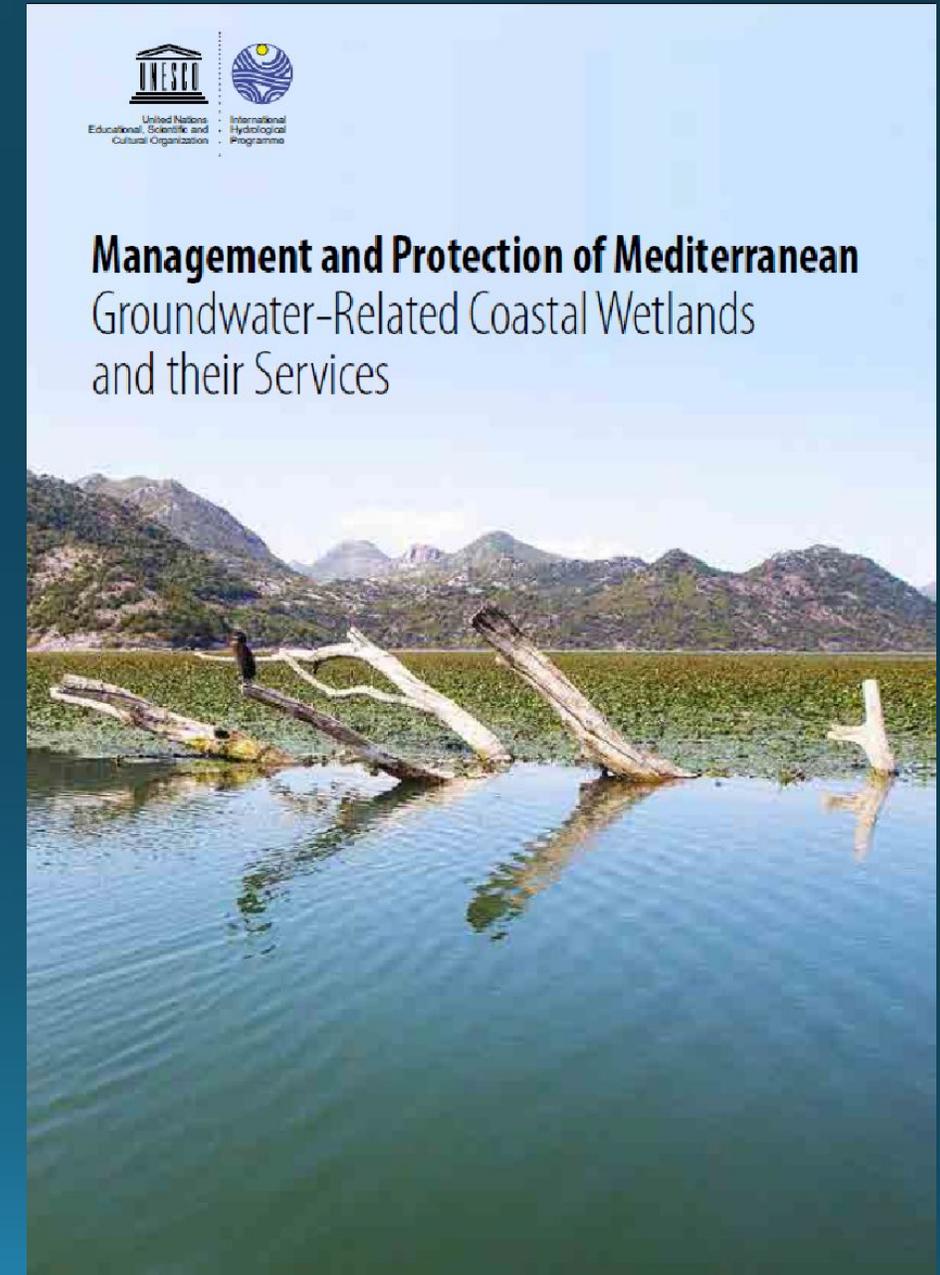


## 2 INTRODUCING THE EA INTO THE MEDPARTNERSHIP PROJECT. Results

- UNESCO, 2019. *Management and protection of Mediterranean groundwater-related coastal wetlands and their services*. Open Access Book, Paris. 136 p. ISBN: 978-92-3-100364-6.  
<https://unesdoc.unesco.org/ark:/48223/pf0000372317>

### Content of the book: three parts

- *Part 1. Basic aspects to be considered for a better management of groundwater related coastal wetlands. 5 chapters:* Environmental, social and economic relevance of groundwater-related wetlands in Mediterranean coast; Methodologies for wetlands inventory; Mapping techniques; Hydrogeological assessment; Ecosystems services and drivers of change assessment; Policy and regulations requirement for the Mediterranean countries.
- *Part 2. Existing knowledge about groundwater related wetlands in the Mediterranean coast. 14 Country reports on 26 Mediterranean coastal wetlands linked to groundwater plus 4 detailed Case studies.*
- *Part 3. Guidelines and recommendations for the evaluation and integrated management of groundwater related coastal wetlands.*
- *Annex 1. Coastal groundwater-related wetlands inventoried. Synthesis charts*



