Convention on Wetlands

Ramsar

State of the World's Wetlands and their Services to People: A compilation of recent analyses

Wetlands continue to decline globally, both in area and in quality. As a result, the ecosystem services that wetlands provide to society are diminished. Contracting Parties and their policymakers are urged to take immediate action to meet the Ramsar Convention's objective to stop and reverse the loss and degradation of wetlands and services to people.

Background

Ramsar Resolution XI.17 requested the Convention's Scientific and Technical Review Panel (STRP) to report on the state of the world's wetlands and their services to people. The Standing Committee identified this task as among the STRP's highest priorities. As a contribution to this task, this Briefing Note summarizes and highlights for Contracting Parties and other decision makers key points from select scientific reports and articles published in 2013 and 2014. In particular, the Briefing Note discusses wetland status and trends, the loss of wetland ecosystem services and future steps for data collection and assessment.

Purpose

This Briefing Note provides Contracting Parties with an overview of selected aspects of the status and trends of wetlands and the loss of ecosystem services drawn from recently published analyses, as a contribution towards assessing the effectiveness of the Convention. The negative trends shown by recent studies should serve as a call to Contracting Parties to avoid further wetland loss and degradation and to strengthen wetland assessment, monitoring and restoration.

Key messages

- The global extent of wetlands is now estimated to have declined between 64-71% in the 20th century, and wetland losses and degradation continue worldwide.
- Because of wetland losses and degradation, people are deprived of the ecosystem services that wetlands provide. Adverse changes to wetlands, including coral reefs, are estimated to result in more than US$ 20 trillion in losses of ecosystem services annually.
- Despite some positive news about Ramsar Sites, even these are under threat. For example, although populations of wetland species appear to be increasing in Ramsar Sites overall, populations of wetland species in Ramsar Sites in the tropics are decreasing.
- While there are ongoing initiatives that will provide a more precise picture of the extent of the world's wetlands, it is clear that there is a negative trend and wetlands are still being lost or degraded, resulting in negative impacts on biodiversity and other ecosystem services.
- Policymakers have sufficient scientific information to understand the urgent need to take appropriate actions to conserve wetlands and their services to people.

Introduction

The state of the world's wetlands involves a myriad of aspects of quantity and quality. This Briefing Note highlights key outcomes from recent reports published on selected aspects of wetland status and trends. It includes assessments on global trends, such as the Global Biodiversity Outlook 4 (GBO-4) and regional trends, as well as assessments of trends in Ramsar Sites. These studies have found that the continuing losses and degradation of wetlands have resulted in diminished ecosystem services, despite the importance of wetlands and the initiatives agreed through the Convention. This Briefing Note concludes with a short discussion of ongoing initiatives for wetland data collection and assessment. While information gaps remain and while each of the studies discussed contains caveats on their methodologies, the trend is unmistakable: wetlands continue to be lost and degraded.

General global trends

Providing a historical perspective, the Millennium Ecosystem Assessment (2005) reported that more than 50% of the area of certain wetland types had been lost during the 20th century in parts of Australia and New Zealand, Europe and North America. It noted, however, that extrapolating this rate of loss to other regions or wetland types was "speculative only." For example, according to Junk et al. (2013), the amount of loss of wetlands around the world varies between 30 and 90%, depending on the region under consideration.

Davidson (2014) provides the most recent and comprehensive picture of historical wetland losses. In his study of 189 wetland assessments, Davidson estimated that wetland losses in the 20th century were 64-71%, "and for some regions, notably Asia, even higher." He found that "[l]osses of natural inland wetlands have been consistently greater, and [have occurred] at faster rates, than [those] of natural coastal wetlands." His review found that the extent of inland wetlands declined 69-75% during the 20th century, while coastal wetlands declined 62-63%.

