Trends and key Messages

Indicator	Indicator factsheet number	Long-term trend c. 1970-2018	Recent trend c. 2010-2018	Key messages
State of the wetlands				
Biodiversity: Species abundance	1	Getting worse	Little change/variable	The abundance of wetland-dependent species has been in long-term decline, but has improved since the mid-2000s, largely due to increases in waterbird populations.
Biodiversity: Extinction risk of species	2	Getting worse	Getting worse	The extinction risk of wetland-dependent globally threatened species has greatly increased since 1990.
Water flow	3	Getting worse	Getting worse	Most Mediterranean rivers have experienced a significant reduction in discharge between 1960 and 2000, of between 25% and 70%.
Water quality	4	Getting worse	Getting worse	Water quality is continuing to degrade in most wetlands.
Surface area of wetlands	5	Getting worse	Getting worse	The area of natural wetlands has continued to decrease rapidly, while human-made wetland area has increased.
Area of surface water	6	Getting worse	Little change/variable	The area of inland surface water increased by almost 13% in the last 30 years despite the constant loss of natural wetlands.
Drivers and pressures				
Impact of climate change	7	Getting worse	Getting worse	Coastal and unprotected wetlands are expected to be most severely impacted by climate change, but conserving and restoring wetlands is a very effective way to mitigate climate change impacts for people and biodiversity.
Exploitation of renewable water resources	8	Getting worse	Getting worse	Water withdrawals from the natural environment are continuing to increase.
Water demand per sector	9	Getting worse	Getting worse	Agriculture is the major user of increasing water withdrawals : two-thirds of all water abstraction in the Mediterranean Basin.
Demography	10	Getting worse	Getting worse	The human population has increased by almost one-third since 1990 and is still on an upward trend.
Conversion of natural wetland habitats	11	Getting worse	Getting worse	Much natural wetland is continuing to be lost through conversion, mostly to urban, agricultural and water storage land-uses.
Impact: ecosystem services				
Contribution of wetlands in flood regulation	12	Getting worse	Getting worse	The capacity of wetlands to regulate floods has steadily decreased.
Contribution of wetlands in education and tourism.	13	Getting better	Getting better	Increasing numbers of people are using and valuing wetlands for education and tourism.
Response: governance and management				
Surface area of Ramsar sites	14	Getting better	Little change/variable	The numbers and area of Mediterranean Ramsar Sites have increased by 16% and 11% respectively since 2010.
National strategic efforts to protect wetlands	15	Little change/variable	Little change/variable	An increasing number of countries have wetland management policies, but fewer are now implementing these policies than in 2010.
Wetlands'contribution to the Sustainable Development Goa	16	NA	Getting worse	Sustainable management of wetlands can contribute significantly to achieving the Sustainable Development Goals, but this potential is currently poorly valued.

Situation for Mediterranean wetlands: Getting worse | Little change/variable | Getting better

MWO

Methodological approach

Methodology

After an initial phase of co-selection of relevant indicators by decision makers and gathering relevant data, the first edition of the MWO (MWO1) was published in 2012. In 2018, the second edition of the MWO (MWO2) was published, allowing for an evaluation of trends since the base line findings of MWO1.

The first Mediterranean Wetlands Outlook reported on 17 indicators covering the status and trends of wetlands and their dependent species, causes of changes in Mediterranean wetlands; impacts of these changes on human well-being; and responses of decision makers. It was the first regional indicator-based assessment of the state of wetlands and the issues they face made anywhere in the world. This second Mediterranean Wetlands Outlook report updates the situation for Mediterranean wetlands since the first MWO report.

The indicator set finally included in MWO 2 consists of 16 indicators following a DPSIR framework. These indicators largely overlap with MWO 1, but are not completely the same due to data availability and methodological and technical improvements.

The main criteria that guide decisions on the inclusion of indicators and datasets are:

1) coverage of all 28 Mediterranean countries*;
2) a spatial resolution that can be related to Mediterranean wetlands and ;
3) validity of data.

The data and interpretation of the individual factsheets are based on a knowledge synthesis using a combination of methods, including: literature and report reviews, publically available data portals, innovative scientific research, cross analysis of spatial datasets, and others. For each factsheet the methodology is documented in the online annex.

Mediterranean region

The "Mediterranean region" is considered hereafter as the 27 Contracting Parties of the Ramsar Convention on Wetlands: Albania, Algeria, Andorra, Bosnia & Herzegovina, Bulgaria, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Jordan, Lebanon, Libya, Malta, Monaco, Montenegro, Morocco, Portugal, Serbia, Slovenia, Spain, Syrian Arab Republic, The Former Yugoslav Republic of Macedonia, Tunisia and Turkey, + Palestine.

However, depending on data available, the results for some indicators may cover only part of the Mediterranean region.

Where possible this report includes results at subregional level over four different groups.

Key Messages for Decision-makers

In the Mediterranean Basin:

Striving to meet the needs of a rapidly increasing human population [Ind. 10] has led to:

- Continuing conversion of coastal and inland wetlands to land-uses such as agriculture, urban development and water supply [Ind. 15 / 16 / 19 / 11] ; and
- Consequent loss of the diversity of species dependent on wetlands [Ind. 1 / 2].

As a consequence:

Human well-being is being compromised through the loss of the multiple benefits provided by wetlands including through:

- Increasing risk of flooding of homes and infrastructure [Ind. 12] ;
- Increasing health risks and treatment costs as a result of degrading water quality [Ind. 14] ;
- Increasing risk of exposure to water shortages and drought [Ind. 13 / 18] ;
- Undermining attempts to create a sustainable future and to deliver on the United Nations' Sustainable Development Goals (SDGs) [Ind. 16] ; and
- Reducing mitigations of the impacts of the climate change, which is expected to make this situation worse for future generations [Ind. 7].

In the light of these threats, positive responses for wetlands can make a difference and benefit the well-being of future generations of people and wildlife. Responses include:

- Encouraging increased public awareness of the importance of wetlands, and stakeholder participation in their management, for maintaining human well-being [Ind. 13] ;
- Strengthening national legal and policy arrangements to conserve all wetlands [Ind. 2 / 12 / 15] ;
- Developing and implementing adaptation strategies for coastal and inland wetlands to minimize the impacts of climate change [Ind. 17] ; and
- Enhancing implementation of the Ramsar Strategic Plan and its supporting guidance to achieve wetland wise use, including:
  - Improving national wetland inventories and tracking wetland extent [Ind. 5 / 6 / 11] ; and
  - Accelerating the designation of Ramsar Sites and their sustainable management [Ind. 14].

In addition, responses suggested in the Global Wetlands Outlook (GWO) are relevant for the Mediterranean basin, such as:

- Integrating wetlands into planning and the implementation of the post-2015 development agenda, especially the SDGs [Ind. 15 / 16] ; and
- Applying targeted and inclusive economic and financial incentives for communities and businesses to safeguard and restore wetlands.

MWO

Recommended Responses for Sustainable Mediterranean Wetlands

Recommended responses	National governments	NGOs	Local goverment/ local communities/ site managers	Private sector	Delivery of global targets supported by:
Policy & legislation					
Increase capacity and implementation of all actions of the Ramsar Strategic Plan 2016-2024 and its supporting wise use guidelines	Lead responsibility	Key actor	Key actor	Key actor	• Ramsar SP • Aichi Targets • SDGs • Paris CCA • Sendai FDRR • Barcelona • UNCCD
Strengthen national legal and policy instruments for safeguarding all wetlands	Lead responsibility	Informal role possible	Informal role possible	Informal role possible	• Ramsar SP • Aichi Targets • Paris CCA
Accelerate designation of further Ramsar Sites	Lead responsibility	Key actor	Key actor	Informal role possible	• Ramsar SP • Aichi Target • SDGs
Ensure financial means for policy implementation, monitoring and enforcement	Lead responsibility	Key actor	Key actor	Key actor	• Ramsar SP
Develop and implement adaptation strategies for coastal and inland wetlands to minimise climate change impacts	Lead responsibility	Lead responsibility	Key actor	Informal role possible	• Ramsar SP • Paris CCA
Sustainable development					
Fully integrate wetland conservation and wise use into national planning and implementation of sustainable development, especially the UN SDGs	Lead responsibility	Informal role possible	Informal role possible	Informal role possible	• Ramsar SP • SDGs • UNCCD
Apply targeted and inclusive economic and financial incentives for communities and businesses to safeguard and restore wetlands	Key actor	Key actor	Lead responsibility	Lead responsibility	• Ramsar SP • SDGs
Develop sustainable tourism strategies that optimise the aesthetic and cultural values of wetlands	Lead responsibility	Key actor	Lead responsibility	Key actor	• Ramsar SP • SDGs
Management					
Develop and implement management plans for all Ramsar Sites and other wetland protected areas	Lead responsibility	Key actor	Key actor	Informal role possible	• Ramsar SP • Aichi Targets
Establish functional and funded wetland committees at the appropriate levels including at the national and site management levels	Lead responsibility	Informal role possible	Lead responsibility	Informal role possible	• Ramsar SP • Aichi Targets
Knowledge					
Improve national wetland inventory coverage and tracking wetland extent	Lead responsibility	Key actor	Key actor	Informal role possible	• Ramsar SP • Paris CCA • Barcelona
Increase awareness of wetland values through stakeholder participation and effective education programmes which are targeted, sustained and diversified across a variety of audiences	Lead responsibility	Lead responsibility	Lead responsibility	Key actor	• Ramsar SP • Paris CCA • Sendai FDRR • Barcelona • UNCCD

Key: Lead responsibility | *Key actor* | *Informal role possible*

Ramsar SP: Ramsar Convention Strategic Plan 2016-2024 | ***Aichi Targets:*** *Convention of Biological Diversity (CBD) Aichi Targets* | *SDGs: United Nations Sustainable Development Goals* | ***Paris CCA:*** *United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement* | ***Sendai FDRR:*** *Sendai Framework for Disaster Risk Reduction* | ***Barcelona:*** *Barcelona Convention* | *UNCCD: United Nations Convention to Combat Desertification*

Ramsar MedWet Tour du Valat

1
INDICATOR

Biodiversity: Species abundance

Trend

Data availability

THE TREND

The abundance of wetland-dependent species has been in long-term decline, but has improved since the mid-2000s, largely due to increases in waterbird populations.

Nevertheless, the abundance of populations of amphibians, reptiles, and fishes is still very low and declining.

The Living Planet Index adapted for Mediterranean wetlands

The Living Planet Index (LPI) provides synthetic information about the trend in the abundance of vertebrate species over time. The results of more than 67,000 monitoring operations of populations belonging to 269 wetland-dependent species of mammals, birds, reptiles, amphibians, and fish were included in the calculation of the index. This indicator can be interpreted as the barometer of the health of biodiversity in Mediterranean wetlands.

The LPI of Mediterranean wetlands continuously declined between 1990 and 2008, before increasing. While this recent positive trend is encouraging, additional efforts must be made to reach a level similar to that of 1990

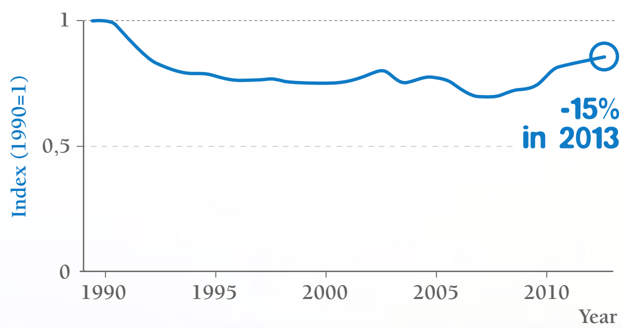
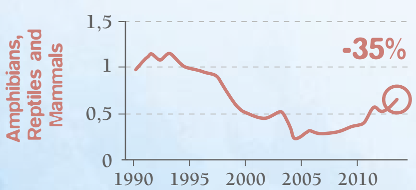
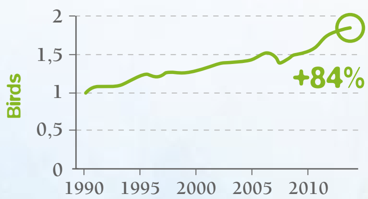
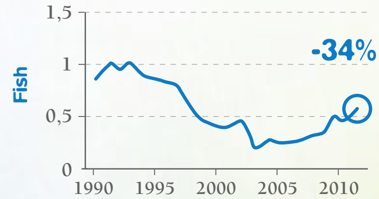


Figure 1 ▸ . *Living Planet Index calculated for the species dependent on Mediterranean wetlands. This index tracks the relative abundance of the populations of mammal, bird, reptile, amphibian, and fish species for which monitoring data are available. The value of the index is arbitrarily set at 1 in 1990.* (source Galewski, unpublished).







Mediterranean wetland species face many anthropogenic pressures, including conversion of natural habitats, pollution, alteration of the natural functioning of watercourses and lagoons, hunting, intensive fishing and shellfish harvesting, rising temperatures, irregular precipitation, and invasive exotic species.

MWO

The populations of many species have declined in numbers, often with serious consequences for the functioning of ecosystems and the services provided. Fortunately, conservation actions have been undertaken to alleviate these pressures. National and international protection systems have succeeded in conserving major sites for biodiversity and limiting the numbers of wild species taken, especially birds. The data show that the "return" of biodiversity is possible if environmental laws are enforced through effective governance.

Waterbirds on the increase

Once extremely rare in Western European and North African wetlands, the Great White Egret is now common (© Thomas Galewski).

In the past, many waterbirds experienced mass destruction, which greatly reduced their numbers and range. Specific protection laws, combined with effective governance, have led to a considerable recovery of nesting populations in EU countries, and consequently of numbers in their Mediterranean wintering grounds (Fig. 1). Some species have also benefited from the creation of artificial wetlands, such as rice fields, saltpans, and gravel pits, which can constitute complementary habitats to natural wetlands. While the LPI indicates clear growth in waterbird numbers between 1990 and 2013 in Western Europe (+101%) and North Africa (+87%), it is more moderate in the eastern Mediterranean (+27%), especially in the Middle-East, where the numbers have even been declining since 2008. These contrasting regional trends can be explained by higher pressure on water resources (Fact Sheet 8), less effective governance (Fact Sheet 16), and the major increase in illegal hunting.

A worrying decline in the other groups of species

The LPI shows that the abundance of amphibians, reptiles, mammals, and fish in Mediterranean wetlands is far lower than in 1990 (Fig. 1). The species in decline are usually victims of the disappearance or degradation of their habitats. For example, small temporary wetlands are very important for amphibians, but are too often converted into agricultural or urban areas, or destroyed by transport infrastructure. The flow of watercourses is decreasing due to the creation of dams or water extraction (Fact Sheet 3), alluvial wetlands are drying out, and water quality is reduced by pollution (Fact Sheet 4), thus endangering fish populations. Only vertebrate species are included in the index, but IUCN Red List assessments also indicate a very worrying status for wetland plants and invertebrates, particularly freshwater molluscs (Fact Sheet 2). Climate change could further aggravate the situation in the next few decades, mainly through less frequent flooding of wetlands and a reduction in the flow of watercourses (Fact Sheet 7).

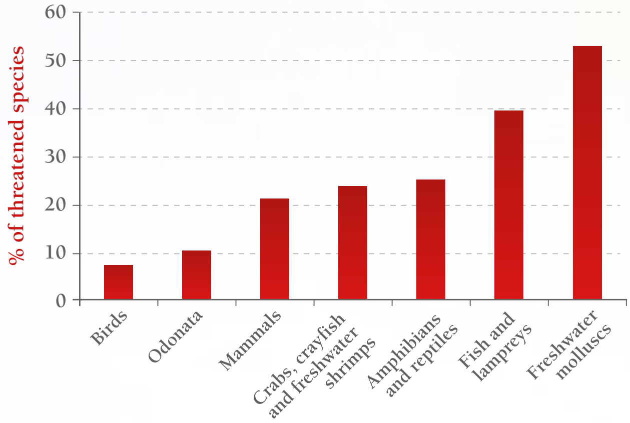


Figure 2 ▸ *Percentage of Mediterranean wetland species assessed as threatened with extinction according to the IUCN Red List.*

Recommendations

- Reinforce the implementation of measures in favour of nature protection, paying particular attention to the most threatened species, such as amphibians, reptiles, fish, molluscs, plants, and arthropods;
- Set up regulations to ensure the good environmental condition of all water to improve its associated biodiversity conservation status;
- Set up new monitoring programmes for groups of species, including amphibians, dragonflies & damselflies, fish, molluscs, and plants, which indicate the quality of wetland habitats;
- Reinforce the monitoring of biodiversity in southern and eastern Mediterranean countries.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

The Natterjack Toad is well distributed over a large part of Europe. In view of the severe declines that have been recorded in the northern part of its range, the large populations in the south of France and the Iberian peninsula play a key role in the conservation of this species (© D. Cohez / Tour du Valat).

Photos: Thomas Galewski (banner)

1
INDICATOR

Biodiversity: Species abundance

Appendix

Method

The Living Planet Index (LPI), advocated by the WWF, has become a global international indicator that measures the trend in the health of biodiversity over time, based on demographic variations in populations of vertebrate species (i.e., mammals, birds, reptiles, amphibians, and fish) (Tittensor *et al.* 2014). A trend is calculated for each species, and then the trends are aggregated and averaged in the form of an index. The first year of the index (1990 in our case) automatically takes the reference value 1, and changes are measured relative to that value: an index value above 1 indicates that biodiversity has increased, between 0 and 1 that it has decreased. 95% confidence intervals, not-shown in Fig. 1, are also calculated (Fig. A1 below):

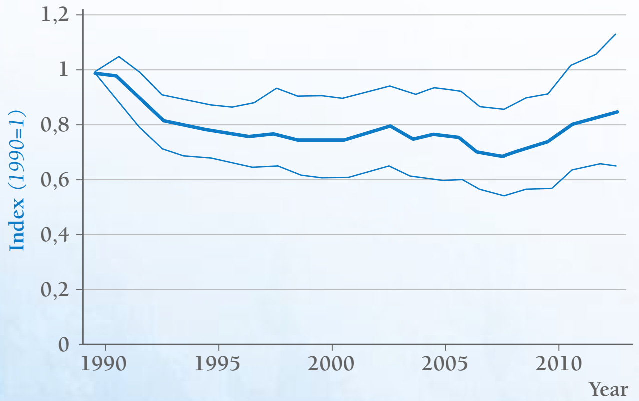


Figure A1 ▸ *Living Planet Index of Mediterranean wetlands. The index values are represented by the curve in bold and the 95% confidence intervals by the light blue curves.*

The trends of 67,176 populations of 269 vertebrate species have been collected so far, mainly in the framework of monitoring programmes carried out by environmental NGOs, scientists, and wetland managers. All the monitoring has been conducted within the limits of the Mediterranean Basin "Biodiversity Hotspot," as defined by Myers *et al.* (2000). Accessibility to these data is variable. Some monitoring results are published either online or in paper format, others are for private use.

In accordance with LPI methodology, the selection of the populations monitored for calculating the index does not take into account their geographical location or taxonomy. Birds, which are better monitored than other groups of species, are therefore much better represented in our database (56% of the species, and 64% of the monitoring operations in the database) than the other groups. On the contrary, many fish or amphibian species have never been monitored, and are thus absent from our database. To mitigate this bias, the Mediterranean wetlands LPI aggregates three indices: a "Birds" index, a "Fish" index, and a "Mammals, Reptiles, and Amphibians" index, which are weighted in function of the percentage of each group present in the real community of vertebrate species. The "Fish" index, for example, is given a higher weighting than the Birds" index in the final calculation of the LPI. This weighting technique follows the methodology described by McRae *et al.* 2017.

MWO

Partners

- **Mediterranean Waterbird Network (MWN):** the Tour du Valat, National Hunting and Wildlife Office (ONCFS), Research Group for the Protection of Birds in Morocco (GREPOM), Directorate General of Forests (Algeria), Association des Amis des Birds / Birdlife Tunisia, Libyan Society for Birds, Ministry of the Environment - Bureau of Environmental Affairs (Egypt)
- **Wetlands International**
- **Institute of Zoology - Zoological Society of London**
- **IUCN Centre for Cooperation in the Mediterranean**

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Photos: Thomas Galewski (banner)

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2
INDICATOR

Biodiversity: Extinction risk of species

Trend ↗
Data availability

THE TREND | The extinction risk of wetland-dependent globally threatened species has greatly increased since 1990.

36% of Mediterranean wetland species are now globally-threatened with extinction. Their decline is still ongoing, their abundance having halved since 1990.

Mediterranean wetlands, hotspots of world biodiversity

The Mediterranean Basin is one of the planet's 34 biodiversity hotspots, characterised by exceptional rates of endemism. The battle against the extinction of its species is a crucial issue. Amongst Mediterranean ecosystems, wetlands are of capital importance for biodiversity: they cover just 2%-3% of the surface area of the Basin, but support more than 30% of its vertebrate species. Twice as many species threatened with extinction are found there than in all the other Mediterranean ecosystems.

The Living Planet Index (LPI) provides overall information about vertebrate species trends. We use it to evaluate whether conservation efforts have been sufficient to reduce the risk of extinction for threatened (or "endangered") species. We calculated a LPI for 40 wetland-dependent Mediterranean species that are threatened according to the IUCN Red List, and for which we have population monitoring data available (Fig. 1).

These threatened species show a continuous decline in their numbers since 1990 (-46% in 2013). The fight against the extinction of these species has therefore been far from sufficient.

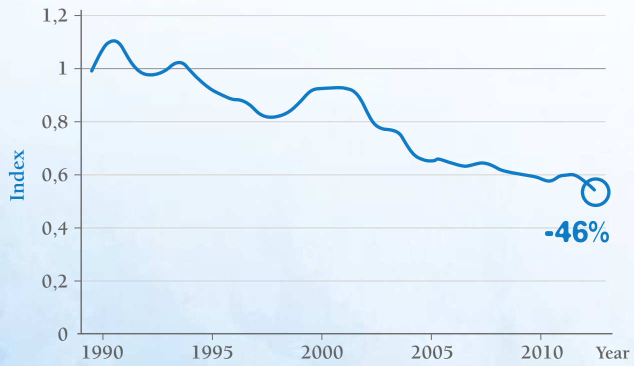

Figure 1 ▸ *Living Planet Index of threatened vertebrate species (CR: Critically Endangered, EN: Endangered, and VU: Vulnerable), and unthreatened vertebrate species (LC: Least Concern, and NT: Near Threatened) between 1990 and 2013* · *Source: Galewski, unpublished*

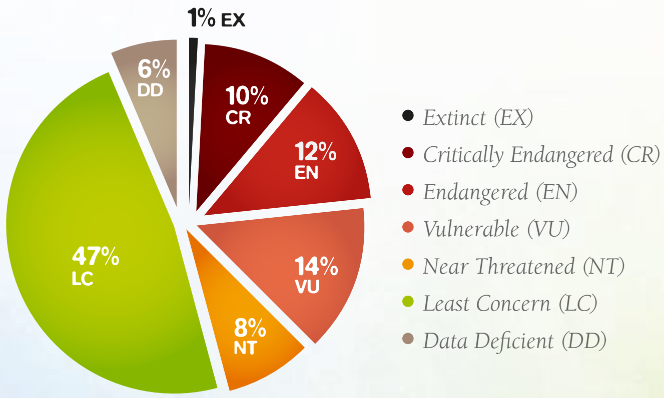

Figure 2a ▸ *Conservation status of Mediterranean wetland species for 8 taxonomic groups representing 1711 species*

MWO

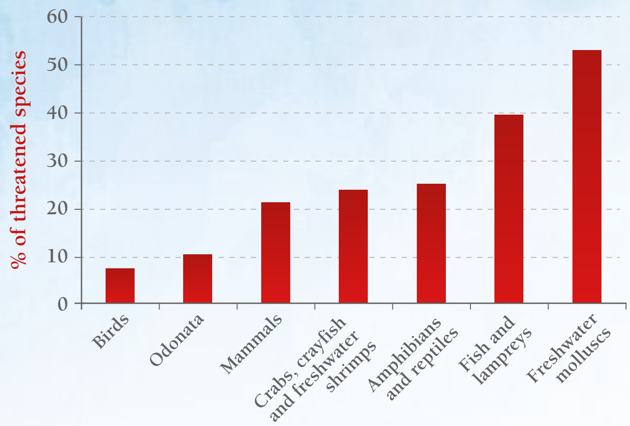

Figure 2b ▸ *Proportion of species threatened (grouping together categories CR, EN, and VU) by taxonomic group* · *Source MWO, IUCN*

Freshwater molluscs and fish, the most threatened species

In the Mediterranean Basin, 36% of wetland-dependent species of mammals, birds, reptiles, amphibians, fish, crustaceans, dragonflies & damselflies, and molluscs are threatened with extinction. The proportion of species threatened varies considerably between groups: 53% of the molluscs and 40% of the fish are threatened, but only 11% of the dragonflies & damselflies, and 7% of the birds. The alarming conservation status of freshwater molluscs and fish can be explained by the serious degradation of their habitats (watercourses and groundwater), and their limited mobility. The main threats are poor water quality due to agricultural and urban pollution, dams that isolate populations and destroy their habitats, the reduced quantity of water in the wetlands because of pumping, and climate change.