## 2 INTRODUCING THE EA INTO THE MEDPARTNERSHIP PROJECT. Results

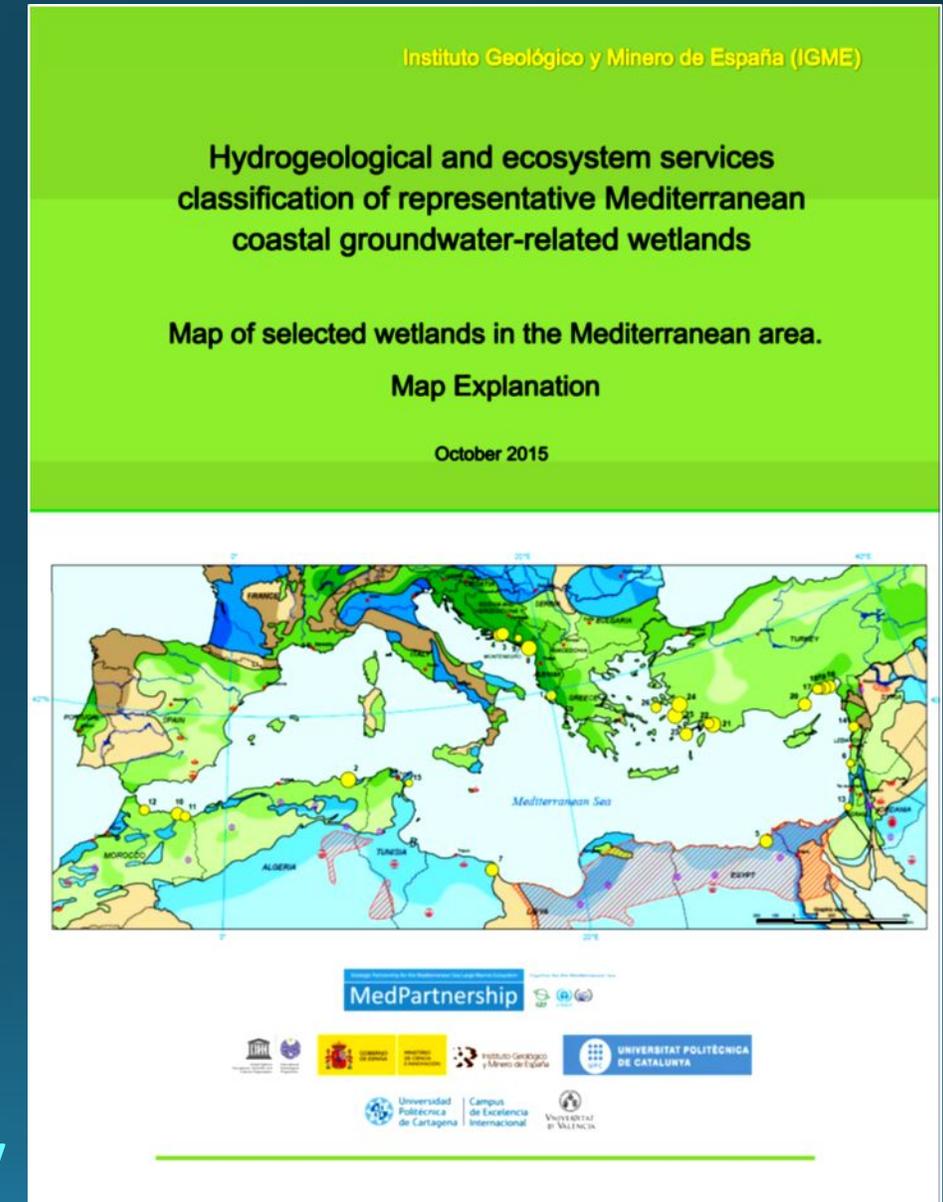
- IGME UNEP-MAP UNESCO-IHP, 2015. *Hydrogeological and ecosystem services classification of representative Mediterranean groundwater-related wetlands*. Map (2 sides) and Explanation Memory (25 p).

<http://info.igme.es/cartografiadigital/datos/MedPartnership/Documentacion/Map%20Report.pdf>

[http://info.igme.es/cartografiadigital/datos/MedPartnership/Mapas/Map-side02\\_A3.pdf](http://info.igme.es/cartografiadigital/datos/MedPartnership/Mapas/Map-side02_A3.pdf)