Losses in natural wetlands continue in the 21st century. The GBO-4 provides a mid-term assessment of progress towards the Aichi Biodiversity Targets (Secretariat of the Convention on Biological Diversity 2014). Target 5 calls for habitat degradation and fragmentation to be reduced, and similarly Target 14 calls for ecosystems that provide essential services, including those related to water, to be restored and safeguarded. The GBO-4 finds, however, that wetlands, including river systems, continue to be fragmented and degraded and that ecosystems particularly important for services, e.g. wetlands, including coral reefs, are still in decline.

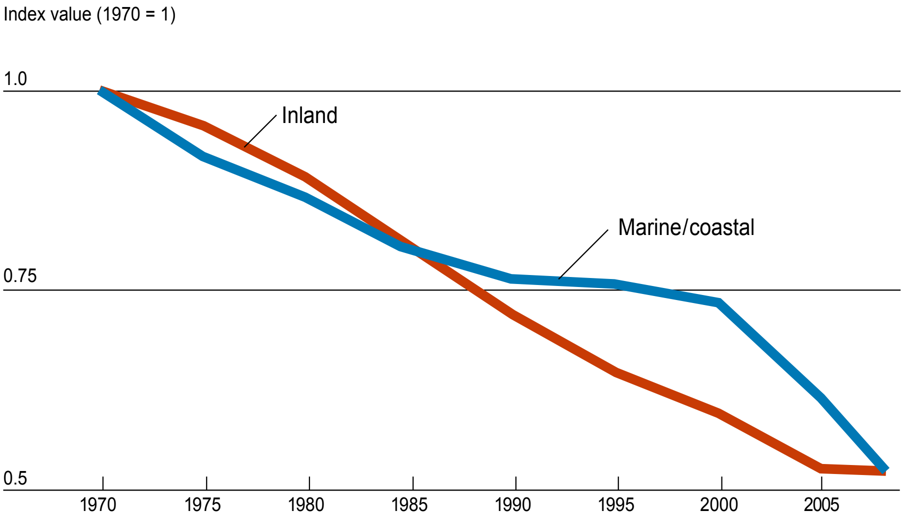
The underlying GBO-4 technical report (Leadley et al. 2014) offers further detail to support the conclusion that wetlands are in serious decline despite the Aichi targets that are designed to stimulate practice and policy to prevent such loss. It acknowledges the limitations of providing definitive statements on wetland extent and losses, emphasizing that "there is currently no agreed global map of these wetland ecosystems." Fluet-Chouinard et al. (2015) make a similar statement, observing that there is a growing need for "[a]ccurate spatial representation of terrestrial surface water" to support the management and conservation of their biodiversity, as well as their ecosystem services. Nevertheless, the GBO-4 technical report notes that "the majority of studies that have measured wetland extent change suggest high rates of global wetland area decreases," perhaps as much as 1.5% annually. The report discusses the Wetland Extent Index, which is "a new method to estimate the average rate of wetland extent change with incomplete data, establishing a baseline for the status of wetlands globally." The analysis, which has not yet been published in a peer-reviewed journal, uses the methodology of the Living Planet Index applied to studies of wetland area.

As explained in the GBO-4 technical report, the Wetland Extent Index showed approximately a 40% decline across the world in the extent of both marine/coastal and inland wetlands over 40 years, although regional differences exist (Fig. 1). The Index also found that "human-made wetlands have increased over the 38-year period, especially in southern Asia due to conversion of natural wetlands into rice paddies." It is important to note that the gain in human-made wetlands does not offset the losses in natural wetland area or the consequent losses of ecosystem functions or services.

