Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem

MedPartnership

Together for the Mediterranean Sea

MAIN HYDRO(GEO)LOGICAL CHARACTERISTICS, ECOSYSTEM SERVICES AND DRIVERS OF CHANGE OF 26 REPRESENTATIVE MEDITERRANEAN GROUNDWATER-RELATED COASTAL WETLANDS

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United Nations Educational, Scientific and Cultural Organization | International Hydrological Programme

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26 REPRESENTATIVE MEDITERRANEAN GROUNDWATER-RELATED COASTAL WETLANDS

Note

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1.

INTRODUCTION AND AIM

Wetlands are landscape features characterized by the permanent or temporary presence of a shallow water depth or a shallow water table. They have high plant productivity, are rich in wildlife and show high species diversity. Since the early stages of civilization, wetlands have been drained, landfilled and ultimately destroyed, with the purpose of obtaining arable land, expanding human habitats, avoiding diseases and also because they were considered useless. In some areas, the disappearance of wetlands has reached 80% of the original surface area. Providentially, in the last decades wetlands have been acknowledged as essential elements in supporting the ecological processes that sustain life on the planet. They are also widely recognized as providing an extensive variety of services for humankind (Acreman and Miller, 2006; Ramsar, 2011). Moreover, they exert a significant influence on the hydrological cycle and, in turn, are influenced by its components, especially groundwater.

Groundwater is vital for many ecosystems, providing crucial support to plants and animals, especially during droughts. "Shallow" groundwater in particular (near the earth's surface) is an essential source of water for many ecosystems, maintaining important wetland habitats and recharging rivers and streams in times of low rainfall (Fan and others, 2013). Many wetlands are related to groundwater and most are partially or even entirely dependent on it, so that any action related to groundwater exploitation may affect wetlands functioning and even their existence. Wetlands located in coastal areas are more probably linked to groundwater than are those located in continental areas for two reasons:

1. shallow water tables are very close to the soil surface in coastal zones, and groundwater usually feeds the existing topographic depressions temporarily or permanently
2. coastal zones are also the areas where medium to large groundwater flow paths discharge to the soil surface.

Thus, many groundwater-related coastal wetlands occur in areas where there are shallow groundwater tables or where groundwater discharges to the surface, but some are linked to deep groundwater flows ascending to the soil surface in the coastal zone. Human-triggered modifications of landscape and land-use activities may produce significant impacts on wetlands and their functions.

As a result of regional and local groundwater processes, coastal wetlands display a wide range of natural typologies such as springs, seepage areas, dune slacks, coastal lagoons, marshlands, abandoned stream courses, deltaic lagoons and ponds, dry ravines and gullies, peatlands, mudflats and saltpans, which are mostly the result of the geological processes originating the wetlands (tectonic, erosional, deltaic/estuarine, aeolian, coastal sedimentation processes, etc.). Artificial coastal wetlands such as salinas, rice fields, excavated channels and ponds may also owe most of their ecological functionality to the presence of groundwater. Both natural and artificial groundwater-related wetlands are abundant along the Mediterranean coastal zone.

Wetlands deliver a wide range of ecosystem services that contribute to human well-being. Following the Millennium Ecosystem Assessment (2005a), ecosystem services can be defined as:

> The benefits people obtain from ecosystems. These include Provisioning Services such as food and water; Regulating and Supporting Services such as regulation of floods, drought, land degradation, and control of diseases, soil formation and nutrient cycling; as well as Cultural Services such as recreational, spiritual, religious, and other nonmaterial benefits.

In groundwater-related coastal wetlands many ecosystem services are derived or supported by the presence of groundwater inflow because of its role in regulating the hydrology of the wetlands. Evaluation of the ecosystem services, their status and trends, is essential for valuing the wetlands, as decision makers at many levels are unaware of the connection between wetland condition and the provision of wetland services and the consequent benefits for people.

Many wetlands around the world have been degraded or destroyed, and their capacity for offering ecosystem services diminished from both anthropogenic and natural causes. In the Millennium Ecosystem Assessment terminology the factors that induce direct changes in wetlands functioning are the so-called "drivers of change". Drivers of change are the causes of shifts in the ecological status of the ecosystems and their capacity for producing services. The degradation and loss of wetlands is more rapid than that of other ecosystems. Similarly, the status of both freshwater and coastal wetland species is deteriorating faster than those of other ecosystems. Direct and indirect drivers of this degradation are mostly associated with human activities. Direct drivers directly affect the ecosystem concerned. In the case of wetlands, they mainly include infrastructure and urban development, land conversion, water withdrawal or disposal, eutrophication and pollution, overharvesting and overexploitation, and the introduction of invasive alien species (Millennium Ecosystem Assessment, 2005a). Indirect drivers are those that affect ecosystems through their consequences. These include population growth, increasing economic activity and development, and climate change.

The aim of this report is to perform a preliminary assessment of 26 Mediterranean groundwater-related coastal wetlands reported by 14 national experts from the countries of the MedPartnership consortium. The report examines:

1. the general geological and hydrogeological characteristics
2. the status and evolution trends of the ecosystem services
3. the drivers that induce changes in wetlands functioning.

This work has benefited from the experience gained by some of the authors in two previous studies of similar aim and scope: the Spanish Millennium Ecosystems Assessment, carried out from 2009 to 2011 in Spain (https://www.dropbox.com/s/2zdlefxa8thwenp/Ecosystems%20and%20biodiversity%20for%20human%20wellbeing%20-%20SNEA%20-%20Shyntesis%20of%20Key%20Findings.pdf?dl=0), and the International Geoscience Programme (IGCP) project IGCP-604 "Hydrological components of the groundwater-wetlands interactions: international cooperation for developing a new conceptual framework in Ibero-American wetlands", carried out from 2011 to 2014 (http://www.mdp.edu.ar/hidrogeologia/IGCP604/description.php). The goal of the latter was to gain knowledge of the interactions between groundwater, wetlands and humans in the Ibero-American countries and Spain.

This report is one of the products of the activity "Implementation of eco-hydrogeology applications for management and protection of coastal wetlands", which is part of the Sub-component 1.1 "Management of Coastal Aquifers and Groundwater" of the project Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem (MedPartnership). The Sub-component 1.1 has been led by UNESCO-IHP.

2.

METHODOLOGY

2.1 DATA COMPILATION

In the framework of the activity "Implementation of eco-hydrogeology applications for management and protection of coastal wetlands", three chart forms were designed and distributed to the national experts to compile the necessary data related to particular coastal wetlands in their countries. The aim and content of each form are shown in the following subsections.

2.1.1 Wetlands general data form

Designed to compile the following general data about the wetlands:

- Name of the wetland and country.
- Wetland type: a classification system was designed specifically for this study (see Figure 2.1).
- Local climate: average rainfall (mm/year); average temperature (°C); average evapotranspiration (mm/year); seasonality (high/low).
- Underlying lithology: siliceous sediments; carbonated sediments; carbonate rocks; evaporite rocks; metamorphic rocks; volcanic rocks; intrusive rocks.
- Morphometry (max-average): surface area (km2); elevation (masl); depth (m); length (m); width (m).
- Wetland genetic processes: tectonic; erosive; dissolution; volcanic; floodplain; delta/estuary; dune morphology; coastal sedimentation; artificial.
- Wetland sediments: sandy; silty; clayey; organic-rich; peat.
- Main water sources: rainfall on the wetland; runoff in the basin; deep groundwater; shallow groundwater; sea (tidal/wave); fluvial inundation; artificial.
- Groundwater flow type: flow through; recharge area; discharge area open; discharge area closed saline; discharge area closed fresh; crypto-wetland; variable.
- Hydroperiod: *pe*rmanent; seasonal; variable.
- Hydrochemistry: electrical conductivity (mS/cm); dominant (>50%) anion/anions; dominant (>50%) cation/cations.
- Groundwater dependence: dominant; shared; secondary
- Dominant vegetation: forest; shrubs; bushes; prairie; halophytic vegetation; phreatophytic vegetation.
- Trophic state: oligotrophic; mesotrophic; eutrophic; hypereutrophic.
- Functionality: almost unaltered; moderately altered; highly altered; artificial.
- Current state of knowledge: validated hydrogeological conceptual model; numerical model, chemical/isotopic information; biological information; socioeconomic information; water level monitoring; groundwater level monitoring; water quality monitoring; groundwater quality monitoring; hydrogeological studies; wetland evolution studies; climate change impact studies; global change impact studies; information on wetland's uses.
- Management status: Ramsar site; UNESCO programme Man and Biosphere (MAB), natural reserve/other; unprotected; protection regulation; management authority; users' involvement.

The aspect and content of the general data form are shown in Figure 2.1.

2.1.2 Wetlands services contributing to human well-being. Global assessment of status and trends form (ecosystem services form)

Designed to compile information related to specific ecosystem services provided by the inventoried groundwater-related wetlands. Three main groups of ecosystem services have been considered: Provisioning (products obtained from ecosystems), Regulating (benefits obtained from regulation processes) and Cultural (nonmaterial benefits obtained from ecosystems). Each main group consists of the following sets of particular services:

- Provisioning Services:
  - Food: both natural and artificial food production have been considered (wild cropping, fishing and hunting; agriculture, aquaculture and livestock farming). An "other" item was added to this and all the services to allow the specifying of an existing service not otherwise mentioned.
  - Supply of good-quality water: supply of water for human use in different activities including drinking water production, irrigation, feedstock and industry.
  - Production of biological source materials including fibre; timber; organic matter; peat; microorganisms; vegetal and animal tissues.
  - Production of mineral source materials including salts; metals (pyrite, calcium, iron, etc.); clay and clay minerals; sands; salts; stromatolites;…
  - Energy production including tidal; wind and sun power.
  - Natural species of medicinal interest: aromatic; cosmetic and medicinal plants.
  - Genetic pool and biotechnology: genes of interest for biotechnological purposes.
- Regulating Services:
  - Hydrological regimes: including physical buffering from floods; protection from sea-level rise and storm effects in coastal areas (e.g. coastal wetlands, such as coastal river floodplains, play an important role in reducing the impacts of floodwaters produced by storm events); mitigation of drought effects; groundwater recharge and discharge; other.
  - Water purification: retention, transformation and removal of pollutants; improvement of water quality.
  - Morpho-sedimentary regulation: retention and export of soil and sediments.
  - Biological control: including habitat for resident or transient species; preservation of ecological interactions

(e.g. pollination, trophic linkages) and biological diversity; resistance to species invasions, discharge; other.

- Carbon sink and global regulation: sequestering and release of carbon.
- Biogeochemical cycles: nutrient retention and transformation; accumulation of organic matter; detoxification of pollutants (e.g. reduction of nitrate concentrations by enhanced denitrification in wetland sediments).
- Air quality regulation: oxygen generation; chemical composition of the atmosphere; retention of greenhouse gases.
- Local climate regulation: influence on local temperature, precipitation; and other meteorological variables.

• Cultural Services:
  - Tourism: knowledge of nature, leisure, and recreational activities linked to natural areas.
  - Educational and scientific knowledge: tools for education and training; information source for the advancement of science.
  - Local knowledge and good practices: maintenance of traditional knowledge regarding sustainable exploitation of natural resources.
  - Landscape and aesthetic: relaxation, emotional response, sense of beauty, appreciation of natural features.
  - Cultural identity and sense of belonging: identity by perceiving wetlands as a local heritage.
  - Religious and spiritual: source of inspiration; sacredness; seat of spiritual values.

For the evaluation of ecosystem services provided by groundwater-related wetlands the same methodological approach used for the United Nations *Millennium Ecosystem Assessment* (Millennium Ecosystem Assessment, 2005a and 2005b), for the Spanish Millennium Ecosystem Assessment (Ecomilenio, 2011; SNEA, 2014) and for the IGCP-604 project (Bocanegra and others, 2013) has been used. The above-mentioned sets of services have been considered for each particular wetland reported upon.

The evaluation reports the current status of each service by means of a code of colours, and the observed or forecasted trends under the most probable scenario using a code of arrows. The aspect and content of the ecoservices form and the code used for the evaluation of services are shown in Figure 2.2.

2.1.3 Main direct drivers of change in wetland systems form (drivers of change form)

To evaluate the drivers of change to groundwater-related wetlands and their services, the following seven main categories and subcategories (particular drivers within each main group) have been used:

1. *Resource exploitation* (*RE*). This refers to the degree of sustainability of the maintenance (or not) of the ecological integrity of the wetland because of this exploitation. Three main resources have been considered: water, biological materials and mineral materials:
   - Water abstraction: from the wetland; from tributaries; from groundwater near the wetland; from groundwater in the basin
   - Biological exploitation: crops; forest; fishing; others
   - Mineral exploitation: fuel; salts; rocks; others.
2. *Changes in land use* (*CLU*). This may alter the capacity to maintain ecological health or cause ecosystem loss. Nine drivers have been considered:
   - Deforestation
   - Reforestation
   - Forest management
   - Replacement of species
   - Extensive agriculture
   - Extensive cattle raising
   - Urbanization
   - Roads
   - Others.
3. *Modification of the hydrological cycle* (*MH*). This may cause hydrological changes compared to the natural regime in terms of water amount. Six drivers have been considered:
   - Drainage
   - Input of excess irrigation water
   - Storage usage
   - Artificial recharge
   - Input of urban wastewater
   - Others.
4. *Pollution* (*P*). This may cause changes in the physical, chemical and/or biological quality of wetland water, sediments and/or biota). Three drivers have been considered:
   - Diffuse agricultural pollution
   - Diffuse atmospheric pollution
   - Urban or industrial point source pollution.
5. *Alteration of biological community structure and ecosystem functioning* (*AB*). This may cause changes in the provision of any kind of ecosystem services. Four drivers have been considered:
   - Invasive exotic species
   - Native species extinction
   - Alteration of biogeochemical cycles
   - Fragmentation.
6. *Effects associated with changes* (*EAC*) (occurrence of these effects resulting from the existence of other drivers). Five drivers have been considered:
   - Changes in chemical water quality
   - Changes in biological water quality
   - Oxidation by lowering the water table
   - Increased erosion

- Soil destruction.

7. *Global and climate changes* (*GCC*) (changes in the patterns of these drivers). Three drivers have been considered:
    - Rainfall
    - Temperature
    - Sea-level rise.

A code based on colours and arrows has been used to evaluate the drivers of change in ecosystem services. Colours refer to the qualitative degree of impact of changes promoted by a particular driver on wetland ecological integrity; arrows show a prognosis of the future impact of the driver of change in the most probable future scenario. The aspect and content of the drivers form and the code used to evaluate the drivers of change are shown in Figure 2.3.

2.2 WETLANDS REPORTED BY NATIONAL EXPERTS AND WETLANDS EVALUATED

Twenty-seven wetlands were inventoried and reported on by the expert representatives of the 13 Mediterranean countries shown in Table 2.1. However, after performing checks, it was realised that one of the wetlands reported (Deir El-Nouriyeh, in Lebanon) is not really a wetland, but a vegetated vertical cliff that constitutes a relevant site for migrating birds. The site is even included in the Ramsar list, but from the scientific point of view it is not a wetland. Thus, in agreement with the Lebanon national expert, it was decided to exclude this site from the report, and only 26 wetlands have been evaluated.

Table 2.1. Coastal wetlands reported per country and national expert undertaking the report

Country	Wetlands reported	National Expert
Albania	Butrinti	Emanuela Kiri
Algeria	Guerbes	Larbi Djabri
Bosnia and Herzegovina	Hutovo Blato	Zoran Mateljak
Croatia	Neretva Delta	Ognjen Bonacci
Egypt	Lake Mariut	Amr Fadl
Lebanon	Deir El-Nouriyeh*	Amin Shaban
Lebanon	Tyre Beach	Amin Shaban
Libya	Tawurgha Spring	Omar Salem
Montenegro	Skadarsko Lake	Dragan Radojevic
Montenegro	Tivatska Solila	Dragan Radojevic
Morocco	Bou Areg Lagoon	Nour-Eddine Laftouhi
Morocco	Moulouya Estuary	Nour-Eddine Laftouhi
Morocco	Oued Laou Estuary	Nour-Eddine Laftouhi
Palestine	Wetland of Wadi Gaza	Khalid Qahman
Syria	Akkar Plain	Abdullah Droubi
Tunisia	Korba (Cap Bon) Lagoon	Noureddine Gaaloul and Kamel Zouari
Turkey	Yumurtalık Lagoon	Serdar Bayari
Turkey	Akyatan Lagoon	Serdar Bayari
Turkey	Tuzla Lagoon	Serdar Bayari
Turkey	Dipsiz Wetland	Serdar Bayari
Turkey	Göksu Delta	Serdar Bayari
Tukey	Dalaman Wetlands	Serdar Bayari
Turkey	Dalyan Wetlands	Serdar Bayari
Turkey	Büyük Menderes Delta	Serdar Bayari
Turkey	Küçük Menderes Delta	Serdar Bayari
Turkey	Gediz Delta	Serdar Bayari
Turkey	Gökçeada Lagoon	Serdar Bayari

2.3 METHODOLOGY USED FOR DATA EVALUATION

As reports are available for only a small number of wetlands, their data cannot be properly evaluated with statistical tools. Thus, a simple case-counting has been performed and described.

Figure 2.1. Aspect and content of the *General data* form.

