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A More Effective Ramsar Convention for the Conservation of Mediterranean Wetlands

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The Ramsar Convention is the multilateral agreement aimed at protecting wetlands globally. Wetlands are particularly recognized for their role in the Mediterranean biodiversity hotspot by providing key habitats for endemic and migratory species, directly contributing benefits to the lives of people and being an integral part of their culture. In response to this importance, the Mediterranean Wetlands Observatory publishes Mediterranean Wetland Outlooks (MWOs) on the state and trends of Mediterranean wetlands; the first edition in 2012 (MWO1) and the second edition in 2018 (MWO2). In this paper, we used the results of the two Mediterranean Wetland Outlooks to highlight ways to increase the impact of the Ramsar Convention by identifying the spatial dimensions of detected biodiversity trends as well as the societal developments and estimated impacts of global change and protection status.

Keywords: assessment, biodiversity, efficiency, governance, indicators, impact, policy, regional

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INTRODUCTION

The Mediterranean basin is one of the richest biodiversity hotspots in the world in terms of species diversity and number of endemic species, especially plants (Cuttelod et al., 2009; Mittermeier et al., 2011). Within the Mediterranean ecosystems, wetlands are of paramount importance for biodiversity: although they occupy only 2–3% of the basin area, they are home to more than 30% of vertebrate species (Mediterranean Wetland Outlook2; Mediterranean Wetland Observatory, 2018). Unfortunately, this ecosystem is expected to be particularly impacted by global change (Malcolm et al., 2006; Vié et al., 2009; Schuerch et al., 2018). Apart from their importance for biodiversity globally, wetlands offer nature based solutions to buffer climate change impacts and ecosystem services that contribute to human well-being (Bridgewater, 2008; Cohen-Shacham et al., 2016; Mediterranean Wetland Observatory, 2018). Investments in the conservation and sustainable use of wetlands therefore directly contribute to the countries' objectives to meet the Paris agreement to combat climate change and adapt to its effects (United Nations, 2015) and to make progress on the Sustainable Development Goals (SDGs).

Established in 1971, the Ramsar Convention is the global agreement for the protection of wetlands, in particular those with international importance. To date 170 countries have ratified this Convention and almost 250 million hectares of wetlands have been designated under this

agreement. Mediterranean countries signing the Ramsar Convention recognized the need to stimulate and facilitate the development of knowledge on the state and trends of Mediterranean wetlands and in 1991, Mediterranean and peri-Mediterranean countries jointly established MedWet, the Mediterranean Wetland Initiative, to ensure the necessary knowledge development and that this knowledge reaches important actors of decisions related to the conservation and management of Mediterranean wetlands in the context of sustainable development, including decision makers, Non-Governmental Organizations (NGOs) and wetland site managers.

Formally recognized as the first regional initiative of the Ramsar Convention, MedWet requested in 2008 the establishment of the Mediterranean Wetlands Observatory, which has since been managed and hosted by the Tour du Valat. Since its establishment, it has published two editions of the Mediterranean Wetland Outlook (MWO) on the state, trends and pressures of Mediterranean wetlands-the MWO1 in 2012 and the MWO2 in 2018 (Mediterranean Wetlands Observatory, 2012; Mediterranean Wetland Observatory, 2018), respectively. Here we use the results of the MWO1 and MWO2 to highlight ways to increase the impact of the Ramsar Convention on Mediterranean wetlands toward the future.

TREND ANALYSIS OF MEDITERRANEAN WETLANDS

Although some previous studies did relate the Ramsar designation to a conservation objective, they were generally limited to a specific taxon or a specific site (e.g., Seto and Fragkias, 2007; Kleijn et al., 2014; Cherkaoui et al., 2015; Barech et al., 2016). The Mediterranean Wetlands Outlooks presents indicators on state, trends, drivers, and pressures of Ramsar and non-Ramsar wetland sites in 27 countries in a region heavily impacted by global change. The indicators used in a MWO are inspired by the Drivers—Pressures—State—Impact—Response (DPSIR) framework (Kelble et al., 2013) (**Figure 1**). The strength of the DPSIR framework is the identification of causal relations between the different elements which facilitates the uptake of the information of the MWOs in policy and management decisions.