Figure 1

Wetland Global Extent Index

adapted from Leadley et al. (2014)

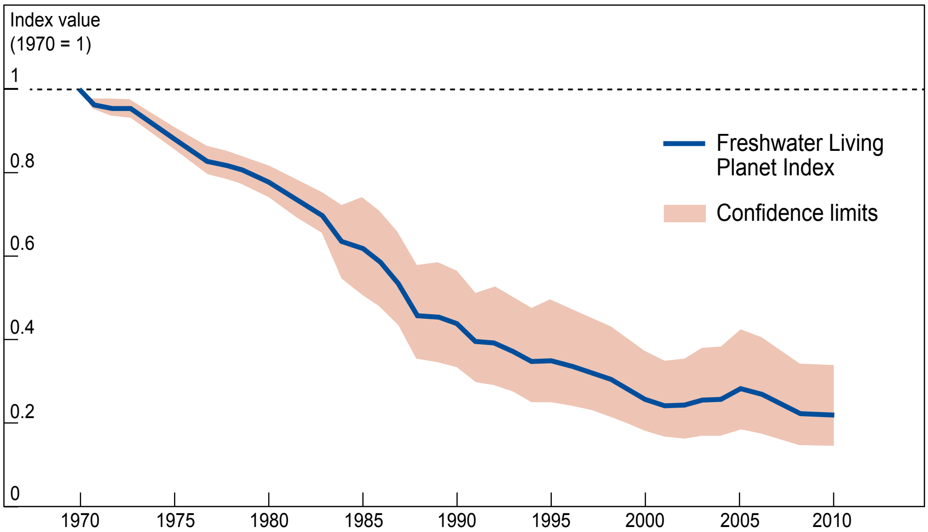


The global average marine/coastal and inland wetland extent trends relative to extent in 1970 and up to 2008 as estimated by the Wetland Extent Index.

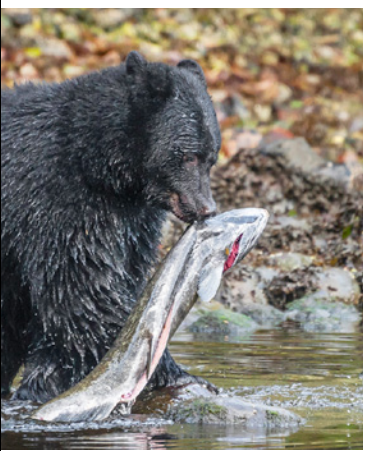
The examination by WWF's Living Planet Index (2014) of one aspect of wetland ecological character — population abundance — also demonstrates a negative trend. The abundance of monitored populations of freshwater species declined an average of 76% over the past 40 years (Fig. 2).

Figure 2

Freshwater Living Planet Index
adapted from WWF (2014)



The Freshwater Living Planet Index shows a decline of 76% between 1970 and 2010 based on trends in 3,066 populations of 757 mammal, bird, reptile, amphibian and fish species.