MEDITERRANEAN GROUNDWATER-RELATED COASTAL WETLANDS INVENTORIED

General data

Inventory number	Name of wetland, country	General type (see below)	Local climate					Underlying lithology							Morphometry					Wetland genesis									Wetland sediments					Water source						
			Average rainfall (mm/year)	Average temperature (ºC)	Average evapotranspiration (mm/year)	High seasonality	Low seasonality	Siliceous sediments	Carbonated sediments	Carbonate rocks	Evaporite rocks	Metamorphic rocks	Volcanic rocks	Intrusive rocks	Suface area (km2)	Elevation, max. - average (m.a.s.l.)	Depth, max. - average (m)	Length, max. - average (m)	Width, max. - average (m)	Tectonic	Erosive	Dissolution	Volcanic	Floodplain	Delta/estuary	Dune morphology	Coastal sedimentation	Artificial	Sandy	Silty	Clayey	Organic-rich	Peat	Rainfall on the wetland	Runoff in the basin	Deep groundwater	Shallow groundwater	Sea (tidal/wave influence)	Fluvial inundation	Artificial

Inventory number	Name of wetland, country	General type (see below)	Local climate					Underlying lithology							Morphometry				
			Average rainfall (mm/year)	Average temperature (ºC)	Average evapotranspiration (mm/year)	High seasonality	Low seasonality	Siliceous sediments	Carbonated sediments	Carbonate rocks	Evaporite rocks	Metamorphic rocks	Volcanic rocks	Intrusive rocks	Suface area (km2)	Elevation, max. - average (m.a.s.l.)	Depth, max. - average (m)	Length, max. - average (m)	Width, max. - average (m)
1	Butrinti, Albania	2H	1500	18.7	1260	•				•					16	1	21.4 - 14	7100 -	3200 -

Wetland genesis									Wetland sediments					Water source							Groundwater flow type (see below)							Hydro - period		
Tectonic	Erosive	Dissolution	Volcanic	Floodplain	Delta/estuary	Dune morphology	Coastal sedimentation	Artificial	Sandy	Silty	Clayey	Organic-rich	Peat	Rainfall on the wetland	Runoff in the basin	Deep groundwater	Shallow groundwater	Sea (tidal/wave influence)	Fluvial inundation	Artificial	Flow through	Recharge area	Discharge area, open	Discharge area, closed saline	Discharge area, closed fresh	Cripto-wetland	Variable	Permanent	Seasonal	Variable
•									•					•				•					•					•		

Groundwater flow type (see below)							Hydroperiod			Hydrochemistry			Groundwater dependence			Dominant vegetation					Trophic state				Functionality				State of knowledge														Management status						
Flow through	Recharge area	Discharge area, open	Discharge area, closed saline	Discharge area, closed fresh	Cripto-wetland	Variable	Permanent	Seasonal	Variable	Electrical conductivity (mS/cm) (*)	Dominant (> 50%) anion/anions	Dominant (> 50%) cation/cations	Dominant	Shared	Secondary	Forest	Shrubs, bushes	Prairie	Halophytic vegetation	Phreatophytic vegetation	Oligotrophic	Mesotrophic	Eutrophic	Hypereutrophic	Almost unaltered	Moderately altered	Highly altered	Artificial	Validated hydrogeological conceptual model	Numerical model	Chemical/isotopic information	Biological information	Socio-economic information	Water level monitoring	Groundwater level monitoring	Water quality monitoring	Groundwater quality monitoring	Hydrogeological studies	Wetland evolution studies	Climate change impact studies	Global change impact studies	Information on wetland's uses	Ramsar site	MAB	Natural reserve/other	Unprotected	Protection regulation	Management authority	Users' involvement

Hydrochemistry			Groundwater dependence			Dominant vegetation					Trophic state				Functionality				State of knowledge														Management status						
Electrical conductivity (mS/cm) (*)	Dominant (> 50%) anion/anions	Dominant (> 50%) cation/cations	Dominant	Shared	Secondary	Forest	Shrubs, bushes	Prairie	Halophytic vegetation	Phreatophytic vegetation	Oligotrophic	Mesotrophic	Eutrophic	Hypereutrophic	Almost unaltered	Moderately altered	Highly altered	Artificial	Validated hydrogeological conceptual model	Numerical model	Chemical/isotopic information	Biological information	Socio-economic information	Water level monitoring	Groundwater level monitoring	Water quality monitoring	Groundwater quality monitoring	Hydrogeological studies	Wetland evolution studies	Climate change impact studies	Global change impact studies	Information on wetland's uses	Ramsar site	MAB	Natural reserve/other	Unprotected	Protection regulation	Management authority	Users' involvement
20 - 40	Cl	Na			•		•						•				•							•	•	•	•					•	•					•	

General types of coastal wetlands considered in this work. They result from the combination of one (or more) number and one (or more) letter.

1 Isolated wetland	A Fresh/brackish coastal lagoon/lake	H Flood plain pool/lagoon	O Dune slacks
2 Wetland complex	B Salt lake	I Deltaic lagoon/pool	P Spring
3 Isolated within a wetland complex	C Salt pan	J Estuary	Q Seepage from shallow water table
	D Natural, concentrated spring or outflow	K Riparian forest	R Saline (artificial)
	E Fresh-water marsh	L Erosive depression	S Reservoir (artificial)
	F Brackish marsh	M Tectonic depression	T Other
	G Salt marsh	N Water course	

Figure 2.2. Aspect and content of the *Ecosystem services* form, and criteria for evaluation of the status and evolution trends of the services considered

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

PROVISIONING SERVICES

Inventory number	Name of wetland, country	Type	Natural production of food: Cropping	Livestock	Fishing	Fruit collection	Hunting	Other	Artificial production of food: Aquaculture	Agriculture	Other	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
1	Butrinti, Albania	2H		Moderate →	High →				Moderate →			Low →	Low →					

REGULATING SERVICES and CULTURAL SERVICES

Inventory number	Name of wetland, country	Type	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
1	Butrinti, Albania	2H	Low →			Low →				High →				High →	

Status of services

- High
- Moderate
- Low
- Non-existent
- Unknown

Trends of services

- ↑ Very rapidly increasing
- ↗ Moderately increasing
- → Continuing
- ↘ Moderately decreasing
- ↓ Very rapidly decreasing
- ? Unknown

Figure 2.3. Aspect and content of the *Drivers of change* form, and criteria for the evaluation of impact degree and trends of the drivers considered

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

Resource exploitation

Inventory number	Name of wetland, country	Type	Water abstraction: From wetland	From tributaries	Groundwater next to the wetland	Groundwater basin	Biological exploitation: Crops	Forest	Cattle raising	Fishing	Others	Mineral exploitation: Fuel	Salts	Soils	Rocks	Others
1	Butrinti, Albania	2H		Low →		Moderate →				High →			High →			

Changes in land use; Modification of the hydrological cycle

Inventory number	Name of wetland, country	Type	Changes in land use: Deforestation	Reforestation	Forest management	Replacement of species	Extensive agriculture	Extensive cattle raising	Urbanization	Roads	Others	Modification of the hydrological cycle: Drainage	Input of excess irrigation	Storage usage	Artificial recharge	Input of urban wastewater	Others
1	Butrinti, Albania	2H							High ↗	Moderate ↗						Moderate →	

Pollution; Alteration of biological community structures and ecosystem functioning; Effects associated with changes; Global and climate changes

Inventory number	Name of wetland, country	Type	Pollution: Agricultural diffuse pollution	Atmospheric diffuse pollution	Urban/industrial point source pollution	Alteration of biological community structures and ecosystem functioning: Invasive exotic species	Native species extinction	Alteration of biogeochemical cycles	Fragmentation	Effects associated with changes: Chemical water quality	Biological water quality	Oxidation by lowering water table	Increased erosion	Soil destruction	Global and climate changes: Rainfall	Temperature	Sea level rise
1	Butrinti, Albania	2H			Moderate →		Moderate →			High ↗					Moderate ↘	Moderate ↗	Moderate ↗

Impact of drivers

- High
- Moderate
- Low
- Non-existent
- Unknown

Trends of drivers

- ↑ Very rapidly increasing
- ↗ Moderately increasing
- → Continuing
- ↘ Moderately decreasing
- ↓ Very rapidly decreasing

3.

REPORTED GENERAL CHARACTERISTICS OF THE COASTAL WETLANDS: MAIN RESULTS

This section includes an analysis of a set of aspects selected from those included in the wetlands General data form shown in Figure 2.1. The selected subjects are: wetland genesis; water salinity; wetland functionality; hydroperiod; groundwater dependence; groundwater flow type; current state of knowledge; and management status.

3.1 WETLAND GENESIS

The different geological genesis considered for the Mediterranean coastal wetlands are shown in Figure 2.1. Only three of the 26 wetlands evaluated originated from a unique geological process; this is the same for all three: tectonics. The remaining wetlands originated from a combination of two to five of the processes considered, and five of the wetlands have some man-made (artificial) element.

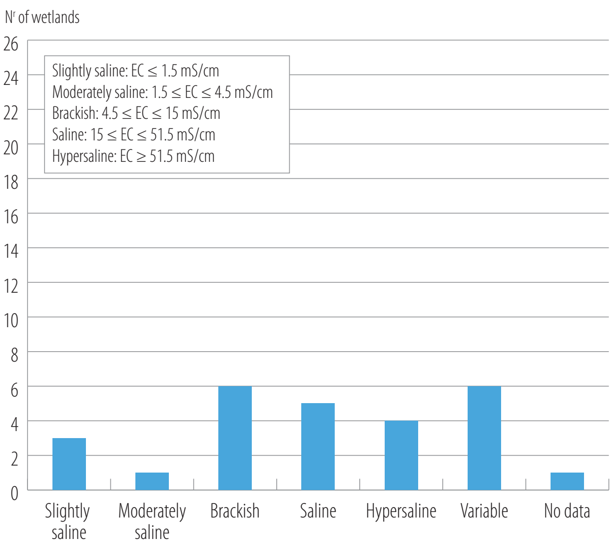
The most common genetic processes for the wetlands basin correspond to delta/estuary, dune morphology, coastal sedimentation and flood plain.

This mixed genesis is common to almost all wetlands worldwide that are located in coastal areas, and so the wetlands evaluated can be considered as good representatives of the major part of the Mediterranean coastal wetlands.

3.2 WATER SALINITY

Most of the evaluated wetlands are brackish to hypersaline (Figure 3.1). A number of them (6 of 26) have *variable* salinity, with a wide salinity range from slightly saline to saline or hypersaline. A smaller number (4) are slightly to moderately saline.

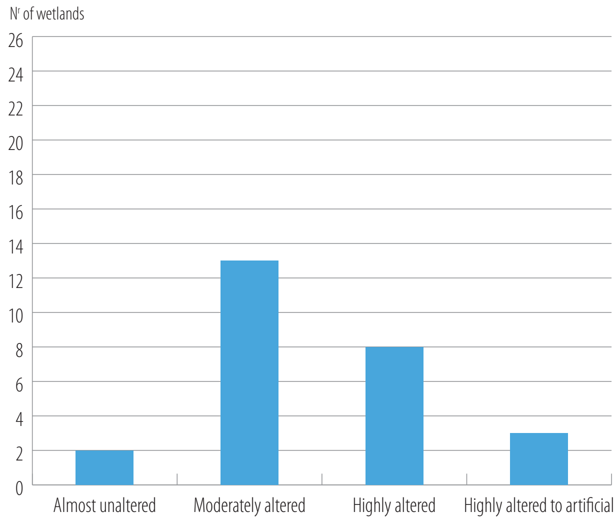
Figure 3.1. Water salinity reported for the evaluated wetlands. EC: electrical conductivity



3.3 FUNCTIONALITY

Most of the wetlands (24 of 26) have been reported as being altered in different degrees (Figure 3.2): 13 are *moderately altered*, 8 are *highly altered* and 3 are *very highly altered* to artificial. Only 2 of the 26 wetlands are reported as being *almost unaltered*.

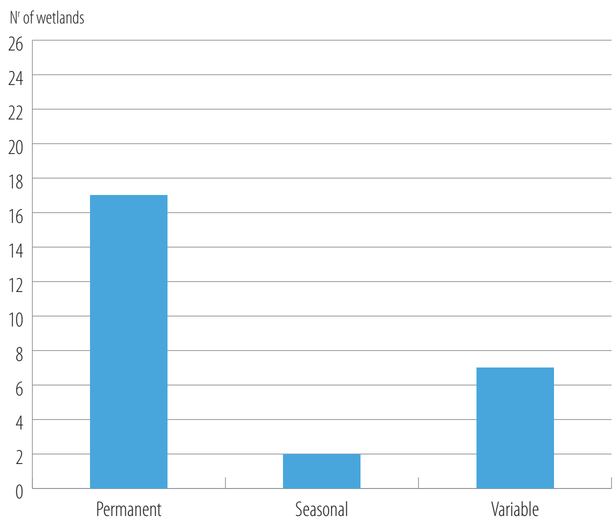
Figure 3.2. Functionality reported for the evaluated wetlands



3.4 HYDROPERIOD

Most of the wetlands inventoried are *permanent* (17 of 26); a few are *seasonal* (2 of 26) and up to 7 have a *variable* hydroperiod (Figure 3.3).

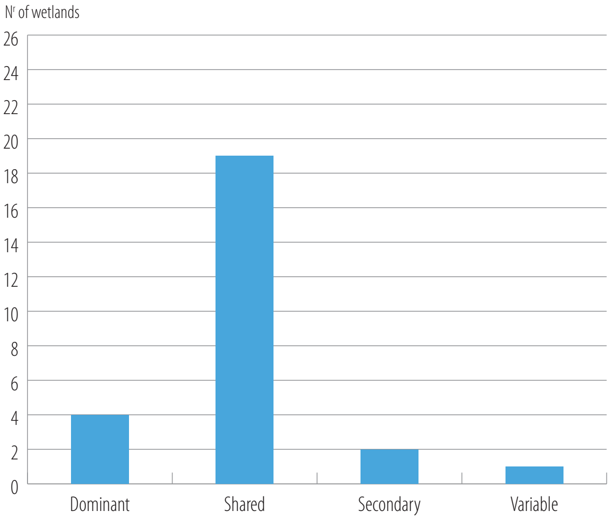
Figure 3.3. Type of hydroperiod reported for the evaluated wetlands



3.5 GROUNDWATER DEPENDENCE

Groundwater plays a *dominant* role in a small number of wetlands (4), a *shared* role in most of the wetlands (19), a *secondary* role in only 2 wetlands and a *variable* role in 1 of the inventoried wetlands (Figure 3.4). This means that groundwater is probably a main supporting factor to the ecology of most of the coastal Mediterranean wetlands.

Figure 3.4. Degree of groundwater dependence reported for the evaluated wetlands



3.6 GROUNDWATER FLOW TYPE

Only 8 of the 26 wetlands inventoried have been reported as corresponding to only one of the six basic groundwater flow types considered (Figure 3.5). Most of the wetlands (18) do not show a dominant flow type, but instead had *variable* combinations of basic types. One of these associations is more abundant than the others (Figure 3.6): the combination of groundwater *flow through* and groundwater *discharge in an open area* is reported to occur in nine wetlands.

Figure 3.5. Number of wetlands reported as having single or combined *(variable)* groundwater flow type

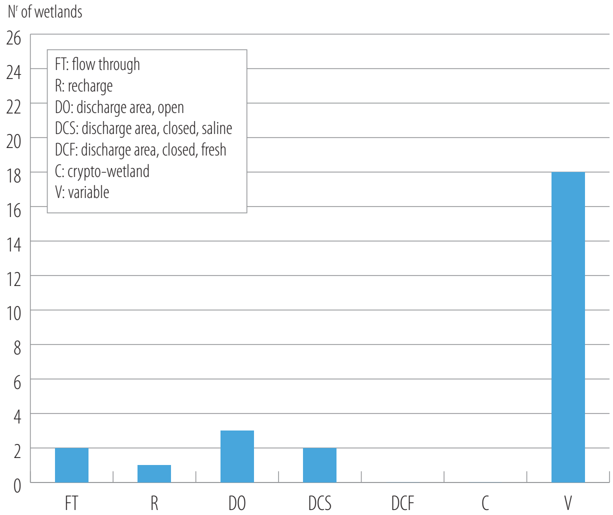
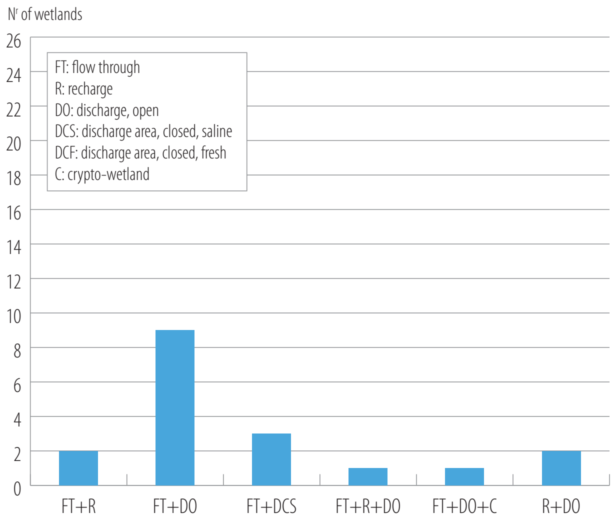


Figure 3.6. Number of wetlands reported as having mixed, *variable* groundwater flow types



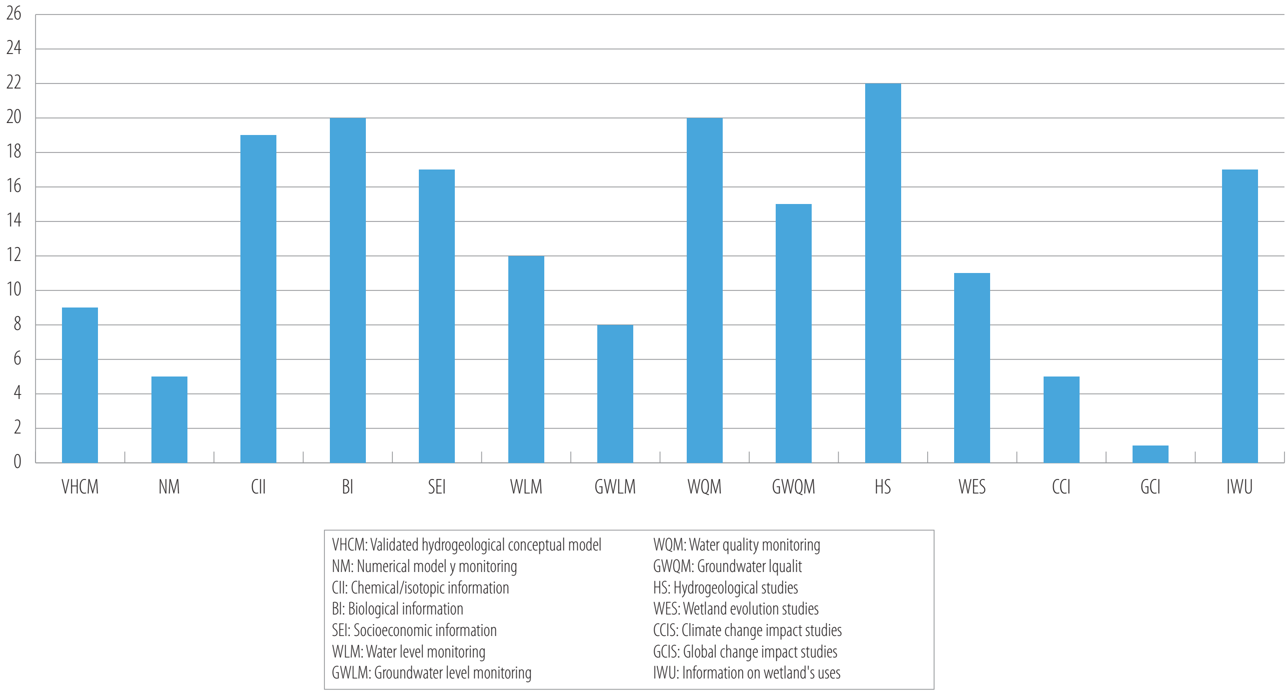
Thus, a major part of the inventoried coastal wetlands are flow-through areas with respect to groundwater flow, and most have parts behaving as groundwater discharge areas, either open or closed at the surface. This result once again points to the fact that groundwater must play a major role in the services provided by these wetlands.