The selection and quantification of the indicators ideally relies on data which are regularly updated, cover a relevant spatial scale for wetlands and which are available for the whole Mediterranean basin. For most indicators this is not (yet) feasible and a whole range of methods are applied to obtain quantifications and estimates of the trends, depending on data availability. An explication on the data sources and methodological approach is provided for each indicator in each MWO, with methods including for instance remote sensing, upscaling from a network of *in-situ* observations or sample sites, downscaling from global and national datasets, modeling, literature reviews and more.

Drivers and Pressures

Indicators for pressures of Mediterranean wetlands, notably those related to agricultural development and urbanization, point at a worrying increase. Increasing human populations in proximity to wetlands are important drivers of wetland degradation either through direct use and overexploitation of the wetland ecosystem services (e.g., unsustainable water withdrawal, aquaculture, overgrazing) or indirectly via for example, water pollution and natural wetland habitat conversion into agricultural lands or artificial wetlands. The latter is most pronounced in the South East of the Mediterranean basin (MWO2). Between 2010 and 2015, the total population increased regionally by 5% with major differences between the Northern and the Southern Mediterranean shores: very low or even negative growth rates in the North (especially in the Balkans and Iberian Peninsula), while high values are recorded in the Maghreb and the Near-East (except in Syria) (MWO2).

Although rare, there are examples of improvements. The EU Directive Water Framework Directive (2000/60/EC) launched in 2000, for example, has had a real significant impact in reducing pollution and nutrient concentrations in surface water. The implementation of measures and monitoring schemes related to the Directive has resulted in significant improvements of the water quality in the European countries. The construction rate of dams slowed down, presumably due to the economic crisis, and political instability. Unfortunately, widespread plans to construct new dams actively threaten Mediterranean wetlands, notably in the Balkans and the Middle-East.

Climate change is expected to lead to prolong droughts and increase temperatures (Mariotti et al., 2015; Cramer et al., 2018) which will reduce freshwater availability and quality. This is expected to particularly affect the biodiversity of Mediterranean wetlands and their related ecosystem services (Ramírez et al., 2018). Additional impacts of climate change on Mediterranean wetlands include direct impacts (e.g., sea level rises, decreased precipitation) and indirect impacts (e.g., increasing demands for water). Not all Mediterranean wetlands are, however, affected equally by the impacts of climate change (**Figure 2**), with the Eastern and Southern part of the basin being most heavily impacted already (MWO2; Cramer et al., 2018).

State

Since 1970, the surface area of natural Mediterranean wetland habitats has continued to decrease by 48%. This is quicker than the global average of 35% presented in the Global Wetland Outlook (Ramsar Convention on Wetlands, 2018). The artificial wetland surface area (e.g., reservoirs) has increased during the last 30 years, with the largest increase located in the South East of the Mediterranean Basin (MWO2). Natural wetland habitats continue to be converted into agricultural land, urban areas, or artificial wetlands, but less quickly in the North-east than elsewhere in the region. Although not the general trend, there are also some examples of positive impacts of governance interventions. For instance, the restoration efforts in the Caracoles Estate in Doñana have increased the surface area of natural wetland habitats (Santamaría et al., 2006).

Between 1960 and 2000, half to two thirds of the Mediterranean rivers demonstrated a significant reduction in their discharge (reductions varying between 25 and 70%)