Endemic species particularly at risk

Aphanius sirhani *is endemic to the oasis of Azraq in Jordan. This fish is in critical danger of extinction, due to overextraction of water, which has dried out the wetland, and the introduction of Tilapia that compete with Aphanius.* (© N. Hamidan)

Although variable in function of the group of species, rates of endemism are very high in Mediterranean wetlands (more than 40%). Endemic species have naturally limited ranges, which makes them extremely vulnerable to pressures on their habitats: 65% of them are threatened with extinction in the short or medium term. Among the groups assessed, 25 species (11 fish, and 14 freshwater snails), i.e. 3% of the total, became definitively extinct during the course of the 20th century, due to the drying out of their habitat or the introduction of non-indigenous species.

Key areas for the biodiversity of wetlands

The IUCN Centre for Mediterranean Cooperation has identified Freshwater Key Biodiversity Areas. These sites represent the ecosystems that contribute significantly to freshwater biodiversity, because they support populations of rare species that are often endemic and threatened with extinction. While these key areas are found throughout the Mediterranean Basin, they are more numerous in Spain, Greece, Turkey, and Morocco.

Mediterranean Hotspot
Freshwater Key Biodiversity Areas

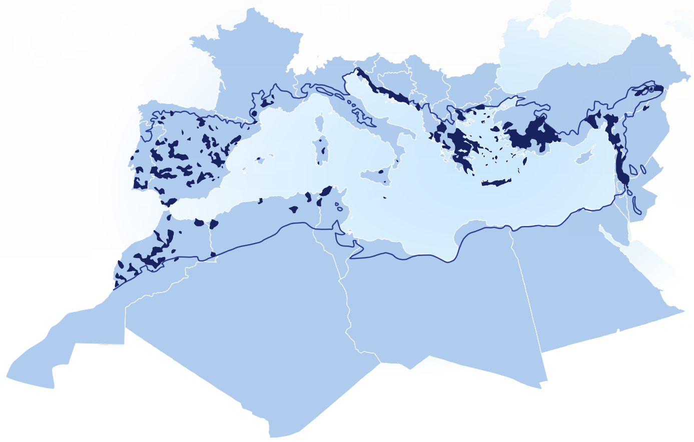

Figure 4 ▸ *Map of Freshwater Key Biodiversity Areas in the Mediterranean Basin* · *Source: IUCN Centre for Mediterranean Cooperation*

Recommendations

- Provide effective protection for all Key Biodiversity Areas in wetlands;
- Set up regulations to reinstate the good environmental condition of all water to improve its associated biodiversity conservation status;
- Ensure that dams are designed and managed in a way that limits their impact on the fauna and flora of associated habitats;
- Apply specific, concrete, short-term action plans that favour species threatened with extinction and their habitats;
- Develop communication and public awareness-raising strategies at national level, and facilitate the monitoring and protection of wetland fish, amphibians, invertebrates, and plants.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

Photos: Thomas Galewski (banner)

2
INDICATOR

Biodiversity: Extinction risk of species

Appendix

Method

Living Planet Index of threatened species

The method for calculating the Living Planet Index (LPI) is presented in the appendix to Fact Sheet 1. We calculated two indices in function of the most recent conservation status in the IUCN Red List: an index for threatened species, i.e. assessed as Critically Endangered (CR), Endangered (EN), or Vulnerable (VU), and an index for non-threatened species, i.e. assessed as being of Least Concern (LC) or Near Threatened (NT). Our calculation was based on 3541 time-series of 40 threatened vertebrate species. In the future, once enough species have been assessed several times in accordance with the Red List criteria, it will also be possible to calculate a "Red List Index" based on a higher number of species than the LPI.

Assessment of the conservation status of Mediterranean wetland species

UOnly an infinitesimal fraction of the species on the Earth has been assessed in accordance with Red List criteria. Nonetheless, major assessment work has been conducted for the Mediterranean Basin Biodiversity Hotspot, especially by the IUCN's Centre for Mediterranean Cooperation and Freshwater Biodiversity Unit teams. Almost exhaustive assessments have been carried out for all of the vertebrate groups (mammals, birds, reptiles, amphibians, and fish including sea fish), and also for some groups of aquatic invertebrates: freshwater molluscs, dragonflies & damselflies, crabs, crayfish, and shrimp. At present, only part of the diversity of aquatic and wetland plants has been assessed, so we did not include that group in our study.

All of the invertebrate species mentioned are dependent on wetlands because they have an aquatic life in freshwater. On the other hand, we had to select the vertebrate species closely linked to wetlands. A bibliographical review was carried out, particularly of the species fact sheets published by the IUCN Red List website www.iucnredlist.org. Whenever a vertebrate species seemed obliged to use one or more types of wetlands at some point in its lifecycle (e.g. during its larval stage, for feeding, breeding, or resting), we considered it to be dependent on wetlands.

The definition of wetlands adopted is the Ramsar definition, that is to say all "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres". There are 882 vertebrate species (581 bony fish, 174 birds, 86 amphibians, 22 mammals, and 6 reptiles) that appear to be dependent on the wetlands of the Mediterranean Hotspot (i.e. 31% of the total).

MWO

Partners

- **Mediterranean Waterbird Network (MWN):** the Tour du Valat, National Hunting and Wildlife Office (ONCFS), Research Group for the Protection of Birds in Morocco (GREPOM), Directorate General of Forests (Algeria), Association les Amis des Oiseaux / Birdlife Tunisia, Libyan Society for Birds, Ministry of the Environment - Bureau of Environmental Affairs (Egypt).
- **Wetlands International**
- **IUCN Centre for Cooperation in the Mediterranean**

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Photos: Thomas Galewski (banner) - J. Jalbert / Tour du Valat

3
INDICATOR

Water flow

Trend

Data availability

THE TREND Most Mediterranean rivers have experienced a significant reduction in discharge between 1960 and 2000, of between 25% and 70%.

This is the result of the combination of too important water abstraction in the watersheds and a low effectiveness of water use.

Essential connectivity for wetland habitats

Rivers not only play a considerable role in human activities for agricultural, industrial, and domestic uses, but also provide biological and hydraulic connections between wetlands. They bring water and sediments to coastal wetlands and are the habitat of hundreds of species endemic to the Mediterranean Basin (Fact Sheet 1). The flow of rivers is a major parameter for the quantities of water effectively available for society, ecosystems, and various vital processes such as the transport of nutrients and sediments. Yet rivers are affected by ever increasing levels of water withdrawal for human activities (Fact Sheet 8), dams, and also climate changes (Fact Sheet 7), resulting in the degradation or disappearance of wetlands downstream (Fact Sheet 5).

A sharp drop in river flows

The drop in the flow of rivers between 1960 and 2000 was from 25% to 70%, reaching 80% for the River Cetina (Croatia). The Nile, previously a major source of freshwater for the Mediterranean, is an emblematic example of this decline (approximately -65%). These global reductions in flow are often combined with other phenomena: the reduction of minimum flows, and the increased frequency of flooding. These changes lead to adaptations by societies, which often involve more intensive hydraulic management, such as the construction of new dam-reservoirs or inter-catchment water transfers.

The water resources available for wetlands are thus scarcer throughout the Mediterranean region. With the decrease in river flows, the wetlands downstream are often lacking water, and the water that does get to them is often more polluted due to reduced dilution levels.

All rivers considered, the total quantity of freshwater discharged into the Mediterranean each year (not including precipitation) declined by about 45% during the 20th century.

Wadi Mujib dam, Jordania (© M. Renaudin / Tour du Valat)

The distribution of flows reaching the Mediterranean Sea can be summarised as follows *(Cf. map on the other side):*

MWO

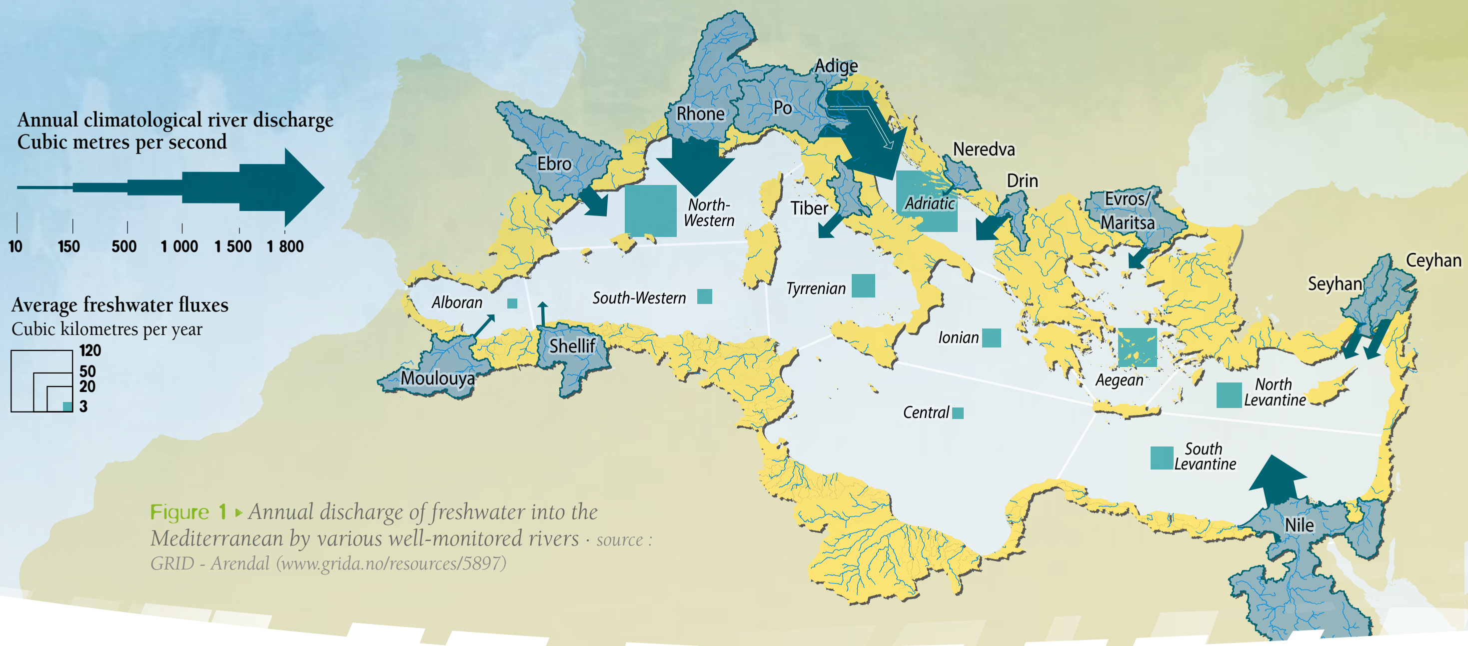

Figure 1 ▸ *Annual discharge of freshwater into the Mediterranean by various well-monitored rivers* · *source : GRID - Arendal (www.grida.no/resources/5897)*

Sharp drop in the flow of main-stem rivers

The drop in total annual flow is estimated at approximately 80-100 km³ between 1960 and 2000 (-15% to -22%, Fig. 2), i.e. almost the combined current flows of the Rhone and the Po. There is no perceptible difference between the west and east of the Basin according to available data. The reduction in river flows is a probable cause of the very unfavourable conservation status of the biodiversity dependent on rivers: 40% of the fish species found in Mediterranean wetlands are endangered (Fact Sheet 2).

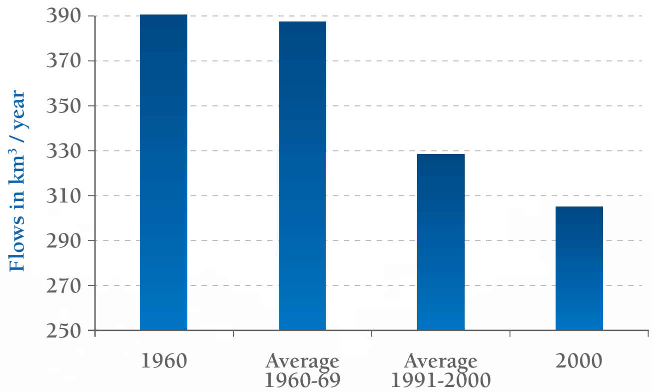

Figure 2 ▸ *Reduction in freshwater discharge flows into the Mediterranean for all rivers (from Ludwig and al. 2009).*

Climate change, the major factor

Decreasing precipitation and increasing temperatures appear to be the major factors in the smaller quantities of freshwater discharged into the Mediterranean. These changes affect most of the Mediterranean Basin (Fact Sheet 7). Reforestation of abandoned agricultural land, the construction of dams, and the increase in water withdrawal upstream also play a significant, or even locally preponderant role.

Development of dam capacities

The construction of dams in the Mediterranean Basin has increased massively, especially since 1950. In 2013 their total storage capacity was estimated at 486 km³, i.e. more than 1.5 time the current annual volume of freshwater discharged by rivers into the Mediterranean Sea (approximately 300 km³, Fig. 2). Dams cause multiple impacts, including the fragmentation of rivers and consequently of fish populations, a reduction in the water and sediments delivered to wetlands, and downstream coastal erosion. There is currently a major resurgence in dam construction in Anatolia and in the Balkans, a region that figures as one of the three world "hotspots" for new dam projects.

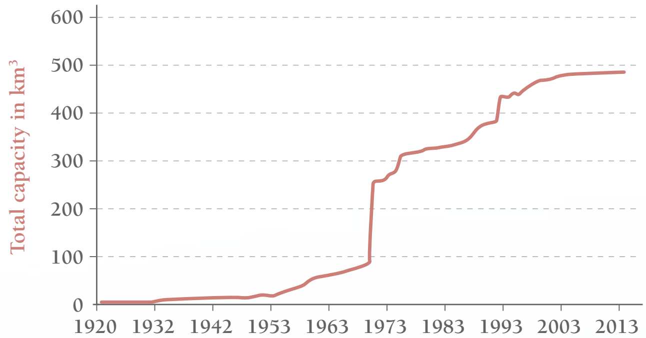

Figure 3 ▸ *Total storage capacity of dams on Mediterranean rivers, in km³*
source : http://www.fao.org/nr/water/aquastat/dams/index.stm, accessed 04/01/2018

Recommendations

The contracting parties and other stakeholders involved, such as scientists and water resource managing bodies, should:

- Implement the appropriate Ramsar resolutions for the planning of water resources and the wise use of wetlands, in particular Resolution VIII.2 "The Report of the World Commission on Dams (WCD) and its relevance to the Ramsar Convention" (Valencia 2002);
- Regularly update existing world databases on river flows and dams, and consolidate the effective sharing of data about water.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

Photos: Hellio & Van Ingen - J. Jalbert / Tour du Valat (banner)

3
INDICATOR

Water flow

Appendix

Methods

The indicator covered by this fact sheet measures trends in water flows over time. It is made up of two sub-indicators:

- The total discharge of freshwater into the Mediterranean;
- The storage capacity of dams, which partly reflects the level of artificial regulation of rivers.

River flows and derived measures

The river flow data come from various projects and several databases, including Global River Discharge RivDIS (worldwide), Medhycos (Mediterranean), and Hydro (France). Because none of them is exhaustive regarding the Mediterranean, any compilation that gathers together several sources to provide a regional panorama requires expert analysis to ensure data comparability and compatibility.

The flows given by these various databases were assessed, assembled, and analysed by Ludwig *et al.* (2009). They established flow trends for 37 Mediterranean rivers since the 1960s, and also the total flow of freshwater discharged by rivers into the Mediterranean Sea. The calculations were completed by hydroclimatic modelling (precipitation, runoff) for the regions where flow data were unavailable (Ludwig *et al.* 2009). The total discharge of freshwater into the Mediterranean Sea is directly derived from these flows, either measured or modelled depending on the catchment concerned.

These calculations slightly update previous work (MWO, 2012, based on Ludwig *et al.* 2003), which focused on 1920, 1970, and 1995. The most recent version, Ludwig *et al.* (2009) essentially compares 1960 and 2000. To the MWO's knowledge, no subsequent summary has been compiled for this indicator for the whole Mediterranean Basin.

Storage capacity of dams

The dam storage capacity sub-indicator is derived from the georeferenced FAO-AquaStat database (http://www.fao.org/nr/water/aquastat/dams/index.stm), which uses data from the official national sources. The update used was from January 2018, but the latest data available for Mediterranean countries, not necessarily exhaustive, dates from 2013. The database includes various types of information, such as the flooding date of each dam-reservoir, its capacity (in km^3), and its surface area. The MWO selected capacity as the main measure of a dam's potential impact on a river.

Precautions :

Given that countries only update the database on a sporadic basis, data concerning periods 10 to 15 years back in time (or older) are likely to be more complete than data concerning more recent years, and excessively fine comparisons between periods should therefore be avoided as they may suffer from this variation in data exhaustivity. The apparent slowdown since the 2000s could very well simply be an artefact due to the lack of recent updates from many countries - or be partly real. For example, out of the 22 dams of the huge Southeastern Anatolia Project (GAP) in Turkey, at least four were completed between 2006 and 2017, but do not figure in the FAO-Aquastat database, in which the latest data on Turkey are from 2005.

MWO

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Photos: Hellio & Van Ingen - J. Jalbert / Tour du Valat (banner) - Tour du Valat

4
INDICATOR

Water quality

Trend

Data availability
East & South
North

THE TREND | Water quality is continuing to degrade in most wetlands.

However, the quality of surface waters is improving for some criteria in European countries, demonstrating the usefulness of European Directives.

Water quality, vital for people and ecosystems

Water quality is of primordial importance not only for human uses, but also for the functioning of freshwater ecosystems and their biodiversity. It depends on the concentrations of numerous chemical components, largely attributable to human activity, including agriculture, industry, and domestic uses. Nutrients (nitrogen, phosphorus, and potassium), which cause the eutrophication of wetlands, are the most frequently monitored parameters, along with Biological Oxygen Demand (BOD), and heavy metals. But there are many other substances that can affect water quality, such as pesticides, polychlorobiphenyls (PCBs), drug residues, and nano-pollutants. For coastal aquifers, salt levels are also a major issue.

Wetlands play an important role in water purification, and therefore contribute to improving the quality of water bodies. The European Union Water Framework Directive (WFD) commits member countries to improving water quality. It sets clear quality objectives for all water bodies in Europe. Southern and eastern Mediterranean countries are not subject to similar obligations, but several of them have voluntarily adopted measures working in the same direction.

Water quality is above all monitored for certain types of wetlands, such as artificial and natural lakes, rivers, coastal marine waters, and water tables (i.e. the water bodies covered by the WFD). Other wetlands are relatively little monitored.

Water quality often declining

It is currently still impossible to obtain an overall assessment of water quality in the Mediterranean region, because too little monitoring of pollutants other than nutrients is carried out, and too little data shared. Nonetheless, recent studies based on field data, socio-economic data, and modelling have enabled regional panoramas to be established for some criteria. In particular, the “Grey Water Footprint” maps the regions in which human activities cause the greatest pressures on water quality (Fig. 1 on the other side).

Common shelducks near a sewage treatment plant in Frontignan (Southern France) © T. Galewski / Tour du Valat

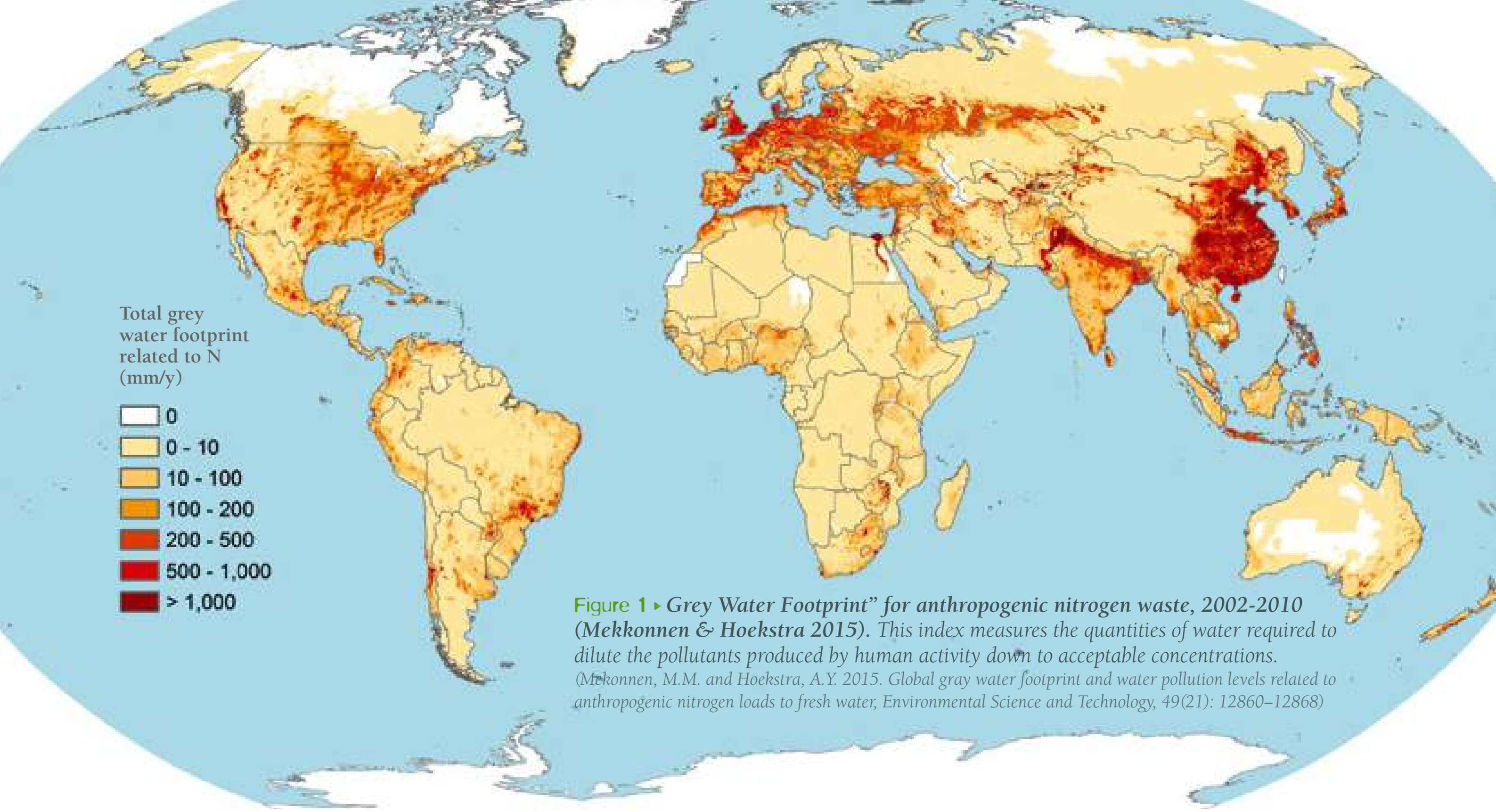

Figure 1 ▸ *Grey Water Footprint" for anthropogenic nitrogen waste, 2002-2010 (Mekkonnen & Hoekstra 2015). This index measures the quantities of water required to dilute the pollutants produced by human activity down to acceptable concentrations.* *(Mekonnen, M.M. and Hoekstra, A.Y. 2015. Global gray water footprint and water pollution levels related to anthropogenic nitrogen loads to fresh water, Environmental Science and Technology, 49(21): 12860–12868)*

Improvements in the northern Mediterranean...