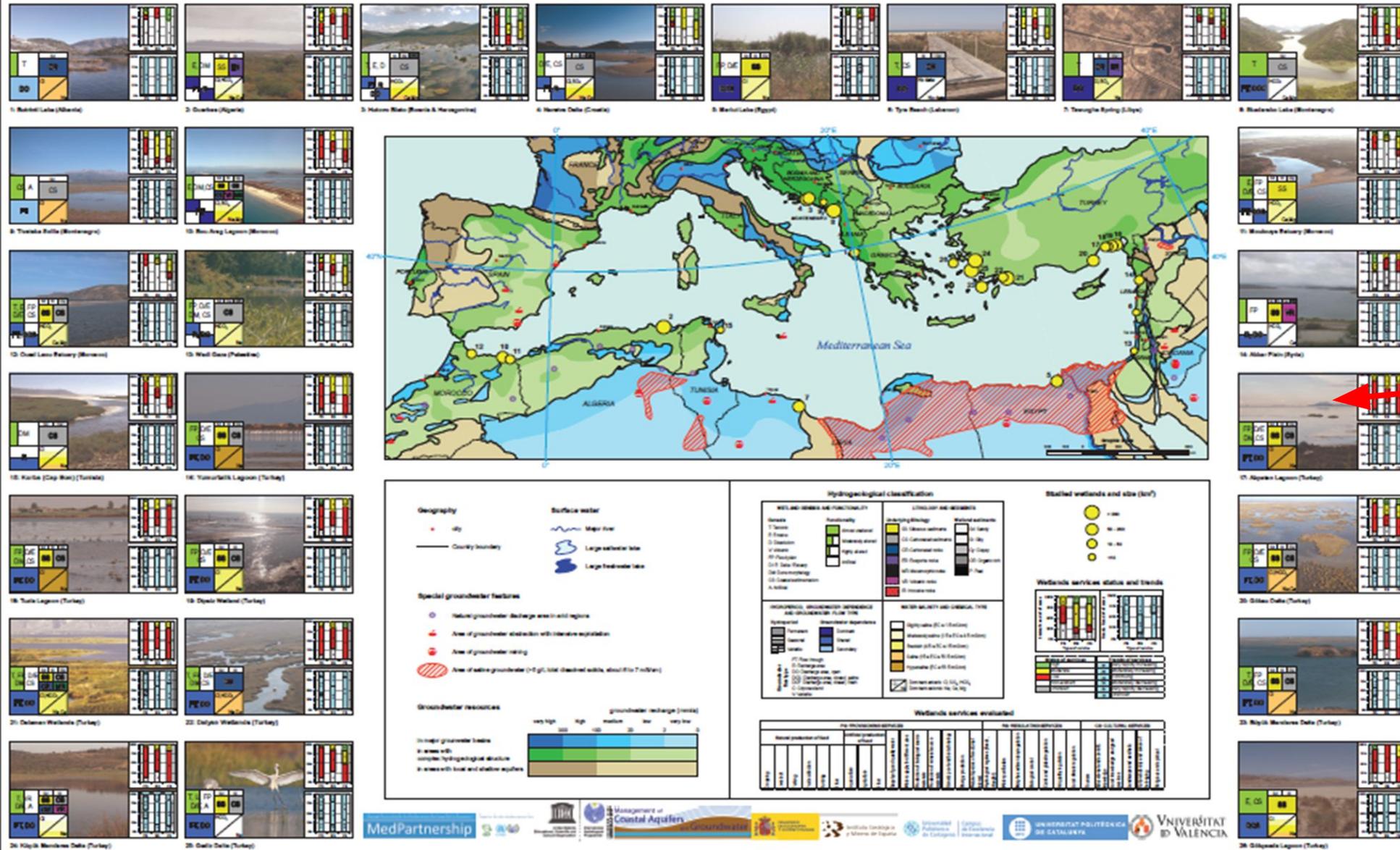
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Explanation Memory



# 2 INTRODUCING THE EA INTO THE MEDPARTNERSHIP PROJECT. Results

## HYDROGEOLOGICAL AND ECOSYSTEM SERVICES CLASSIFICATION OF REPRESENTATIVE MEDITERRANEAN COASTAL GROUNDWATER-RELATED WETLANDS



Map, side 1

Picture, hydrogeological classification, and synthesis of Ecosystem Services Status and Trends as reported by the National Experts.

# 2 INTRODUCING THE EA INTO THE MEDPARTNERSHIP PROJECT. Results

## Map, side 2

### Synthesis of data from the 26 inventoried wetlands:

#### General Data chart

#### Status and trends of Ecosystem Services chart

#### Impact and trends of Drivers of Change chart

#### Credits

MEDITERRANEAN GROUNDWATER RELATED COASTAL WETLANDS INVENTORIED  
General data

Wetland number	Name of wetland, Country	General type	Local climate	Underlying lithology	Morphology	Wetland genesis	Wetland substrate	Water source	Groundwater flow type	Hydrodynamics	Groundwater discharge	Trophic state	Functionality	State of knowledge	Management status
1	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
5	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
6	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
8	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
10	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
11	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
13	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
14	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
15	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
16	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
18	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
19	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
20	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
21	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
22	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
23	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
24	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
25	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...
26	Algeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Ecosystem services are defined as the benefits people obtain from ecosystems (Millennium Ecosystem Assessment 2005). These include provisioning services such as food and water; regulating and supporting services such as regulation of floods, droughts, land degradation, and diseases, soil formation and nutrient cycling and cultural services such as recreational, spiritual, religious, and other nonmaterial benefits. These three categories can also be subdivided into other subgroups.

Under the perspective of human well-being, ecosystems can be considered as a "natural capital" which provides an interest to humans as ecosystem services. The ecological integrity of ecosystems consists in the maintenance of the functional features and the structure of the ecosystem, as well as of their capacity to recover from perturbations (ecological resilience).

Ecological processes in a healthy ecosystem support the capacity of such ecosystem to provide ecosystem services, which are used by humans to increase our well-being. Human activities, however, are the main cause of alterations of ecosystem health, thus affecting the capacity of ecosystems to provide services. These anthropogenic alterations are the so-called "drivers of change" as have been considered in the MedPartnership project.