3.7 CURRENT STATE OF KNOWLEDGE

The information reported by the country experts provides abundant scientific and technical information about all the wetlands inventoried (Figure 3.7). For many of the wetlands there exist some types of information that only generate from specialized scientific studies, such as chemical and isotopic information (reported from

19 wetlands), biological information (reported from 20 wetlands) or socioeconomic information (reported from 17 wetlands). This means that the inventoried wetlands are relevant landscape elements for the participating countries.

Figure 3.7. Current state of knowledge reported for the evaluated wetlands (available information).



Monitoring surveys are available for a good number of wetlands on water levels (12 wetlands), water quality (20 wetlands), groundwater levels (8 wetlands) and groundwater quality (15 wetlands). These activities are essential to understanding wetlands functioning, as well as the relationships between wetlands and groundwater. This would mean that, at least in theory, for most of the inventoried wetlands a good part of the information needed to perform a functional evaluation is already available.

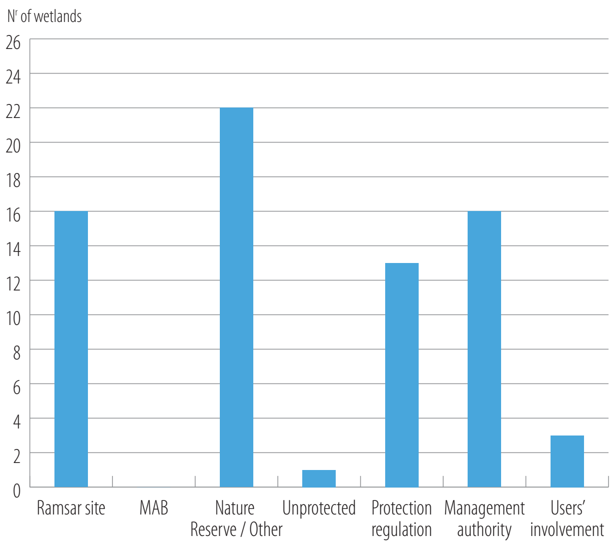
3.8 MANAGEMENT STATUS

Only one of the 26 wetlands evaluated does not have any type of protection, neither at national nor at international scale: the Akkar Plain, in the north of Syria. All the other wetlands have one or more levels of protection: 22 have a minimum level of protection as Nature reserves; 16 are Ramsar sites; 16 have a Management authority; 11 have some Protection regulation; and in 3 wetlands (Tawurga Spring, in Libya; and Dalaman and Dalyan wetlands, in Turkey) there is some type of Users' involvement in the management of the wetland (Figure 3.8).

The situation of the Akkar Plain wetlands in Syria reveals the great differences still existing along the Mediterranean coastline, even though the coastal zone of Syria is one of the main natural resources of the country, to which the Akkar Plain wetlands contribute.

The fact that the majority of the reported wetlands have been considered elements worth protecting suggests that most of the countries participating in this activity are conscious of the role that wetlands play for the well-being of their environment in general, including human well-being.

Figure 3.8. Reported management status for the evaluated wetlands



4. SERVICES PROVIDED BY THE EVALUATED MEDITERRANEAN GROUNDWATER-RELATED COASTAL WETLANDS: MAIN RESULTS

This section comprises the following information:

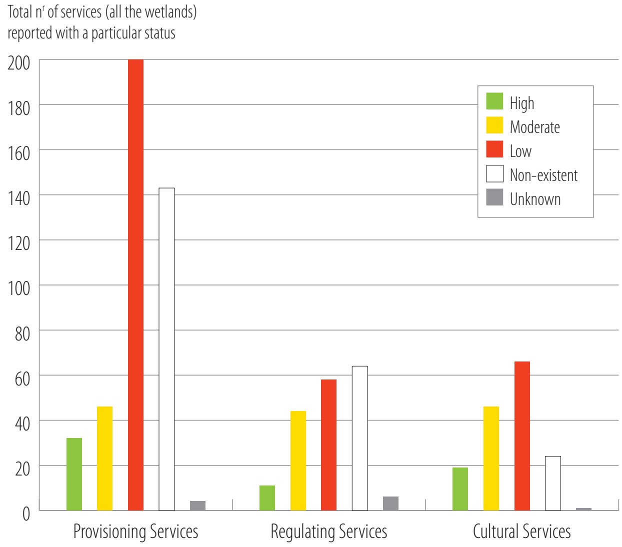
- Subsection 4.1: a description of the compared performance status reported for the three main types of Ecosystem services considered in this work: Provisioning Services, Regulating Services and Cultural Services.
- Subsection 4.2: a description of the compared evolution trends of the three main types of ecosystem services considered.
- Subsection 4.3: a description of the evolution trends reported for the specific services evaluated within each main category.

4.1 COMPARED PERFORMANCE STATUS OF THE THREE MAIN TYPES OF ECOSYSTEM SERVICES CONSIDERED

The following general results derive from comparing the reported status of performance of the three main types of ecosystem services considered in the whole set of wetlands (Figure 4.1):

- A small number of services are reported as having a *high* level of performance in the whole set of wetlands
- A slightly larger number of services are reported as having a *moderate* level of performance
- Most of the three main types of services are reported as performing at a *low* level
- The second status category reported in the largest number of cases is *non-existent*. Figure 4.2 shows the particular services within the three main types reported in this category.

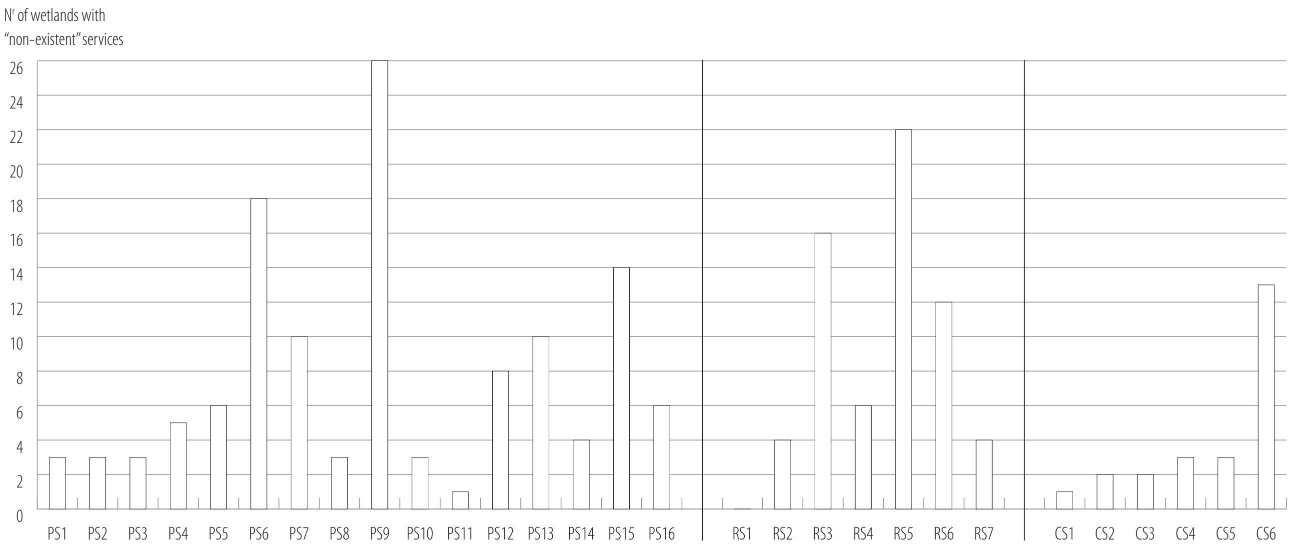
Figure 4.1. Status reports for the three main categories of ecosystem services (Provisioning, Regulating and Cultural) considered



A main result is that most of the Provisioning, Regulating and Cultural Services evaluated occur at a low level in the whole set of wetlands inventoried. This conclusion is consistent with the results of similar evaluations performed in comparable studies (Millennium Ecosystem Assessment, 2005a; Borja and others, 2012; Manzano and others, 2013; SNEA, 2014).

A second main result is that although most of the services evaluated have been reported as *non-existent*, there are sound reasons to think that this conclusion is more apparent than real. Many of the services reported to be *non-existent* are known to be performed around the world by the major part of the wetlands located in areas of similar climatic, hydrological and socioeconomic conditions as those on the Mediterranean coastline. The result could be due to different reasons, among them being the still limited knowledge of ecosystem services in Earth scientists from the Mediterranean basin, limited access to information relevant in assessing these aspects, lack of time to use and integrate this information, or a combination of these.

Figure 4.2. Specific services of the main categories (Provisioning, Regulating and Cultural) reported as *non-existent*



PROVISIONING SERVICES	Natural production of food	PS1	Cropping
		PS2	Livestock
		PS3	Fishing
		PS4	Fruits collection
		PS5	Hunting
		PS6	Other
	Artificial production of food	PS7	Aquaculture
		PS8	Agriculture
		PS9	Other
		PS10	Supply of good-quality water
		PS11	Water supply for different uses
		PS12	Production of biological source materials
		PS13	Production of mineral source materials
		PS14	Genetic pool and biotechnology
		PS15	Energy production
		PS16	Natural species of medicinal interest
REGULATING SERVICES		RS1	Hydrological regimes (floods, drought)
		RS2	Water purification
		RS3	Morpho-sedimentary regulation
		RS4	Biological control
		RS5	C sink and global regulation
		RS6	Air quality regulation
		RS7	Local climate regulation
CULTURAL SERVICES		CS1	Tourism
		CS2	Educational and scientific knowledge
		CS3	Local knowledge and good practices
		CS4	Landscape and aesthetic
		CS5	Cultural identity and sense of belonging
		CS6	Religious and spiritual

4.2 COMPARED EVOLUTION TRENDS OF THE THREE MAIN TYPES OF ECOSYSTEM SERVICES CONSIDERED

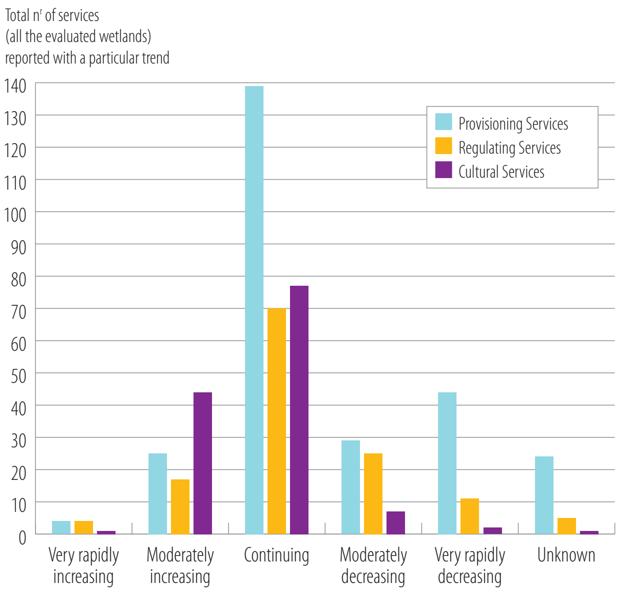
The following main results can be derived by comparing the reported evolution trends of the performance of the three main types of ecosystem services considered for the whole set of wetlands inventoried (Figure 4.3):

- A very short number of Provisioning, Regulating and Cultural services are reported as very rapidly increasing their level of performance
- A larger, but also reduced, number of services are reported as *moderately increasing* their level of performance. Cultural Services are those reported in most cases
- Most of the three types of services are reported as continuing their level of performance. Provisioning Services are those reported as such in most cases
- A moderate number of services are reported as *decreasing* their performance, either moderately or very rapidly. Provisioning Services are those mainly reported in such cases.

The main conclusion about the observed or forecasted evolution trends of services is that, in nearly all the wetlands evaluated, the major part of the evaluated ecosystem services are not changing their level of performance. However (and as discussed in section 4.1 in the case of the *non-existent* services), based on existing knowledge of the most common situations concerning present-day wetlands functioning along the coastal areas of many Mediterranean countries, there are reasons to think that this result may be more apparent than real, at least to some extent.

On the other hand (and also based on existing knowledge and understanding of conditions in many Mediterranean countries and other parts of the world), we can be more confident of the results reporting the small number of wetlands services increasing their level of performance, and the moderate (but larger) number of services *decreasing* their performance.

Figure 4.3. Evolution trends reported for the three main categories of ecosystem services (Provisioning, Regulating and Cultural) considered



4.3 EVOLUTION TRENDS OF THE SPECIFIC SERVICES EVALUATED WITHIN EACH MAIN CATEGORY

4.3.1 Services showing a very rapidly increasing trend

Very few services from any category are reported as *very rapidly increasing* (Figure 4.4). Two Regulating Services (regulation of hydrological regimes and morpho-sedimentary regulation) are reported to be increasing *very rapidly* in two wetlands, and five other services (both Provisioning and Cultural) are reported to be increasing *very rapidly* in just one wetland. Thus, it can be concluded that almost no service is increasing *very rapidly* in the evaluated wetlands.

4.3.2 Services showing a moderately increasing trend

A limited number of wetlands (1-5) experience a moderate increase in 9 of the 13 specific Provisioning Services evaluated (note that Provisioning Services 6 and 9 in Figure 4.5 are "other"). The two Provisioning Services increasing in a major number of wetlands are Cropping of natural products and artificial Agricultural production of foods, each one affecting 5 wetlands. The other Provisioning Services showing an increase each affect between 1 and 3 wetlands.

Four of the 8 Regulating Services evaluated are reported as increasing moderately in a number of wetlands (Figure 4.5). Two of them, Water purification and Biological control, affect 7 wetlands; the other two, Regulation of hydrological regimes and Local climate regulation, only affect 1 and 2 wetlands, respectively.

As mentioned in section 4.2, Cultural Services are those experiencing a *moderately increasing* trend in the largest number of wetlands. The six Cultural Services evaluated are *moderately increasing* in some wetlands (Figure 4.5). Four of them (Tourism, Educational and scientific knowledge, Local knowledge and good practices, and Landscape and aesthetic) showed this trend in 8-12 wetlands. The other two increased *moderately* in 1-3 wetlands.

4.3.3 Services showing a continuing trend

As already mentioned, this is the most common trend reported for the greatest number of services and wetlands (Figure 4.6): nine Provisioning Services are reported as performing in a *continuing* manner in 12-18 wetlands, and three more show a *continuing* trend in 1-6 wetlands. Seven Regulating Services show a *continuing* trend in 7–14 wetlands, and all six Cultural Services are *continuing* in 10-18 wetlands.

Section 4.2 explained why there are sound reasons to think that this result may have been reached and why the exact trend could not be identified.

4.3.4 Services showing a moderately decreasing trend

Five specific Provisioning Services have been reported as being *moderately decreasing* in 1-11 wetlands (Figure 4.7). The two Provisioning Services *decreasing* in a major number of wetlands (11 of 26) are Supply of good-quality water and Water supply for different uses.

Seven Regulating Services are also reported as *moderately decreasing* in 2-8 wetlands. Regulation of hydrological regimes is the service showing this pattern in a major number of wetlands (8).

Five Cultural Services are decreasing moderately in 1-2 wetlands.

In summary, only three services (Supply of good-quality water, Water supply for different uses and Regulation of hydrological regimes) have been reported as decreasing moderately in a significant number of wetlands. However, these services are very much related to the role that groundwater plays in wetlands.

4.3.5 Services showing a very rapidly decreasing trend

Four Provisioning Services have been reported as *very rapidly decreasing* in 11 wetlands, all of them located in the same country, Turkey (Figure 4.8). These Provisioning Services are: Production of biological source materials, Production of mineral source materials, Genetic pool and biotechnology, and Energy production. Three other Provisioning Services (Fishing, Aquaculture and Supply of good-quality water) have been reported as *very rapidly decreasing* only in one wetland, Wadi Gaza.