Despite the growing pressures, there are improvements to be noted. For Europe in general, water quality has improved in the main water bodies with regard to BOD, nitrates, phosphates, and ammonium (Fig. 2). Various factors, such as the development of wastewater treatment plants and phosphate-free detergents have contributed to this progress.

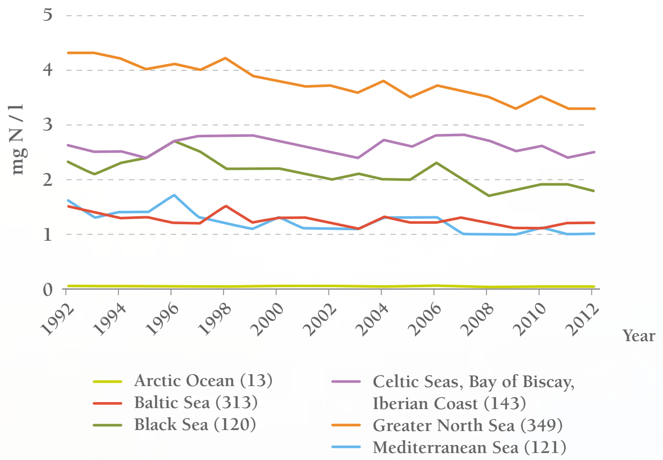

Figure 2 ▸ *Concentrations of nitrates and phosphorus (ortho-phosphates) in the European rivers that empty into the Mediterranean Sea · source: online data from the European Environment Agency; EEA 2015). Figures in brackets: number of measurement stations that provided useable data.*

In spite of these improvements for surface wetlands, the chemical status of a quarter of European water tables is still poor, mainly due to nitrates.

... but a decline in the South and East

In North Africa and the Middle East, the trend is clearly toward a degradation of water quality, for example regarding BOD (Fig. 3). There is a connection between this development and the degraded status of aquatic biodiversity (Fact Sheet 2).

Demographic growth, especially in the coastal zone (Fact Sheet 10) considerably affects water quality, and the wastewater treatment systems used are often inadequate in scale and/or inefficient.

Pessimistic forecasts for the future

The degradation of water quality seems set to continue in the Mediterranean region. Since there are no standardised data available for the whole Mediterranean Basin concerning other pollutants, such as pesticides, heavy metals, drug residues, or various nano-pollutants, consolidated analysis is impossible. But significant quantities of sporadic data suggest a very worrying decline of the health of both humans and ecosystems.

Recommendations

The Contracting Parties, together with all the stakeholders involved, such as users, water management professionals, and water basin agencies should work to:

- Eliminate the use of persistent organic pesticides through alternative, sustainable management strategies;
- Restore or create wetlands to help to improve water quality, especially water tables;
- Set up or reinforce water quality monitoring tools, particularly for non-organic pollutants such as pesticides, heavy metals, and drugs;
- Regularly update existing worldwide water quality databases in order to improve the sharing of data and assess the progress made.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

Photos: Thomas Galewski (banner)

4
INDICATOR

Water quality

Appendix

Methods

This fact sheet was compiled based on the available literature, which did not enable the quantification of a pan-Mediterranean indicator with the data updated every five years. Given the lack of required raw data, the MWO summarised the information available in the bibliography - generally by subregion (EU *versus* the rest of the basin) due to the differences in availability of information.

For the MWO, an ideal Water Quality indicator should include in a single synthetic index at least the organic factors, such as the BOD and the concentrations of nitrates and phosphorus in wetlands, as well as other pollutants deemed to be essential (e.g. pesticides and heavy metals).

However, there is no existing pan-Mediterranean data source or database, even for the most commonly monitored factors like N, P, and BOD, because the international sharing of water data is notoriously complicated (e.g. Haener 2008; Ludwig *et al.* 2009). Haener (2008) provides a panorama summarising the water data systems at the pan-Mediterranean scale, which has not changed very much since that time:

"[…] knowledge about fresh water resources and their uses, co-ordinated between all the Mediterranean countries, is currently insufficient especially on groundwater abstractions and water quality. […] The major problems raised by the international and regional organisations are as follows:

1) The organisations encounter great difficulties in identifying and accessing data.

2) The regional organisations emphasize the difficulties encountered in the collection steps, even within established processes (Plan Bleu, Medstat, Aquastat, IME, etc.)

3) The organisations are encountering major problems of heterogeneity, completeness and quality of the received data,

4) The organisations mention the lack of data on major topics […] Difficulties more often related to the lack of organisation and coordination than to the lack of the data themselves..."

The best existing source of water quality data is Waterbase, the European Environment Agency (EEA) database, compiled by the member countries of the EU and/or the EEA in compliance with the Water Framework Directive (EEA 2015). It only covers:

- The territories of the member countries of the EEA, i.e. the northern Mediterranean, although some non-EU countries are included. It potentially represents up to 17 of the 28 MedWet countries;
- Water bodies as defined in the WFD: watercourses, water bodies (e.g., lakes, lagoons, reservoirs), and coastal waters.

The raw data are abundant (5200 Mo on 8/03/2018) and publicly accessible (https://www.eea.europa.eu/data-and-maps/data/waterbase-water-quality), but there are persistent gaps (e.g. countries late in transmitting data). The EEA aggregates the database to calculate its own water quality indicators, related to the WFD. They are generally expressed in terms of: 1) trends in the average concentrations of various substances (by country, catchment), and 2) the proportion of measurement stations in various categories (e.g. "good chemical status" or "degraded status").

The status and trends are assessed separately for each main type of water mass (e.g. rivers or lakes) and for each key parameter, and the results are published regularly, although the precise indicators are not systematically the same in each new publication. Two of them (concentrations of phosphorus and nitrates in Euro-Mediterranean rivers) are given as examples in Fact Sheet 4.

For the rest of the Mediterranean Basin (South and East), apart from isolated and/or local studies or data, water quality is quantified in:

- Various worldwide reports (e.g. Mekkonen & Hoekstra 2015, Veolia & IFPRI 2015, UNEP 2016), where it is based more on modelling results than field measurements. Some of these indicators were used in Fact Sheet 4 for the southern and eastern half of the Mediterranean Basin;
- Reports at southern and eastern Mediterranean scale for some parameters (e.g., EEA & UNEP/MAP 2014, MEDPOL 2015).

These summaries are useful for quantitative and mapping assessments, but are temporally limited (no diachronic data). In the future, improvements are expected that will harmonise pan-Mediterranean monitoring operations and water quality indicators (together with other types of water indicators) through major ongoing initiatives, including:

SEIS II South (https://eni-seis.eionet.europa.eu/south), a collaboration between the European Environment Agency and the United Nations Environment Programme's Mediterranean Action Plan (UNEP/MAP), aims to extend to the South and East of the Mediterranean the use of certain water indicators and monitoring operations coordinated in Europe by the EEA (e.g. MEDPOL 2015). The data requirements of the SEIS-II South indicators have not yet been optimised for all countries in the southern and eastern parts of the Basin (see maps at https://eni-seis.eionet.europa.eu/south/areas-of-work/data-and-statistics), but are set to be reinforced.

SEMIDE/EMWIS (http://www.emwis.org/overview) has been involved for several years in the setting up of a Euro-Mediterranean system of water monitoring (including water quality) by means of close working partnerships with the countries in the southern and eastern parts of the Basin, pilot projects, and other initiatives.

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Photos: Thomas Galewski

5
INDICATOR

Surface area of wetlands

Trend
Data availability

THE TREND | The area of natural wetlands has continued to decrease rapidly, while human-made wetland area has increased.

A sample of 405 Mediterranean sites lost in average 45-51% of their wetland habitats between 1970-2013.

Measurement of recent losses

Although they cover just 2%-2.5% of the total area of Mediterranean countries, wetlands are extremely productive habitats that provide many services to human societies (Fact Sheets 12 and 13). They support very high levels of biodiversity proportionally to their area (Fact Sheet 1). However, the extent of Mediterranean wetlands has been greatly reduced for more than 2000 years due to multiple human pressures, for example to gain agricultural or urban land, or for sanitary reasons. While the losses are obvious, there are nonetheless few precise data available, and the status and trends of wetlands in the Mediterranean Basin remain poorly known. Only one half of the countries have an inventory of their wetlands, and none of them have regular monitoring of their surface areas.

Natural wetland habitats lost a considerable amount of area between 1975 and 2005, as seen in a sample of 302 coastal Mediterranean sites. The MWO evaluated this total loss at 9%, with a major parallel increase in artificial wetland habitats (+99%, Fig. 1). Within our sample, southeastern Mediterranean countries suffered the greatest losses of natural wetlands, but also the highest gains in artificial wetlands (Fig. 1).

The latter development probably explains the increase in the total area of open water in the Mediterranean Basin between 1984 and 2015 (Fact Sheet 6). An example of a national study (French Ramsar sites) can be found in the online appendix (Fig. S2).

[1] See the online appendix for additional explanations and bibliography.

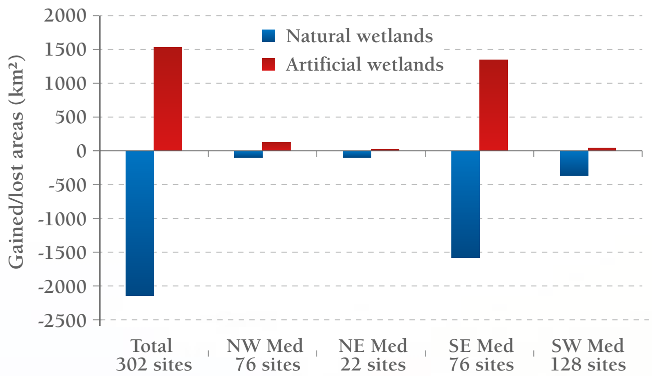

Figure 1 ▸ *Comparison of the losses/ gains in the total area of natural and artificial wetlands for 302 Mediterranean sites (1975-2005) (MWO OcSol database)*[1]

The above figures, concerning emblematic major sites, probably underestimate the real changes affecting the "ordinary" wetlands of the Mediterranean Basin as a whole. To attenuate this bias, a complementary method was used: the WET Index, recently developed by the World Conservation Monitoring Centre (WCMC). It does not calculate the variations in the total areas for a sample of sites, but an average of the loss rates (or gain rates) for the same sites. For the Mediterranean region, it reports an average loss rate of 45%-51% of natural wetland habitats between 1970 and 2013 (confidence interval 95%) for an enlarged sample of 405 sites (Fig. 2). The decline in the Mediterranean region is therefore shown to be higher than those of the three regions surrounding it (Darrah *et al.*, in press), that is to say 42% in Africa, 32% in Asia, and 35% in Europe.

MWO

It should be noted that the WET Index applies to a sample of wetlands, and does not therefore necessarily reflect the change in the total area of wetlands in the region.

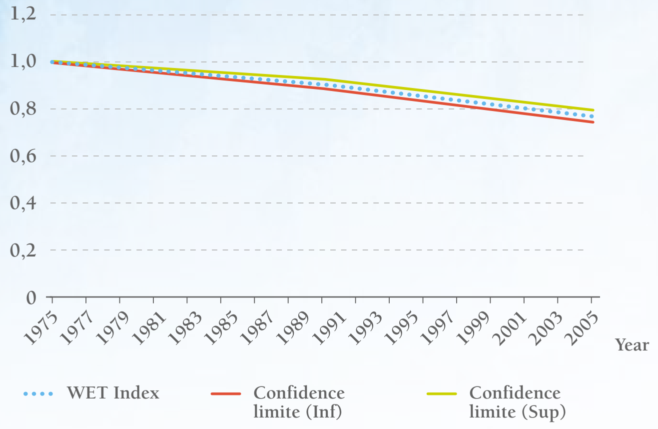

Figure 2 ▸ *WET Index for 405 Mediterranean wetlands*[2] · *source : UNEP-WCMC 2017*

Marine wetlands: often forgotten... but far from negligible!

In its definition of wetlands, the Ramsar Convention includes marine areas less than 6 m deep at low tide. However, such areas are very rarely mapped, inventoried, or included in national inventories. An initial readjustment for the Mediterranean region (Fig. 3) shows that the surface areas concerned are considerable – approximately 4.2 million hectares for the 28 Mediterranean countries (including 2.7 million for the Mediterranean seaboards alone). If they are added to the estimated 15 to 22 million hectares of terrestrial wetlands, the total area of wetlands in the 28 Mediterranean countries covers between 19 and 26 million hectares.

Nevertheless, this revaluation should not be allowed to mask the continuous decline in the total area of natural Mediterranean wetlands.

[2] 305 MWO/GlobWetland 2 sites/data series + WCMC sites/data series

Permanent shallow marine waters < 6 m depth

Figure 3 ▸ *Marine waters less than 6 metres deep off the Tunisian coast form a 10km - 50km wide band covering hundreds of thousands of hectares.*

Recommendations

The contracting parties, together with the other stakeholders involved (e.g. scientists, NGOs) should:

- Halt the still widely prevalent loss of natural wetlands (including "ordinary" wetlands), by the official protection of new wetlands (including marine protected areas), or the designation of new Ramsar sites;
- Implement or update their national wetlands inventory in collaboration with MedWet;
- Carry out a national inventory of marine wetlands, and integrate it with that of terrestrial wetlands.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

Photos: Tour du Valat (banner) - M. Renaudin / Tour du Valat

5
INDICATOR

Surface area of wetlands

Appendix

Context and historical background

In 2012, a first MWO assessment counted 15 to 22 million hectares of wetlands in the Mediterranean Basin still in existence at the beginning of the 21st century (one-fourth of which were artificial wetlands), and a loss on the order of 50% during the 20th century. A recent worldwide study estimated that the losses could even have reached 71% in Europe and 84% in Asia (Davidson, 2014) during the same period, showing an acceleration compared to the previous centuries.

Methods

This quantitative indicator measures, in absolute and relative terms, the trends of natural and artificial wetland habitats in the Mediterranean Basin. In practice, it currently covers a sample of 405 wetland-rich Mediterranean sites. The base data are derived from:

- A bibliographic review carried out by the World Conservation Monitoring Centre (WCMC), and
- An analysis by the MWO of satellite images covering 302 sites in the Mediterranean Basin (Fig S1) using the GlobWetland-II (GW2) method.

The data derived from these two sources are aggregated in a database, from which the “WET Index” is calculated.

Figure S1 ▸ *Distribution of the 302 sites whose land cover was analysed by the MWO.*

Summary of the WET Index method and precautions

Based on a method developed by the UNEP-WCMC and the Ramsar Convention Secretariat (Dixon *et al.*, 2016; UNEP-WCMC 2017), the WET index is the transposition in terms of wetland surface areas of the Living Planet Index (LPI) for biodiversity (Loh *et al.* 2005; cf. Fact Sheet 1). It represents the regional average of trends for the surface area of natural wetlands, calculated as the weighted aggregation of the trends for coastal/marine and inland wetlands relative to the reference year 1970. It requires a sufficient number of diachronic data series for the same sites - at least two measures of the wetland surface area (natural and/or artificial) at different dates.

MWO

The main advantage of the method is that it takes into account series covering durations that can vary considerably between sites. This configuration, in practice very frequent in the real data available, generally prevents the calculation of the loss rate between two dates by simple addition of the surface areas at those dates.

In order to avoid overrepresentation of certain subregions or types of wetlands that are likely to be better monitored, a weighting is applied. The geometric mean of the loss rates is first calculated for all the sites for each pair (subregion x major wetland type), whatever the number of sites monitored for that subregion and wetland type (e.g. Adriatic x lagoon). Then the average of all these pairs is calculated to produce the WET Index for the total sample of sites. It should be noted that the WET index represents the changes in the wetlands studied, but should not necessarily be seen as an indication of the total change in each region.

A sufficient number of data series is required to calculate the WET index for a given area. This minimum has been evaluated for at least several hundreds of sites (S. Darrah, WCMC, personal communication). It is therefore not currently possible, with the 405 Mediterranean sites available for the WCMC database, to calculate reliable subregional (or national) indices for different parts of the Mediterranean Basin.

N.B.: 1. the WET Index concerns a sample of wetlands (research in the literature and a call for data launched by Ramsar), and does not necessarily reflect the change in total wetland area in the region; and 2. the wetlands are not weighted in function of their size.

The precise formulation used in this Fact Sheet is crucial for avoiding misinterpretation: the WET Index represents an average of the loss rates (or gain rates) of wetland habitats for 405 sites, not the measurement of the total loss rate (or gain rate) for the sample. If we consider the MWO dataset for the same period 1975-2005 (288 GW2-II and French Ecology Ministry sites covering exactly the same dates, an exceptional case), the net loss of area of natural wetland habitats is 9%, whereas the concomitant WET index is 23% (weighted average of the loss rates of the 302 sites). This difference stems mainly from the fact that wetland loss rates are not equally distributed between small and large sites, and from the WET Index weighting mechanism. The method is also very sensitive to the sampling used: the WET Index is -23% for the 288 MWO sites, but -48% for all of the 405 WCMC sites.

The WET Index method has been suggested for the monitoring of one of the Sustainable Development Goals (SDG 6.6.1), which is promising in the medium/long term. However, each country needs to have sufficient data time series available (several hundred sites) for the calculation to be reliable.

Use of the "simple addition of wetland surface areas" method

This simple method is often inapplicable because the data series usually cover different periods for each site (see above). But it is applicable, exceptionally, to the MWO dataset obtained using the GW2 method, as it consists of 302 sites measured at exactly the same dates (1975, 1990, and 2005).

The chart in Fig. 1 uses this method to compare Mediterranean subregions, where the excessively small number of sites prevents the calculation of subregional WET indices.

It was also able, from a single dataset, to compare the natural wetland loss rates given by the WET index (23%) and by the sum of surface areas (9%); see above.

Summary of the method for calculating marine surface areas less than 6 metres deep

The surface area of (non-intertidal) marine waters less than 6 metres deep was calculated country by country, and by seaboard for each country (Table S1), using the GEBCO model (General Bathymetric Chart of the Oceans; http://www.gebco.net). It was then added to the surface areas of the other wetlands already summarised by country (Perennou *et al.* 2012), to obtain the new totals for this fact sheet.

Country/ seaboard	Marine surface area in km² (< 6 m deep)	Territory	Marine surface area in km² (< 6 m deep)
Albania	345	Libya	2798
Algeria	432	Malta	52
Bosnia-Herz.	12	Monaco	2
Bulgaria Black Sea	291	Montenegro	77
Croatia	1938	Morocco Atl.	1107
Northern Cyprus	152	Morocco Med	432
Southern Cyprus	129	Palestine	29
Egypt Med.	1728	Portugal	418
Egypt Red Sea	4067	Slovenia	21
France Atl.	5493	Spain Atl.	1072
France Med.	561	Spain Med.	1309
Greece	4716	Syria	49
Israel Med	112	Tunisia	4721
Israel Red Sea	1	Turkey Black Sea	1266
Italy	3913	Turkey Med	2529
Jordan Red Sea	1	Western Sahara	1731
Lebanon	126	**TOTAL**	**41 628**

Table S1 ▸ *Surface area in km² of marine areas less than 6 metres deep at low tide, for each seaboard of each Mediterranean country.*

Complementary results - a national assessment

In 2015, the French Environment Ministry launched an assessment of habitat trends in metropolitan French Ramsar sites. In 2005, wetland habitats covered 39% of the total surface area, which therefore mainly consists of dry land. Natural wetland habitats lost 2% of their surface area in 30 years (1975-2005) while artificial wetlands gained 31% (update according to Perennou *et al.* 2016) (Fig. S2). These trends are probably not representative of French wetlands in general, because they are calculated on the basis of Ramsar sites, often better managed/ protected than the typical wetland.

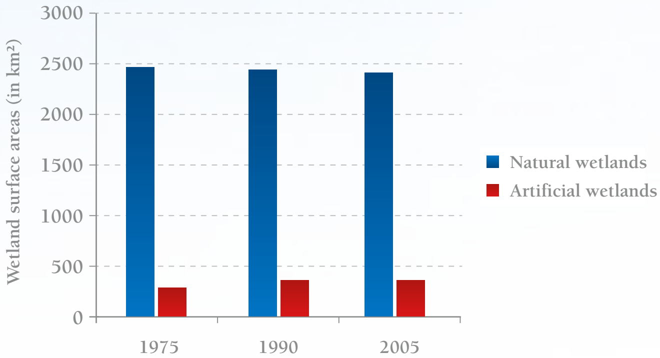

Figure S2 ▸ *Natural and artificial wetland surface area trends in 32 Metropolitan French Ramsar sites between 1975 and 2005.*

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Photos: Tour du Valat (banner)

6
INDICATOR

Area of surface water

Trend

Data availability

THE TREND | The area of inland surface water increased by almost 13% in the last 30 years despite the constant loss of natural wetlands.

Human-made openwater wetlands area, especially with the construction of new dams increased by 26% but the area of natural open-water wetlands is still decreasing.

Evolution of open water surface areas in the MedWet countries

Open water surface areas (see the definition in the online appendix) increased worldwide between 1984 and 2015 (Pekel *et al.*, 2016). This trend is confirmed for the Mediterranean countries, where respective rises of 4.2% and 16.1% were observed for permanent and temporary water surface areas over the same period.

Effects of dams and reservoirs

This trend is partly explained by the considerable rise in the number of dams and reservoirs constructed in the Mediterranean Basin during this period (Lehner *et al.*, 2011).

The regions with the highest increases of total flooded surface areas (North Africa, the Iberian Peninsula, part of the Balkans, or Cyprus and Turkey) contain 1032 of the 1345 dams and reservoirs put into operation between 1984 and 2011 (Fig. 1).