- Groundwater flow type considered:
- 1. Free flow (unconfined)
  - 2. Water table complex
  - 3. Isolated within a wetland complex
- General type:
- A. Freshwater (unconfined)
  - B. Freshwater (confined)
  - C. Salt water
  - D. Salt water (unconfined)
  - E. Salt water (confined)
  - F. Freshwater (unconfined) spring or outflow
  - G. Freshwater (confined) spring or outflow
  - H. Freshwater (unconfined) spring or outflow
  - I. Freshwater (confined) spring or outflow
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  - 26. Bouček (2010)

MEDITERRANEAN GROUNDWATER RELATED COASTAL WETLANDS INVENTORIED  
Wetlands services contributives to human well-being. Global assessment of status and trends

Wetland number	Name of wetland, Country	Provisioning services	Regulating services	Cultural services	Supporting services
1	Algeria	...	...	...	...
2	Algeria	...	...	...	...
3	Algeria	...	...	...	...
4	Algeria	...	...	...	...
5	Algeria	...	...	...	...
6	Algeria	...	...	...	...
7	Algeria	...	...	...	...
8	Algeria	...	...	...	...
9	Algeria	...	...	...	...
10	Algeria	...	...	...	...
11	Algeria	...	...	...	...
12	Algeria	...	...	...	...
13	Algeria	...	...	...	...
14	Algeria	...	...	...	...
15	Algeria	...	...	...	...
16	Algeria	...	...	...	...
17	Algeria	...	...	...	...
18	Algeria	...	...	...	...
19	Algeria	...	...	...	...
20	Algeria	...	...	...	...
21	Algeria	...	...	...	...
22	Algeria	...	...	...	...
23	Algeria	...	...	...	...
24	Algeria	...	...	...	...
25	Algeria	...	...	...	...
26	Algeria	...	...	...	...

MEDITERRANEAN GROUNDWATER RELATED COASTAL WETLANDS INVENTORIED  
Main direct drivers of change in wetland systems

Wetland number	Name of wetland, Country	Water resources	Biological activities	Physical activities	Chemical activities	Climate change	Land use change	Other drivers
1	Algeria	...	...	...	...	...	...	...
2	Algeria	...	...	...	...	...	...	...
3	Algeria	...	...	...	...	...	...	...
4	Algeria	...	...	...	...	...	...	...
5	Algeria	...	...	...	...	...	...	...
6	Algeria	...	...	...	...	...	...	...
7	Algeria	...	...	...	...	...	...	...
8	Algeria	...	...	...	...	...	...	...
9	Algeria	...	...	...	...	...	...	...
10	Algeria	...	...	...	...	...	...	...
11	Algeria	...	...	...	...	...	...	...
12	Algeria	...	...	...	...	...	...	...
13	Algeria	...	...	...	...	...	...	...
14	Algeria	...	...	...	...	...	...	...
15	Algeria	...	...	...	...	...	...	...
16	Algeria	...	...	...	...	...	...	...
17	Algeria	...	...	...	...	...	...	...
18	Algeria	...	...	...	...	...	...	...
19	Algeria	...	...	...	...	...	...	...
20	Algeria	...	...	...	...	...	...	...
21	Algeria	...	...	...	...	...	...	...
22	Algeria	...	...	...	...	...	...	...
23	Algeria	...	...	...	...	...	...	...
24	Algeria	...	...	...	...	...	...	...
25	Algeria	...	...	...	...	...	...	...
26	Algeria	...	...	...	...	...	...	...

Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem

Donors: GEF, EU, Participating countries.  
Partners: UNEP/MAP (implementing) and 33 co-executing partners including UNESCO, Partner countries: Albania, Algeria, Bosnia & Herzegovina, Croatia, Egypt, Lebanon, Libya, Morocco, Palestine, Syria, Tunisia and Turkey.

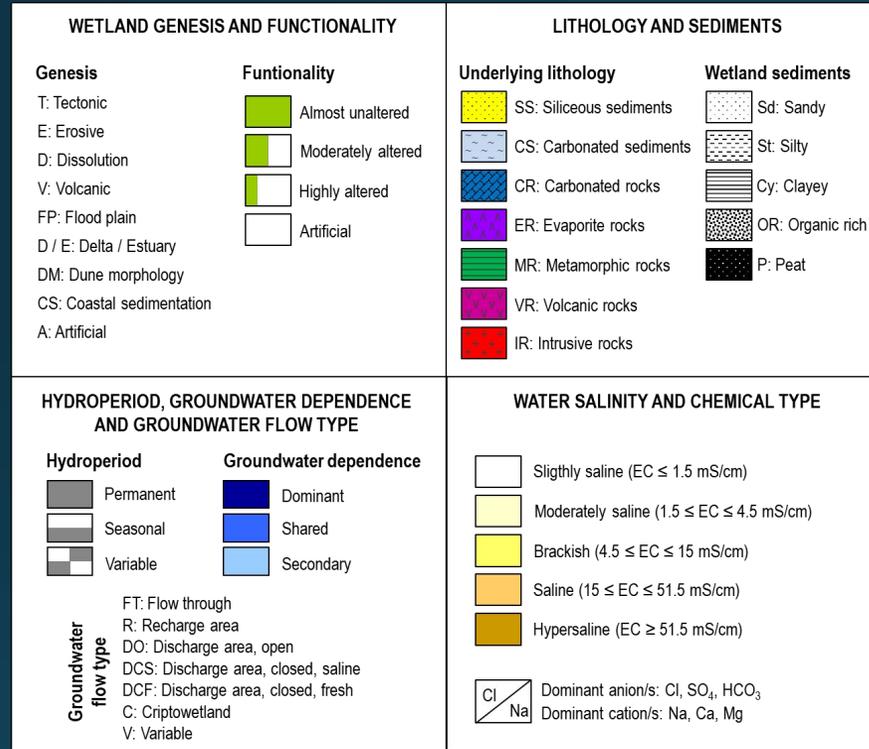
UNESCO II (P) component  
Management of Coastal Aquifers and Groundwater  
Implementation of eco-hydrogeology applications for management and protection of coastal wetlands