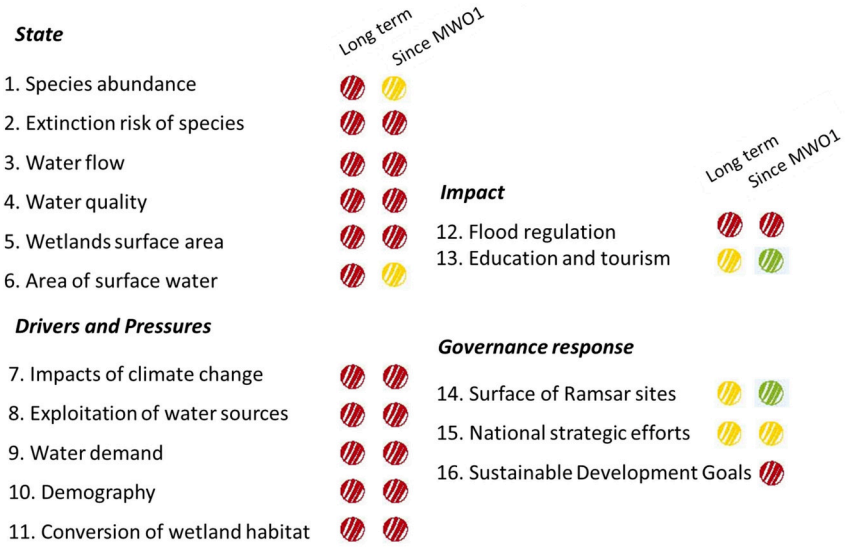

FIGURE 1 | Overview of the identified overall trend (long term starting from roughly 1970 depending on the data source until 2018) and the trend since the publication of the MWO1 (2012) for the 16 indicators of the MWO2 (2018). The color coding indicates if a trend is getting worse (red), is variable or stable (yellow), or is improving (green).

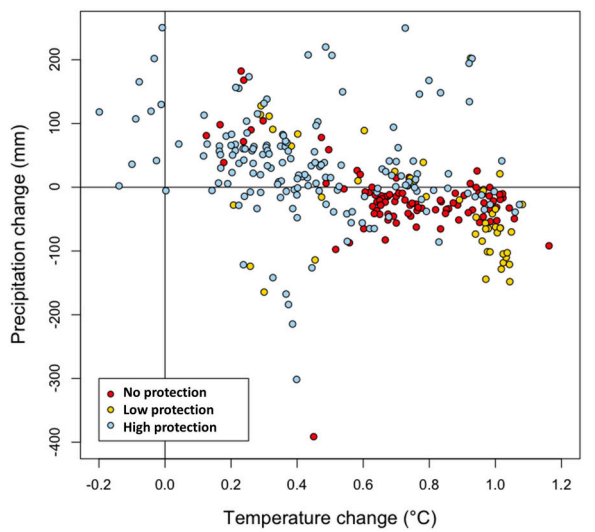

FIGURE 2 | Temperature and precipitation changes detected for 236 Mediterranean wetlands sites between 1990 and 2005. The colors a "high protection coverage" indicating that more than 50% of the total surface area of a site has a protection status (blue); a "low protection coverage" indicating that less or equal to 50% the total surface area of a site has a protection status (yellow); or "no protection coverage" (red). For more information on the method see the **Supplementary material**.

while the quality of surface and ground water is simultaneously decreasing (MWO2).

Species abundance levels in Mediterranean wetlands are currently lower than in 1990 due to the degradation of their habitats. According to the IUCN Red lists, 36 % of the evaluated species associated to Mediterranean wetlands are threatened with extinction. Since 1990 abundances of these species has decreased with 46%, indicating a significant increase in their extinction risk. Strict protection measures for several waterbird species (e.g., Dalmatian Pelican and Eurasian Spoonbill) has boosted their abundance in Western Europe and North Africa since 1970 (MWO2; Galewski et al., 2011).

Impact

With increasing population numbers in coastal and floodplain areas, such as the Nile delta, the demand for living space, water, and food increases while the exposure to risks also increases, especially to flooding (Plan Bleu pour la Méditerranée, 2009; Geijzendorffer et al., 2018). Wetlands provide many ecosystems services (Zedler, 2003) and under the influence of urbanization and agricultural development the overall capacity to supply ecosystem services decreased between 1990 and 2015, especially in the European Mediterranean countries (García-Nieto et al., 2018). In a study on five watersheds in the Mediterranean basin, the potential capacity of wetlands to regulate floods of rivers decreased with 20% (MWO2). Water consumption has continued to increase, whereas water renewal rates have decreased. North-East Africa and the Middle East have been identified as the regions in the world with the most unsustainable water use (MWO2; Joodaki et al., 2014). In the Mediterranean basin, agriculture is the top consumer of freshwater, followed by industrial and then domestic water use (MWO2; Kummu et al., 2010).