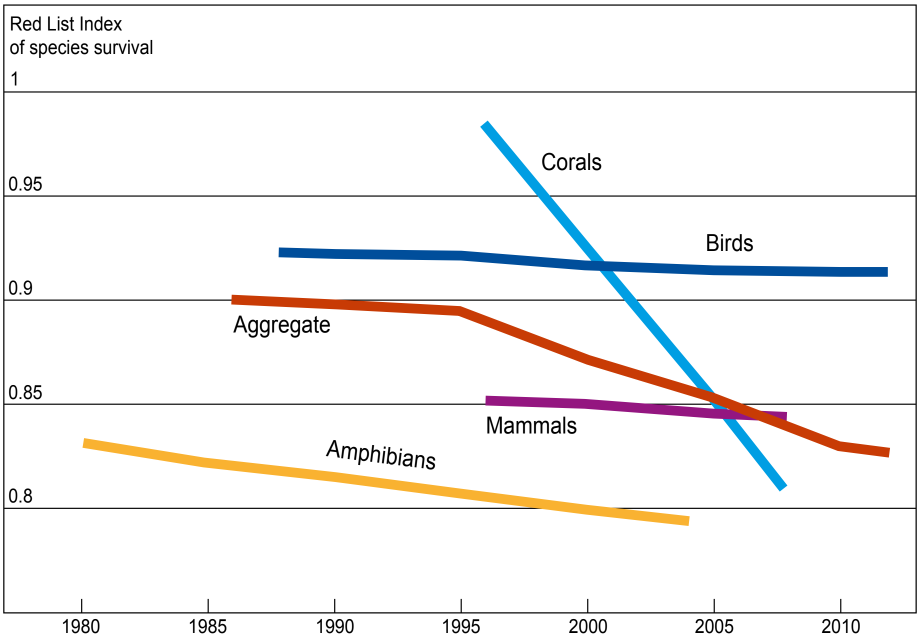
The Freshwater LPI is based on data on population changes in species of vertebrates and is geographically biased towards temperate regions. Hence, it may under-represent the loss of freshwater biodiversity given the rates of biodiversity loss determined for other regions. Nevertheless, it is providing an increasing evidence base that "freshwater species are faring much worse than terrestrial species." Causes of the decline in freshwater biodiversity are numerous, but the principal and most widespread threats are habitat degradation, pollution, flow regulation and water extraction, fisheries overexploitation, and alien species introductions, all of which are or will be compounded by climate change (Strayer & Dudgeon 2010). Various attempts have been made to map these patterns of threats, for example see information presented online for the *State of the World's Rivers* (International Rivers 2014) and the *Global Freshwater Biodiversity Atlas* (Biofresh 2015). The period of decline in freshwater biodiversity corresponds with the duration of the Ramsar Convention, suggesting that the implementation of the Convention by the Parties overall has not been adequate in preventing wetlands loss over the same period. Analyzing the Contracting Parties' national reports, Finlayson (2012) found ineffective implementation at the national level.

An examination of trends in the survival probability of sets of wetland species on the IUCN Red List yields similar results. CBD SBSTTA (2014) reports that trends for the Red List Index for wetland birds, mammals, amphibians and corals are negative (Fig. 3). This means "that overall, wetland species are increasingly moving towards extinction in these groups, and that conservation successes are being increasingly outweighed by worsening pressures."

Figure 3

Red List Index of species survival for wetland birds, mammals, amphibians, corals and in aggregate

adapted from CBD SBSTTA (2014)



Garcia-Moreno et al. (2014) point out that while knowledge on freshwater species is improving, "information gaps in the tropics" exist, meaning that the overall threat from habitat degradation, pollution, water abstraction and invasive alien species "may be even greater than currently estimated."

It is important to recognize that aggregation of data to identify global trends may not be particularly helpful to regional or national policymakers and site-level managers. An average or total trend for wetland vertebrates, for example, might mask the fact that certain populations are doing well, while others are in crisis. Similarly, a certain ecosystem type might be recovering in some regions and disappearing in others. Accordingly, while overall global trends convey a specific message and have an important communications value, it is critical to consider specific regional and site-level conditions when fashioning appropriate responses.