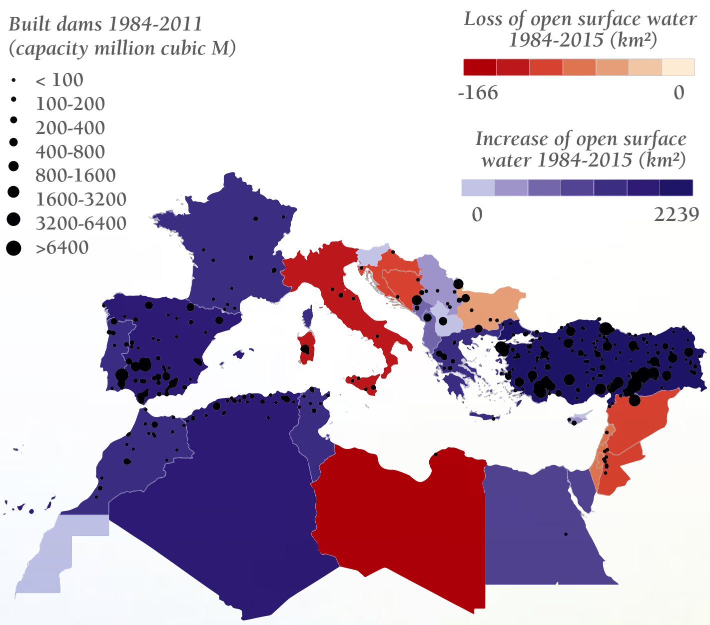

Figure 1 ▸ *Trends in total flooded surface areas (permanent + temporary) in the MedWet countries between 1984 and 2015 (Pekel et al., 2016), with locations of the main dams and reservoirs (black circles proportional in size to their storage capacities) put into operation between 1984 and 2011 (Lehner et al., 2011).*

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Trends in coastal catchment basins

The same trends are observed within coastal catchment basins (Lehner, 2014), where the vast majority of the socio-economic activities of the Mediterranean Region are concentrated, with an increase in open water surface areas, rising from 64,710 km² in 1984 to 70,974 km² in 2015 (+10%). This trend is particularly strong for permanently flooded zones with +13% (as compared with "only" +1% for temporarily flooded zones). However, we can note that certain catchments have nonetheless undergone a loss of flooded surface area in the last 30 years; especially the Nile Delta catchment in Egypt (with the drying out of some wetlands around the lagoons of Burullus and Manzalah), or the catchment of Lakes Tuz and Aksehir in Turkey (with a net loss of 777 km² of open water between 1984 and 2015 for the whole catchment).

What trend for Mediterranean wetlands?

The monitoring results, calculated for a sample of 1257 wetlands spread over all 28 MedWet countries, show that trends are rather the same as those previously observed (increase in open water surface area between 1984 and 2015). However, there is a considerable contrast between natural and artificial sites. Figure 4 suggests that this increase is above all linked to the major increase in open water surface areas in artificial wetlands (essentially dams and reservoirs in this case). This difference is even more significant in the region of the Mediterranean biodiversity hotspot, where sites dominated by artificial wetland habitats have had their open water surface area augmented by more than 60%, whereas there has been a drop of 0.17% in those dominated by natural habitats.

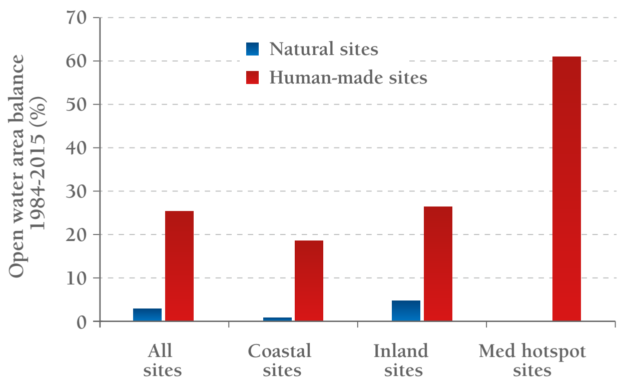


Figure 2 ▸ *Trends in open water surface areas (%) for a sample of 1257 Mediterranean wetlands (346 natural and 911 artificial with respective total surface areas of 75,929 km² and 31,913 km²).*

Furthermore, these results show that this increase in open water surface areas is essentially due to the increase in permanently flooded surface areas, especially in artificial wetlands. Again, the region of the Mediterranean biodiversity hotspot seems to be the most impacted by this phenomenon, with +67.5 % of permanently flooded surface areas in artificial sites, compared with –1.8 % for natural wetlands.

This situation could be due to the fact that in recent decades many Mediterranean countries have oriented their water management policies toward a major reinforcement of the storage capacities (cf. the serious decline in river flows highlighted in Fact Sheet 3), in response to the needs of certain key socio-economic sectors (e.g. irrigation, aquaculture, demand for drinking water), to the detriment of natural ecosystems. Consequently, some natural wetlands have received less and less surface water, causing their permanent open water surface areas to progressively dry out, and to be transformed into temporarily flooded zones, or even to disappear completely (Fig. 3 gives the example of Lake Aksehir in Turkey).

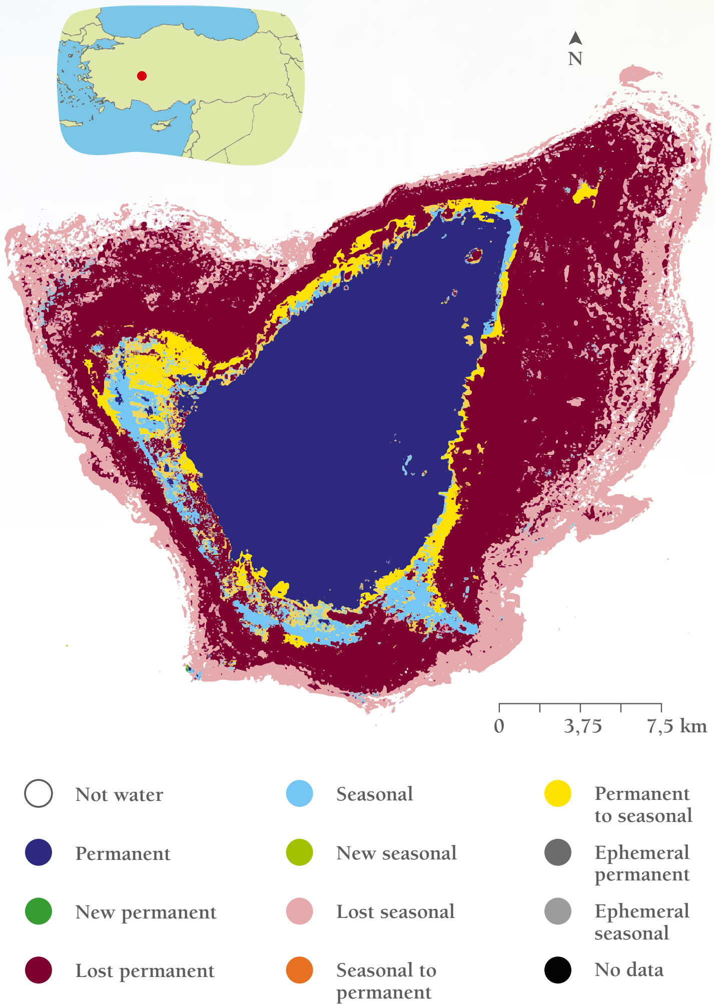


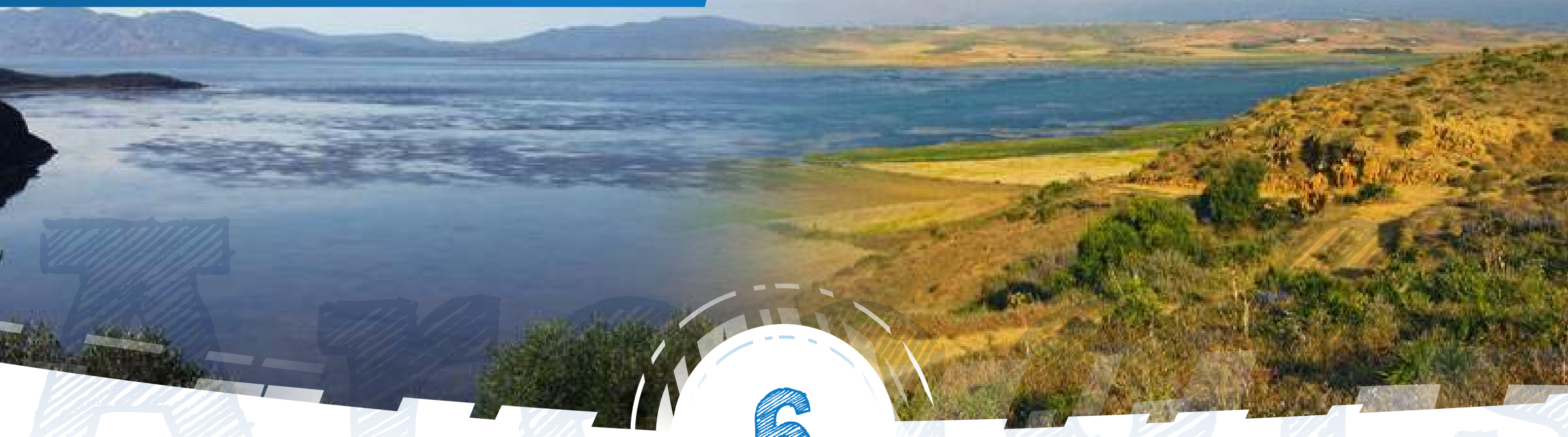
Figure 3 ▸ *Map of spatial-temporal surface water dynamics in Lake Akşehir (Turkey) between 1984 and 2015 (Pekel et al., 2016). We can note the progressive drying out of the wetland, in particular with the regression of permanently flooded surface areas (transformed into temporarily flooded zones or totally dried out).*

Recommendations

- Strengthen the implementation of integrated water resource management policies at catchment scale;
- Improve the taking into account of the water requirements of natural ecosystems and the setting up of environmental flows for rivers heavily impacted by water management structures.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

Photos: Tour du Valat (banner)



6
INDICATOR

Area of surface water

Appendix

Method and reliability

Water is an essential component for Mediterranean wetlands: its quantity, quality, and temporality are key ecological determining factors. Yet hydrological functions are altered in various ways, particularly by withdrawal and storage (dams, retention basins, hydroelectric production) to respond to human and economic needs. These factors weigh heavily on all water resources, including wetlands.

The aim of this indicator is to estimate the modifications of surface water resources, whether increasing or decreasing, at several geographical scales (regional, national, catchment, and site). The causes of the trends are assumed to be essentially anthropogenic, with a minor influence of interannual climate changes and variations.

However, it is different from the indicator measuring the surface area dynamics of wetlands, because it essentially focuses on the flooded surface area rather than wetland habitats in the ecological sense. Moreover, the data used to calculate it are mainly derived from Earth observation tools (optical satellites in this case), which have certain limitations, notably their inability to estimate the flooded surface area when the plant cover is too dense, or with images featuring clouds.

Data

The raw data are derived from the Global Surface Water Explorer (Pekel et al., 2016). They are available free of charge at worldwide scale, in the form of rasters (spatial resolution 30m), enabling them to be cross-analysed with other georeferenced databases (e.g. administrative boundaries within countries, or catchment watersheds obtained from the HydroSHEDS database), and therefore to be presented at different geographical scales (subregional, national, catchment, and site).

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7
INDICATOR

Impact of climate change

Trend
Data availability

THE TREND | Coastal and unprotected wetlands are expected to be most severely impacted by climate change, but conserving and restoring wetlands is a very effective way to mitigate climate change impacts for people and biodiversity.
Wetlands prove to be very cost effective "natural climate buffers" on which we should invest.

Climate change impacts

Climate change will impact Mediterranean wetlands predominantly through increasing temperatures, decreases in precipitation, increases in sea level and increases of extreme weather events. In particular, longer droughts and larger down pours are expected with the latter favoring the frequency of floods. These four impacts of climate change in combination with other pressures will further decrease river flows (Factsheet 3), especially during summer. By 2050, the Mediterranean basin is estimated to experience an average sea level rise of 9.8-25.6 cm and this rise will accelerate in following decades. Increased frequencies of flooding from the sea will put pressure on the existence of coastal wetlands.

Impacts more pronounced in coastal and unprotected wetlands

Between 1990 and 2005, temperature increased moderately (0 – 0.5°C) in 128 of 305 Mediterranean wetland sites and increased strongly (0.5 – 1.2°C) for 167 sites (Fig. 1). Precipitation increased (> 5%) in 113 sites and decreased (> 5%) for 119 sites. Sites that experienced higher rates of change are situated predominantly in the Eastern part of the Mediterranean basin where they are less protected (Fig. 1).

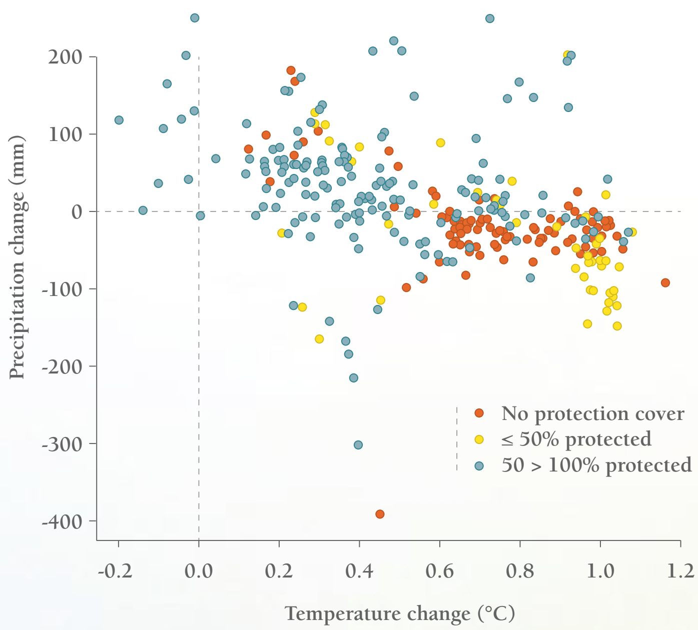

Figure 1 ▸ *Temperature and precipitation changes for 305 Mediterranean wetlands sites (1990 – 2005) and in colour the proportion of surface area per site that has a protection status (Leberger et al, ongoing work).*

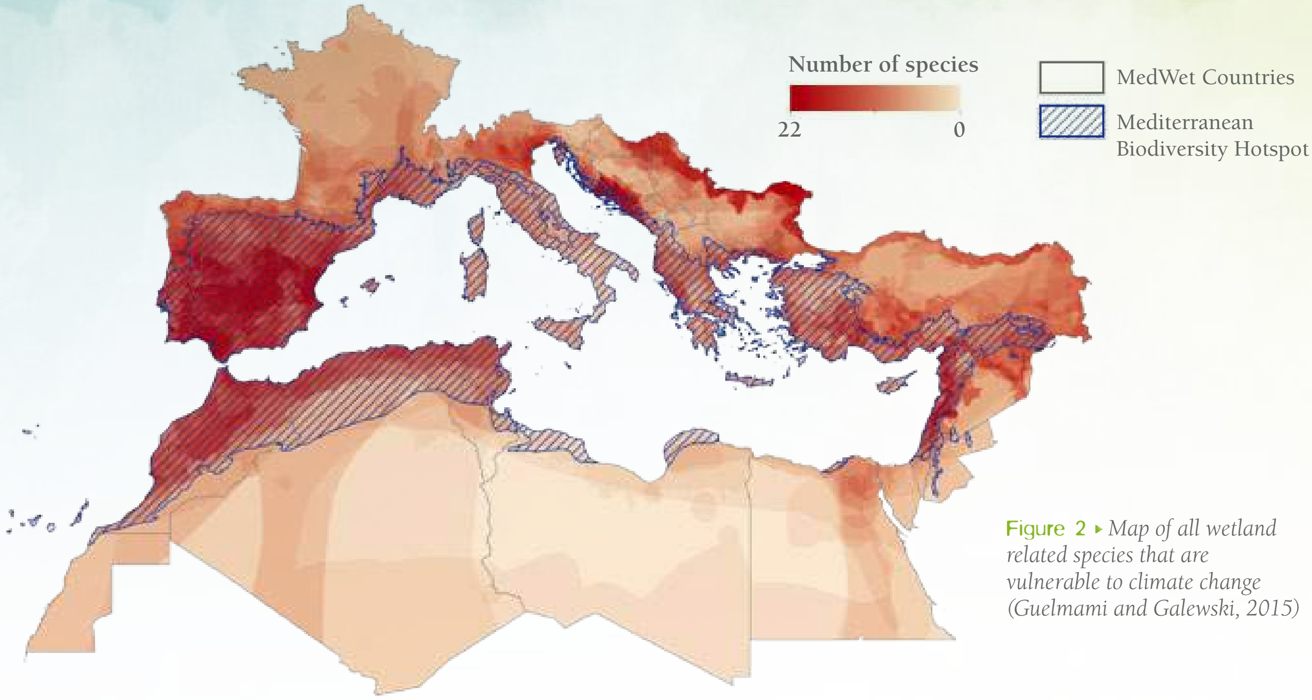

Figure 2 ▸ *Map of all wetland related species that are vulnerable to climate change (Guelmami and Galewski, 2015)*

Climate change impacts species depending on (1) their tolerance to higher temperatures and decreased water availbility and (2) their ability to reach safe habitats. The impact of climate change on threatened species is particularly strong in Spain and Portugal, around the Danube river and in the coastal areas of the Balkans and the Middle East (Fig. 2). Freshwater endemic species are the most threatened, especially those in permanently cold waters (Factsheet 2). Water bird communities consist of more high-temperature loving species. Bird species have shown a greater capacity to adapt to climate change if they are protected from additional pressures such as hunting and habitat reductions.

Nature based solution of climate change mitigation and adaptation

Wetlands contribute to the mitigation of several impacts of climate change (Factsheet 12) and investing in healthy wetlands ensures that these benefits can be obtained on the long-term.

As the population in proximity of wetlands keeps growing (Factsheet 10), they are increasingly dependent on the absorption of water excesses by wetlands. Wetlands buffer impacts of sea-level rise and the flooding of rivers (Factsheet 13). In addition, wetlands also release water in times of droughts which improves the water availability for people and agriculture. These benefits are however strongly dependent on the surface of the natural habitats which continues to decrease (Factsheets 5 & 11).

Temperatures are reduced at a local scale by evaporation from wet areas and at a global scale via carbon sequestration, with carbon sequestration rates being dependent on the natural dry periods of Mediterranean wetlands. Reducing water supply or draining of wetlands, such as resulting from dam constructions, can trigger enormous carbon emissions in the near future (Factsheet 3).

Investments in wetlands conservation and restoration offer powerful means to mitigate climate change impacts to people and biodiversity. Action is, however, required now before the capacity of wetlands to provide these nature based solutions is compromised any further.

Recommendations

- Respect the decisions taken in the context of the UN Framework Convention on Climate Change;
- To ensure nature based contributions for the mitigation of climate change impacts, Mediterranean wetlands should be protected and where needed restored;
- To better predict the impacts of climate change, the lack of monitoring in unprotected areas of biodiversity and water availability and quality should be addressed;
- Wetland dependent species and their habitats should be protected to facilitate community adaptation;
- A geographically better aligned protection strategy with expected impact, by focusing investments and resources for wetlands protection in the eastern Mediterranean;
- Ensure sufficient water availability year round for wetlands so they can continue to absorb water excesses, release water in dry periods and contribute to the sustainable management of scarce water resources.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

Photos: L. Chazée / Tour du Valat (banner)

7
INDICATOR

Impact of climate change

Appendix

Distribution of climate change impacts on 305 sites

This is part of an ongoing research project that is soon to be submitted for publication. In this study, we considered 305 wetland sites in this study, present in 26 countries sharing Mediterranean borders in accordance with the MedWet framework. To construct a database on Mediterranean wetland site, the GlobWetland-II database (European Space Agency project) held by Tour du Valat was used. Land-cover data in 1990 and 2005 were derived from Landsat satellite images (see Beltrame *et al.* (2015) and Perennou *et al.* (2018) for methods) and 164 sites out of the 305 documented in the GlobWetland-II database were also monitored for mid-winter waterbird populations between 1991 and 2010. We considered as 'protected' the following labels: Biotope Protection Order, Forest Reserve, Hunting Reserve, Land acquired by a regional conservatory of natural areas, land acquired by Natural Seaside and Lakeside Conservatory, Marine Protected Areas, Natura 2000, National Park, Nature Monument, Nature Park, Nature Reserve, protected area of Mediterranean Importance, Protected Landscape, Ramsar, Regional Park, Special Reserve, Waterfowl Hunting Bloc, Wildlife Refugee, World Heritage Site. The protection measures were implemented from 1934 to 2016. International labels like Important Birds Areas (IBA) that does not impose any legal constraint were not considered as a form of protection per se if no any other kind of protection overlapped. The total percentage of surface area protected per site was then considered to be a protection grade taking into account all constraining labels. We separated between sites for which the percentage of protected area per site was above and below 50 % and those without any protection in three protection levels: highly protected, low protection level and no protected, respectively.

Community Temperature Index for waterbirds

The reported increase of temperature for water bird communities was computed using the community temperature index (Fig. S1). To calculate the community temperature index, we used the Species Temperature Index (STI) which is a species level measure of climate envelope based on the long-term average temperature over a species range. This index was shown to be a straightforward niche metric to predict species responses to climate change both for breeding and wintering birds . We computed a winter STI following Godet *et al.* (2011) as the average of the mean temperature of January (1950-2000, WorldClim database http://worldclim.org) across the wintering range of each species (winter range maps extracted from BirdLife International datazone, www.birdlife.org 2015) within the geographical zone defined by the African-Eurasian Migratory Waterbird Agreement.

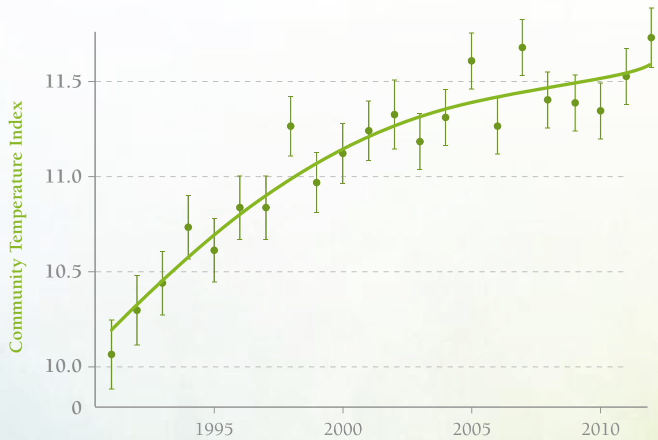

Figure S1 ▸ *Community Temperature Index of wintering waterbirds in the Mediterranean. An increasing index means that the community has changed over years towards an increased relative abundance of warm-dwelling waterbird species (Gaget et al. in press[a], submitted[b]).*

Integrated impact of climate change on red list species

The IUCN Red List datasets provide the information on the distribution areas of all threatened species worldwide. Using these datasets, it was possible to select wetland-dependent species in the Mediterranean Basin for taxonomic groups which have been exhaustively assessed by the IUCN Red List (vertebrates and Odonata), that were said to be threatened with climate change according to IUCN experts and to combine (spatially) their dispersal areas using GIS tools (raster sums pixel to pixel). The resulting product is a map (1km x 1km) representing a spatial overlay of all these layers, where vulnerability hotspots (regarding climate change) could be identified based on the number of existing species (areas with highest values).

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8
INDICATOR

Exploitation of renewable water resources

Trend
Data availability

THE TREND | Water withdrawals from the natural environment are continuing to increase.

Total withdrawals increased from 287 km³/year (2005-2010) to 295 km³/year (2014) for the 22 Mediterranean countries monitored by the Plan Bleu.

Water resources: a key ingredient

Freshwater is a crucial component in Mediterranean wetlands, and its characteristics (quantity, quality, and variation over time) are key ecological factors. This resource, which is unequally accessible in the region, is taken by human populations to meet their growing needs in terms of irrigation, manufacturing, drinking water, and tourism.

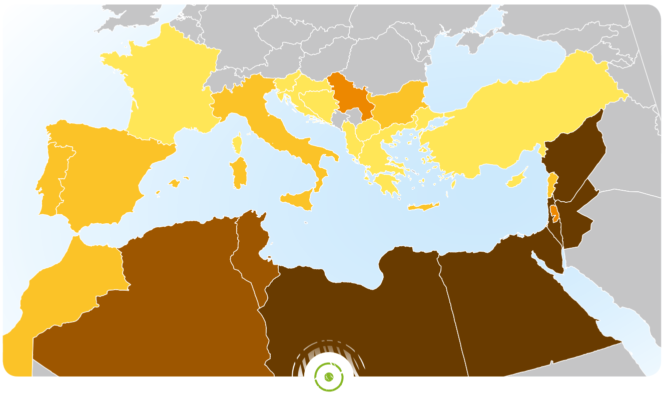
The Water Exploitation Index (WEI) assesses the long-term utilisation of freshwater. It is the relationship between the total volume of water used to cover human needs in a given area and the renewable water resources available in that area. This indicator is used in the framework of the Mediterranean Strategy for Sustainable Development, of Aichi Target 4 of the Convention on Biological Diversity (water stress), as well as in the monitoring of Target 6.4 of the Sustainable Development Goals, which gives countries a strong incitement to report on it on a regular basis.