Only one Regulating service has been reported as *very rapidly decreasing*, the Regulation of species of natural interest. This situation has been reported for the 11 wetlands inventoried by Turkey.

Two Cultural Services (Landscape and aesthetic, and Cultural identity and sense of belonging) are *very rapidly decreasing* in just one wetland, Wadi Gaza.

Thus five services are reported as *very rapidly decreasing* in a significant number of wetlands, all of them in the same country, Turkey. The five services are not among the most evident wetlands services, and they are closely related to each other: four relate to the production of natural sources, genetic pool and energy, and one to the regulation of species of natural interest. This could be interpreted as Turkey being a country very concerned about the role of wetlands in providing less evident services and about the loss of those services because of deterioration in wetlands functionality. On the other hand, these five services have been reported as *non-existent* in a significant number of wetlands (4-14; see Figure 4.2), which means that the wetlands inventoried in the other countries are probably in a less favourable situation than those in Turkey.

Furthermore, it is clear than the wetland of Wadi Gaza is rapidly losing the ability to provide very basic Provisioning Services. A very clear indicator of the general deterioration experienced in this wetland is the fact that it is the only wetland reported as losing Cultural Services.

4.3.6 Services reported as having an unknown trend

A few services, mostly of the Provisioning and Regulating types, are reported as either having an unknown existence or *unknown* evolutionary trend (Figure 4.9).

This is a frequent result from surveys performed in places where there is little information about wetlands. But, for some specific services whose existence and/or evolution trend can easily be deduced by observing the traditional habits of populations living near the wetland, this result suggests that the experts performing this type of assessment need to be trained in the aspects they have to evaluate.

Figure 4.4. Services reported as *very rapidly increasing* in the wetlands evaluated. See Figure 4.2 for explanation of abbreviations

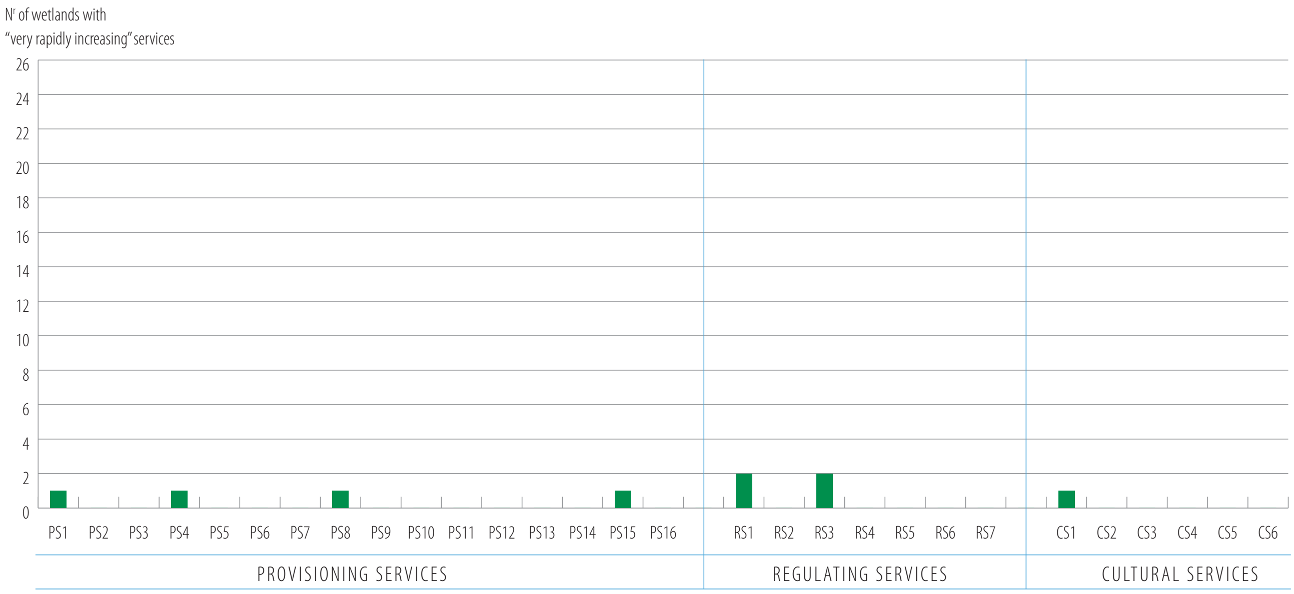


Figure 4.5. Services reported as *moderately increasing* in the wetlands evaluated. See Figure 4.2 for explanation of abbreviations

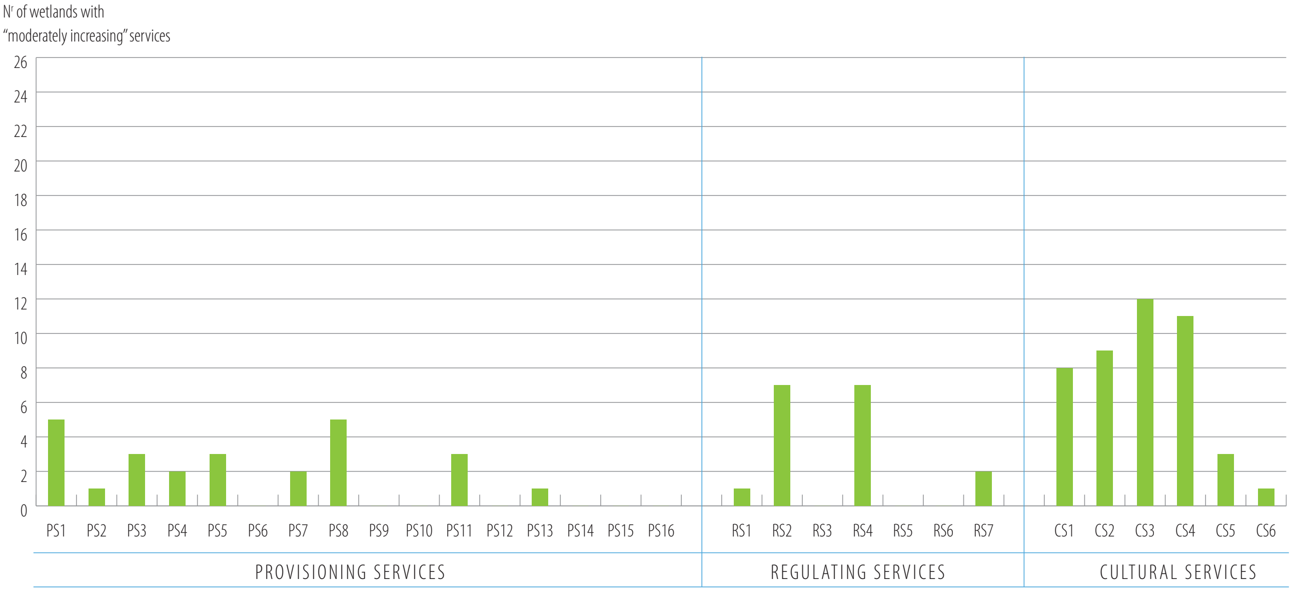


Figure 4.6. Services reported as *continuing* in the wetlands evaluated. See Figure 4.2 for explanation of abbreviations

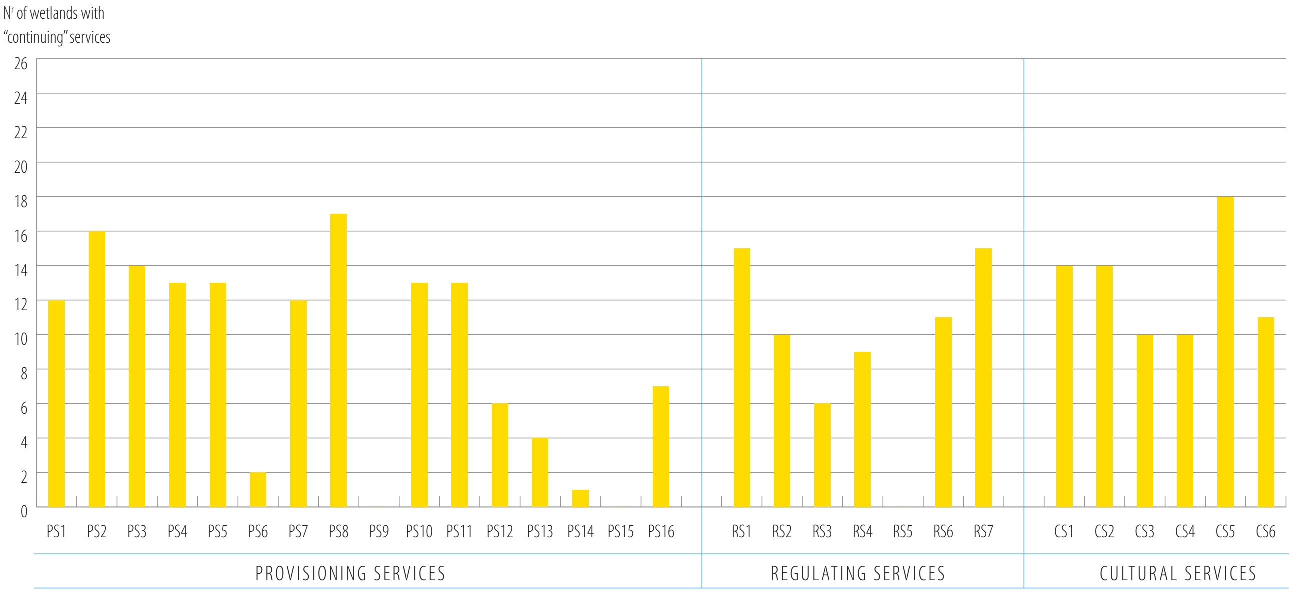


Figure 4.7. Services reported as *moderately decreasing* in the wetlands evaluated. See Figure 4.2 for explanation of abbreviations

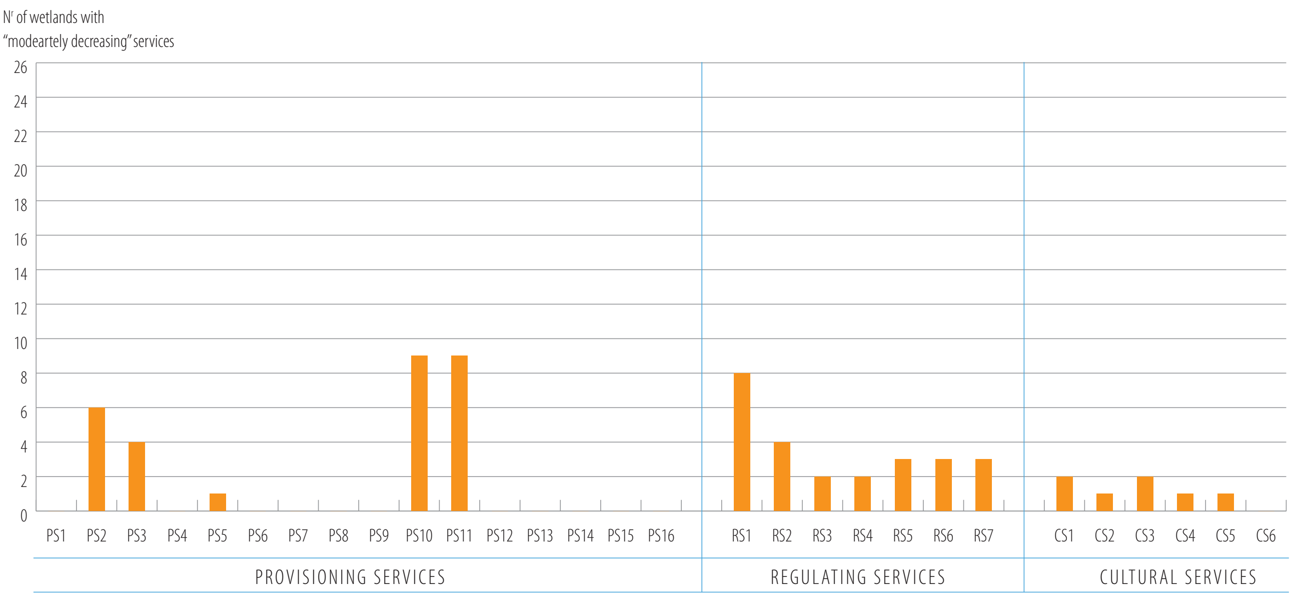


Figure 4.8. Services reported as *very rapidly decreasing* in the wetlands evaluated. See Figure 4.2 for explanation of abbreviations

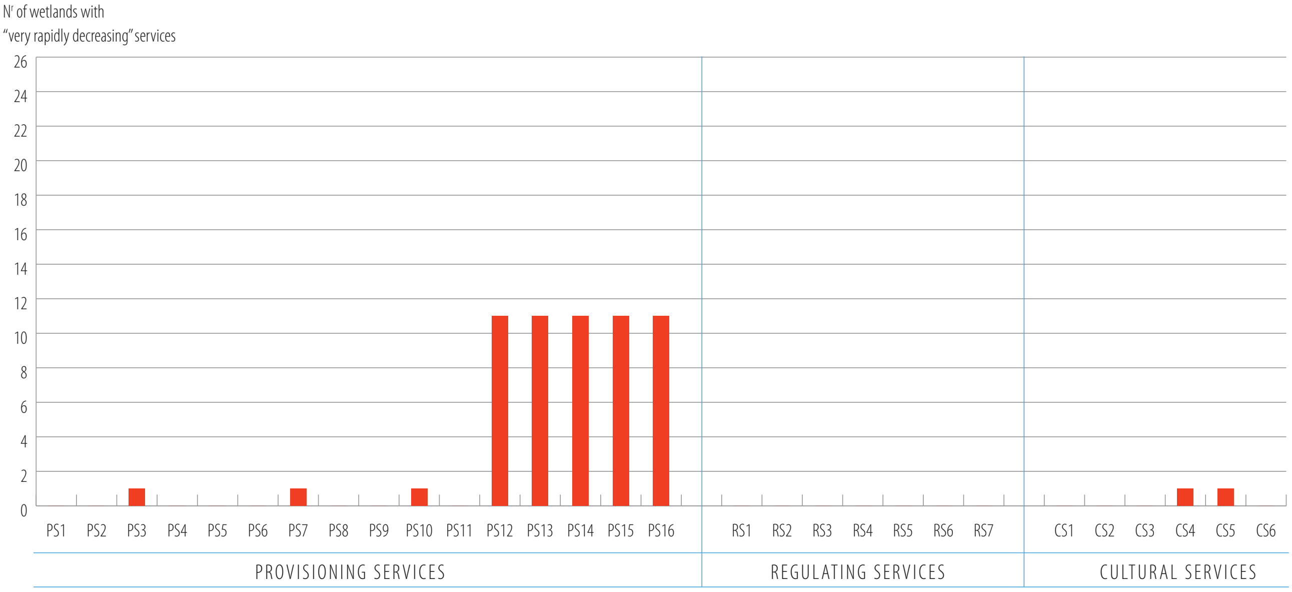
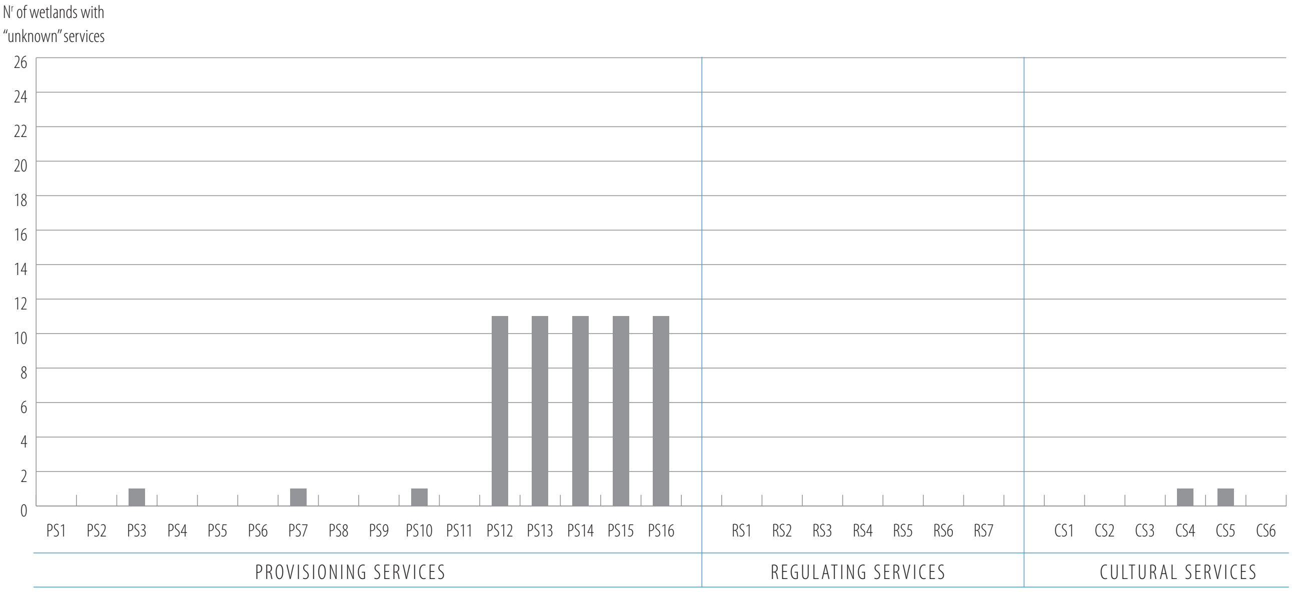


Figure 4.9. Services reported as having *unknown* trends in the wetlands evaluated. See Figure 4.2 for explanation of abbreviations



5.

DRIVERS OF CHANGES IN THE EVALUATED MEDITERRANEAN GROUNDWATER-RELATED COASTAL WETLANDS: MAIN RESULTS

This section comprises comprises de following information:

- Subsection 5.1: a description of the compared degrees of impact of the seven main types of drivers of change considered in this work: *Resource Exploitation*, *Changes in land use*, *Modification of hydrological cycle*, *Pollution*, *Alteration in biological communities' structures and ecosystems*, *Effects associated with changes* and *Global and climate changes.*
- Subsection 5.2: a description of the relative impacts of the specific drivers of change considered by each main category.