Regional trends

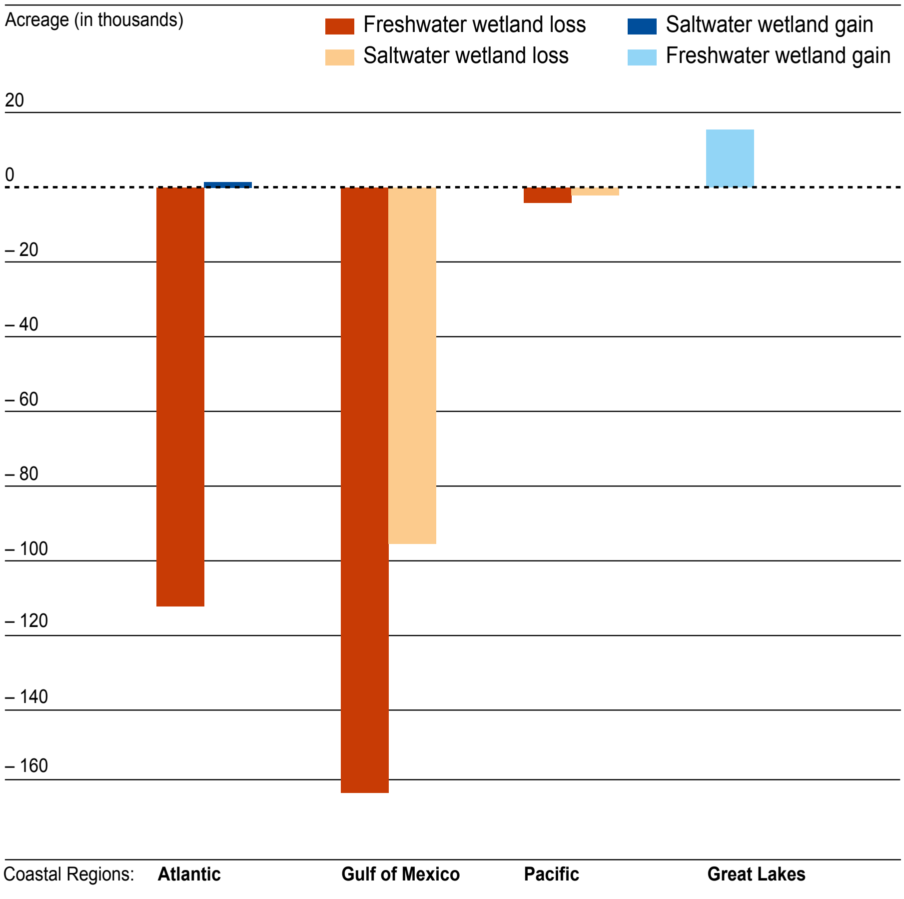
Recent studies on a regional scale have generally produced similar negative findings, although the rate of loss varies significantly from region to region. For example, the Yellow Sea has been identified as an area of greatest concern in the East Asian-Australasian Flyway (MacKinnon, Verkuil, & Murray 2012). Using a remote sensing methodology, Murray et al. (2014) studied approximately 4,000 kilometers of the Yellow Sea coastline. They reported a loss of approximately 65% of intertidal wetlands over the past 50 years. From the 1980s to the late 2000s, approximately 28% of intertidal wetlands were lost, which constitutes a 1.2% annual decline. Kuenzer et al. (2014) note that intensive industrialization and urbanization associated with the oil industry in the Yellow River Delta have resulted in large changes in the structure of the Yellow River Delta, with significant shoreline erosion in some areas and accretion in others. In light of expected growing urbanization pressures on these areas, losses are expected to continue unless policies and practices change.

Dahl and Stedman (2013) examined wetland losses and gains from 2004-2009 in coastal watersheds in the conterminous United States (Fig. 4). They found an annual loss of approximately 80,000 acres (32,375 ha). Although this constitutes only 1% of the total wetland area over the 4.5-year study period,

Figure 4

Wetland gains and losses in US coastal watersheds between 2004 and 2009

adapted from Dahl and Stedman (2013)



it was a 25% increase in the rate of loss from 1998-2004. Much of the loss in freshwater wetlands was attributable to silvicultural activities.

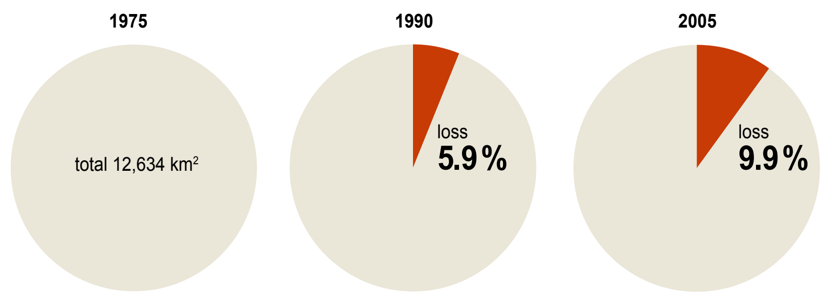
Some indicators do provide positive news in the United States. For example, freshwater breeding birds (data on 87 species) have increased by more than 40% since 1968 (North American Bird Conservation Initiative, US Committee 2014). Similarly, birds wintering along US coasts (50 species) have seen a 28% gain since 1968, including an 8% rise in the most recent five years studied. In contrast, however, long-distance migrant shorebirds in the United States (19 species) have declined by 50% since 1974.