Objectives:

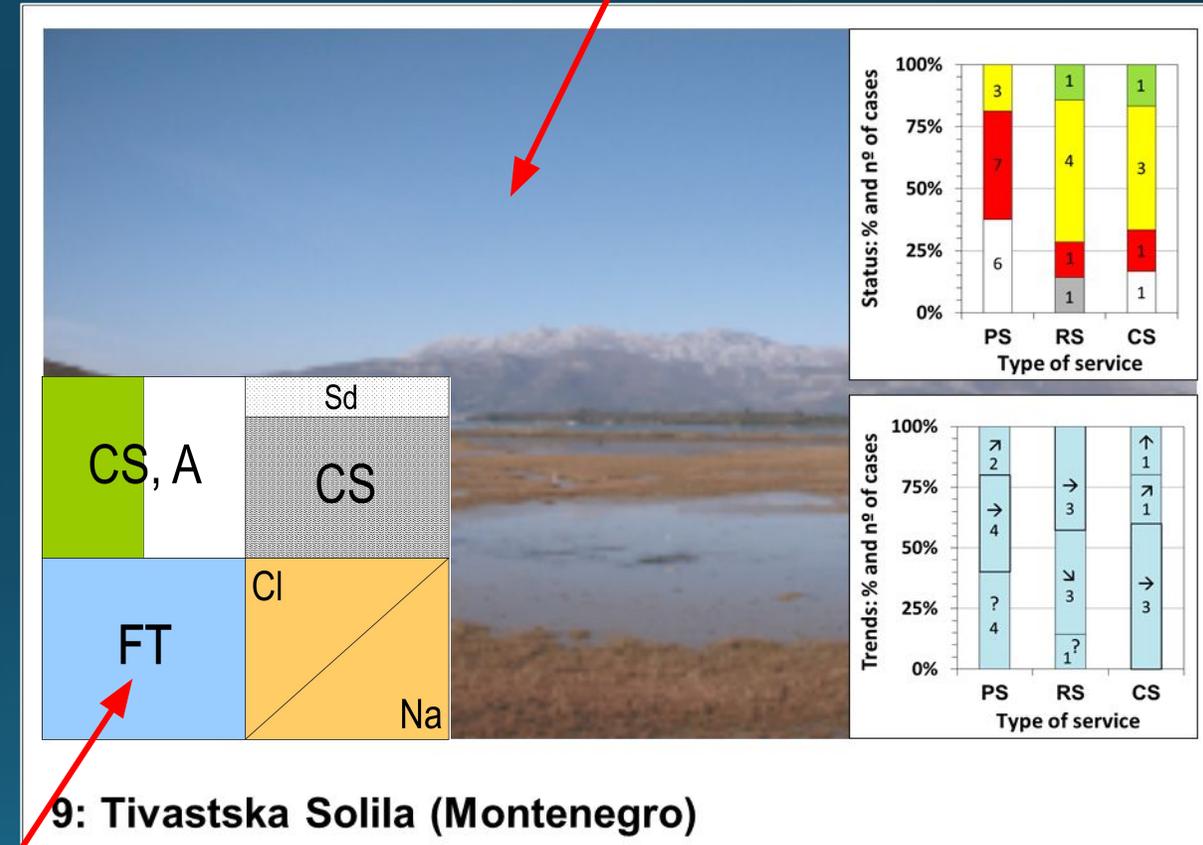
1. Hydro-geological pre-assessment of Mediterranean groundwater dependent ecosystems
2. Methodology and guidelines for hydro-geological management of coastal wetlands.