5.1 COMPARISON OF DEGREES OF IMPACT REPORTED FOR THE MAIN TYPES OF DRIVERS OF CHANGE CONSIDERED

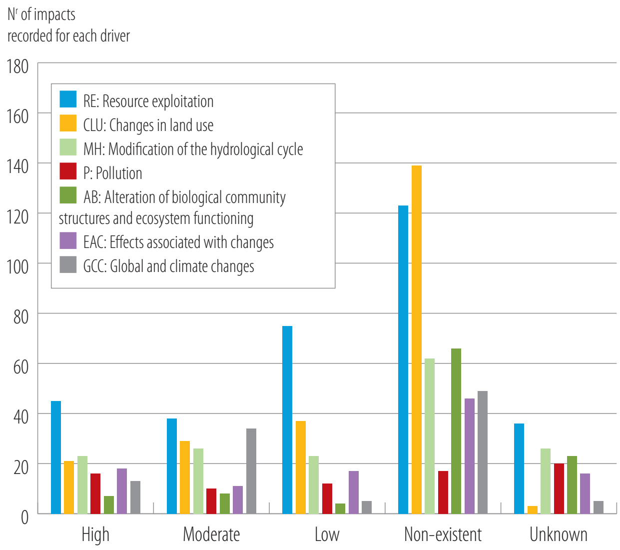
After comparing the reported degrees of impact of the seven main types of drivers of change to wetlands functioning considered in this work, it can be stated that the most frequently reported result for almost every type of driver is *non-existent*, followed by *low* impact (Figure 5.1). The drivers most reported as *non-existent* were those related to the main category *Changes in land use*, followed by the drivers related to *Resource expoitation*.

Based on existing scientific knowledge of the most common situations existing along the coastal areas of many Mediterranean countries with respect to the exploitation of water, and of biological and mineral materials, and to the present-day impacts caused by *Changes in land use* that took place over decades and/or centuries, this result is surprising and leads to some scepticism. The result is more uncertain because most of the coastal wetlands reported are known to have been used historically (and in many cases still are) for fishing; cropping; cattle raising; supplying water for irrigation, domestic and industrial uses; and/or supplying salts, soil and hard-rock materials as agricultural substrate and building materials. An additional reason to distrust the above-mentioned result is that, for most of the wetlands reported, there are a number of scientific papers that deal with different aspects (geology, hydrogeology, biology, water pollution, climate change, agricultural activity, etc.), most of which are good sources of information useful in evaluating the impact of the drivers of change considered. Thus, this result suggests unfavourable conditions for the country experts to access and process the existing information within the time schedule of the project.

Another result illustrated in Figure 5.1 is that the number of drivers having some degree of impact (low, moderate or high) was very modest and far smaller than expected when compared with similar studies. The drivers most reported as causing low, moderate and high impacts were those of the main category, *Resource exploiattion*, followed by the drivers related to *Changes in land use* and by those related to *Modification of hydrological regimes*, with the two last categories reported in similar number of cases.

The drivers of change related to the main categories *Pollution* and *Alteration of biological community structures and ecosystem functioning* were mostly reported as *non-existent* and as *unknown*. Little confidence should be placed in this result, for the same reasons stated above.

Figure 5.1. Degrees of impact reported for the main types of *drivers* of change considered



5.2 DEGREE OF IMPACT ON WETLAND FUNCTIONING REPORTED FOR THE SPECIFIC DRIVERS OF CHANGE WITHIN EACH MAIN CATEGORY

5.2.1 Impact of drivers related to the main category Resource exploitation (RE)

The following general results arise after comparing the impacts of the three main types of *RE* (exploitation of water, biological material and mineral material) (Figure 5.2):

1. the drivers related to Water abstraction are causing *high*, *moderate* and *low* impacts in a variable (between 1 and 13) number of wetlands
2. most of the drivers related to Biological exploitation are causing either *low* or *non-existent* impacts in the major part of the wetlands
3. all the drivers related to Mineral exploitation (fuel, salts, soils and rock exploitation) are reported mostly as non-existent and as *unknown*, and only a few are causing *low* to *high* impacts per driver in between 1 and 6 wetlands.

A *high* impact has been reported for the following specific *RE* drivers and number of wetlands affected (Figure 5.2): Groundwater abstraction from the basin (13 wetlands), Crops (9 wetlands), Groundwater abstraction near the wetland (8 wetlands), Water abstraction from tributaries (5 wetlands), Water abstraction from the wetland (3 wetlands), Fishing (3 wetlands), Salts exploitation (2 wetlands) and Other (2 wetlands).

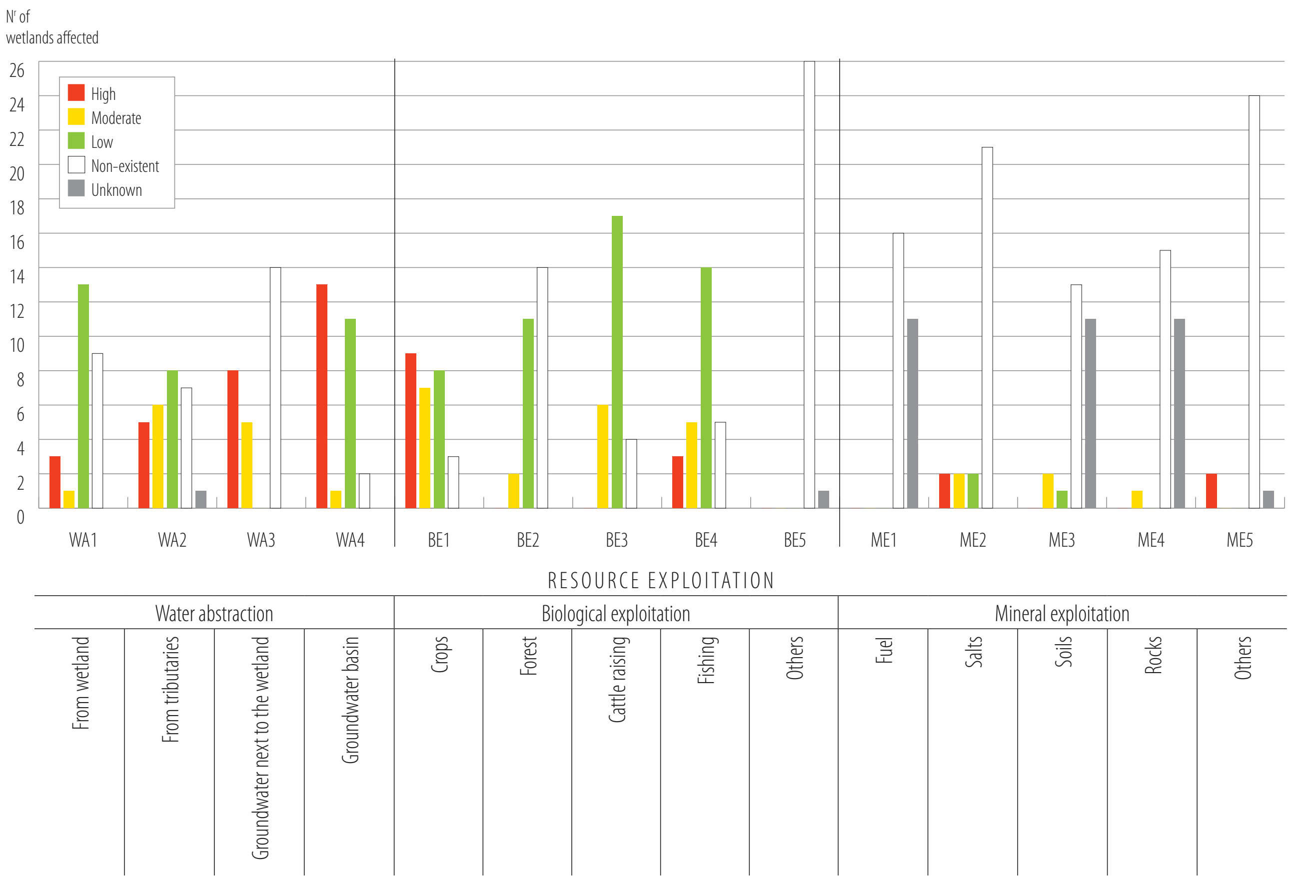
A *moderate* impact has been reported for the following specific *RE* drivers and number of wetlands affected: Crops (7 wetlands), Water abstraction from tributaries (6 wetlands), Cattle raising (6 wetlands), Groundwater abstraction near the wetland (5 wetlands), Fishing (5 wetlands), Forest exploitation (2 wetlands), Salts exploitation (2 wetlands), Soil exploitation (2 wetlands), Water abstraction from the wetland (1 wetland), Groundwater abstraction from the basin (1 wetland) and Rock exploitation (1 wetland).

A *low* impact has been reported for the following specific *RE* drivers and number of wetlands affected: Cattle raising (17 wetlands), Fishing (14 wetlands), Water abstraction from the wetland (13 wetlands), Groundwater abstraction from the basin (11 wetlands), Forest exploitation (11 wetlands), Water abstraction from tributaries (8 wetlands), Crops (8 wetlands), Salts exploitation (2 wetlands) and Other (1 wetland).

Some specific *RE* drivers, and especially those related to Mineral exploitation, have been reported as *non-existent* in large numbers of wetlands (up to 21 wetlands).

As mentioned in section 5.1, based on the existing scientific and cultural knowledge about traditional and present-day human activities and resource uses along the Mediterranean coastline, the information reported on the impact of the *RE* drivers of change is somewhat unreliable. Many of the coastal wetlands reported are known to have been used historically in an intensive way, and still are in most cases. The results are especially surprising in the case of water exploitation because, in many coastal areas of southern and eastern Mediterranean countries, coastal wetlands and their associated aquifers have been the only water source to fulfil all the water needs and uses in extensive areas.

Figure 5.2. Impacts reported for the drivers of the main category *Resource exploitation (RE)* (drivers related to water abstraction, WA1 to WA4; to biological exploitation, BE1 to BE5, and to mineral exploitation ME1-ME5)



5.2.2 Impact of drivers related to the main category Changes in land use (CLU)

A *high* impact has been reported for the following specific *CLU* drivers and number of wetlands affected (Figure 5.3): Urbanization (13 wetlands), Extensive agriculture (7 wetlands) and Replacement of species (1 wetland).

A *moderate* impact has been reported for the following specific *CLU* drivers and number of wetlands affected (Figure 5.3): Roads (10 wetlands), Extensive cattle raising (6 wetlands) and Extensive agriculture (6 wetlands).

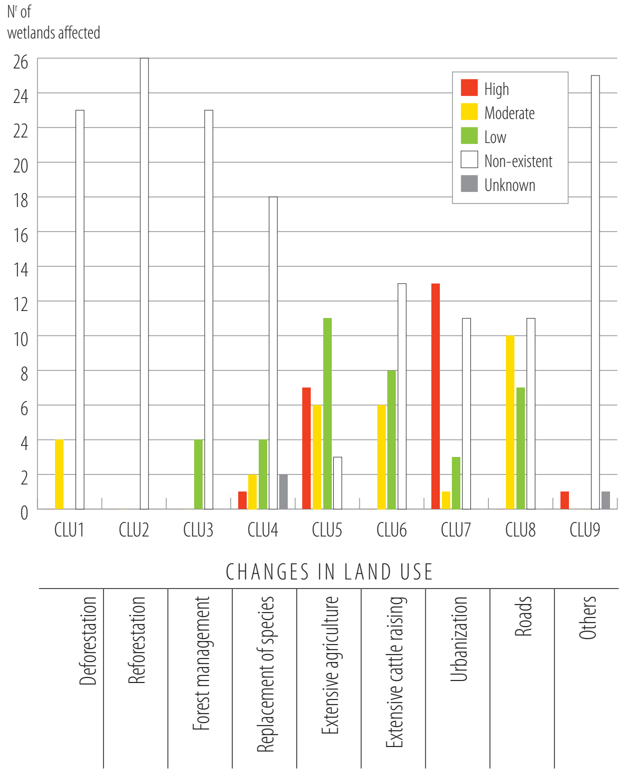
A *low* impact has been reported for the following specific *CLU* drivers and number of wetlands affected (Figure 5.3): Extensive agriculture (11 wetlands), Extensive cattle raising (8 wetlands) and Roads (7 wetlands).

Several specific *CLU* drivers have been reported as *non-existent* in a large number of wetlands (Figure 5.3): Reforestation (26 wetlands), Deforestation (23 wetlands), Forest management (23 wetlands), Replacement of species (18 wetlands), Extensive cattle raising (13 wetlands), Urbanization (11 wetlands) and Roads (11 wetlands).

Urbanization and Extensive agriculture are thus the two specific drivers related to *CLU*, causing large impacts in the wetlands evaluated, followed by Roads and Extensive cattle raising. This result is coherent with that expected.

Based on knowledge of historical vegetation management in the Mediterranean basin, it is surprising (and perhaps hardly credible) to see results indicating the large number of wetlands unaffected by human activities related to the management of vegetation, either natural or introduced.

Figure 5.3. Impacts reported for the drivers of the main category *Changes in land use (CLU)* (drivers *CLU1-CLU9*)



5.2.3 Impact of drivers related to the main category Modification of the hydrological cycle (MH)

A *high* impact has been reported for the following specific MH drivers and number of wetlands affected (Figure 5.4): Storage usage (7 wetlands), Input of urban wastewater (6 wetlands), Input of excess irrigation (4 wetlands), Drainage (4 wetlands) and Artificial recharge (2 wetlands).

A *moderate* impact has been reported for the following specific MH drivers and number of wetlands affected (Figure 5.4): Drainage (10 wetlands), Input of excess irrigation (10 wetlands), Input of urban wastewater (10 wetlands), Storage usage (4 wetlands) and Artificial recharge (2 wetlands).

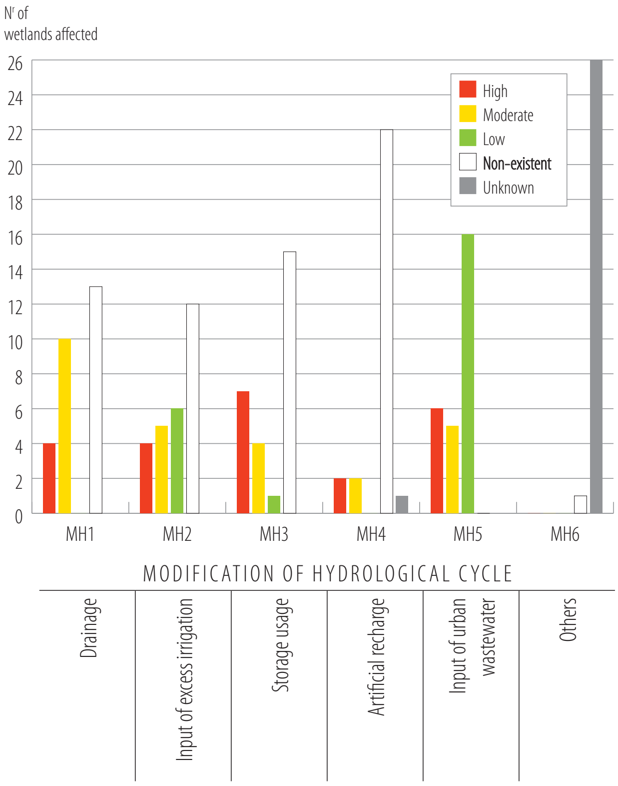
A *low* impact has been reported for the following specific MH drivers and number of wetlands affected (Figure 5.4): Input of urban wastewater (16 wetlands), Input of excess irrigation (6 wetlands) and Storage usage (1 wetland).

Several specific MH drivers have also been reported as being *non-existent* in large numbers of wetlands (Fig 5.4): Artificial recharge (22 wetlands), Storage usage (10 wetlands), Drainage (13 wetlands) and Input of excess irrigation (12 wetlands).

In synthesis, the drivers related to MH that are causing more impacts in wetland functioning are: Input of urban wastewater, Input of excess irrigation water, Drainage and storage usage. Together, they affect a good number of the wetlands inventoried. This result is coherent with what was expected.

However, with the exception of the MH driver Input of urban wastewater, the other drivers are reported as *non-existent* in the major part of the wetlands inventoried (in 12-22 wetlands). As already mentioned for other results, this result is not coherent with existing knowledge of the historical use and the present-day situation of many areas along the Mediterranean coastline. It may suggest that the existing information is not being used effectively.

Figure 5.4. Impacts reported for the drivers of the main category *Modification of the hydrological cycle (MH)* (drivers MH1-MH6)



5.2.4 Impact of drivers related to the main category Pollution (P)

A *high* impact has been reported for the following specific *P* drivers and number of wetlands affected (Figure 5.5): Agricultural diffuse pollution (11 wetlands) and Urban/industrial point source pollution (5 wetlands).

A *moderate* impact has been reported for the following specific *P* drivers and number of wetlands affected (Figure 5.5): Urban/industrial point source pollution (3 wetlands), Agricultural diffuse pollution (4 wetlands) and Atmospheric diffuse pollution (1 wetland).