In 2014, the annual withdrawals of water in the Mediterranean Basin were evaluated at between 313km³ and 323km³ (approximately 30% of its total renewable resources). Surface water abstraction from rivers, lakes, and dams accounts for 80% of this amount, and the rest is pumped from underground aquifers. Water consumption increased significantly during the 20th century, especially due to the demand for irrigation, which accounts for two-thirds of regional consumption (Fact Sheet 9).

Water consumption already at the maximum sustainable limit

The Mediterranean Basin is a region with one of the highest water exploitation indices in the world. The first Sustainable Development Goals Report (2016) shows that North Africa and West Asia (including eastern Mediterranean countries) are two of the regions the most heavily impacted by the overconsumption of freshwater. The degree of water exploitation varies significantly from one country to another (Fig. 1). The map draws attention to the regions in which Mediterranean wetlands are the most likely to suffer from a lack of water: about one-third of Mediterranean countries are water stressed. The overexploitation of the underground water resources along the coast also often results in the intrusion of seawater and the salinisation of water tables. In some inland areas, this has brought about the drying out of numerous wetlands fed by aquifers, such as the Azraq marshes in Jordan and the Tablas de Daimiel in Spain.

MWO



< 20% : Albania, Bosnia and Herzegovina, Croatia, France, Greece, Macedonia FYR, Slovenia, Turkey
20-40% : Bulgaria, Cyprus, Italy, Lebanon, Morocco, Portugal, Spain / 40-60% : Serbia, Palestine / 60-80%: Algeria, Tunisia / > 100%): Egypt, Israel, Jordan, Libya, Syria / Non disponible : Kosovo, Malte, Montenegro

Figure 1 ▸ *Water Exploitation Index (in %) in 2014* · *source: World Bank, http://wdi.worldbank.org/table/3.5#, accessed 08/03/2018. An index above 80% indicates high tensions concerning water resources; 60%-80% means there are high risks of structural tensions. Above 40%, a country is considered to be water stressed, and 20%-40% signifies temporary local tensions. An index over 100% means that the same water is used more than once (reused or recycled).*

Increasing pressure

The WEI trend is only available for southern Europe. Water exploitation is increasing in Spain, on the French Mediterranean coast, and on some large Mediterranean islands (Fig. 2).

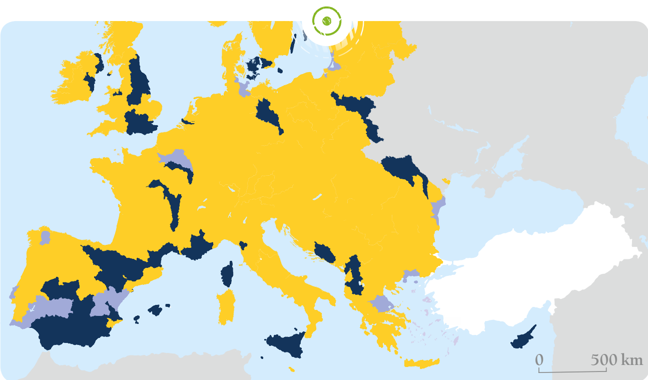


Figure 2 ▸ *Water Exploitation Index trend for 2007-2012 compared to 2002-2006 trend*[2] · *source : EEA 2016*

Varying prospects in the major catchment basins

In 2005, the European Environment Agency launched a prospective study on the expected evolution of the exploitation of renewable water resources, notably taking account of the effects of climate change (Fact Sheet 7). The degree of exploitation was estimated to significantly increase in numerous Mediterranean regions including Italy, Spain, the Balkans, and Turkey (Fig. 3). In some major catchment basins (Rhone, Po, Tejo), the expected implementation of better water management would enable this water stress to be decreased.

[2] See the online appendix for additional explanations and bibliography.

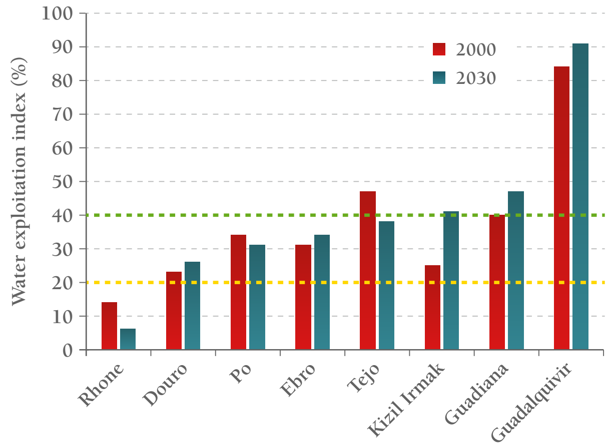


Figure 3 ▸ *Expected evolution of the exploitation indices in some major Euro-Mediterranean catchment basins* (EEA 2005 ; Fig. 5.3)

Recommendations

The contracting parties and all of the stakeholders concerned, including the agricultural community, municipalities, and environmental agencies in the catchment should work together in the aim of:

- Reducing water consumption through management adapted to the demand in order to reconcile the flow rates required by the ecosystems and the minimum vital amounts required by human populations;
- Implementing the appropriate Ramsar resolutions, particularly Resolution VIII.1 "Guidelines for the allocation and management of water for maintaining the ecological functions of wetlands," and Resolution VIII.35 "The impact of natural disasters, particularly drought, on wetland ecosystems";
- Reinforcing the pan-Mediterranean systems put in place for sharing water-related data, and ensuring that the data provided by the countries to international organisations is compatible.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

Reghaia - Algeria (© L. Chazée / Tour du Valat)

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Ramsar MedWet Tour du Valat

8
INDICATOR

Exploitation of renewable water resources

Appendix

Methods

This indicator is one of the 34 priority indicators in the Mediterranean Strategy for Sustainable Development (Index WAT_P03, see www.planbleu.org/methodologie/liste_fiches_indicateursSmdd.html).

IIt is also an indicator for the UN Sustainable Development Goals as well as the Convention on Biological Diversity (called “water stress” in these two frameworks), and in-depth information on the data sources, computation method, and limitations can be found at: https://unstats.un.org/sdgs/metadata/files/Metadata-06-04-02.pdf. The data (only for 2014) are available at http://wdi.worldbank.org/table/3.5#.

This indicator is the ratio (%) of the quantity of renewable freshwater abstracted and the amount available in a country or at the catchment basin level. The index is calculated as follows:

- The numerator of the ratio is equal to the total amount of water taken by people from the various sources of renewable freshwater. This first component of the ratio varies more inter-annually than the second;
- The annual amount of freshwater available in a country or at the catchment level is the long-term average calculated over 20 or 30 years. It takes account of all of the resources that feed the country/catchment, including rainfall, water arriving from upstream, and underground flows.

This indicator is considered to be accurate, because water resources are rather well estimated at national and Mediterranean levels. However, the data-gathering methods may vary in different countries, and some countries tend to overestimate or underestimate certain forms of consumption for political reasons. The Plan Bleu corrects or weights figures by calling on national experts for its own summary data for Mediterranean countries, but these corrections only concern 22 of the 28 Mediterranean countries, and are provided irregularly. It is therefore important to be prudent when comparing the Mediterranean data compiled by two intermediate sources. In the World Bank’s on-line data for 2014, used in Fact Sheet 8, data are lacking or incomplete for four countries (Kosovo, Malta, Monaco, and Montenegro).

One of the main limitations of this indicator is that the variations in the index can be interpreted in different ways. The national trends may be due to various causes. An index that is increasing may be the result of growing pressure on water resources or, on the contrary, a sign that the same water is being reused or recycled more. Likewise, a declining index may be due to lower water withdrawals (a better utilisation of water) or instead to a growing use of desalination or non-renewable fossil aquifers, which relieves the pressure on the renewable resources. Additional information concerning the specific uses of the water is therefore required to interpret these data correctly.

MWO

In addition, the indicator takes account of the water abstracted for human uses, and not the amount actually consumed. Yet in function of the uses, a varying proportion of this water is subsequently returned to the environment, potentially in different forms and places.

Ultimately, more promising indicators may be developed through the "Water Footprint" approach (Hoekstra *et al.* 2012; Mekkonen & Hoekstra 2016: cf. http://waterfootprint.org/en/water-footprint/what-is-water-footprint), which uses modelling based on various world data banks for agriculture, manufacturing, and climate. Theoretically, indicators such as "blue water footprint" and "blue water scarcity" would seem to be more accurate, because they cover the actual consumption of water (not only the withdrawals). In addition, they take account of intra-annual variation, contrary to the current measuring system.

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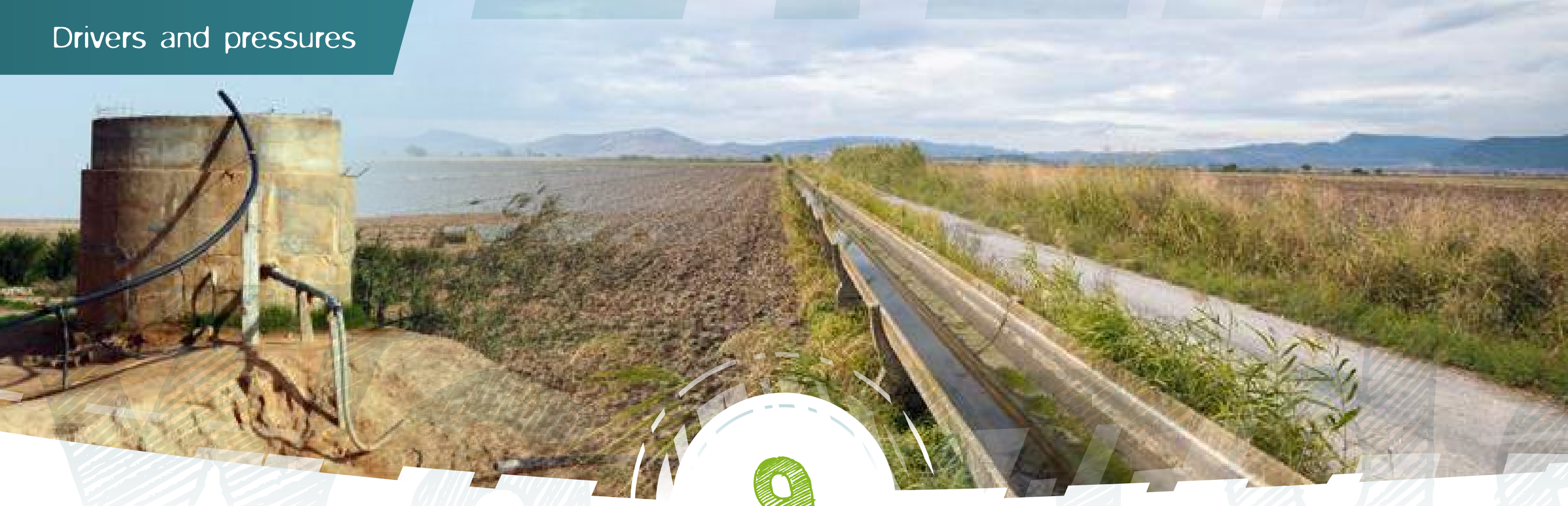
Photos: L. Chazée / Tour du Valat



9
INDICATOR

Water demand per sector

Trend

Data availability

THE TREND | Agriculture is the major user of the ever-increasing water withdrawals: two-thirds of all water abstraction in the Mediterranean Basin.

A large proportion of water abstracted for agriculture is lost due to ineffective irrigation techniques.

Skyrocketing water consumption in the Mediterranean Basin

Water is one of the most important natural resources in the Mediterranean Basin from environmental, political, social, and economic points of view. Total water demand, which has doubled there in the past 50 years, now represents 313 km^3 to 323 km^3/year for the 28 MedWet countries, and is continually increasing (Fig. 1 and Fact Sheet 8). The increasing population (Fact Sheet 10), economic development, and losses in water supply networks, are resulting in excessive withdrawals from river, wetland, and underground aquifer ecosystems.

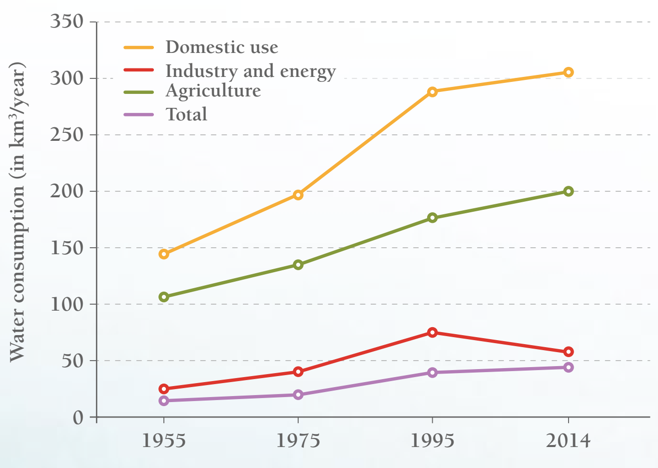


Figure 1 ▸ *Utilisation of renewable freshwater resources (in km^3/ year) by different economic sectors in the 22 Mediterranean countries as defined by the Plan Bleu* · *sources: Margat and Treyer 2004 for 1955-1995; FAO/ AQUASTAT, http://wdi.worldbank.org/table/3.5 accessed 3/01/2018 for 2014). N.B.: since the data sources for these two periods are not identical, we should be careful not to interpret them overly optimistically as a sign that there has been a hypothetical slowdown in water consumption since 1995.*

However, it is also worth noting that not all of the water abstracted is definitively removed from the natural environment. Part of this water does in fact return to it. The proportion is quite substantial for the energy sector (electric power plants), but more limited for the farming sector and for domestic uses. This water returned to the natural environment is often of lower quality than the water originally abstracted.

Agriculture: the main consumer

Irrigated agriculture consumes the greatest amount of water in the Mediterranean Region, accounting for 66% of total consumption in 2014, followed by industry and energy (19%), and then the domestic sector (15%) (Fig. 1). The relative percentage of agriculture has decreased slightly (from about 75% in the 1950s), while the demands from the domestic and industrial sectors have increased. Agricultural consumption is linked to the increasing land area irrigated, which doubled from 1965 to 2005, although there has been a downturn in its rate of expansion. The development of irrigation has resulted in the loss of many wetlands (Fact Sheet 5), because of the upstream withdrawal of water, as is the case in Turkey.

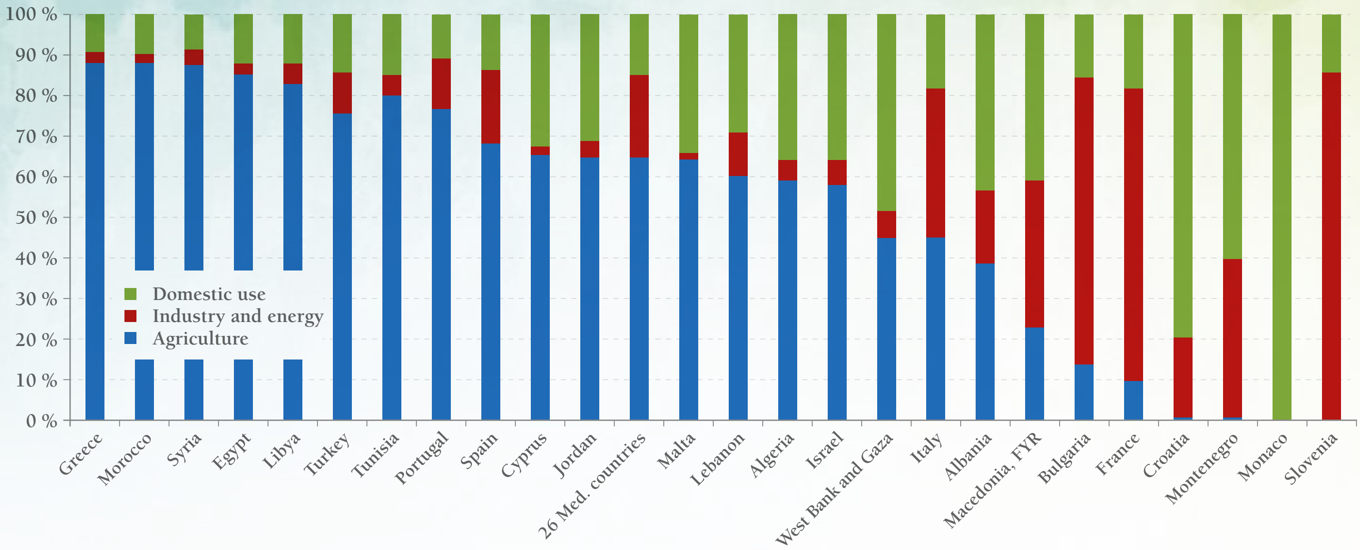


Figure 2 ▸ *Breakdown of water demand by sector of activity in 26 Mediterranean countries in 2014*
source: http://wdi.worldbank.org/table/3.5, accessed 04/01/2018; no data available: Serbia, Kosovo

Water utilisation varies considerably in different countries

Water is used mainly for agriculture in North African and Middle Eastern countries, as well as in Greece and Spain, while other countries like the Balkans and France that have more abundant water resources use it especially for domestic, industrial, and energy purposes (Fig. 2).

A potential for significant savings

Nearly one-third of the water withdrawn every year is not used for the purpose for which it was intended, mainly due to dilapidated networks and inefficient technologies. A large percentage of this waste could be reduced by making the necessary technological investments. Given the importance of irrigation in terms of water consumption, a significant decrease in consumption would require more efficient irrigation. Progress can be made, particularly in the southern and eastern Mediterranean regions, where most irrigation systems are not equipped with water-saving technologies (Fig 3). However, as the case of Turkey demonstrates, such systems are not cure-all solutions. The water savings made in this way have often not resulted in a larger amount of water left for the natural environment, but in the development of new irrigated land areas nearby, which consume the water saved elsewhere. Therefore, the pressure on water resources in natural habitats has not necessarily been alleviated.

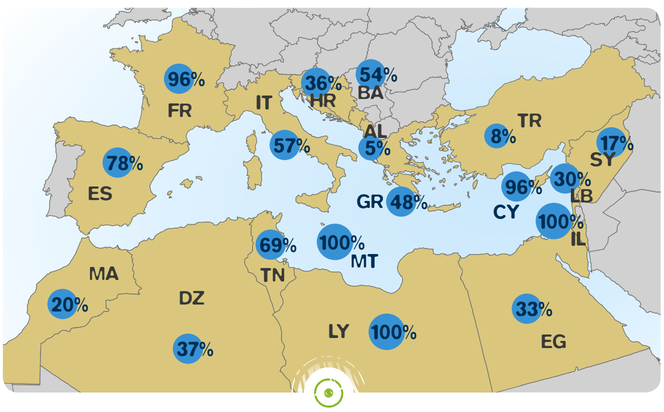


Figure 3 ▸ *Percentage of land irrigated with water-saving equipment ·*
source : Blinda 2012

Recommendations

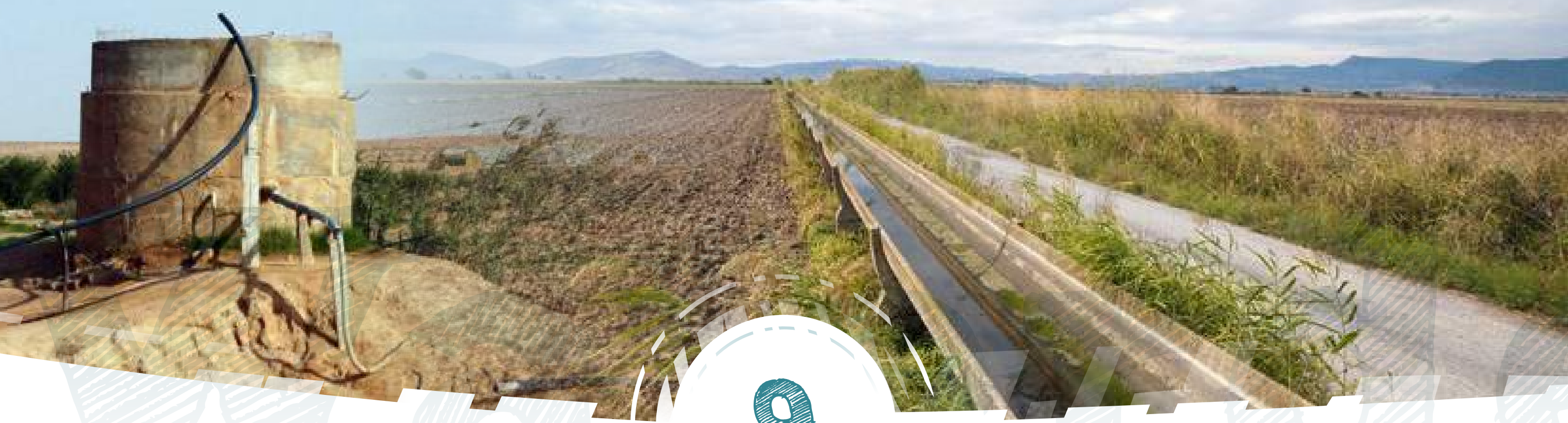
The contracting parties, as well as all of the stakeholders concerned, including those from the agricultural world, municipalities, and water agencies in the Basin, should work together in order to:

- Decrease water demand by promoting the development of agriculture that has low water requirements, particularly in the driest regions, and making the irrigation systems more efficient;
- Ensure the minimum flows and levels needed to maintain wetlands and their functions;
- Implement the relevant Ramsar resolutions, particularly those cited in Fact Sheet 8 (VIII.1 and VIII.35), as well as Resolution VIII.40 *"Guidelines for rendering the use of groundwater compatible with the conservation of wetlands."*

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

Cotton crops in the Gediz delta in Turkey (© Hellio & Van Ingen)

Photos: Hellio & Van Ingen (banner)



9
INDICATOR

Water demand per sector

Appendix

Methods

This indicator measures demand for freshwater in various socio-economic sectors, in order to identify and quantify the principal factors of change potentially affecting wetlands.

Each country keeps a record of the amounts of water withdrawn by the different socio-economic sectors from natural sources such as waterways, lakes, and water tables. It transmits these data to supranational bodies in the framework of regular reports or specific projects like the FAO, World Bank, or Plan Bleu. In this file, the MWO has used the most recent on-line data available, presented by the World Bank for 2014 (http://wdi.worldbank.org/table/3.5, accessed 04/01/2018). To be able to make an accurate comparison with pre-2000 figures, which only concern 22 Mediterranean countries adhering to the Plan Bleu (those with a Mediterranean coast), only the data for these 22 countries were used for Fig. 1, while they are in fact available for 26 of the 28 MedWet countries for 2014.

The methods for collecting data may vary from one country to another, and some might tend to overestimate or underestimate certain forms of consumption for political reasons. The Plan Bleu corrects or weights figures by calling on national experts for its own summary data for Mediterranean countries, but these corrections only concern 22 of the 28 Mediterranean countries, and are provided irregularly. Prudence is therefore recommended when comparing Mediterranean data compiled by two intermediate sources such as the Plan Bleu (used in MWO 2012) and the World Bank (used here).

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Photos: Hellio & Van Ingen (banner)

10
INDICATOR

Demography

Trend

Data availability

THE TREND The human population has increased by almost one-third since 1990 and is still on an upward trend.

Coastal areas are the most impacted (+ 42% of human population since 1990).