Between 2012 and 2017, recreation and education activities provided by protected and managed wetlands were perceived by visitors to positively impact their knowledge and their overall feeling of satisfaction and well-being (MWO2). These ecosystem services were demonstrated to be to a large extent determined

by the wetlands managers who render wetlands accessible and ensure facilities (e.g., parking places, picknick places and toilets).

Response

The governance response indicators (i.e., the implementation of management and governance measures) demonstrate an overall willingness of governments to protect Mediterranean wetlands, despite the social and economic difficulties that the Mediterranean countries have been facing since the MWO1. Since 2012, Mediterranean governments have designated 55 new sites to Ramsar, adding 660,000 hectares of wetlands of international importance for biodiversity conservation to the Ramsar Convention. Most of these wetlands, however, continue to suffer from human activities (mainly water pollution, agriculture, and urbanization), despite some sites having been designated more than 30 years ago. In 2017, 44% of all the Mediterranean Ramsar sites had developed a management plan and 30% had implemented their plan. Additionally, only 29% of the countries have an inter-sectorial working group in place to oversee their implementation (a decrease of 8% in comparison to the situation in 2012, MWO2; MWO1). This limited implementation of management plans is significantly lower than the 77% of Mediterranean countries that claimed to have a specific policy for the management of wetlands in 2016 (MWO2).

An improvement of the conservation status can be detected at the wetland sites where conservation measures have been implemented. For instance, the use of international environmental conventions improve waterbird population trends and facilitate climate warming adaptation of their communities (Gaget et al., 2018). Similarly implemented restoration efforts demonstrate an increase in natural wetland habitats (Santamaría et al., 2006).

INCREASING THE IMPACT OF THE RAMSAR CONVENTION

A more effective impact of the Ramsar Convention does not contribute to the conservation objectives of Mediterranean wetlands alone. Mediterranean wetlands provide many nature based solutions and ecosystem services that can help countries progress simultaneously toward other objectives, such as the SDGs. Unfortunately, the indicators of the MWO2 related to specific SDGs suggest a general degradation of the wetland surface areas, their ecosystem state, their biodiversity and related ecosystem services (MWO2). Despite this general trend, we also found examples of the positive impacts that sustainable management, restoration, protection, and societal awareness can have on the conservation of Mediterranean wetlands. This suggests that from a more effective Ramsar Convention would allow Mediterranean countries to simultaneously progress toward multiple international policy convention goals while ensuring and investing in the protection and sustainable management of Mediterranean wetlands.

The Future of Ramsar Sites

To date, intention declarations of countries to live up the Ramsar Convention have not resulted in an overall improvement of the conservation of wetlands globally (Davidson, 2014; Dixon et al., 2016; Finlayson et al., 2018; Ramsar Convention on Wetlands, 2018) nor that of Mediterranean wetlands. Under the projected impacts of global change (Cramer et al., 2018), this situation is expected to worsen in the near future. Countries have, however, continued to designate Ramsar sites. Within a selection of 236 wetland sites we found that the sites that have undergone the largest changes in precipitation and temperature are also the least well covered by protection (**Figure 2**, MWO2). Looking toward the future, the Ramsar Convention should focus on those areas where the stakes for biodiversity are most precarious, where there is a chance that global change impacts can be mitigated and that adaptation measures can be implemented.

Contracting Parties (countries) of the Ramsar Convention themselves propose the sites within their own country for a Ramsar designation based on their international importance for biodiversity. The Ramsar Convention and the scientific community can help countries by identifying sites of importance given the expected impacts of global change, be it climate change, the construction of dams or the impacts of urbanization. In the last two decades, International Organization Partners of Ramsar, NGOs such as BirdLife International, WWF International, IUCN or Wildfowl & Wetlands Trust, have identified potential Ramsar sites based on their current importance for biodiversity (e.g., http://datazone.birdlife.org/sowb/spotwetlands), but a forecasting perspective is clearly lacking. In the perspective of impacts of global change, coastal wetlands, and wetlands in the South East of the Mediterranean basin seem to be particularly vulnerable. In addition, where many sites are currently identified using bird species, sites of importance to plants, molluscs, *Odonata* or fish are often linked to habitat types which are currently poorly represented among Ramsar sites (e.g., small sized temporary ponds) and particularly vulnerable to destruction and degradation (e.g., reductions in water availability, pollution). It is equally unclear how well the current Ramsar sites cover wetlands of cultural importance or the key areas of ecosystem services supply.