# 2 INTRODUCING THE EA INTO THE MEDPARTNERSHIP PROJECT. Results

## Hydro-geo-logical legend developed for this work



## Picture provided by the National experts

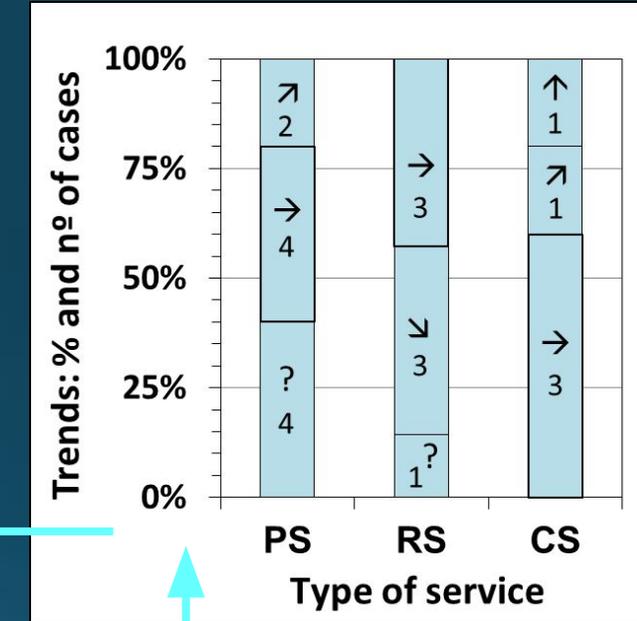
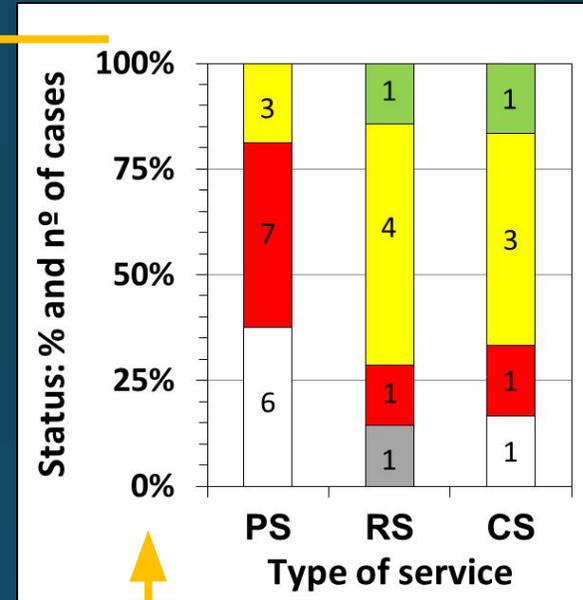
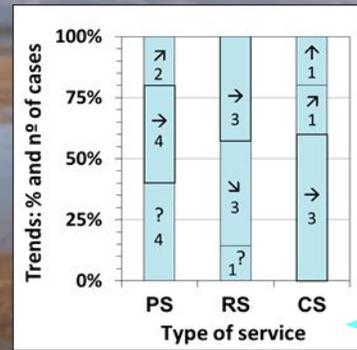
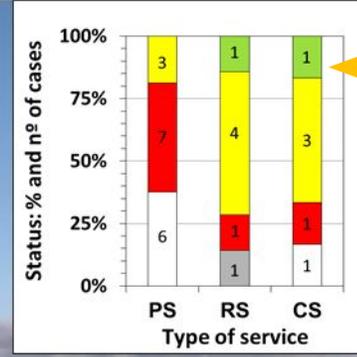
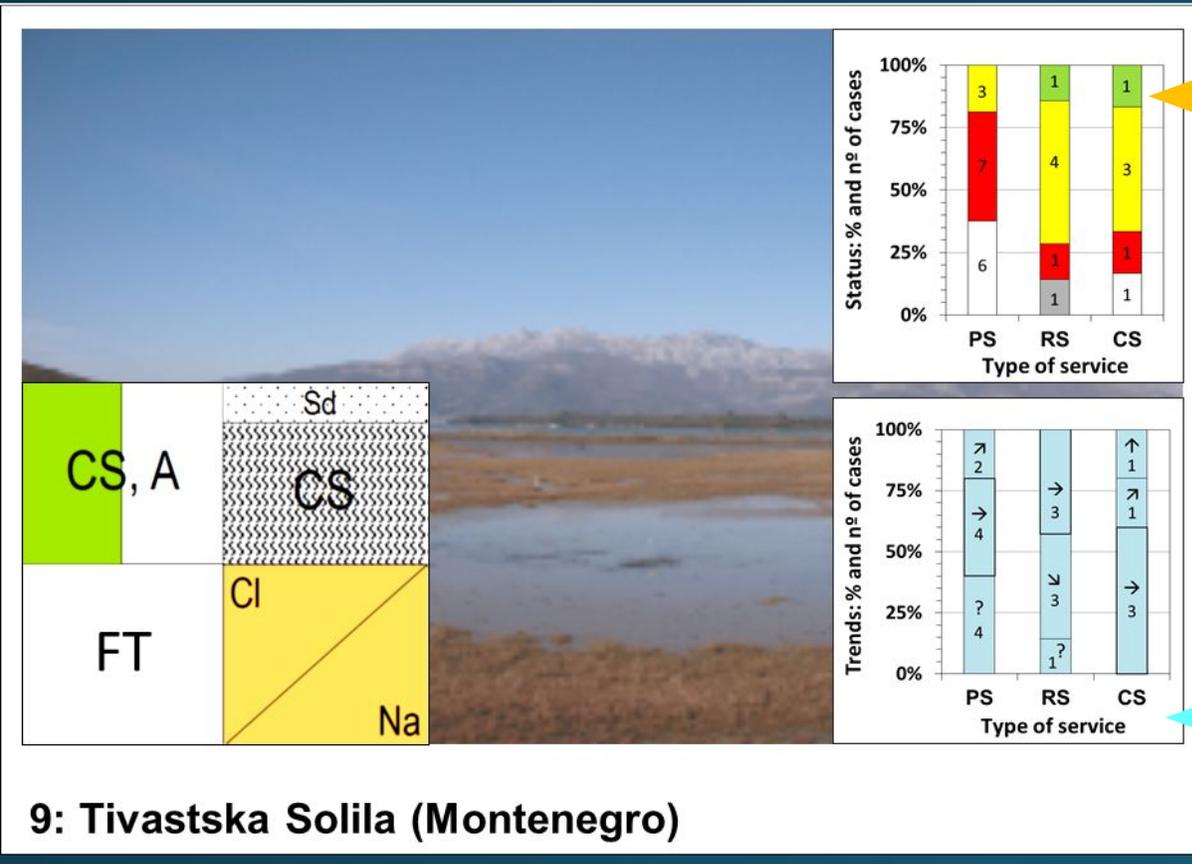