Status and evolution of human demography in MedWet countries (1990-2015)

According to GPWv4 (*Gridded Population of the World* version 4) data, between 1990 and 2015, the total Mediterranean population increased by more than 32%, from 463 million to more than 590 million inhabitants (with an average annual increase of about 1.3%). This increase was not homogeneous throughout the Basin (Fig. 1). For example, in the Balkans subregion, the growth observed over the past 25 years has been the lowest (+7.3%), which contrasts significantly with the Maghreb (+48.3%) and the Middle East (+54.8%).

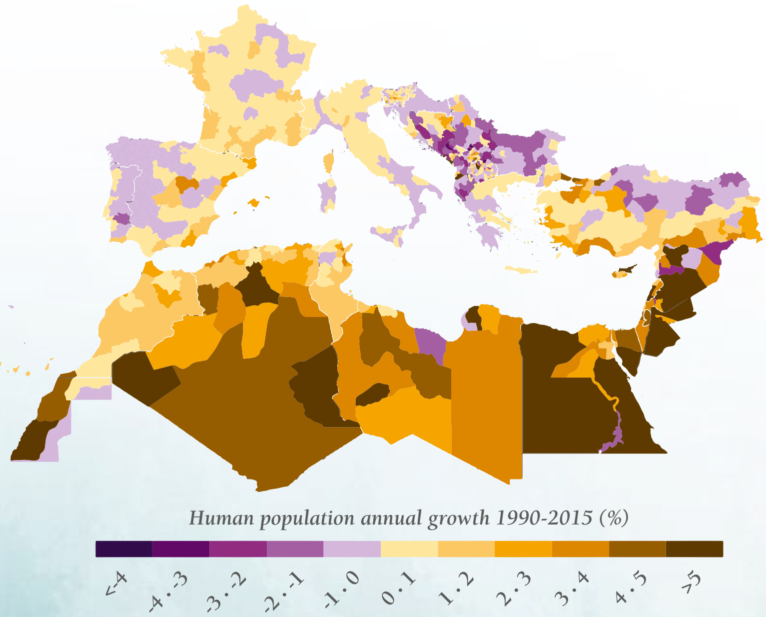


Figure 1 ▸ *Average annual demographic growth rate in MedWet countries from 1990 to 2015, calculated at the scale of regions and provinces* (CIESIN, 2016).

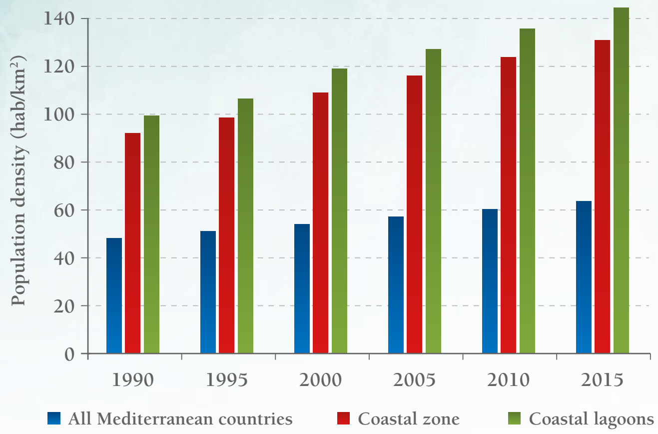
Growing demographic pressures on coastal zones

In coastal zones (i.e. all Mediterranean towns less than 30 km from the coast), the population growth rate is higher than 42% (10 percent more than the overall rate), with the same geographic imbalances indicated above. In addition, population density is much higher (Fig. 2), which is exacerbating the already excessive pressures on natural resources, such as water (the index for the exploitation of renewable freshwater resources is one of the highest in the world in the Mediterranean Basin) and natural habitats.

The case of Lebanon represents an extreme example for illustrating this situation: between 1990 and 2015, its total population nearly tripled (increasing from 1.6 million to 4.6 million inhabitants), with more than two-thirds living today along the coastal strip (approximately 1/5 of its national landmass) where the average population density is some 2155 in hab/km².

This demographic pressure on the coastal zones is even higher in wetlands, because it is estimated that nearly 80 million people live near Mediterranean coastal lagoons (compared to 178 million for the entire coastal zone).

Figure 2 ▸ *Trend in average density of human populations around the Mediterranean Basin* (CIESIN, 2016).



An example of demographic pressures on wetlands at the national level: the case of Tunisia

The comparison of a mapping survey of wetlands in Tunisia and demographic data show that 8.6% of the Tunisian population (1.1 million inhabitants) lives less than 2 km from a wetland, in areas where the demographic growth over the past 25 years was more than 94% (compared to the national average of 38%). This case is a clear example of the growing pressures on these ecosystems; particularly on the services they provide society, which include the provision of water and food, recreation, protection against floods and submergence by sea water, and water purification.

In addition, when urban development occurs without reconciling socio-economic concerns and the protection of habitats and their biodiversity, wetlands can even become a source of nuisances for local populations, as is the case of the Sejoumi Sebkha shown in Fig. 3, located in the southwest suburb of Tunis. Such sites entail the risks of flooded housing (especially when it is developed directly in the wetlands), foul odours resulting from the high eutrophication of the water, degraded landscapes, and the proliferation of mosquitoes. On the other hand, if the territory is managed in an integrated and intelligent manner, the proximity of wetlands does not result in any major nuisances and may become an advantage for local residents, providing areas for recreational and leisure activities, relaxing, and getting back to nature. They could even contribute to local development through ecotourism.

Recommendations

This indicator shows that Mediterranean wetlands and the areas around them remain highly attractive, particularly those along the coast. It is therefore vital to take effective measures to better protect them and promote their value, such as:

- Promoting development models that include economic, social, and environmental components, so that these growing demographic pressures are not accompanied by the degradation of ecosystems;
- Encouraging the development of new urban zones located more inland to reduce the pressures on the coast, and promoting the creation of no-build zones along the coast in all Mediterranean Basin countries;
- Integrating and advocating for wetlands in urban and peri-urban land-use planning schemes;
- Raising public awareness about the roles played and services provided by wetlands, particularly in terms of recreation and culture.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

Photos: L. Chazée / Tour du Valat (banner)

Figure 3 ▸ *Photo of one of the most important wetlands for waterbirds in Tunisia (the Sejoumi Sebkha), but which is also highly urbanised and impacted by pollution, particularly because of the solid waste that accumulates along its edge. (© Hichem Azafzaf)*

Ramsar MedWet Tour du Valat

Photos: L. Chazée / Tour du Valat (banner)

10

INDICATOR

Demography

Appendix

Method and reliability

Description

Human demography is an important factor putting pressure on Mediterranean wetlands. Measuring it should therefore be a good indicator of the overall anthropogenic pressure on these habitats. Combining demography with other parameters, such as the economic development models adapted, produces a good image of the major stressors impacting wetlands, which include urban development, public infrastructure, agriculture, industry, pollution, and other disturbances.

This MWO indicator measures the trends of human populations living in Mediterranean countries. It can be interpreted in relation with data concerning changes in land cover, urban and agricultural stressors, and to quantify the ecosystem services potentially provided by wetlands, by estimating societal demand.

Data

The findings in these studies are based on georeferenced data concerning the world population in *The Gridded Population of the World Version 4* (GPWv4) provided by the CIESIN *(Center for International Earth Science Information Network)*. These data are freely accessible on-line in the form of rasters, with a spatial resolution of 30 arc-seconds (~1km). The two parameters studied (the number of inhabitants and population density) were analysed at the national as well as at the town level, which enabled the coastal zones of MedWet countries to be defined (i.e. all towns with geographic access to the sea, taking account of all the different sea coasts). Our study of these trends was made possible thanks to the time series provided by the GPWv4 (estimations pour 1990, 1995, 2000, 2005, 2010, and 2015).

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MWO

Ramsar MedWet Tour du Valat

11
INDICATOR

Conversion of natural wetland habitats

Trend

Data availability

THE TREND | Much natural wetland is continuing to be lost through conversion, mostly to urban, agricultural and water storage land-uses.

Between 1975-2005 urban areas, inside a sample of wetland sites, increased by 294% and agricultural areas by 42%.

Urban development and agriculture: the two main causes behind the conversion of wetlands

The conversion of natural and semi-natural habitats into land for farming or urban use is one of the major stressors facing wetlands. It leads to both the destruction and modification of natural habitats (Fact Sheet 5) and species, while disturbing nearby habitats.

In recent decades, urban development has accelerated in the Mediterranean Basin, notably in relation with demographic growth (Fact Sheet 10). This process has been more rapid in southern and eastern Mediterranean countries, particularly in their coastal zones. Agriculture has also developed to the detriment of wetlands.

Whereas the total cultivated area did not increase in Mediterranean countries between 1961 and 2005, this apparent stability hides both the continuing disappearance of farmland that is replaced by cities and infrastructure, and the fact that this "lost" farmland is then transferred to natural or semi-natural habitats, including wetlands.

This indicator is based on remote sensing data, from a sample of 302 wetlands throughout the Mediterranean Basin (Fig. 1), which cover 70,556 km². The study of their land cover at three dates (1975, 1990, and 2005) enabled us to quantify the trends.

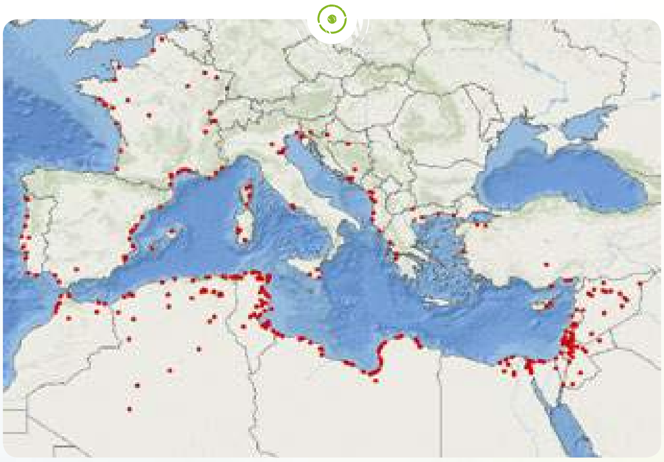

Figure 1 ▸ *Distribution of 302 sites whose land cover was studied by the MWO* · *source: MWO data*

MWO

Ongoing conversion

In the sample of 302 sites, urbanisation increased by 1225 km² (+294%) and cultivated land by 4699 km² (+42%) between 1975 and 2005. These trends vary from one part of the Mediterranean Basin to another, particularly in function of socio-economic conditions (see additional results in on-line Annex). Less wetlands were converted in southwestern Europe than in the rest of the Basin. In addition, these transformations seem to be slowing down globally: they were less significant for 1990-2005 than for 1975-1990.

The natural wetland habitats converted between 1975 and 2005 (in all 2150 km² for the 302 sites), were transformed into about equal parts of cropland and artificial wetlands (Fig. 2)[1]. Urban development concerned smaller, but nonetheless significant, areas.

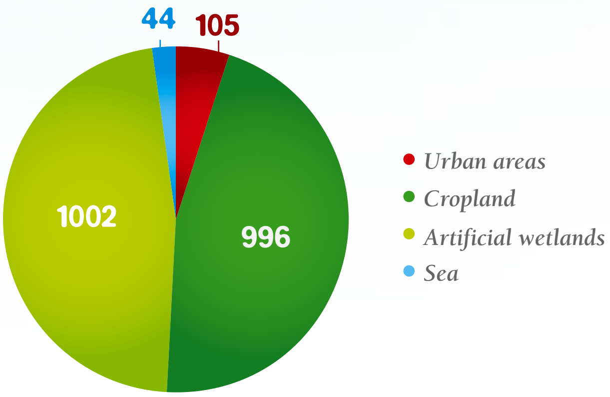

Figure 2 ▸ *Land cover (in km²) conversion for 2150 km² of natural wetlands in 302 sites from 1975 to 2005* · *source: MWO data*

On the other hand, more than 1550 km² of artificial wetland habitats were created during these 30 years. Nearly two-thirds of them were developed in natural wetlands, in areas such as alluvial plains in which gravel pits and sand pits have often replaced wet meadows and riverine woodlands (Fig. 3). Likewise, after the construction of dams, reservoirs have replaced natural riparian habitats along watercourses. The other third corresponds essentially to the construction of water storage reservoirs in terrestrial or agricultural habitats, generally for the purposes of irrigation.

[1] It is worth noting that in these calculations rice fields were included in the cropland, because the remote sensing methods could not separate them from other crops accurately, whereas in the Ramsar Convention they are considered to be artificial wetlands.

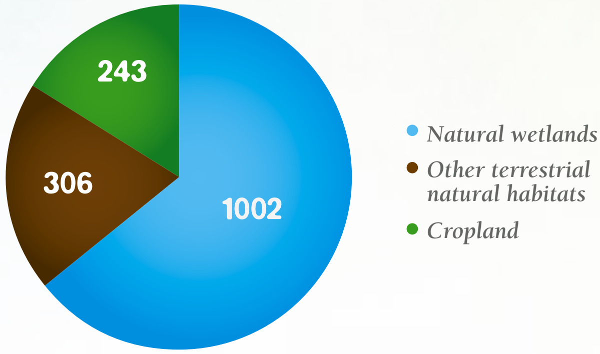

Figure 3 ▸ *Initial land cover (in km²) on which 1550 km² of artificial wetland habitats were created (1975-2005), at 302 sites* · *source: MWO data*

Recommendations

The contracting parties, and the other relevant stakeholders (agricultural, urban planning and land-use planning bodies), should:

- Forbid the conversion of natural wetlands into cultivated farmland or urbanised land in Ramsar sites and in their immediate vicinity, as well as in other important wetlands;
- Limit urban development to artificial zones where there is no significant farmland;
- Ensure that regulations and land-use tools are respected by everyone.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

Photos: L. Chazée / Tour du Valat (banner)

Ramsar MedWet Tour du Valat

11
INDICATOR

Conversion of natural wetland habitats

Appendix

Methods

This quantitative indicator measures the conversion of wetlands into urbanised and cultivated areas, or into artificial wetlands, in Mediterranean wetlands, in absolute and relative terms (% of change compared to the total area studied). It is based on a comparison of successive land cover maps, which were obtained by interpreting satellite images that cover a sample of wetland sites throughout the Mediterranean Region.

The European Space Agency's GlobWetland-II project established a methodology (GlobWetland-II 2011) that was applied to c. 200 sites in the southern and eastern parts of the Mediterranean Basin. These sites are most often Ramsar sites or Important Bird Areas (IBAs), but other sites have also been taken into consideration. The MWO subsequently added to this sample by studying over 70 additional sites on the northern shores of the Mediterranean. Finally, in the framework of a project conducted with the French Environment Ministry, additional French Ramsar sites were added (Perennou *et al.* 2016). In all, the 305 sites studied are distributed throughout the entire Mediterranean Basin, except for some countries, and cover 70,556 km² (Fig. 1).

Land cover was interpreted based on LandSat satellite images taken mainly in 1975, 1990, and 2005, but sometimes extending to a maximum of one or two years from the date chosen. A reinterpretation had to be conducted at a later date for many of the sites (Perennou *et al.* 2018), due to issues identified during the quality control of the initial results, leading to some flawed results (e.g. MWO 2014).

Land cover was ultimately defined in six broad classes:

- Crops,
- Urban habitats,
- Natural wetlands,
- Artificial wetlands,
- Other (non-wetland) natural habitats,
- Sea.

The finer classes that were initially used, such as marshes and lakes, resulted in too high a rate of confusion, so they had to be abandoned. The MWO ultimately obtained for each of the 305 sites, at each of the three dates, the area covered by each of the broad habitat classes listed above. However, as data is not available for three sites for 1975, the 1975-2005 comparisons concern only 302 sites.

It is important to be precise when we speak of "wetlands" in the context of this indicator, so as to not mix up wetland habitats, as they are identified through the interpretation of images within our sites, with the entire sites themselves, which are sometimes also called "wetlands." In fact, on average only 35% of the total area of these sites is covered by wetland habitats. Various distinct but complementary statistics are then calculated: the expansion of urban and farming areas within all "wetland sites," and the rate of conversion of only natural wetland habitats into cultivated or urbanised land, or into artificial wetland habitats.

After correction of some initial errors, the results are now considered to be sufficiently accurate for use in a MWO study. However, this accuracy (rate of residual errors, matrix of confusion, and so on) could not be quantified for the corrected data.

Complementary results

Conversion into farmland or urban land varies considerably in the different regions of the Mediterranean Basin. In the northwestern part of the Basin, farming is practically no longer expanding, but urban development is still increasing. In the other three Mediterranean subregions, cropland and urban development are expanding more (Fig. S1).

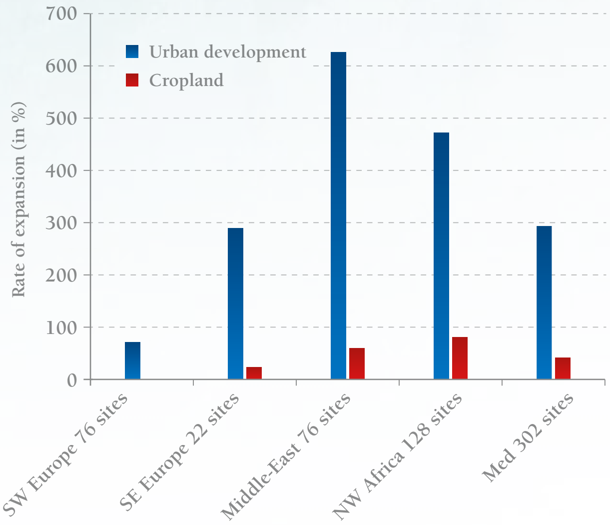

Figure S1 ▸ *Expansion (in %) of urban land and farmland for 302 major Mediterranean wetland sites, and regional differences.*

The rate of conversion seems to be slowing down: the expansion of urban areas for the 302 sites dropped from +111% for 1975-90 to +87% for 1990-2005, and for cultivated areas from +25% to +14% for the same periods (Figure S2).

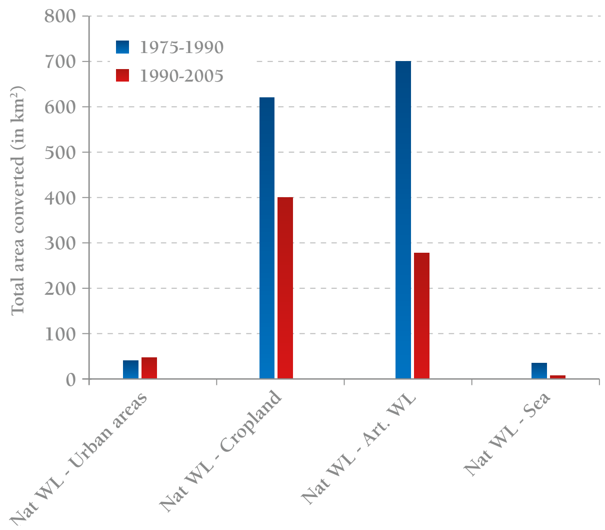

Figure S2 ▸ *Expansion (in km²) of urban development and cropland in the 302 sites (1975-1990), and (1990-2005).*

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12
INDICATOR

Contribution of wetlands in flood regulation

Trend
Data availability

THE TREND | **The capacity of wetlands to regulate floods has steadily decreasing.**
In the five Mediterranean watersheds assessed, flood regulation capacity has decreased by 20% in 30 years (1987-2016).

Natural habitat loss: the main cause decreasing flood regulation services

The loss of natural habitats is one of the principal causes of the decreasing capacity of catchment basins to mitigate flooding phenomena and their effects on human populations and infrastructure. Since these environments are the ones that regulate flooding the most effectively, their loss results in an increased risk for society.

For the catchment basins studied, the rapid expansion of urban and farmland areas, to the detriment of natural habitats, resulted in a decreased overall capacity to regulate flooding between 1986 and 2016 (Fig. 1). This is particularly true of floodplain wetlands, which lost the greatest amount of natural habitats, particularly wetland habitats, due to their transformation into cropland or built infrastructure (soil impermeabilisation).

Another probable cause for the regression of this ecosystem service, which is also linked to the loss and degradation of natural wetland habitats in floodplains, is the increasing number of sites in river beds where various raw materials are extracted (extraction from sand pits and gravel pits--still very common in some Mediterranean countries, in spite of the fact that it has been forbidden). This extraction leads to a modification of their hydrology and morphology, with in particular the degradation of their banks, a decrease of sediments, a sunken river bed, dried out wetlands along the river, and a lower capacity to replenish the water tables.

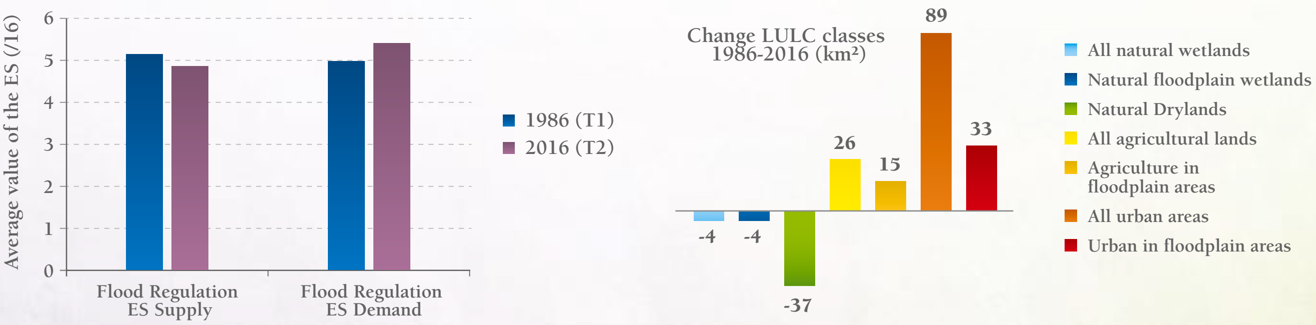

Figure 1 ▸ *Evolution in habitat area in km² (left) and average values calculated for flood regulation services (right) from 1986 to 2016 for all of the coastal catchment basins monitored.*

MWO

In the five catchment basins monitored, the most striking example is the Sebaou River (in northern Algeria), which experienced the greatest increase in the number of sites where there was illicit extraction in and along the bed of the principal waterway and its tributaries, from 1987 to 2016 (Fig. 2).

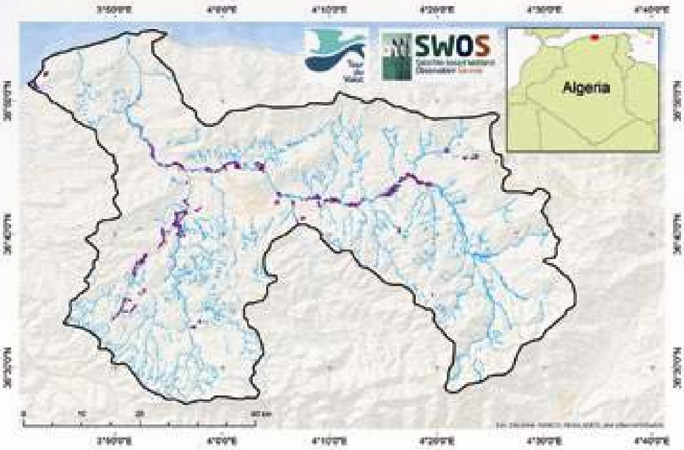

Figure 2 ▸ *Location of the principal sand and gravel extraction sites (active between 1987 and 2016) along the Sebaou River and its tributaries (results of the analysis of LandSat TM and Sentinel-2 images).*

Finally, some natural terrestrial habitats that feature dense vegetation (such as forests) seem to play a very important role in terms of flood protection. These habitats can indeed reduce the runoff speed and the subsequent intensity of flooding (desynchronization of water inputs). If their loss is accompanied by the fragmentation and degradation of extant habitats, this would explain all the more the decreasing capacity of catchment basins to regulate these flooding phenomena.