In Europe, there are some positive indicators as well. Significant progress has been made in reducing nutrient levels in lakes and rivers between 1992-2012, due largely to wastewater treatment improvements and reduced agricultural inputs (EEA 2015). Agriculture, however, continues to play a role in continued loss of wetland area.

Figure 5

Natural wetland habitat area loss between 1975, 1990 and 2005 in a sample of 214 wetland sites around the Mediterranean

adapted from Mediterranean Wetlands Observatory (2014)



A study by the Mediterranean Wetlands Observatory (2014) examined 214 sites in the Mediterranean Basin, consisting of a range of wetland types, and found that natural wetland habitat had decreased by 10% from 1975-2005 (Fig. 5). Only wetland sites still extant in 2005 were analyzed. The figure is clearly an underestimate of total regional wetland losses, which should also encompass wetland sites that had disappeared altogether by 2005. In the 214 sites, 6% of the total area was lost during 1975-1990, while 4% was lost during 1990-2005. Although less total area was lost from 1990-2005, the report concluded that "the decrease in the rate of loss is not statistically significant." Losses were due primarily to agricultural conversion, but the ultimate responsible factor is urbanization that consumes agricultural areas. Agriculture is then pushed onto natural habitats (including wetlands) in order to maintain its surface area. Weak policy, poor law enforcement, inappropriate governance and limited consideration of wetlands in national and local land-use planning and development agendas were identified as the main regional drivers of wetland degradation (Mediterranean Wetlands Observatory 2012). Given the extent of effort expended to develop wetland policy and management responses in the Mediterranean since the Mediterranean wetland conference in Grado, Italy, in 1991, the effectiveness of such actions needs to be reassessed and indeed reinforced by putting much more emphasis on the benefits that wetlands provide to society at large.