Classification figure done with the information provided by the National Experts in their National Reports (revised and completed, in some cases, by UPCT)

# 2 INTRODUCING THE EA INTO THE MEDPARTNERSHIP PROJECT. Results

## Synthesis of the reported Status for the wetland services

## Synthesis of the reported Trends for the wetland services



Status of wetland services. Nº of cases				
	PS	RS	CS	
High	0	1	1	
Moderate	3	4	3	
Low	7	1	1	
Non-existent	6	0	1	
Unkown	0	1	0	

Trend of wetland services. Nº of cases				
	PS	RS	CS	
↑ Very rapidly increasing	0	0	1	
↗ Moderately increasing	2	0	1	
→ Continuing	4	3	3	
↘ Decreasing	0	3	0	
↓ Very rapidly decreasing	0	0	0	
? Unknown	4	1	0	

### 3 CONCLUDING REMARKS

- Integrating the EA into the activity *Implementation of eco-hydrogeology applications for management and protection of coastal wetlands of the MedPartnership Project* was an encouraging approach.
- All the wetlands evaluated in the MedPartnership project have their functionality altered in different degrees due mostly to three Drivers of change: Intensive water resources exploitation, Changes in land use, and Modification of the hydrological cycle. As a consequence, most of the services of those wetlands are performing at a low level in terms of their contribution to human wellbeing.
- Groundwater plays different but relevant roles in all the wetlands, which suggest that it is a main supporting factor to the functioning of most of the coastal Mediterranean wetlands.
- The work developed can be an example for managers and decision makers of how to identify the relevant Services to human wellbeing to be secured in coastal wetlands, the Drivers of Change to be controlled to minimize loss of services, and the hydrogeological aspects to be understood to preserve the sustaining role of groundwater to many services to human wellbeing provided by Mediterranean coastal wetlands.

## ***National experts of the UNESCO-IHP MedP Project (by country alphabetic order)***

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Larbi Djabri (Algeria)  
Zoran Mateljak (Bosnia-Herzegovina)  
Ognjen Bonacci (Croatia)  
Amr Fadl (Egypt)  
Amin Shaban (Lebanon)  
Omar Salem (Lybia)  
Nour-Eddine Laftouhi (Morocco)  
Khalid Qahman (Palestine)  
Noureddine Gaaloul (Tunisia)  
Kamel Zouari (Tunisia)  
Serdar Bayari (Turkey)  
Dragan Radojevic (Montenegro)  
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Antonio Camacho (UV)  
Africa de la Hera (IGME)  
Alice Aureli (UNESCO-IHP)  
Raya Stephan (UNESCO-IHP)  
Matthew Lagod (UNESCO-IHP)  
Mark Whiteman (EA)  
Gareth Farr (BGS)  
Daniela Russi (IEEP)  
Marco-Prem (PAC/RAC)  
Belén Martí-Cardona (UPC)  
Dave Pritchard (DENDROS)  
Alex Lewis (TERRADAT)

## La Unesco exige a España que cierre las fincas junto a Doñana que PP, Cs y Vox quieren legalizar

El organismo internacional reclama al Gobierno que le informe de la ampliación de regadíos prevista junto a la reserva natural, declarada Patrimonio de la Humanidad



Captación ilegal de agua abandonada a 20 metros del Parque Natural de Doñana, en Lucena del Puerto (Huelva).  
PACO PUENTES