Urbanisation and soil impermeabilisation accelerate these trends

The rapid expansion of impermeable surfaces (+38.7% during the period studied in essentially urban, peri-urban, and industrial environments), 35% of which are located in alluvial plains and in floodable zones, has also contributed to the decreased flood-regulation capacity of catchment basins. This expansion has indeed tended to exacerbate these flood phenomena and to worsen their consequences by concentrating and accelerating the transfer of rainwater downstream into heavily-populated areas and/or ones in which there are significant socio-economic issues at stake.

The demographic explosion and the concentration of populations in areas where there is urban sprawl explain these negative consequences. In addition, with the increasing size of inhabited areas (with a strong de facto socio-economic impact), this trend means increased demand for such ecosystem services, sometimes significantly, particularly in floodplains (Fig. 3).

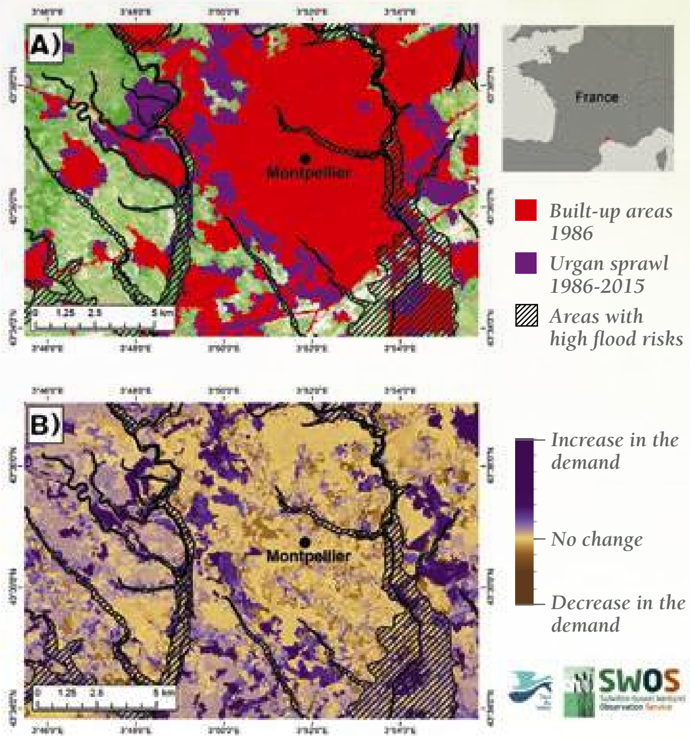

Figure 3 ▾
A) Expansion of impermeable surfaces around the Montpellier conurbation between 1986 and 2015, particularly in the floodable zones of the Lez and its tributaries, and
B) Increase in the demand for flood regulation ecosystem services, linked to this expansion (map results taken from the analysis of LandSat TM and OLI images, cross-analysed with the digital atlas of floodable zones in the Languedoc-Roussillon Region).

Recommendations

- Halt the loss and degradation of natural habitats, particularly of wetland habitats in alluvial plains, and restore them wherever that is possible;
- Conserve and/or restore wetlands located upstream from socio-economic activities, because they play a role as a buffer and mitigate flooding of the catchment basin;
- Establish flood prevention plans that fully take account of the role played by wetlands in regulating floods, from the head of the catchment basin to the coast;
- Implement land-use plans for permeable cities, which foster virtuous urban development that is the source of numerous ecosystem services and meets the expectations of local authorities and inhabitants.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

Photos: L. Chazée / Tour du Valat (banner) - Tour du Valat

12
INDICATOR

Contribution of wetlands in flood regulation

Appendix

Methods

Description

Through their structure and functions, wetlands are ecosystems that play one of the most important roles in protecting human populations against the flooding of catchment basins. The goal of this indicator is to first measure the capacity of these habitats to provide this service, and then to study its spatial and temporal evolution over the past three decades.

It is based on an evaluation of the potential capacities of different types of habitats (natural and artificial) for regulating the flooding of catchment basins, with the help of land cover maps that are produced using Earth observation data. It is subsequently weighted in function of the environmental conditions that influence the provision of the service (e.g. slope, vegetation-cover density, and the location in the catchment basin) and the socio-economic conditions that influence the demand (e.g. the demography with the average population density). Since all of these parameters can be measured at different spatial and temporal scales, it is possible to calculate this indicator for specific catchment basins, while conducting a diachronic study to better characterise the changes over time. The final result, for each period studied, is a map in the form of a raster, with for each pixel, a value between -16 and +16, which combines two aspects for calculating the service: the provision of the service minus the demand (each of which is estimated using a score ranging from 0 to 16).

In the case at hand, this figure was calculated for 1986 and 2016 for 5 Mediterranean coastal catchment basins, characterised by different ecological, demographic, and socio-economic contexts: the Guadalhorce (Spain), the Lez and the Mosson (France), the Sebaou River (Algeria), the catchment sub-basins surrounding the wetlands complex in the El Kala region (Algeria), and the Nestos River catchment and the National Park that goes by the same name (Greece).

Data

The information used here comes from various geographic databases:

- The time series from the LandSat TM and OLI satellite images for mapping land cover and vegetation;
- The Digital Elevation Model (DEM), the EU-DEM, and the SRTM for the characterisation of certain environmental conditions that influence surface flows;
- Demographic data from the *Gridded Population of the World version 4* (GPWv4);
- Flood risk data taken from different digital atlases of floodable zones (for the catchment basins for which they exist).

Main references

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Photos: L. Chazée / Tour du Valat (banner) - Tour du Valat

13
INDICATOR

Contribution of wetlands in education and tourism

Trend
Data availability

THE TREND | Increasing numbers of people are using and valuing wetlands for education and tourism.

Surveys indicate that more people appreciate wetlands and visit them for wetland education and as tourists.

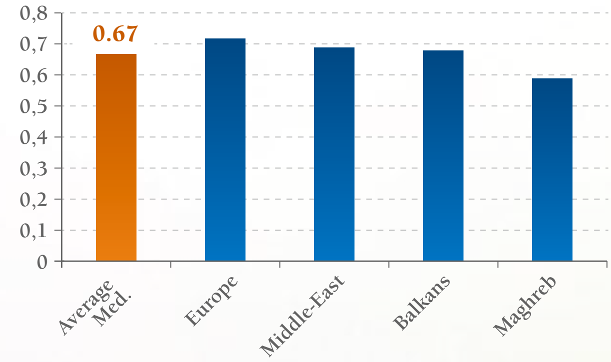
Index of recreational and educational services above the threshold of satisfaction, but varies at different sites

The "recreational and educational services provided by Mediterranean wetlands" (RES) indicator is a composite, non-monetary impact index, developed using the "multiple capital" method, based on the following concept: *a natural capital* (a wetland), made accessible by built capital (infrastructure and visitor-oriented services), makes an impact on *human capital* (knowledge) and *social capital* (satisfaction, promotion). The value of the index varies between 0 and 1 (0 is the lowest score, and 1 is the highest). Developed in 2016, it concerns wetlands at which there is a visitor centre (there are about 150 in Mediterranean countries).

In 2017, the value of the index was based on responses to 3,717 questionnaires at 27 sites, in 10 different countries[1]. The average Mediterranean index was 0.67 (Fig. 1). Sites whose index is above 0.61 generally provide a level of satisfaction that is sufficient for the general public. In 2017, 74% of the sites studied were in this situation.

[1]Albania (three sites), Algeria (seven sites), Croatia (three sites), France (four sites), Jordan (two sites), Lebanon (two sites), Montenegro (one site), Serbia (two sites), Slovenia (two sites), Tunisia (one site).

Figure 1 ▸ *2017 index of recreational and educational services provided by Mediterranean wetlands*



To obtain this score, the level of protection and the condition of the site must be favourable, and the infrastructure and the services provided by the site manager and considered to be essential (trails, toilets, welcoming staff, access to drinking water, rest areas, information, and observation platforms) must be operational. If generally speaking, wetlands in the European Union, the Middle East, and the Balkans obtained scores that are above the Mediterranean average, the "site" effect, more than the "country" effect, plays a predominant role in the value of the index.

MWO

Recreational and educational impacts on visitors directly linked to the efforts made by site managers

Our study of the responses of the site managers and those who visited the sites for recreational and educational reasons shows that the greater the efforts are in terms of site management and welcoming services, the higher are the visitors' levels of satisfaction and appreciation of the natural capital (Fig. 2). Management efforts were particularly effective in the Balkans (+0.14 increase in the visitor index due to efforts made by the site manager), and less rewarded in the rest of Europe (+0.03), where visitors have a much wider choice of wetlands to visit, are therefore more demanding, and often declare that they were aware of the environmental issues before visiting the site, which reduces the impact of their visit in terms of the knowledge they acquire.

Figure 2 ▸ *Level of impact in relation to efforts made by site managers*

Aesthetic qualities of landscapes and educational programmes: the two principal vectors of human and social impacts

Aesthetic qualities and landscape integrity as well as tranquillity are the most common reasons cited by the general public for visiting wetlands, and which it is important to conserve in and around these sites. For visitors with an educational goal, it is programmes featuring a didactic field visit that enable the most effective transfer of new knowledge about wetlands and the issues they concern.

Score attributed to wetland ecosystems penalised by external pressures

Our analysis of the natural capital of wetlands shows that the score of the index is especially penalised by external stressors, such as landscape degradation, urban development, public infrastructure, and pollution around the site.

Recommendations

- Encourage wetland site managers to make an effort especially in terms of the services for welcoming visitors and ensuring a comfortable visit for the general public, which are essential conditions for increasing the interest visitors will have for discovering nature in a positive and satisfying way;
- For effective recreational and educational services and for the image of wetlands, prioritise the quality rather than the quantity of welcoming services in wetlands. Indeed, if the general public considers the infrastructure and the management to be inadequate, their visit can become counterproductive;
- Increase visitors' interest in better understanding the value of wetlands, and encourage managers to regularly adapt the information and the messages for visitors, in relation with current issues in society, and communicate about them in an original and appealing way;
- Influence decisions concerning territorial planning in and around wetlands, by working with stakeholders in the development sector and local administration, so as to conserve or restore the aesthetic value of landscapes and their tranquillity;
- Develop monitoring activities on 40 sites (ten per subregion), to acquire a better representation of the diversity of the sites at the Mediterranean level and at that of its subregions.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

Photos: L. Chazée / Tour du Valat (banner)

Ramsar MedWet Tour du Valat

13

INDICATOR

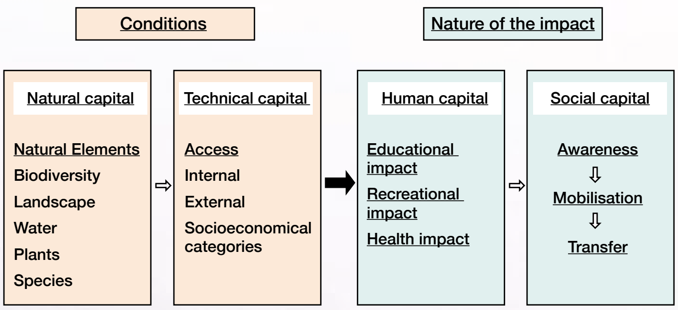
Contribution of wetlands in education and tourism

Appendix

Method and reliability

Method

Developed in 2016, the "recreational and educational services provided by Mediterranean wetlands" (RES) indicator concerns the nearly 150 wetlands with a visitor centre, in MedWet countries. This indicator is a composite, non-monetary impact index, based on the "multiple capital" method, according to the following concept: a natural capital (a wetland), made accessible by built capital (infrastructure and welcoming staff), makes an impact on human capital (knowledge) and social capital (satisfaction, promotion). This composite index ranges from 0 (lowest score) to 1 (highest score), and is measured based on a scoring system with 12 defined variables (3 per type of capital). Its goal is to compare the effectiveness of the services provided by the wetland and by the manager (visit condition capital) and the impact on the well-being of the visitors (impact capital).



Theoretical model underlying the indicator for monitoring cultural services provided by WLs

The composite index ranges from 0 to 1, and is developed based on a scoring system with 12 defined variables (3 per type of capital), for a maximum score of 20 (a maximum score of 5 for each type of capital):

- Natural capital variables: reasons for the visit, recognition/reputation of the site, pressures on the site;
- Built capital variables: material capacity, institutional capacity, and economic accessibility;
- Human capital variables: knowledge production, knowledge transfer, and acquisition of knowledge;
- Social capital variables: management and partnerships, organisation of events, and social networks.

The direct targets of this indicator are national and local decision-makers, as well as site managers, who are considered to be the principal stakeholders that make decisions concerning the sites. The monitoring of this indicator starts at the level of wetland sites, and aggregations are possible at several scales of analysis (country, ecological zone, subregion, and Mediterranean region). The results for each site can be disaggregated by type of capital and variable, which is particularly interesting for site managers.

Data

The data needed to calculate the value of this indicator are gathered from each site manager involved in this monitoring (16 questions). Some data linked to the decision to make the visit and the perception of it are gathered through a sampling system based on 3 questions asked to 150 visitors who come to each site for educational and recreational purposes. For the first year of monitoring (2017), of the 40 sites involved in this programme (10 countries), 30 sites with adequate data were retained.

Limitations and reliability of the monitoring

Limitations

- Only sites that have a visitor centre or a permanent site manager, and which propose recreational and/or educational services are adapted to this monitoring;
- Our study of the recreational and educational services provided by wetlands concerns only part of their cultural services, which are themselves only part of the total services provided by wetlands.

Reliability

Overall, reliability is considered to be average to good according to the site.

- All of the forms filled out by site managers and visitors are controlled in terms of quality and consistency, and only those that are validated are kept;
- The reports available at the sites, at the Ramsar level, and of partners enable some of the site managers' responses to be verified.

However,

- If, after the different sensitivity tests carried out in 2016 and 2017, the monitoring method and the variables used are considered to be robust, it is in the interpretation of the results that it is important to determine the external effects that may explain these results;
- The sampling system was not really respected during the first year, which may have favoured some kinds of recreational and educational profiles.

The human impact is highly dependent on visitors' level of sensitivity to nature and the appeal of the information provided by the site manager

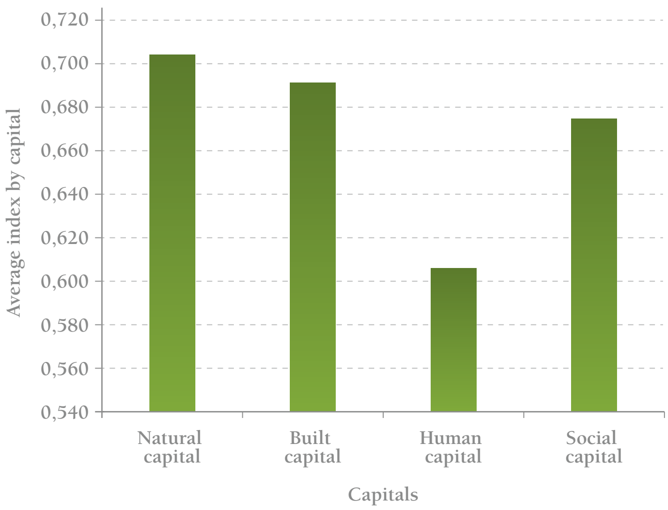


Chart 3 ▸ *Analysis of the index averages by type of capital*

Our analysis of the results (Chart 3) shows that on average the score of conditional capital (natural capital and built capital) is higher than that of impact capital for the sites studied. The value of the average index (0.66) is pulled down in particular by the average index for human capital (0.606).

A quick reading of the message conveyed by the indicator suggests that the average natural capital of Mediterranean wetlands that have a visitor centre is attractive, that site managers make a significant effort to promote it, but that the impact of the visits on humans remains below expectations, in spite of a relatively good rate of visitor satisfaction. Consequently, improving the RES index will necessarily require an improvement of the human capital impact, for which reflections will be linked in particular to a review of the built capital (the infrastructure and services provided by the site manager must correspond to visitor expectations in term of impact on humans), and of the external effects that can influence the human capital. The external effects that decrease the impact on humans of the visits seem to stem from three causes: 1) People who choose to visit a wetland are above all seeking a connection with nature and tranquillity, learning is often of secondary importance; 2) In EU countries, a higher proportion of visitors are aware of environmental issues, and therefore do not really acquire new knowledge during their visits; 3) Many sites focus their information and communication on biodiversity, particularly on waterbirds, whereas some visitors are looking for other kinds of information more closely related to societal issues, such as the modification of ecosystems, the link between humankind and nature, water management, and climate change.

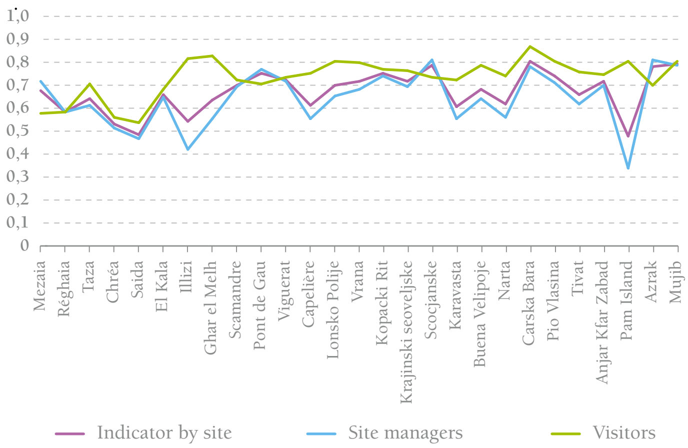


Figure S2 ▸ *Overall index and disaggregated index for site managers and visitors*

The results, disaggregated by site, show that overall the scores obtained from the visitors depend on the efforts made by the site manager. However, there are two sites for which a major gap exists between the site conditions for the visit and the impact. In spite of the few services provided by the site manager (Illizi) or the pressures on the site (Palm Island), the aesthetic qualities of the landscape (and the perception of wildness for Illizi) move visitors significantly and relegate to the background the conditions for the visit. These findings remind us of the importance of a wide-open aesthetically-pleasing landscape in wetland visitors' search for well-being.

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Photos: L. Chazée / Tour du Valat (banner)

Ramsar MedWet Tour du Valat

14
INDICATOR

Surface area of Ramsar sites

Trend
Data availability

THE TREND | The numbers and area of Mediterranean Ramsar Sites have increased by 16% and 11% respectively since 2010.

Since 2010: 55 new Ramsar Sites, covering an extra 660,000 hectares.

Since 1971, 6.7 million hectares have been designated as Ramsar sites of which approximately only 38% of the area consists of wetland habitats.

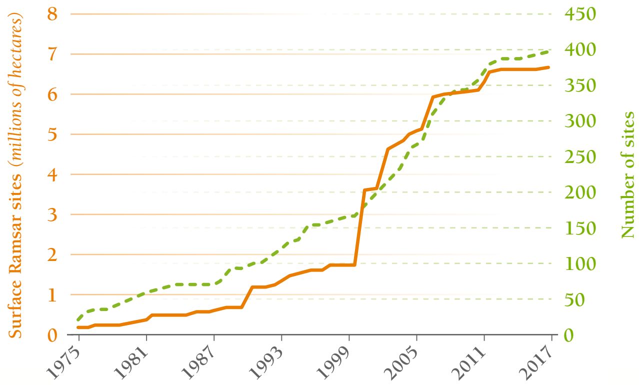
The countries that have designated the most sites are Tunisia with 21 additional sites, France eight and Spain seven. Of these 55 sites, 14 are coastal, 27 inland and 14 mainly man-made.

Ramsar: an international designation of the most important wetland sites

The Ramsar Convention on wetlands is the only global environmental convention that aims to protect one particular ecosystem: wetlands. The 169 Contracting Parties that have signed the Convention have committed themselves to designate suitable wetlands within their territory for inclusion in a List of Wetlands of International Importance, also known as "Ramsar sites". Each Contracting Party is responsible for the conservation, management and wise use of the wetlands within its territory with the objective to maintain the ecological character of the sites. Thus the designation may imply the development and implementation of a conservation management plan.

The main function of the designation is to create international visibility of the most emblematic wetlands for a large audience. The indicator corresponds to the emblematic areas (number and surface area in ha) which contain wetland habitats that have been designated as Ramsar sites over time in the Mediterranean.

Figure 1 ▸ *The accumulated surface area of Ramsar sites (in million ha's) by the Mediterranean Contracting Parties* · *Source : www.ramsar.org*



Since Mediterranean Wetland Outlook, published in 2012, Tunisia doubled its number of Ramsar sites increasing the designated area by 16%; Jordan and Montenegro declared their 2nd Ramsar site each ; and Egypt, thanks to the designation of two very large Ramsar sites covering over 300,000 ha, accounted for nearly half the total surface area newly designated in the Mediterranean.

Although a plateau is expected to arrive when all the emblematic sites have been designated as Ramsar sites, ongoing work at the Mediterranean Wetlands Observatory indicates that an important share of emblematic wetlands sites, notably for birds species, have not yet been designated by their respective Contracting Parties as Ramsar sites.

Designation of a Ramsar site is however not sufficient as some Ramsar sites experienced a dramatic decrease of the total surface area of natural habitats.

MWO

The conservation of natural habitats requires not only the designation as a Ramsar site, but also the development and implementation of conservation management plan.

In 2017, 44% of all the Mediterranean Ramsar sites had developed a management plan (MP), and 30% had implemented their plan.

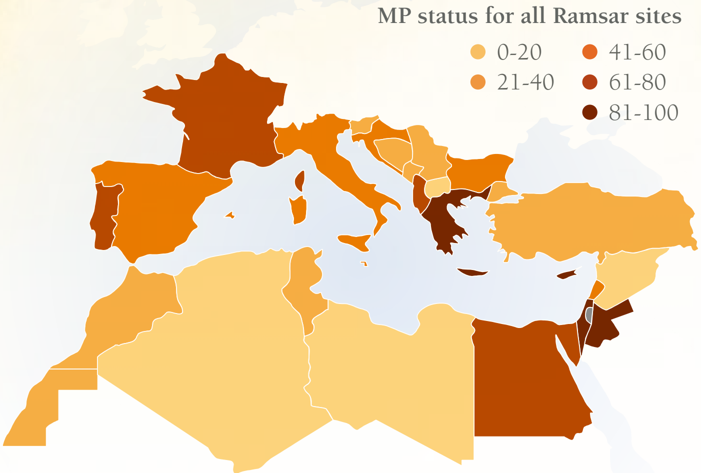


Figure 2 ▸ *Index of availability and implementation of management plans (MP) for Ramsar sites in 2016* · *Source : internal MWO analysis*[2]

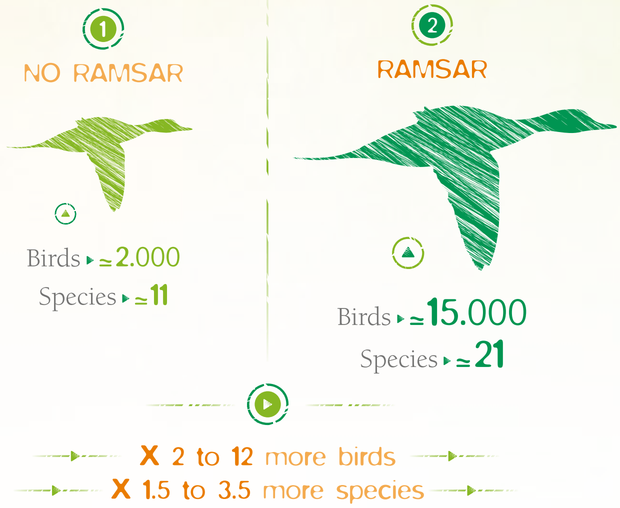
Among the 55 new Ramsar sites in the Mediterranean since 2010, 23 sites report an implemented management plan, one plan not yet implemented, five sites are developing one and 24 sites do not report any plan.