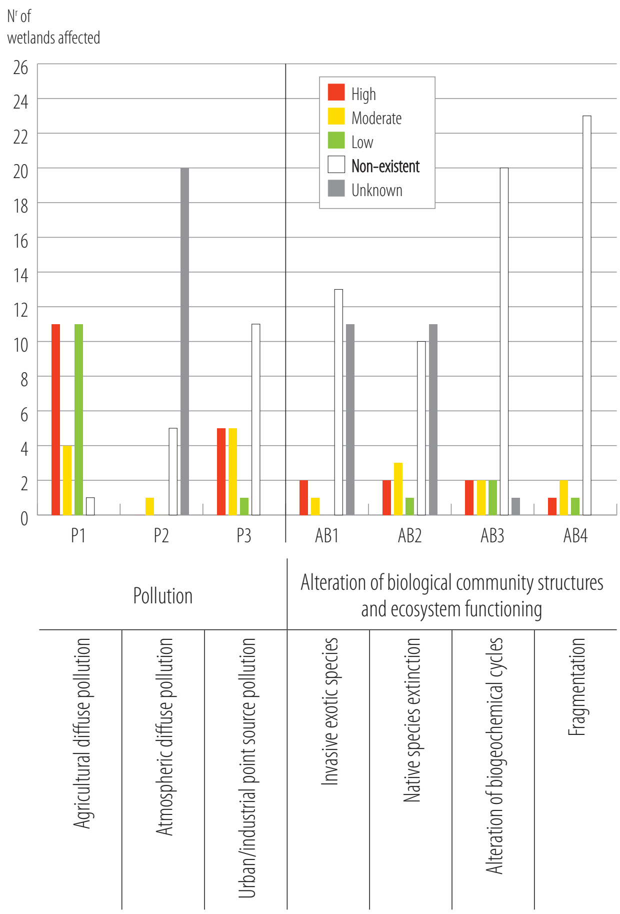
A *low* impact has been reported for the following specific *P* drivers and number of wetlands affected (Figure 5.5): Agricultural diffuse pollution (11 wetlands) and Urban/industrial point source pollution (1 wetland).

The specific *P* drivers reported as *non-existent* are (Figure 5.4): Urban/industrial point source pollution (11 wetlands), Atmospheric diffuse pollution (5 wetlands) and Agricultural diffuse pollution (1 wetland).

Thus, the specific drivers related to *P* that are impacting a major number of wetlands are Agricultural diffuse pollution and Urban/industrial point source pollution, with the first affecting twice the number of wetlands than the second. This is coherent with the fact that many wetlands are located in intensively cultivated areas.

The possible impact caused by Atmospheric pollution is unknown in most of the wetlands. This result is also coherent with the small number of studies about this source of pollution that exists. It may, however, be a main cause of modification of the functioning of biological communities – and their services – in coastal wetlands.

Figure 5.5. Impacts reported for the drivers of the main category pollution *(P)* (drivers *P1-P3)* and Alteration of biological community structures and ecosystem functioning *(AB)* (drivers *AB1-AB4*)



5.2.5 Impact of drivers related to the main category Alteration of biological community structures and ecosystem functioning (AB)

A *high* impact has been reported for the following specific *AB* drivers and number of wetlands affected (Figure 5.6): Invasive exotic species (2 wetlands), Native species extinction (2 wetlands), Alteration of biogeochemical cycles (2 wetlands) and Fragmentation (1 wetland).

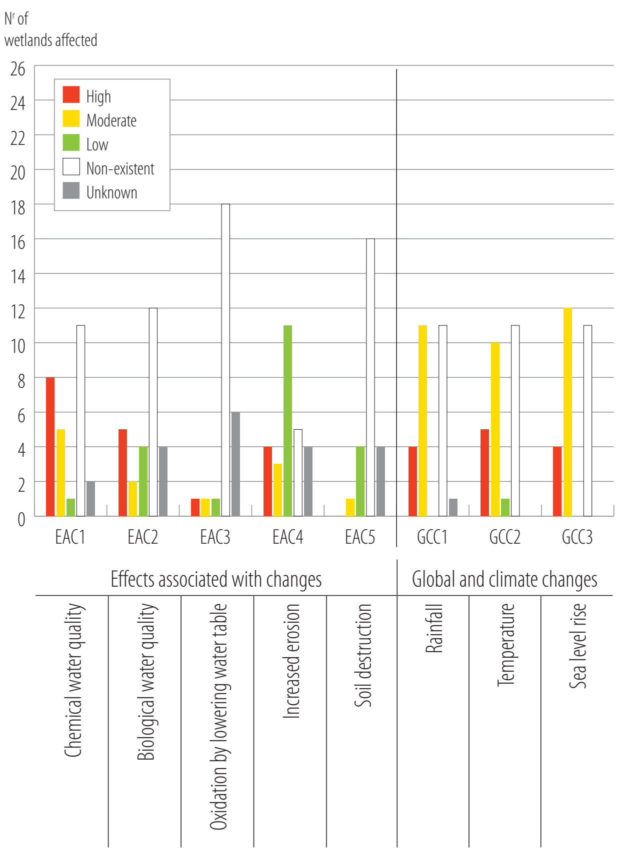
A *moderate* impact has been reported for the following specific *AB* drivers and number of wetlands affected (Figure 5.6): Native species extinction (3 wetlands), Alteration of biogeochemical cycles (2 wetlands), Fragmentation (2 wetlands) and Invasive exotic species (1 wetland).

A *low* impact has been reported for the following specific *AB* drivers and number of wetlands affected (Figure 5.6): Alteration of biogeochemical cycles (2 wetlands), Native species extinction (1 wetland) and Fragmentation (1 wetland).

The specific *AB* drivers reported as *non-existent* involve large numbers of wetlands (Figure 5.6): Fragmentation (23 wetlands), Alteration of biogeochemical cycles (20 wetlands), Invasive exotic species (13 wetlands) and Native species extinction (10 wetlands).

The reported impacts of the specific drivers of change related to *AB* seem much smaller than the probable real situation. This is mostly attributed to the lack of related studies and information, which are not well known even in most wetlands outside the Mediterranean coast.

Figure 5.6. Impacts reported for the drivers of the main category *Effects associated with changes (EAC)* (drivers *EAC*1-*EAC*5) and *Global and climate changes (GCC)* (drivers *GCC1-GCC3*)



5.2.6 Impact of drivers related to the main category Effects associated with changes (EAC)

A *high* impact has been reported for the following specific *EAC* drivers and number of wetlands affected (Figure 5.6): Chemical water quality (8 wetlands), Biological water quality (5 wetlands), Increased erosion (4 wetlands) and Oxidation by lowering water table (1 wetland).

A *moderate* impact has been reported for the following specific *EAC* drivers and number of wetlands affected (Figure 5.6): Chemical water quality (5 wetlands), Increased erosion (3 wetlands), Biological water quality (2 wetlands), Oxidation by lowering the water table (1 wetland) and Soil destruction (1 wetland).

A *low* impact has been reported for the following specific *EAC* drivers and number of wetlands affected (Figure 5.6): Increased erosion (11 wetlands), Soil destruction (4 wetlands), Biological water quality (4 wetlands), Chemical water quality (1 wetland) and Oxidation by lowering the water table (1 wetland).

As in the case of the other driver categories, the specific drivers reported as *non-existent* involve large numbers of wetlands (Figure 5.6): Oxidation by lowering the water table (18 wetlands), Soil destruction (16 wetlands), Biological water quality (12 wetlands), Chemical water quality (8 wetlands) and Increased erosion (5 wetlands).

In summary, the specific drivers related to *EAC* that have been reported as causing impacts in more wetlands are: Increased erosion, Changes in chemical water quality and Changes in biological water quality. This result is coherent with what was expected.

The specific drivers *soil Destruction* and Oxidation by lowering the water table are reported as *non-existent* in the major part of the wetlands. In principle, this result is not coherent with existing knowledge about land and aquifer management on most of the Mediterranean coastline. This may suggest a lack of access to the relevant information by people performing the compilations.

5.2.7 Impact of drivers related to the main category Global and climate changes (GCC)

A *high* impact has been reported for the following specific *GCC* drivers and number of wetlands affected (Figure 5.6): Temperature (5 wetlands), Rainfall (4 wetlands) and Sea-level rise (4 wetlands).

A *moderate* impact has been reported for the following specific *GCC* drivers and number of wetlands affected (Figure 5.6): Sea-level rise (12 wetlands), Temperature (11 wetlands) and Rainfall (10 wetlands).

A *low* impact has been reported only for one specific *GCC* driver (Figure 5.6): Temperature (2 wetlands).

As in the case of the other driver categories, the specific *GCC* reported as *non-existent* involves large number of wetlands (Figure 5.6): Sea-level rise (11 wetlands), Temperature (11 wetlands) and Rainfall (11 wetlands).

The three specific drivers related to Global and climate changes evaluated – Rainfall, Temperature and Sea-level rise – seem to be causing similar impacts in the wetlands evaluated. However, the number of wetlands reported as impacted by these factors is rather small, less than half the total inventory, and similar to the number of wetlands where these factors have been reported as *non-existent*. When these factors are taken into account, this result is considered relatively unreliable.

As mentioned in section 5.1, a number of scientific papers are available that deal with different aspects of most of the wetlands reported. Most of these are good sources of qualitative and quantitative information, and are useful in evaluating the impact of the drivers of change considered in this study. This is also applicable to climate change. Technical and scientific reports relating to some coastal areas and wetlands can be found on the Internet, and it is possible to find results from international projects focusing on specific drivers such as climate change and global change. Thus, a recurrent conclusion is that although there are data and studies with good information potentially useful to evaluate the wetlands services and the impact of the drivers of changes, this does not mean that this information would be used.

6.

CONCLUSIONS AND DISCUSSION

Main conclusions attained with respect to the general features of the Mediterranean groundwater-related coastal wetlands evaluated:

1. Wetlands genesis: the majority of the wetlands evaluated (23 of 26) have their origin in the interaction of several geological processes such as delta/estuary dynamics, dune morphology, coastal sedimentation and fluvial plain processes. Some of these mechanisms operate at a local scale and others at a regional scale. Thus, to design and conduct efficient wetland conservation programmes it is necessary to be aware of the geological processes originating and controlling wetland evolution. This means that it is necessary to perform integrated geological and hydrogeological studies at different spatial scales.
2. Water salinity: most of the evaluated wetlands are brackish to hypersaline, and a notable number have variable salinity in different areas and/or periods, ranging from slightly saline to hypersaline.
3. Wetlands functionality: most of the studied wetlands (24) are reported as having their functionality altered to different degrees. Half of the wetlands are *moderately altered*, and for the rest the alteration is *high* to *very high*.
4. Groundwater dependence, groundwater flow type and wetlands hydroperiod: groundwater is reported to play a *dominant* role in a small number of wetlands (4), a *shared* role in most of the wetlands (19), a *secondary* role in only 2 wetlands and a *variable* role in 1 of the inventoried wetlands. In addition, most of the wetlands (18) do not show a dominant groundwater flow type but variable combinations of basic flow types, with the majority of the wetlands showing a combination of two types: some areas of the wetland behave as *groundwater flow-through* zones, and some as *groundwater discharge open areas*. A notable number of wetlands evaluated have a *permanent* hydroperiod (17); a few are *seasonal* (2) and 7 have a *variable* hydroperiod. Combining the information provided on groundwater role, groundwater flow type and hydroperiod, it can be concluded that groundwater is probably a main supporting factor in the ecological functioning of most of the coastal Mediterranean wetlands.
5. Current state of knowledge: from the information reported by the country experts it seems that there is abundant scientific and technical information about most of the wetlands evaluated. For many of them there are even very specialized data such as chemical, isotopic, biological and socioeconomic information. Moreover, monitoring surveys of wetland water levels, water quality, groundwater levels and/or groundwater quality are maintained for a good number of wetlands. This suggests that the inventoried wetlands are relevant elements for the participating countries. This result shows that – for most of the inventoried wetlands – part of the information needed to understand their functioning, their relationships with groundwater, and to evaluate their functionality and evolution trends, is already available.
6. Management status: the majority (25) of the wetlands evaluated have one or more legal protections: in 22 wetlands there is a minimum level of protection over Nature reserves or similar; 16 wetlands are Ramsar sites; 16 wetlands have a Management authority, 11 have some Protection regulation and 3 of them (Tawurga Spring, in Libya; Dalaman and Dalyan wetlands, in Turkey) have some type of users' involvement in their management. The fact that the majority of the reported wetlands have been considered as elements worth protecting suggests that most of the countries participating in this activity are conscious about the relevant role that wetlands play in the well-being of their environment in general, including human well-being.

Only 1 of the 26 wetlands inventoried does not have any type of protection: the Akkar Plain, in Syria. This situation reveals the great differences still existing along the Mediterranean coastline. The coastal zone in Syria is one of that country's scarce natural resources, and provides important economic, transport, residential and recreational functions. All of these depend on its appealing landscape, cultural heritage, natural resources, and rich marine and terrestrial biodiversity, to which the Akkar Plain wetlands contribute notably. This fact has been recognized by PAP/RAC in its proposed vision and policy for the integrated management of the Syrian coastal zone (UNEP/MAP-METAP, 2009). It is desirable that in the near future the Akkar Plain wetlands could be included in an integrated management plan for the entire Syrian coastal zone.

Main conclusions attained with respect to the performance status of the main types of ecosystem services in the Mediterranean groundwater-related coastal wetlands evaluated:

1. A main result is that most of the Provisioning, Regulating and Cultural Services evaluated are performing at a *low* level in the whole set of wetlands inventoried. This conclusion is consistent with the results of similar evaluations performed around the world in comparable studies.
2. A second main result is that, although most of the services evaluated have been reported to be *non-existent*, there are sound reasons to think that this is appearance rather than reality. Many of the services reported as not existing are known to be performed around the world by the major parts of the wetlands located in areas of similar climate, hydrological and socioeconomic conditions as those on the Mediterranean coastline. This result could have been generated for various reasons, among them limited knowledge by Earth scientists of ecosystem services around the Mediterranean basin, limited access to the information relevant to assess these aspects, a lack of time to use and integrate this information or a combination of motivations.

Main conclusions attained with respect to the reported evolution trends of the main types of ecosystem services in the Mediterranean groundwater-related coastal wetlands evaluated:

1. A very small number of specific Provisioning, Regulating and Cultural Services are reported as *very rapidly increasing* their level of performance.
2. A larger, but also limited, number of services are reported as *moderately increasing* their level of performance. Cultural services are those mostly showing this trend.
3. Most of the services of the three types are reported as *continuing* their level of performance. Provisioning Services are those where this pattern is more common.

4. A moderate number of services are reported as *decreasing* their performance, either moderately or very rapidly. Provisioning Services are, again, reported to be most commonly presenting this pattern.

A notable result is that one of the wetlands evaluated, the wetland of Wadi Gaza, is rapidly losing the ability to provide very basic Provisioning Services. A very clear indicator of the general deterioration this wetland is experiencing is the fact that it is the only wetland reported as losing Cultural Services.

Most of the evaluated services are reported as not changing (*continuing*) their level of performance in nearly all the wetlands inventoried. As in the case of the *non-existent* services, and based on existing knowledge of the most common behaviour in present-day wetlands along the coastal areas of many Mediterranean countries, there are reasons to think that this result may be just apparent rather than real, at least to some extent.

Also based on existing knowledge and understanding of the conditions in many Mediterranean countries and in other parts of the world, the results from the small number of wetland services that are increasing their level or performance, and the moderate, but larger, number of services that are decreasing their performance, can be viewed with confidence.

Main conclusions attained with respect to the impact of the main types of *drivers* of change on the functioning of the Mediterranean groundwater-related coastal wetlands evaluated:

1. The most frequently reported impact for almost every type of driver of change is *non-existent*, followed by *low*. The drivers most reported as not existing are those related to the main category *CLU*, followed by those related to *RE*.
2. The number of drivers reported as having some degree of impact, whether *low*, moderate or high, is very modest and far smaller than expected. The drivers most reported as causing *low*, *moderate* and *high* impacts are those of the main category *RE*, followed by those related to *CLU* and by those related to MH. The drivers related to the main categories *P* and *AB* are mostly reported as *non-existent* or as *unknown*.
3. Based on actual knowledge of the most common situations existing along the coastal areas of many Mediterranean countries with respect to the exploitation of water, biological and mineral resources, and to the present-day impacts caused by *changes in land use* (which took place over decades and/or centuries), the former two results (16 and 17) are somewhat surprising and lead to scepticism. It is difficult to place confidence in them because most of the coastal wetlands evaluated are known to have been historically used (and still are in many cases) for fishing, cropping, cattle raising, supplying water for irrigation, domestic and industrial uses, and/or supplying salts, soil and hard-rock materials as agricultural substrate and building materials.

The results are especially surprising in the case of water exploitation, because in many coastal areas of southern and eastern Mediterranean countries, coastal wetlands (and their associated aquifers) have been the only water source to fulfil all the water needs and uses in extensive areas. In some places, the small population density at present may explain a low impact of the water use, but in many other places the intensive use over decades of wetland water and of groundwater near the wetland is a major factor for the economic and social well-being level observed at present.

An additional reason to distrust the above results is that a considerable number of scientific papers exist that deal with different aspects of most of the wetlands inventoried. These are potentially good sources of qualitative and quantitative information that would be useful in evaluating the impact of the drivers of change considered in this work. But the existence of data and studies with good information potentially useful in evaluating the wetlands services and the impact of the drivers of changes does not mean that this information could be used. Thus, the results seem to point to limitations in time (and perhaps in terms of material possibilities) to access and process existing, relevant scientific and technical information that might be useful in making assessments.

6.1 LESSONS LEARNED

A main lesson learned from the work carried out is that abundant and good-quality technical and scientific information is now readily available, and could be used to evaluate many environmental aspects with minimal expense. However, to get the best possible benefits from what existing resources can offer, it is necessary that the persons in charge of performing evaluations have a sound training in background studies related to ecosystem services, drivers of change in ecosystems, and their respective assessment.

This will be especially relevant for professionals who will be in charge of monitoring and assessing wetlands and groundwater, and their services, in their respective countries. Groundwater is one of the water sources feeding most of the coastal wetlands reported on in this project. The relevant role that groundwater plays in supporting wetland habitats and vegetation in times of low rainfall (or even permanently), as well as the human needs for food, energy, building materials, etc., is well known. Thus, it seems clear that Earth scientists and technicians involved in works devoted to characterizing wetlands functioning and/or to designing wetlands management plans should have an adequate understanding and knowledge of what relates to ecosystem services, and on the strong relationships existing between groundwater flows, wetlands services and human well-being.