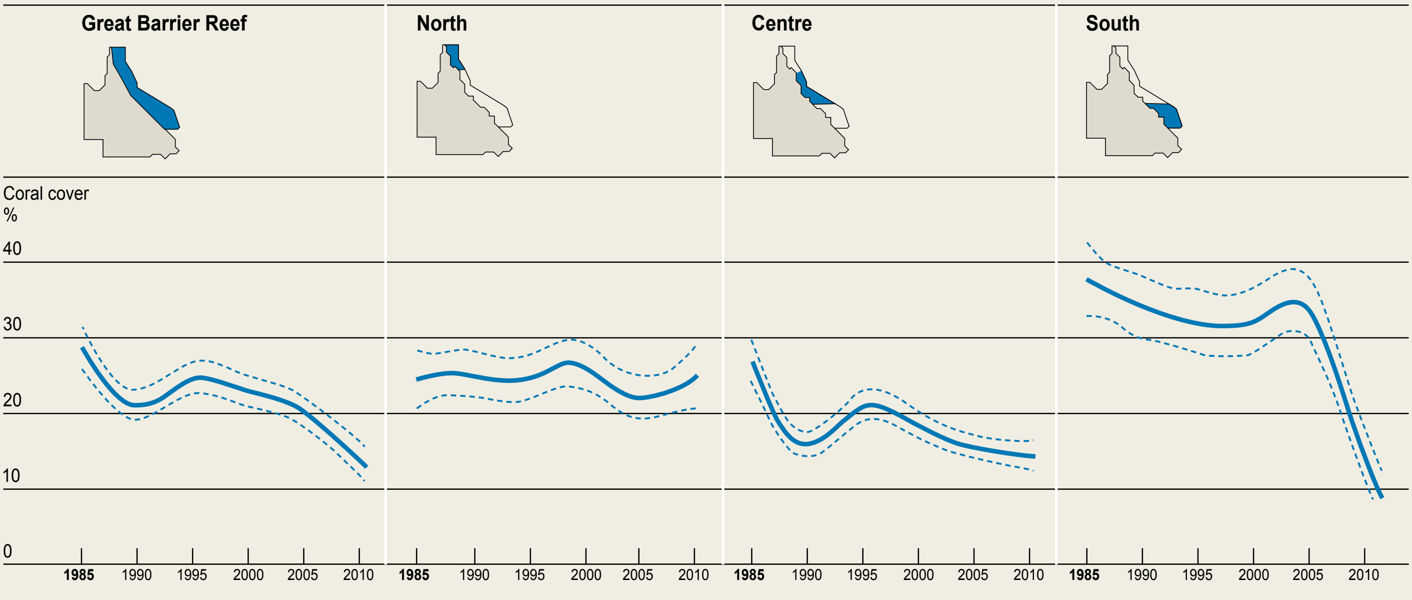
Great Barrier Reef, Australia

The Great Barrier Reef stretches 2,300 km along Australia's northeastern coast, comprises more than 2,900 individual reefs and covers approximately 344,400 km². An assessment of the status of the biodiversity in 2014 showed the northern third of the Reef had good water quality and was in good condition in contrast to the central and southern inshore areas that had continued to deteriorate from cumulative impacts, particularly the seagrass meadows and coral reefs (see figures below).

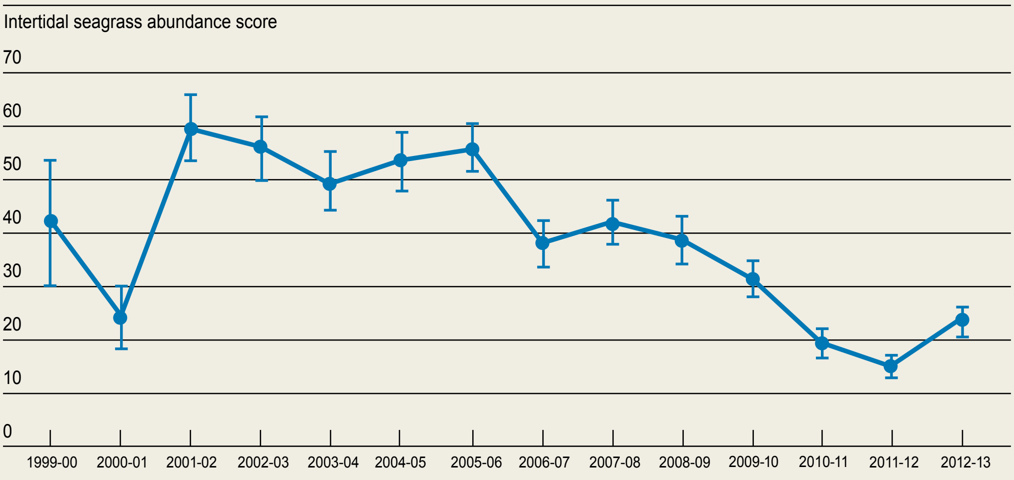
The average hard coral cover declined from 28 to 14%, and the rate of decline had increased substantially, largely due to the effects of cyclones, crown-of-thorns starfish outbreaks and mass bleaching, with elevated nutrients, sediments and pesticides in land-based run-off likely to have affected recovery in inshore areas. Many inshore seagrass meadows had declined since 2007 due to extreme weather and ongoing poor water quality and extended periods of cloud cover. Some meadows were showing early signs of recovery.

There were examples of species that were recovering after past declines, including populations of humpback whales, estuarine crocodiles, loggerhead turtles and the southern stock of green turtles.