Role of Ramsar sites for wintering waterbirds

Mediterranean wetlands harbour many threatened species and large numbers of common waterbird species. Mediterranean Ramsar wetlands for instance host both a higher abundance and species richness than non-designated wetlands and harbor around half of the regional wintering waterbirds.

[1-2] More information on the methodology and the used sources can be found on the appendix

Figure 3 ▸ *Total species richness and average numbers of wintering waterbirds found in Ramsar sites or other wetland sites in the region* · *Source : Gaget & Galewski, unpublished*

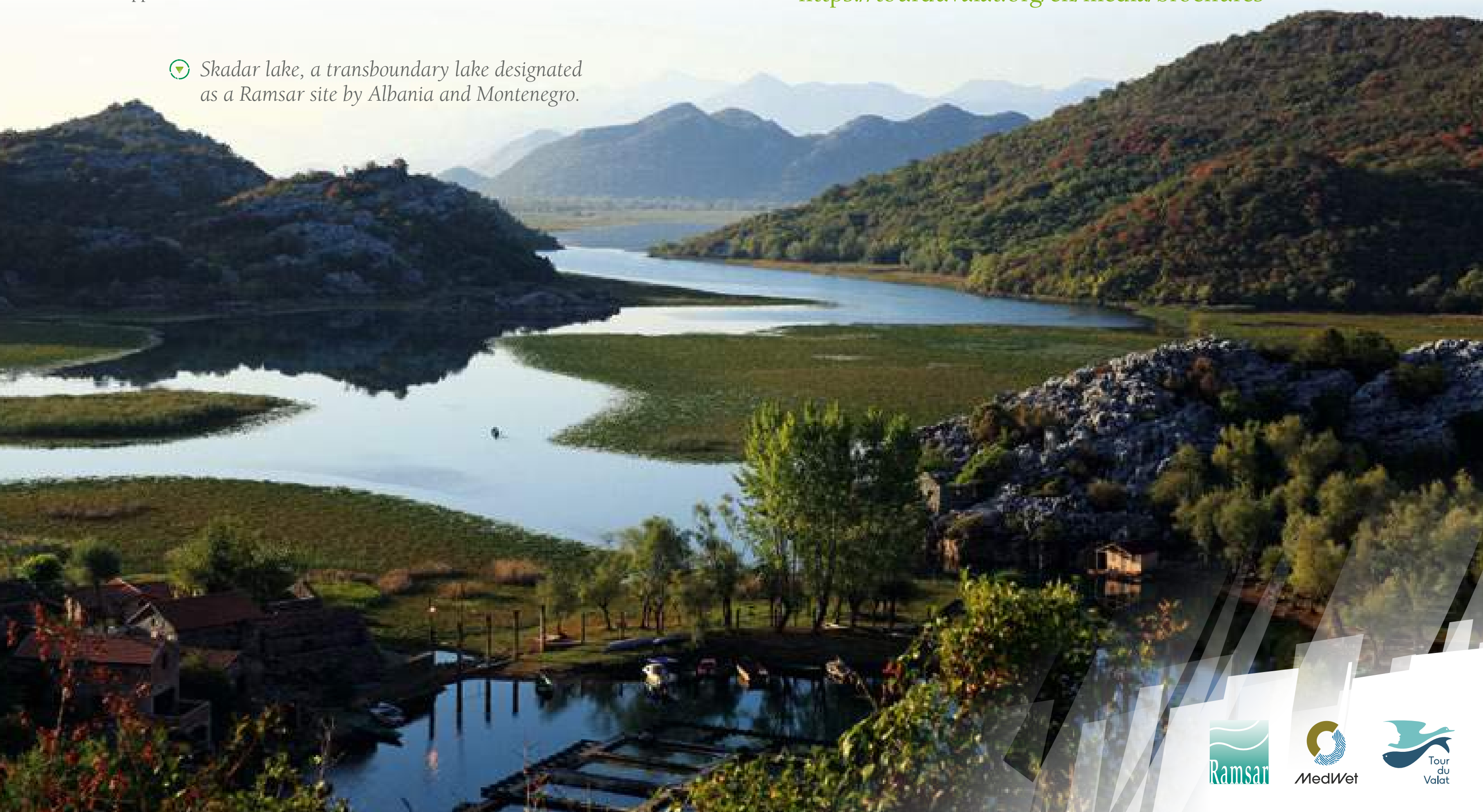


Recommendations

To improve the importance and impact of the Ramsar Convention for Mediterranean wetlands, the Contracting Parties, together with NGOs, site managers and local actors should:

- Ensure that all emblematic wetlands in the Mediterranean region fulfilling the Ramsar criteria are progressively designated as Ramsar sites;
- Develop and implement an integrated management plan for each Ramsar site, and ensure that skilled staff is dedicated to ensure their effective conservation and wise use;
- Promote the monitoring of natural wetland habitat and ecological quality within the Ramsar sites.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures



Skadar lake, a transboundary lake designated as a Ramsar site by Albania and Montenegro.

Photos : Tour du Valat (banner) - J. Jalbert / Tour du Valat

14
INDICATOR

Surface area of Ramsar sites

Appendix

Methods

The cumulated surface area of Ramsar sites is extracted from the constantly updated Ramsar Site Information Service (www.ramsar.org). The evolution of the indicator was reconstructed using this database for the whole metropolitan area of all MedWet countries (i.e. excluding Overseas Territories), but including their non-Mediterranean parts. The military UK zone in Cyprus has been included as well. By nature and due to the absence of known cases of removing a site from the Ramsar list, the indicator can only remain stable or increase.

The values must be interpreted with caution in order to avoid confusion between “surface or Ramsar sites” and “surface of wetlands designated under Ramsar”, as Mediterranean Ramsar sites have less than 40% of their surface area covered with wetlands (a result over 167 Ramsar sites designated in or before 2005).

Management plans *(Fig. 2)***:**

The score for the existence and implementation of management plans in a given country’s Ramsar site has been calculated as follows.

Each site gets an individual score according to the development of its management plan :

- **0.** no management plan and none foreseen ;
- **1.** Plan under preparation ;
- **2.** Plan written down ;
- **3.** Plan developed and implemented.

These scores are summed up for all sites over the whole country, and divided by the theoretical maximum score possible, if every site had an implemented management plan in existence. This amounts to 3 times the number of Ramsar sites in the country. The national score therefore falls between 0 and 100%. The score in Fig. 2. should therefore NOT be read as “% of Ramsar sites with a (implemented) management plan”

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Photos: Tour du Valat (banner) - J. Jalbert / Tour du Valat

15
INDICATOR

National strategic efforts to protect wetlands

Trend
Data availability

THE TREND | An increasing number of countries have wetland management policies, but fewer are now implementing these policies than in 2010.

In 2016 77% of Mediterranean countries reported having a specific wetland management policy or strategy: a 13% increase since 2012 but 8% fewer countries reported.

A larger proportion of countries with a specific national wetlands strategy

Countries are making progress in the development of specific or overall national wetlands strategies.

Since 2012, of the 26 countries for which there is data, 12 countries have adopted a specific national wetlands strategy, 8 other countries have included them specifically in their national biodiversity strategy in relation with the Convention on Biological Diversity (CBD), the European Union (EU), or the Organisation for Economic Co-operation and Development (OECD) (Fig. 1).

Overall, while three countries did make efforts to develop their strategic framework for wetlands during the period 2012-2016, this same period was marked by a low level of implementation of these strategies for different reasons in different countries (national Ramsar reports, 2015).

The two major reasons were: (1) institutional and political instability, and (2) the decreasing budgets for the environment because of the financial crisis that affected all of the countries.

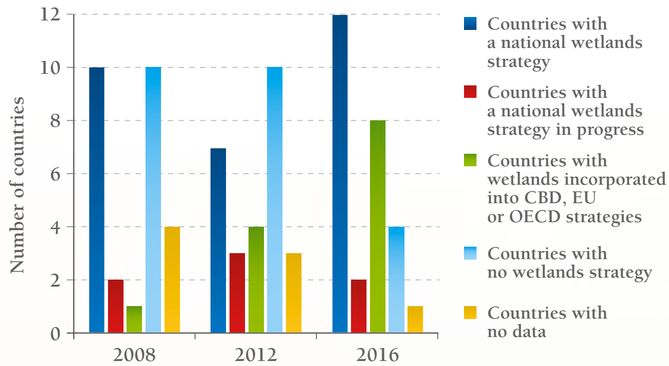


Figure 1 ▸ *Trend in strategic efforts made by countries (2008-2016). Sources: 2015 national reports for Ramsar COP 12, and 2017 update by National Focal Points (MWO questionnaire).*

Other reasons cited include the decreasing price of hydrocarbons (four countries), and budgetary priorities to allocate money for security (at least three countries). In fact, 83% of Mediterranean countries (100% of the non-EU countries) indicated financial constraints that limited the implementation of activities planned for wetlands. The financial constraints have gotten worse since 2012.

MWO

Furthermore, few new operational management plans were developed on Ramsar sites during this period. Most of the 80 new management plans foreseen for 2015-2018 for 23 countries were not finalised, and sometimes not even started due to a lack of funding. Of the 211 management plans for existing Ramsar sites, only 70% have been implemented, sometimes only partially.

Only 29% of the countries indicated they have a cross-sectoral wetlands committee (an 8% drop compared to 2012).

Low capacity of national Ramsar representatives to influence development sectors

In 2016, 7 of the 26 countries that provided data had operational cross-sectoral national wetlands committees (Fig. 2). Only one country created a committee during the period 2012-2016, while two others lost their committee due to institutional changes. On the whole, these committees held very few meetings during this period. Without these committees, the national Ramsar representatives do not generally have any other means to federate the sectors and influence the political agenda in favour of wetlands. In addition, it is rare for the Ramsar National Focal Points to have a strategic, cross-sectoral function, since their role is especially administrative and technical. Their capacity to influence decisions thus remains limited.

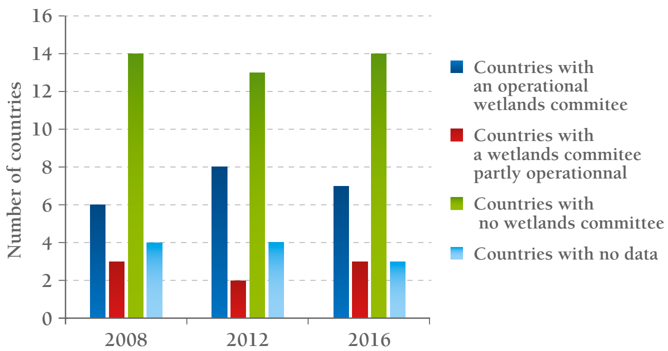


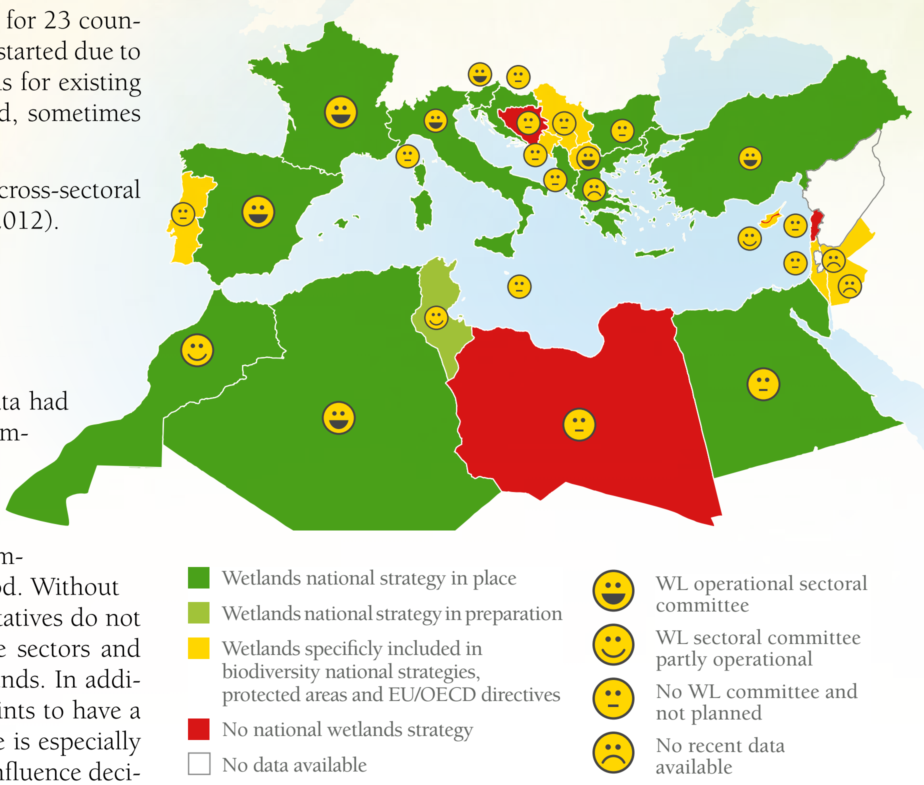
Figure 2 ▸ *Trend in efforts to potentially influence development sectors to take better account of wetlands.*

A tendency to include wetlands protection in broader protection policies

Overall, of the 26 countries considered in 2016, 12 have a strategy or a specific and operational policy concerning wetlands, 8 (31%) have included wetlands protection in their national biodiversity strategy, or must comply with EU or OECD directives, two are preparing their national strategy, and four have no framework for the protection of wetlands (Fig. 1).

In 2016, seven countries had both a specific strategic framework for wetlands and a cross-sectoral committee (Figure 3). For the 19 other countries, their capacity to influence remains limited. However, the trends show that these countries increasingly include wetlands in a broader national strategy on biodiversity or protected areas. The 13 countries that are members of the EU or of the OECD benefit from stricter directives that favour these habitats.

Figure 3 ▸ *Situation of strategic efforts and pro-wetlands policies of Mediterranean countries in 2016* · *Source : Ramsar and MWO.*



NGO Steering Committee in 2016 (© Tour du Valat)

Photos: L. Chazée / Tour du Valat (banner)

Recommendations

- During this period marked by budgetary constraints, especially for southern and eastern Mediterranean countries, continue defining and implementing management plans and institutionalising a national monitoring system while seeking outside funding more actively;
- Stimulate, through international partners, support projects for Ramsar / MedWet Focal Points, and more generally speaking for national wetlands teams;
- Promote the assets of wetlands with respect to the strategic priorities of Mediterranean countries, such as adapting to climate change or decreasing natural risks.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

Ramsar MedWet Tour du Valat

15
INDICATOR

National strategic efforts to protect wetlands

Appendix

Method and reliability

This indicator has two components and is measured based on the 21 national reports for 2015 submitted by Mediterranean countries for the Ramsar COP 12, and on the results of an electronic questionnaire sent at the end of 2017 to all Ramsar National Focal Points. The Syrian Arab Republic, Greece, and Jordan were not included in this study due to a lack of data.

Data reliability concerning the existence of strategies and committees is considered to be good following the controls carried out in 2017 with the National Focal Points (except for the three countries indicated). However, to analyse their levels of performance and operationalization, other questions had to be taken into account, particularly in national reports. In all, we received the following questions:

- *1.1.1. Does your country have a complete national inventory of wetlands?*
- *1.1.2. Are your inventory data and information on wetlands kept up to date and accessible to all stakeholders?*
- *1.3.1. Is a national policy or equivalent instrument in place?*
- *1.4.3. Were the socio-economic and cultural values of wetlands taken into account in the management plans for Ramsar sites and other sites?*
- *1.7.2. Were communication, education, awareness-raising and participation tools, and expertise included in the planning and management of catchment/hydrographic basins?*
- *2.4.1. How many Ramsar sites have a management plan?*
- *2.4.2. In how many Ramsar sites is the plan applied?*
- *2.4.3. For how many Ramsar sites is a plan being prepared?*
- *2.4.4. In how many Ramsar sites is a cross-sectoral management committee in place?*
- *4.1.2. How many visitor centres have been set up?*
- *4.1.6. Is there a Ramsar committee/national wetlands committee in place and operational?*
- *4.1.8 Were any Ramsar-specific activities organised for world wetlands day?*

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Photos: L. Chazée / Tour du Valat (banner)

16
INDICATOR

Wetlands and Sustainable Development Goals (SDGs)

Trend
Data availability

THE TREND

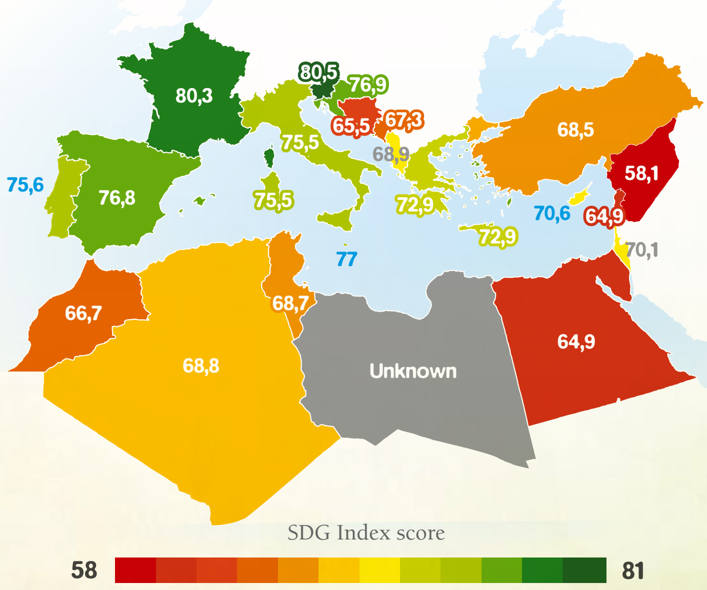
The sustainable management of wetlands can contribute significantly to the achievement of Sustainable Development Goals (SDGs); however, this potential is currently underexploited.

The trends concerning the status of wetlands indicate that achieving the SDGs is not yet within reach in the Mediterranean Basin.

State of progress towards reaching SDGs

The 26 Mediterranean MedWet countries have made variable progress towards their sustainable development goal commitments (Fig. 1). Just as these countries were still preparing their first SDG progress report the first international SDG report (United Nations, 2017) gave few results concerning water and wetlands at the same time as the MWO was preparing its second report. This observation is similar with respect to the Ramsar Convention: its new format of national reports (2018), which incorporate some SDG indicators, were not yet available when this Fact Sheet was prepared. However, the MWO monitoring activities that contribute to some SDG indicators show there is a decline in the surface area and quality of wetlands, as well as of their biodiversity (Table 1). Yet, some positive trends have been observed in terms of management, restoration and protection measures, and public awareness-raising initiatives, as well as the recreational and educational services provided by wetlands. These results concerning the protection of wetlands are linked to the efforts made by countries to achieve the SDGs.

Figure 1 ▸ *Sustainable Development Goals (SDG) Index score 2017 for countries in the Mediterranean Basin. SDGs index scores are represented by a gradient of colors: lowest values refer to red colors, while highest values are represented with green colors. Grey color for Libya indicates that SDG index has not included due to insufficient data availability* (Map based Sachs et al. 2017).



MWO

Wetlands taken into account regionally and internationally in the framework of sustainable development (2016-2030)

The 17 Sustainable Development Goals, adopted by 193 countries for 2016-2030, include five indicators that directly concern wetlands and the water in these ecosystems, within Goals 6 and 15 (Fig. 2). A list of 13 other indicators that indirectly concern wetlands may be useful for cross-analyses of wetlands. The Ramsar Convention 2016-2030 strategic plan and the MedWet 2016-2030 action framework indicate their contributions to 16 Sustainable Development Goals (all but Goal 7 on the access to reliable and sustainable energy services). This international framework provides more precise wetlands indicators to stakeholders involved in wetlands protection and management than the previously used Millennium Development Goals[3].

The first international Sustainable Development Goals Report (2017) gives little data on these indicators, many of which are still being developed. The results for indicator 15.1.2 (Fig. 3) show an improvement in the rate of protection of KBA (key biodiversity area) wetland ecosystems between 2000 (32%) and 2017 (43%) for all regions in the world. However, while 54% of these habitats are protected in Europe (above average), North Africa and western Asia (Middle East) are significantly below this average (17%), in spite of various efforts, including the implementation of the first 5-year cycle of the CEPF between 2012 and 2017.

Figure 3 ▸ *Trends in average proportions of freshwater ecosystem KBAs covered by protected areas (2000 (pale green), 2010 (light green), and 2017 (dark green)* (United Nations SDGs Report 2017).

Traditional fishing in Greece (© L. Chazée / Tour du Valat)

Progress toward the Sustainable Development Goals monitored by the MWO

SDGs directly linked to wetlands	MWO monitoring indicators
SDG 15.5. Urgent and significant action to reduce the degradation of natural habitats and halt the loss of biodiversity	Abundance of biodiversity and risk of extinction (indicators 1 & 2)
SDG 6.5. Integrated water resources management	Water flow (indicator 3)
SDG 6.3. Improve water quality	Water quality (indicator 4)
SDG 6.6. Protect and restore water-related ecosystems	Surface area of wetlands, floods, and land conversion (indicators 5, 6, and 11)
SDG 13.1. Strengthen resilience and adaptive capacity	Wetlands and climate change (indicator 7)
SDG 6.4. Increase water-use efficiency	Exploitation of water resources and demand by sector (indicators 8 and 9)
SDG 15. Preserve terrestrial ecosystems	Ecosystem services (indicators 12, 13, and 14)
SDG 15.1. Conservation, restoration, and sustainable use of ecosystems	Surface area of Ramsar sites (indicator 15)
SDG 15.9. Integrate ecosystem and biodiversity values into national and local planning	Efforts to protect wetlands (indicator 16)

Table 1 ▸ *The MWO indicators inform on the progress made toward various SDG targets (see corresponding MWO Fact Sheets).*

Recommendations

- Use the results and the trends identified by the Mediterranean Wetlands Observatory to inform the national bodies in charge of implementing and reporting on SDGs about the contributions Mediterranean wetlands can make toward achieving these goals;
- Make a link between investments in wetlands conservation and the national contributions toward achieving the SDGs;
- Encourage regular discussion between National Focal Points for the Ramsar Convention, the Convention on Biological Diversity (CBD), and the Barcelona Convention with those in charge of the SDGs, for concerted action and decisions concerning wetlands within the scope of SDGs.

For more information see the appendix:
https://tourduvalat.org/en/media/brochures

[1-2] For more information see the appendix
[3] Indicator 6.3.2: Proportion of bodies of water with good ambient water quality; Indicator 6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources; Indicator 6.5.1: Degree of integrated water resources management implementation (0-100); Indicator 6.6.1: Change in the extent of water-related ecosystems over time; Indicator 15.1.2: Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type.
[4] Critical Ecosystems Partnership Fund

Photos: L. Chazée / Tour du Valat (banner)

16
INDICATOR

Wetlands and Sustainable Development Goals (SDGs)

Appendix

Method and reliability

Regarding the official SDG indicators, methodology sheets are progressively developed and validated by the member states. The data are gathered by national statistics bureaux and reviewed by expert international organizations, coordinated by the United Nations Statistical Commission. For Europe, Eurostat established a list of 100 indicators that member countries had the capacity to provide as of 2017. These methodology sheets also indicated the limitations of the reliability of these indicators. The sheets can be freely accessed at: https://unstats.un.org:sdgs/indicators/indicators-list

The following SDG indicators are directly related to wetlands and the water in these ecosystems: 2.4.1, 6.1.1, 6.2.1, 6.3.1, 6.3.2, 6.4.1, 6.4.2, 11.3.1, 11.4.1, 13.1.2, 13.2.1, 14.1.1, 15.1.2, 15.3.1, 15.5 .1, 15.9.1, and 15.a.1.

Regarding the monitoring indicators developed within the framework of MWO activities, please refer to the methodology sheets of the indicators concerned.

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