The above statement points to the convenience of elaborating and using methodological guides, as well teaching dedicated courses on ecosystem services and the methodologies to assess them. This would build capacity in the professionals who would be involved in the projects and tasks mentioned. These capacity-building activities should be developed both at the national level (within individual Mediterranean countries) and at the international one.

7. ANNEX

7.1 WETLANDS DATA FORMS

1. GENERAL DATA FORM

MEDITERRANEAN GROUNDWATER-RELATED COASTAL WETLANDS INVENTORIED

General data

			Local climate					Underlying lithology							Morphometry					Wetland genesis									Wetland sediments					Water source						
Inventory number	Name of wetland, country	General type (see below)	Average rainfall (mm/year)	Average temperature (ºC)	Average evapotranspiration (mm/year)	High seasonality	Low seasonality	Siliceous sediments	Carbonated sediments	Carbonate rocks	Evaporite rocks	Metamorphic rocks	Volcanic rocks	Intrusive rocks	Suface area (km^2)	Elevation, max. - average (m.a.s.l.)	Depth, max. - average (m)	Length, max. - average (m)	Width, max. - average (m)	Tectonic	Erosive	Dissolution	Volcanic	Floodplain	Delta/estuary	Dune morphology	Coastal sedimentation	Artificial	Sandy	Silty	Clayey	Organic-rich	Peat	Rainfall on the wetland	Runoff in the basin	Deep groundwater	Shallow groundwater	Sea (tidal/wave influence)	Fluvial inundation	Artificial
1	Butrinti, Albania	2H	1500	18.7	1260	•				•					16	1	21.4 - 14	7100 -	3200 -	•									•					•				•		
2	Guerbes, Algeria	2HKN	700	18.5	430	•		•			•				421	<1	10 - 20	1500 -	300 -		•					•			•	•				•	•			•		
3	Hutovo Blato, Bosnia and Herzegovina	2ENPQS	1160	14.7	855	•			•						79.72	432 - 1	14.5 - 2.5	10500 -	7500 -	•	•	•								•	•		•	•		•	•			
4	Neretva Delta, Croatia	2AHJ	1250	15.7	880	•			•						127.42	20 - 0.5	1.5 - 0.5	16 -	7.5 -						•		•			•	•	•	•	•	•		•	•	•	•
5	Lake Mariut, Egypt	1A	195	14.8			•	•							75	13	2.7 - 0.83	25000 -	10000 -					•	•		•	•	•	•	•			•			•		•	•
6	Tyre Beach, Lebanon	3Q	730	20.2	395					•					3.8	1 - 20	2 - 5	4025 -	950 -	•							•				•						•		•	
7	Tawurgha Spring Libya	3D	125	20.3	2226		•			•	•				80	1 - 3	5	10000 -	8000 -	•										•	•					•				
8	Skadarsko Lake, Montenegro	2A	1800	14.5	1260				•						395	10 - 8	60 - 6	14000 -	40000 -	•									•								•		•	
9	Tivatska Solila, Montenegro	1R	1500	15	1200				•						1.5	0 - 1	?	- 1600	- 1000								•	•	•								•			
10	Bou Areg Lagoon, Morocco	2AL	350	27	860	•		•	•	•	•	•			115	50-0.5	8	25000 -	15000 -		•					•	•		•	•	•			•	•		•	•		
11	Moulouya Estuary, Morocco	2HKN	550	18.6	1200	•		•							27	20-0.6	6 - 0.5	300 - 500	40 - 100		•			•	•		•		•	•	•			•	•		•	•	•	
12	Oued Laou Estuary, Morocco	2HKN	630	18.3	1022	•		•	•						18	2 - 20	6	70000 -	200 - 500	•	•			•	•		•		•	•	•			•	•		•	•	•	
13	Wetland of Wadi Gaza, Palestine	2AHJ	335	20	1582	•			•						0.025	0.0	2.0 - 1.0	1000 -	100 -					•	•	•	•		•		•	•		•	•		•			
14	Akkar Plain, Syria	2EHN	880	22	550	•		•					•		25	<50	<0.5	5000 -	5000 -					•					•	•	•		•	•	•		•	•	•	
15	Korba (Cap Bon), Tunisia	1BHIQ	480	20	630	•			•						5	<1	0.1,1,0.5	- 8500	- 350							•			•		•			•	•		•	•		
16	Yumurtalık Lagoon, Turkey	1AHI	770	18.7	890	•		•	•						164	1 - 0.5	1.5 - 1.0	21.4 - 17.0	8.4 - 6.0					•	•	•	•		•	•	•			•		•	•	•		
17	Akyatan Lagoon, Turkey	1AHI	770	18.7	890	•		•	•						131	1 - 0.5	1.5 - 1.0	18.3 - 15.0	6.5 - 4.5					•	•	•	•		•	•	•			•	•	•	•	•		
18	Tuzla Lagoon, Turkey	1AHI	770	18.7	890	•		•	•						21	1 - 0.5	1.5 - 1.0	9.9 - 5.7	2.3 - 1.3					•	•	•	•		•	•	•			•	•	•	•	•		
19	Dipsiz wetland, Turkey	1B	675	19.0	890	•		•	•						10.7	1 - 0.5	1.5 - 1.0	2.7 - 0.8	1.8 - 0.6					•	•		•		•	•				•	•	•	•			
20	Göksu Delta,Turkey	2AIP	603	18.5	1027	•		•	•						150	2 - 0.5	1.5 - 1.0	6.1 - 4.0	5.3 - 4.0					•	•		•		•	•	•			•	•	•	•	•		
21	Dalaman Wetlands, Tukey	1AIP	1044	18.9	1209	•		•	•	•		•			284	4 - 0.5	1.5 - 1.0	2.8 - 2.8	1.5 - 1.5	•				•	•	•	•		•	•	•			•	•	•	•			
22	Dalyan Wetlands, Turkey	1AIP	1064	18.3	1415	•				•					15	2 - 0.5	2.5 - 1.0	6 - 6	1.7 - 1.7	•				•	•	•	•		•	•				•	•	•	•			
23	Büyük Menderes Delta, Turkey	2AHI	601	21.7	1200	•		•	•						91	5 - 0.5	1.5 - 1.0	18.4 - 18.4	4.7 - 4.7	•				•	•		•		•	•	•			•	•	•	•			
24	Küçük Menderes Delta, Turkey	1AIP	637	16.6	820	•		•	•	•			•		326	5 - 0.5	1.5 - 1.0	1.5 - 1.5	0.7 - 0.7	•			•		•			•	•	•				•	•	•	•			
25	Gediz Delta, Turkey	2AIP	646	17.9	851	•		•	•						908	5 - 0.5	1.5 - 1.0	21.5 - 21.5	6.9 - 6.9	•			•	•	•			•	•	•				•	•	•	•			
26	Gökçeada Lagoon,Turkey	1AHI	735	15.2	1021	•		•							4	2 - 0.5	1.5 - 1.0	2.2 - 1.3	1.3 - 0.8		•						•		•	•				•			•			

General types of coastal wetlands considered in this work

1 Isolated wetland	A Fresh/brackish coastal lagoon/lake	H Flood plain pool/lagoon	O Dune slacks
2 Wetland complex	B Salt lake	I Deltaic lagoon/pool	P Spring
3 Isolated within a wetland complex	C Salt pan	J Estuary	Q Seepage from shallow water table
	D Natural, concentrated spring or outflow	K Riparian forest	R Saline (artificial)
	E Fresh-water marsh	L Erosive depression	S Reservoir (artificial)
	F Brackish marsh	M Tectonic depression	T Other
	G Salt marsh	N Water course	

Groundwater flow types of coastal wetlands:

Flow through: Wetland is conected to a shallow aquifer and the water-table slope induces groundwater discharge in the upstream part of the wetland and aquifer recharge in the downstream part of the wetland.

Recharge area: Wetland water elevation is higher than the aquifer water-table elevation (wetland may even be perched). Wetland water sources may be precipitation, overland flow, rivers, sea water or artificial supply, but the dominant outflow mechanism is infiltration by lateral or by downwards flow, producing aquifer recharge.

Discharge area, open: Wetland receives groundwater discharge and the dominant natural mechanism of wetland evacuation is surface water outflow.

Discharge area, closed, saline: Wetland receives groundwater discharge and the dominant natural mechanism of wetland evacuation is evapotranspiration. Wetland water and sediments are increasingly saline.

Discharge area, closed, non-saline: Wetland receives groundwater discharge and the dominant natural mechanism of wetland evacuation is evapotranspiration, but surface water outflow occurs from time to time, avoiding wetland salinization.

Crypto-wetland/hidden wetland: Water table is very shallow under and around the wetland, which does not stand water but has permanent/semipermanent characteristic phreatophytic vegetation masses. Examples: salt pans, salt and brackish marshes, dune slacks.

Variable: The groundwater-wetlands relationship pattern changes over time.

1. GENERAL DATA FORM (Continuation)

Groundwater flow type (see the legend)							Hydroperiod			Hydrochemistry			Groundwater dependence			Dominant vegetation					Trophic state				Functionality				State of knowledge														Management status						
Flow through	Recharge area	Discharge area, open	Discharge area, closed saline	Discharge area, closed fresh	Cripto-wetland	Variable	Permanent	Seasonal	Variable	Electrical conductivity (mS/cm) (*)	Dominant (> 50%) anion/anions	Dominant (> 50%) cation/cations	Dominant	Shared	Secondary	Forest	Shrubs, bushes	Prairie	Halophytic vegetation	Phreatophytic vegetation	Oligotrophic	Mesotrophic	Eutrophic	Hypereutrophic	Almost unaltered	Moderately altered	Highly altered	Artificial	Validated hydrogeological conceptual model	Numerical model	Chemical/isotopic information	Biological information	Socio-economic information	Water level monitoring	Groundwater level monitoring	Water quality monitoring	Groundwater quality monitoring	Hydrogeological studies	Wetland evolution studies	Climate change impact studies	Global change impact studies	Information on wetland's uses	Ramsar site	MAB	Natural reserve/other	Unprotected	Protection regulation	Management authority	Users' involvement
		•					•			20 - 40	Cl	Na			•		•						•				•							•	•	•	•					•	•					•	
•	•						•	•		0.5 - 11.5	Cl, HCO3	Na, Ca	•			•		•	•							•	•		•		•			•	•	•	•	•	•				•		•				
•	•	•					•	•		0.5 - 40	HCO3	Ca, Mg	•	•			•		•			•	•			•	•	•			•	•	•	•		•		•	•			•	•		•		•	•	
•	•						•	•		0.5 - 40	Cl, SO4	Na, Ca		•			•		•			•	•				•	•	•			•		•				•		•	•	•	•						
			•				•			1 - 7	Cl	Na		•			•	•	•				•				•		•		•			•	•			•				•	•		•		•	•	
		•					•						•					•					•			•						•						•					•		•				
		•					•			4.5	Cl, SO4	Na	•						•				•			•			•	•	•		•	•	•	•	•	•				•						•	•
•		•			•		•			0.3	HCO3	Ca, Mg		•			•						•		•				•		•	•	•	•		•		•				•	•		•				
•							•			>15	Cl	Na			•		•						•			•						•	•									•	•		•				
•							•	•		0.5 - 56	Cl, SO4	Na, Mg	•				•	•	•			•	•				•		•	•	•	•						•		•			•		•			•	
•			•				•	•		2.5 - 3	HCO3	Ca, Mg		•				•	•			•					•				•	•		•				•				•	•		•			•	
•			•				•	•		3.6	HCO3	Ca, Mg		•			•	•				•					•				•	•	•	•	•	•	•	•				•	•		•			•	
	•	•							•	1.5 - 3.3	HCO3	Na		•			•		•	•			•				•				•	•	•	•	•	•	•	•							•				
	•	•						•		0.5 - 1	HCO3	Ca		•				•									•		•	•	•			•	•	•	•	•								•			
	•							•		20 - 80	Cl	Na		•					•	•							•		•	•	•			•	•	•	•	•	•				•		•				
•		•					•			58.7	Cl	Na		•			•	•	•			•				•						•	•			•	•	•	•	•		•	•		•		•	•	
•		•					•			62.2	Cl	Na		•			•		•			•				•						•	•			•	•	•	•	•		•	•		•		•	•	
•		•					•			76.4	Cl	Na		•			•	•	•			•				•						•	•			•	•	•							•		•	•	
•			•				•			13.07	Cl	Na		•			•		•			•				•					•	•	•			•	•								•		•	•	
•		•					•			32.1	Cl, HCO3	Na, Ca		•				•				•				•			•	•	•	•	•			•		•	•	•		•	•		•		•	•	
•		•					•			8.5	Cl, HCO3	Na, Ca		•			•	•	•			•				•					•	•	•			•		•	•			•			•		•	•	•
•		•					•			37.3	Cl, HCO3	Na, Ca		•			•		•	•		•				•					•	•	•			•		•	•			•			•		•		•
•		•					•			25.3	Cl	Na		•			•	•	•			•				•					•	•	•			•	•	•	•			•			•		•		
•		•					•			3 - 11	Cl	Na		•			•					•				•					•	•	•			•	•	•	•			•			•		•	•	
•		•					•			1.09	HCO3	Na		•			•	•				•				•					•	•	•			•	•	•				•	•		•		•	•	
			•				•			0.5 - 129	Cl	Na		•			•		•			•			•						•	•	•			•	•		•						•		•	•	

* Average or range of values.

2. WETLANDS SERVICES FORM

MEDITERRANEAN GROUNDWATER RELATED COASTAL WETLANDS INVENTORIED

Wetland services contributing to human well-being. Global assessment of status and trends