# General remarks

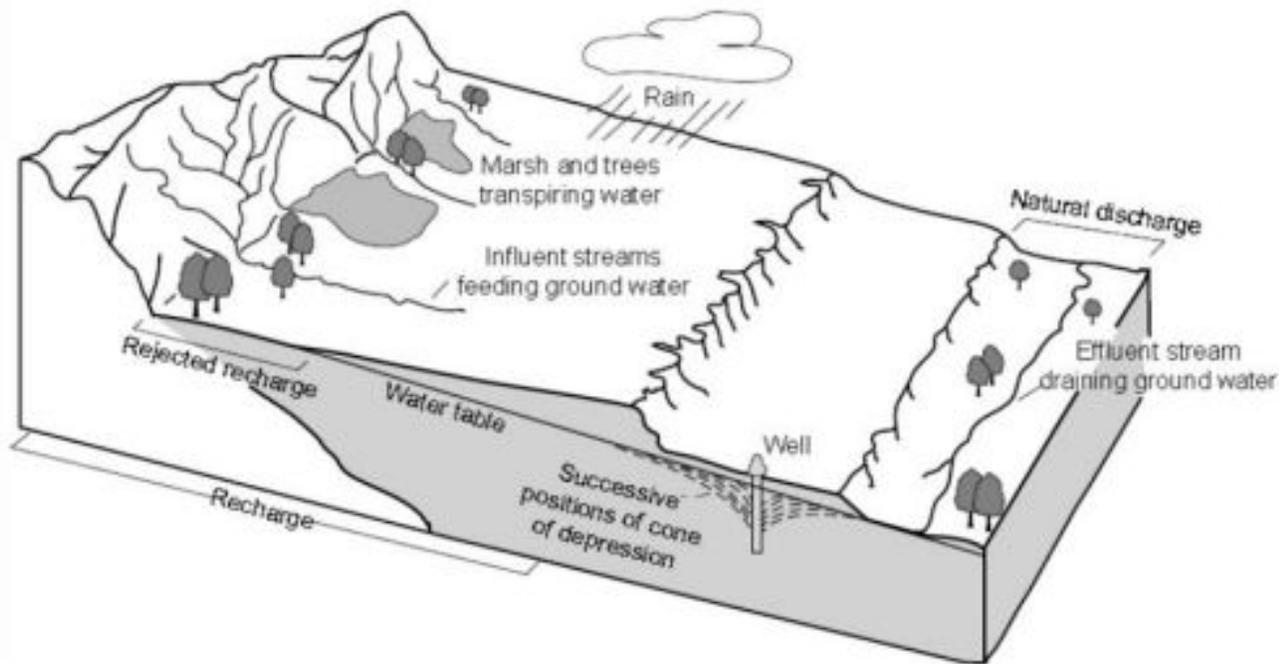


Figure 2.4. Factors controlling the response of an aquifer to discharge by wells. Source: Sophocleous (1998) (adapted from Theis, 1940)

- Groundwater pumping captures flows (*quantitative view*) (through perturbation of table)
- Groundwater pumping redistribute flows (*spatial view*)
- Lack of consideration in decision-making, conclusions of scientists, modelling, formulation of indicators, etc.

# General remarks

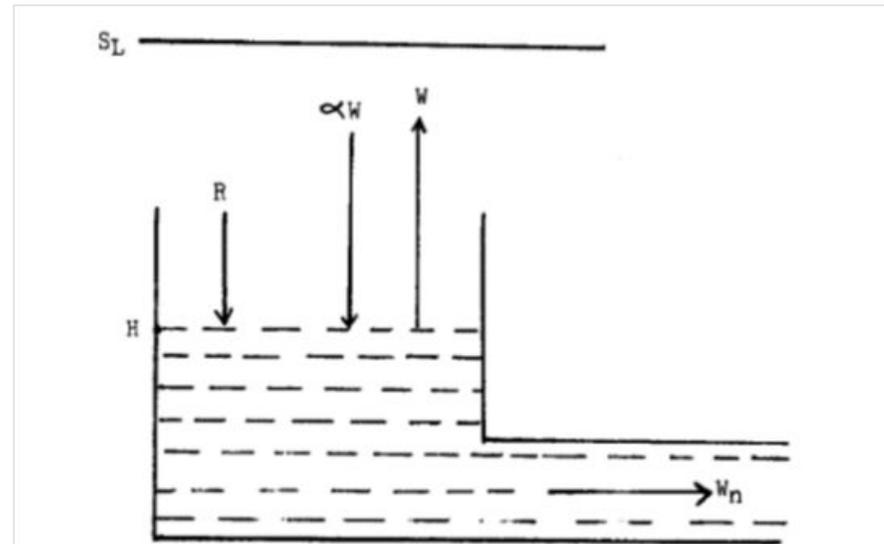


Fig. 1. A model of an aquifer.

The differential equation which describes the water table as a function of time is obtained by equating 'rate in' minus 'rate out' with the impact on the water table, as displayed in Figure 1, namely

$$AS \cdot \dot{H} = R + (\alpha - 1)W \quad (6)$$

where  $R$  is natural recharge,  $\alpha$  is return flow coefficient, and  $AS$  is area of the aquifer times storativity.

Figure 3.2. Extracts of the paper by Gisser & Sánchez (1980) showing that the factor accounting for the outflows in the water budget is disregarded. Source: Gisser & Sánchez (1980).

# • What is conjunctive water management (CWM) ?

1. At area-wide planning level

## **Incorporating all water components**

- Exploring and analysing connectivities and exchanges of water
- Preventing 'double counting'
- Identifying promising opportunities
- Identifying hazards of harmful interaction

2. Activities and techniques at the level of implementation in the field

## **Optimal selection of source of supply**

- Conjunctive use of surface water and groundwater

## **Resource augmentation**

- Managed aquifer recharge (MAR)
- Watershed management (e.g. Water harvesting)
- Desalination of brackish and saline water
- Recycling treated wastewater
- Improvement of irrigation efficiency

## **Environmental control**

- Restricting ground-water pumping to control surface water environmental flows
- Groundwater level control to prevent flooding (e.g. surface water irrigated zones, urbanized wetlands, or polder)
- Managing waste-water