Countries have already indicated that the number of sites they can designate and manage is limited due to, for instance, availability of resources. This partly explains the lack of implementation of management plans in designated sites. Some countries additionally state a lack of awareness, expertise or capacity. This could easily be solved by tapping into the expertise available with other committed Ramsar contracting parties or partners like the Mediterranean Wetlands Observatory, for instance via expert missions for which the Ramsar Conventions has limited funding available.

Strengthening the Current Ramsar Sites

To support the conservation of Ramsar sites, monitoring can render the impact of measures and also pressures visible and more tangible to all stakeholders involved. Various Ramsar resolutions already call for monitoring and it is well-known that the conservation interest of some Ramsar sites has eroded significantly over time (e.g., the Azraq Oasis in Jordan, Green et al., 2017). Countries are encouraged to report degradation to the Ramsar Secretariat and in extreme cases to propose a site for the Montreux Record (a register of immediately threatened

wetlands of international importance). However, as biodiversity and ecosystem function are not monitored in the majority of the sites, ecological change is poorly reported. Remote sensing tools, training, and capacity building of citizen scientists and expert missions at specific intervals could provide complementary solutions to a more permanent infrastructure (Navarro et al., 2017), with funding for citizen scientist projects or expert missions being more easily obtained (Groom et al., 2017).

While developing countries can apply to Ramsar's Small Grants Fund, developed countries also sometimes choose to invest their own funds in helping others. For instance, in 2017 the Mediterranean Wetlands Observatory organized, in collaboration with the Municipality of Dubai, a training workshop on the development of wetland monitoring programs for conservation practitioners from different countries. Internationally there are funding bodies that focus on supporting capacity building programmes on environmental and sustainable development. Given the previously mentioned limitations in resources and capacity, the 27 Mediterranean Contracting Parties could collaborate more to identify and mobilize funds for training and site-based monitoring programmes.

Management plans have been promoted within the Ramsar Convention in multiple resolutions over time (e.g., Resolution 5.7 which adopted Guidelines on management planning for Ramsar sites and other wetlands; Recommendation 6.13 which called upon the Ramsar Scientific and Technical Review Panel to review the most recent advances in this area). The development and full implementation of management plans would be a major leap forward for individual Ramsar sites and for the conservation of wetlands related biodiversity in the Mediterranean basin. The effective implementation of conservation measures has for instance been shown to reduce the conversion of wetland habitats to agriculture and urban areas (Korichi and Treilhes, 2013) as well as that it facilitates the adaptations of waterbird communities to climate change (Gaget et al., 2018).

Wetland ecology, water levels and their fluctuations (Keddy, 2010) depend not only on the management at the site level, but also the land and water use in the entire catchment (e.g., Likens et al., 2009). This broad spatial scale and the connections with the wider landscape through biophysical and social processes, continues to make wetland conservation relatively more challenging than that of many other ecosystems (Hermoso and Clavero, 2011). In the Mediterranean basin this is especially the case where a high societal demand for water restricts the amount of water available for conservation purposes (Grantham et al., 2010). Therefore, considering the results of the MWOs, concrete actions are needed to overcome the current conservation challenges that Mediterranean wetlands face and the Ramsar Convention still has some cards up its sleeve.

AUTHOR CONTRIBUTIONS

IG is the main author of this manuscript. For this work she has collaborated closely with the other authors from the Mediterranean Wetland Outlook 1 and 2 (CB, LC, TG, EG, AG, CP, and PG) to ensure accuracy of statements, to do additional analysis of data where needed and to write the section on the detected trends. NP has undertaken the data collection, cleaning, and analysis of the protection status of wetlands (**Figure 2** and **Supplementary Material**). RL and CG have contributed an additional analysis on the impacts of climate change (**Figure 2** and **Supplementary Material**). JJ has contributed to the development of the text with the recommendations for the Ramsar Convention. All authors contributed to manuscript revision, read and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fevo.2019.00021/full#supplementary-material

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