			PROVISIONING SERVICES																REGULATING SERVICES							CULTURAL SERVICES					
			Natural production of food						Artificial production of food																						
Inventory number	Name of wetland, country	Type	Cropping	Livestock	Fishing	Fruit collection	Hunting	Other	Aquaculture	Agriculture	Other	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
1	Butrinti, Albania	2H		Moderate →	High →				Moderate →			Low →	Low →						Low →			Low →				High →				High →	
2	Guerbes, Algeria	2HKN	Moderate ↗	Moderate →	Low →		Low ?	Low ?		Moderate →		High →	High →	Low →	Low →			Moderate →	Low ↘	Moderate →	Low →					Low →	Low →	Low →	Low →	Moderate →	
3	Hutovo Blato, Bosnia and Herzegovina	2ENPQS	Low →	Low →	Moderate ↗	Low →	High ↗	Low →		Low →		Low →	Low →	Low →			High ↑	Low →	High ↑	Moderate ↘	High ↑	Low →	High ↘	Low ↘	Moderate ↘	Moderate ↘	Moderate ↘	Moderate →	High ↘	High ↘	
4	Neretva Delta, Croatia	2AHJ	High →	Low →	Moderate →	High ↗	Low →			High ↗		Moderate ↘	High →						Moderate ↗	Moderate ↘	Moderate ↘	Moderate ↘				High ↗	High ↗	Moderate ↗		Moderate ↗	Moderate ↗
5	Lake Mariut, Egypt	1A			Moderate ↘				High →					Unknown ?	High →			Unknown ?	Moderate ↘	Unknown ?	High →	Unknown ?			Unknown ?				Low →	Low →	
6	Tyre Beach, Lebanon	3Q	High →		Moderate →	High ↗	Moderate →		High →	High →		Moderate →	Moderate →			Moderate →		Unknown ?	Low →	Moderate →		Moderate →	Unknown ?		Low →	High →	High →	Moderate ↗	Moderate ↗	High ↗	
7	Tawurgha Spring, Libya	3D	High →	Low →		High →				Low →		Low ↘	High ↘						Moderate →			Moderate →			Low →	Low ↗	Low ↗	High ↗	Moderate ↗	High ↗	Unknown ?
8	Skadarsko Lake, Montenegro	2A	Low →	Low →	Moderate ↗	Low →	High ↗	Low →		Low →		Low →	Low →	Low →	Moderate ↗			Low →	High ↑	Moderate →	High ↑	Low →	High ↘	Low ↘	Moderate ↘	Moderate ↗	Moderate ↗	Moderate ↗	Low →	Low →	
9	Tivatska solila, Montenegro	1R	Low ?	Moderate →	Low ?	Low ?	Moderate ↗	Low ?				Low →	Moderate ↗	Low →				Low →	Moderate →	Moderate →	Moderate →	Unknown ?	High ↘	Low ↘	Moderate ↘	High ↑	Moderate →	Moderate ↗	Moderate →	Low →	
10	Bou Areg Lagoon, Morocco	2AL	Low ?	Moderate →	Low →	Low ?		Low ?	Low ?	Low →		Low →	Low →	Low →	Low →			High →	Moderate ↘	Low →	Low →				Moderate ↗	Moderate ↗	Moderate ↗	Moderate ↗	Low →	Low →	
11	Moulouya Estuary, Morocco	2HKN	Low ?	Moderate →	Low ↘	Low ?		Low ?		Low →			Low ↘					High →	Moderate ↘						High →	High →	Moderate →	Moderate ↗	Low →		
12	Oued Laou Estuary, Morocco	2HKN	Low ?		Low ↘	Low ?				Low →			Low →						Moderate ↘						High →	High →	Moderate →	Moderate →	Low →		
13	Wetland of Wadi Gaza, Palestine	2AHJ		Moderate →	Low ↓		Low ↘		Low ↓	Moderate →		High ↓	High ↗						Moderate ↘	Moderate ↗	Low ↘	Low ↘				Moderate ↘	High →	Moderate ↘	High ↓	Moderate ↓	
14	Akkar Plain, Syria	2EHN	High ↑	Moderate ↗		High ↑	Unknown ?	Low ?	Moderate →	High ↑		Moderate →	High ↗						Moderate ↘	Low →	Low →				Unknown ?	Low →	Low →	Moderate →			
15	Korba (Cap Bon), Tunisia	1BHIQ	Low ?	Moderate →	Low →	Low ?	Low ?	Low ?		Low →		Low →	Low →	Low →	Low →			Moderate →	Moderate ↘	Low →	Low →				Moderate ↗	Moderate ↗	Moderate ↗	Moderate ↗	Low →	Low →	
16	Yumurtalık Lagoon, Turkey	1AHI	Moderate ↗	Low →	Low →	Low →	Low →		Moderate →	Moderate ↗		Low ↘	Low ↘	Low ↓	Low ↓	Low ↓	Low ↓	Low ↓	Moderate →	Moderate ↗		Moderate ↗		Low →	Low →	Low →	Moderate ↗	Moderate ↗	Moderate ↗	Low →	Low →
17	Akyatan Lagoon, Turkey	1AHI	Moderate ↗	Low →	Low →	Low →	Low →		Low →	Moderate →		Low ↘	Low ↘	Low ↓	Low ↓	Low ↓	Low ↓	Low ↓	Moderate →	Moderate ↗		Low →		Low →	Low →	Low →	Low →	Low →	Moderate ↗	Low →	Low →
18	Tuzla Lagoon, Turkey	1AHI	Moderate ↗	Low →	Low →	Low →	High →		Low →	Moderate →		Moderate ↘	Moderate ↘	Low ↓	Low ↓	Low ↓	Low ↓	Low ↓	Moderate →	Moderate ↗		Low →		Low →	Low →	Low →	Low →	Low →	Moderate ↗	Low →	Low →
19	Dipsiz Wetland, Turkey	1B	Moderate →	Low →	Low →		Low →		Low →	Low →		High →	High →	Low ↓	Low ↓	Low ↓	Low ↓	Low ↓	Moderate →	Moderate ↗		Low →		Low →	Low →	Low →	Low →	Low →	Moderate ↗	Low →	Low →
20	Göksu Delta, Turkey	2AIP	Low →	Low →	Low →	Low →	Low →		Low →	Low →		Moderate ↘	Moderate ↘	Low ↓	Low ↓	Low ↓	Low ↓	Low ↓	Moderate →	Moderate →		High ↗		Low →	Low →	Low →	High ↗	Moderate ↗	Moderate ↗	Low →	Low →
21	Dalaman Wetlands, Tukey	1AIP	Low ↗	Low ↘	Low ↘	Low →	Low →		Low →	Low →		Low →	Low →	Low ↓	Low ↓	Low ↓	Low ↓	Low ↓	Low →	Low ↗		Moderate ↗		Low →	Low →	Low ↗	Low →	Low →	Moderate ↗	Low →	Low →
22	Dalyan Wetlands, Turkey	1AIP	Low →	Low ↘	Moderate ↗	Low →	Low →		Moderate ↗	Low →		Low →	Low →	Low ↓	Low ↓	Low ↓	Low ↓	Low ↓	Low →	Low ↗		Moderate ↗		Low →	Low →	Low ↗	Low →	Low →	High →	Low →	Low →
23	Büyük Menderes Delta, Turkey	2AHI	Moderate →	Low ↘	Low →	Low →	Low →		Low ↗	Low ↗		Low ↘	Low ↘	Low ↓	Low ↓	Low ↓	Low ↓	Low ↓	Low →	Moderate →		Moderate ↗		Low →	Low →	Low →	Moderate ↗	Low →	Moderate ↗	Low →	Low →
24	Küçük Menderes Delta, Turkey	1AIP	Moderate →	Low ↘	Low →	Low →	Low →		Low →	Low ↗		Low ↘	Low ↘	Low ↓	Low ↓	Low ↓	Low ↓	Low ↓	Low →	Low ↘		Moderate ↗		Low →	Low →	Low →	Low →	Low ↘	Moderate ↗	Low →	Low →
25	Gediz Delta, Turkey	2AIP	Moderate →	Low ↘	Low →	Low →	Low →		Low →	Low ↗		Low ↘	Low ↘	Low ↓	Low ↓	Low ↓	Low ↓	Low ↓	Low →	Low ↘		Moderate ↗		Low →	Low →	Low ↗	Moderate ↗	High ↗	Moderate ↗	Low →	Low →
26	Gökçeada Lagoon, Turkey	1AHI	Low →	Low ↘		Low →	Low →			Low →		High →	High →	Low ↓	Low ↓	Low ↓	Low ↓	Low ↓	Low →	Low →		Low →		Low →	Low →	Moderate →	Low →	Low ↗	Moderate →	Low →	Low →

Status of services	
(green)	High
(yellow)	Moderate
(red)	Low
(white)	Non-existent
(grey)	Unknown

Trends of services	
↑	Very rapidly increasing
↗	Moderately increasing
→	Continuing
↘	Moderately decreasing
↓	Very rapidly decreasing
?	Unknown

3. DRIVERS OF CHANGE FORM

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

Inventory number	Name of wetland, country	Type	Resource exploitation – Water abstraction: From wetland	From tributaries	Groundwater next to the wetland	Groundwater basin	Biological exploitation: Crops	Forest	Cattle raising	Fishing	Others	Mineral exploitation: Fuel	Salts	Soils	Rocks	Others
1	Butrinti, Albania	2H		Low →		Moderate →				High →			High →			
2	Guerbes, Algeria	2HKN		Moderate →	Moderate →	High ↗	High ↗		Low →							High →
3	Hutovo Blato, Bosnia and Herzegovina	2ENPQS	High ↑	High ↑	High ↑	High ↑	Low →		Low →	Moderate ↗				Low →		
4	Neretva Delta, Croatia	2AHJ	Low →	Moderate →	High ↗	High ↗	High ↗		Low →	Moderate →						
5	Lake Mariut, Egypt	1A	Moderate →							Moderate →			Low →			
6	Tyre Beach, Lebanon	Q3		Moderate ↗		High ↗	High ↗			Moderate →						Unknown
7	Tawurgha Spring Libya	3D	High →		High ↗	High ↗	Moderate →		Moderate →							
8	Skadarsko Lake, Montenegro	2A	High ↗	High ↗	High ↗	High ↗	High ↗		Moderate →	Moderate →						
9	Tivatska solila, Montenegro	1R	Moderate ↗	Moderate ↗	High ↗	High ↗	Moderate →		Moderate →					Moderate →		
10	Bou Areg Lagoon, Morocco	2AL		Unknown	Moderate →	High ↗	High ↗		Low →	Low →						
11	Moulouya Estuary, Morocco	2HKN		High ↗	High ↗	High ↗	High →		Moderate →	Low →						
12	Oued Laou Estuary, Morocco	2HKN		High ↗	High ↗	High ↗	High →		Moderate →	Low →						
13	Wetland of Wadi Gaza, Palestine	2AHJ	Low ↘	High ↗	High ↗	High ↗		Low →	Low →	Low ↓				Moderate ↗	Moderate ↗	
14	Akkar plain, Syria	2EHN		Moderate →	Moderate →	High ↗	High ↗		Moderate →							
15	Korba (Cap Bon), Tunisia	1BHIQ		Moderate →	Moderate →	High ↗	High ↗		Low →							High →
16	Yumurtalık Lagoon, Turkey	1AHI	Low →	Low ↘		Low ↗	Moderate ↗	Low ↘	Low →	Low →		Unknown	Low →	Unknown	Unknown	
17	Akyatan Lagoon, Turkey	1AHI	Low →	Low ↘		Low ↗	Moderate ↗	Moderate →	Low →	Low →		Unknown		Unknown	Unknown	
18	Tuzla Lagoon, Turkey	1AHI	Low →			Low ↗	Moderate ↗	Low ↘	Low →	High →		Unknown		Unknown	Unknown	
19	Dipsiz Wetland, Turkey	1B	Low →			Low ↗	Moderate →	Low ↘	Low →	Low →		Unknown	Moderate →	Unknown	Unknown	
20	Göksu Delta, Turkey	2AIP	Low →	Low ↘		Low ↗	Low →	Low ↘	Low →	Low →		Unknown		Unknown	Unknown	
21	Dalaman Wetlands, Tukey	1AIP	Low →	Low ↘		Low ↗	Low ↗	Low ↘	Low →	Low →		Unknown		Unknown	Unknown	
22	Dalyan Wetlands, Turkey	1AIP	Low →	Low ↘		Low ↗	Low →	Low ↘	Low →	Low →		Unknown		Unknown	Unknown	
23	Büyük Menderes Delta, Turkey	2AHI	Low →	Low ↘		Low ↗	Low →	Low ↘	Low →	Low →		Unknown		Unknown	Unknown	
24	Küçük Menderes Delta, Turkey	1AIP	Low →	Low ↘		Low ↗	Low →	Low ↘	Low →	Low →		Unknown		Unknown	Unknown	
25	Gediz Delta, Turkey	2AIP	Low →			Low ↗	Low →	Low ↘	Low →	Low →		Unknown	High →	Unknown	Unknown	
26	Gökçeada Lagoon, Turkey	1AHI	Low →			Low ↗	Low →	Low ↘	Low →	Low →		Unknown		Unknown	Unknown	

Inventory number	Name of wetland, country	Type	Changes in land use: Deforestation	Reforestation	Forest management	Replacement of species	Extensive agriculture	Extensive cattle raising	Urbanization	Roads	Others	Modification of the hydrological cycle: Drainage	Input of excess irrigation	Storage usage	Artificial recharge	Input of urban wastewater	Others
1	Butrinti, Albania	2H							High ↗	Moderate ↗						Moderate →	
2	Guerbes, Algeria	2HKN				Low →	High ↗	Low →	High →	Low →		Moderate →	High ↗	High ↗		Low →	
3	Hutovo Blato, Bosnia and Herzegovina	2ENPQS				Moderate ↗	Low →	Low →	Low →	Moderate →		Moderate →	Low →	High ↑	High →	Low →	
4	Neretva Delta, Croatia	2AHJ					High ↗		Moderate ↗	Moderate ↗		High →	Moderate ↗	Moderate →		Moderate ↗	
5	Lake Mariut, Egypt	1A					High ↗			Low →	High →	High →	High ↗	High ↗		Low →	
6	Tyre Beach, Lebanon	Q3				High →	High ↗			Low →	Unknown	High →	Moderate ↗	High ↗		Low →	
7	Tawurgha Spring Libya	3D					High ↗	Moderate →	High ↑	Moderate ↗		Moderate →	Moderate →	Low →		Moderate ↗	
8	Skadarsko Lake, Montenegro	2A	Moderate →			Moderate →	Moderate →	Low →	High →	Low →		Moderate →	Moderate →	Moderate →		High →	
9	Tivatska solila, Montenegro	1R	Moderate →			Unknown	Low →	Low →	High ↗	Moderate →		Moderate →	Moderate →	Moderate →		Moderate →	
10	Bou Areg Lagoon, Morocco	2AL				Low →	Low →		High →	Low →		Moderate →	Low →	High ↗		High →	
11	Moulouya Estuary, Morocco	2HKN					Moderate →	Moderate →	High →	Moderate →		High →	Low →		Moderate →	Moderate →	
12	Oued Laou Estuary, Morocco	2HKN					Low →	Low →	High ↗	Moderate →		Moderate →	Low →			High →	
13	Wetland of Wadi Gaza, Palestine	2AHJ	Moderate ↗		Low ↘		Low ↘		High	Moderate ↗			Low →	Moderate ↗	Moderate ↗	High ↗	
14	Akkar plain, Syria	2EHN				Unknown	High ↗	Low →	High ↗	Moderate →		Moderate →	High ↗	High ↗		High →	
15	Korba (Cap Bon), Tunisia	1BHIQ				Low →	High ↗	Low →	High →	Low →		Moderate →	High ↗	High ↗	High ↗	Low →	
16	Yumurtalık Lagoon, Turkey	1AHI					Moderate →	Moderate →								Low →	
17	Akyatan Lagoon, Turkey	1AHI			Low →		Moderate →	Moderate →								Low →	
18	Tuzla Lagoon, Turkey	1AHI			Low →		Moderate →	Moderate →								Low →	
19	Dipsiz Wetland, Turkey	1B					Moderate →	Moderate →								Low →	
20	Göksu Delta, Turkey	2AIP					Low →	Low →								Low →	
21	Dalaman Wetlands, Tukey	1AIP					Low →		Low ↗							Low →	
22	Dalyan Wetlands, Turkey	1AIP					Low →									Low →	
23	Büyük Menderes Delta, Turkey	2AHI					Low →									Low →	
24	Küçük Menderes Delta, Turkey	1AIP					Low →									Low →	
25	Gediz Delta, Turkey	2AIP					Low →		Low ↗							Low →	
26	Gökçeada Lagoon, Turkey	1AHI														Low →	

Inventory number	Name of wetland, country	Type	Pollution: Agricultural diffuse pollution	Atmospheric diffuse pollution	Urban/industrial point source pollution	Alteration of biological community structures and ecosystem functioning: Invasive exotic species	Native species extinction	Alteration of biogeochemical cycles	Fragmentation	Effects associated with changes: Chemical water quality	Biological water quality	Oxidation by lowering water table	Increased erosion	Soil destruction	Global and climate changes: Rainfall	Temperature	Sea level rise
1	Butrinti, Albania	2H			Moderate →		Moderate →			High ↗					Moderate ↘	Moderate ↗	Moderate ↗
2	Guerbes, Algeria	2HKN	High ↗	Unknown	Unknown					High ↗	Unknown	Unknown	Unknown	Unknown	Moderate ↘	Moderate ↗	Moderate ↗
3	Hutovo Blato, Bosnia and Herzegovina	2ENPQS	Moderate →		Low ↘	High →	High ↗	High ↗	High ↑	High ↗	High ↗	High ↗	High ↗	Low →	Moderate →	Moderate ↗	Moderate ↗
4	Neretva Delta, Croatia	2AHJ	High ↗		Moderate ↗		Moderate ↗	Moderate ↗	Moderate ↗	Moderate ↗	Moderate ↗				Moderate →	Moderate →	Moderate →
5	Lake Mariut, Egypt	1A	High ↗	Unknown	Moderate ↗	High ↗				High ↗	High ↗	Unknown	Unknown	Unknown	Unknown	Moderate ↗	Moderate ↗
6	Tyre Beach, Lebanon	Q3	Low →		Unknown			Moderate →		Low →	Low →				Moderate →	High →	Moderate ↗
7	Tawurgha Spring Libya	3D	Low ↗		Moderate ↗		Low ↗	Low →	Low ↗	Moderate ↗	Low →				Moderate →	Moderate →	Moderate →
8	Skadarsko Lake, Montenegro	2A	High ↗	Unknown	Moderate →					Moderate →	Low →	Low →	Low →	Low →	Moderate ↘	Moderate ↗	Moderate ↗
9	Tivatska solila, Montenegro	1R	Moderate →	Unknown	Moderate →					Unknown	Unknown	Unknown	Low →	Low →	Moderate ↘	Moderate ↗	Moderate ↗
10	Bou Areg Lagoon, Morocco	2AL	High ↗	Unknown	High ↗					High ↗	Unknown	Unknown	High ↗	Unknown	Moderate ↘	Moderate ↗	Moderate ↗
11	Moulouya Estuary, Morocco	2HKN	Moderate ↘	Unknown	High ↗					Unknown	High ↗	Moderate →	Low →	Low →	High ↗	High ↗	High ↗
12	Oued Laou Estuary, Morocco	2HKN	High →	Unknown	High ↗					High ↗	High ↗			Low →	High ↗	High ↗	High ↗
13	Wetland of Wadi Gaza, Palestine	2AHJ	Moderate →	Low →	Moderate →	Moderate ↗	Moderate →	Low →		Moderate ↗	Moderate ↗		Moderate ↗	Moderate ↗	High ↗	Low ↗	High ↗
14	Akkar plain, Syria	2EHN	High ↗	Unknown	Unknown		High ↑	High ↑		High ↗	High ↗	Unknown	Unknown	Low →	High ↗	High ↗	Moderate ↗
15	Korba (Cap Bon), Tunisia	1BHIQ	High ↗	Unknown	High ↗					High ↗	Unknown	Unknown	Unknown	Unknown	Moderate ↘	Moderate ↗	High ↗
16	Yumurtalık Lagoon, Turkey	1AHI	Low →	Unknown		Unknown	Unknown						High ↗				
17	Akyatan Lagoon, Turkey	1AHI	Low →	Unknown		Unknown	Unknown						Low ↗				
18	Tuzla Lagoon, Turkey	1AHI	Low →	Unknown		Unknown	Unknown						Low ↗				
19	Dipsiz Wetland, Turkey	1B	Low →	Unknown		Unknown	Unknown						Low ↗				
20	Göksu Delta, Turkey	2AIP	Low →	Unknown		Unknown	Unknown						High ↗				
21	Dalaman Wetlands, Tukey	1AIP	Low →	Unknown		Unknown	Unknown						Low ↘				
22	Dalyan Wetlands, Turkey	1AIP	Low →	Unknown		Unknown	Unknown						Low ↘				
23	Büyük Menderes Delta, Turkey	2AHI	High →	Unknown		Unknown	Unknown						Low ↗				
24	Küçük Menderes Delta, Turkey	1AIP	High →	Unknown		Unknown	Unknown						Moderate →				
25	Gediz Delta, Turkey	2AIP	Low →	Unknown		Unknown	Unknown						Low ↘				
26	Gökçeada Lagoon, Turkey	1AHI	Low →	Unknown		Unknown	Unknown						Low →				

Impact of drivers

- High
- Moderate
- Low
- Non-existent
- Unknown

Trends of drivers

- ↑ Very rapidly increasing
- ↗ Moderately increasing
- → Continuing
- ↘ Moderately decreasing
- ↓ Very rapidly decreasing

8.
REFERENCES

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