Hard coral cover, 1986-2012



Seagrass abundance score for intertidal seagrass meadows, 1999–2013



The assessment concluded that while many of the management measures implemented were making a positive difference, the ability to address cumulative impacts was weak. Climate change was already affecting the Reef and was the most serious threat with sea temperatures increasing with an increased risk of mass coral bleaching, while gradual ocean acidification, due to increased absorption of atmospheric carbon dioxide, was expected to increasingly restrict coral growth and survival. The overall outlook was poor and was expected to further deteriorate.

Great Barrier Reef Marine Park Authority 2014, Great Barrier Reef Outlook Report 2014, GBRMPA, Townsville.

Ramsar site trends

There are limited studies regarding the ecological condition of Ramsar Sites on a country or regional basis, and the results are mixed. The Mediterranean Wetlands Observatory study (2014), discussed above, found “no significant difference in the rate of loss of natural wetland habitats from 1990 to 2005 in the 35 sites already on the Ramsar list in 1990, and the 132 that were not on the list in either 1990 or 2005.” The study suggested “that merely placing a site on the Ramsar list does not ensure the conservation of the natural wetland habitats within it.”

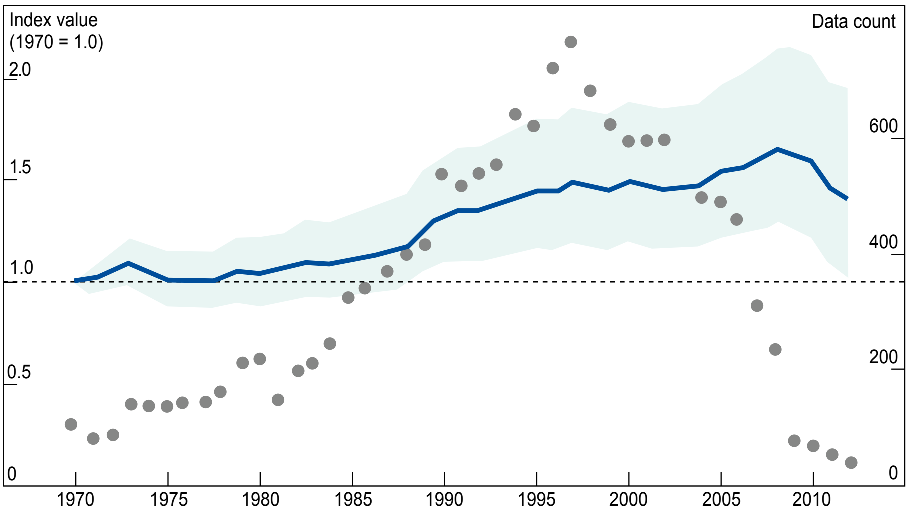
In contrast, Kleijn et al. (2014) analyzed 21 years of waterbird survey data for more than 200 wetlands in Morocco. They determined that “waterbird species richness and abundance increased more rapidly” in Ramsar Sites (post-designation) when compared to non-Ramsar Sites. They were careful to note, however, that it was unclear “whether these differences were caused by conservation management or were already present prior to conservation designation.” It is also important to emphasize that waterbirds may not be a reliable indicator of the status of broader aquatic biodiversity. Guareschi et al. (2015) examined 36 Ramsar Sites in southern Spain and found contrasting trends in biodiversity between taxonomic groups. The Mediterranean Wetlands Observatory (2012) found a similar incongruence. The Living Planet Index, when applied to Mediterranean wetlands, showed a 70% increase for waterbird populations since 1970, and a 40% decline for fish, amphibians, reptiles and mammals.

On a broader scale, the Living Planet Database was used to examine vertebrate population abundance trends at 172 Ramsar Sites in 74 countries (Convention on Biological Diversity 2014). On the positive side, it was found that “[b]y 2011 average trends in abundance had increased by 40%,” although data limitations exist towards 2011, thus resulting in wider confidence limits (Fig. 6).

Figure 6

Index of change in abundance of populations in Ramsar Sites between 1970 and 2011

adapted from CBD SBSTTA (2014)



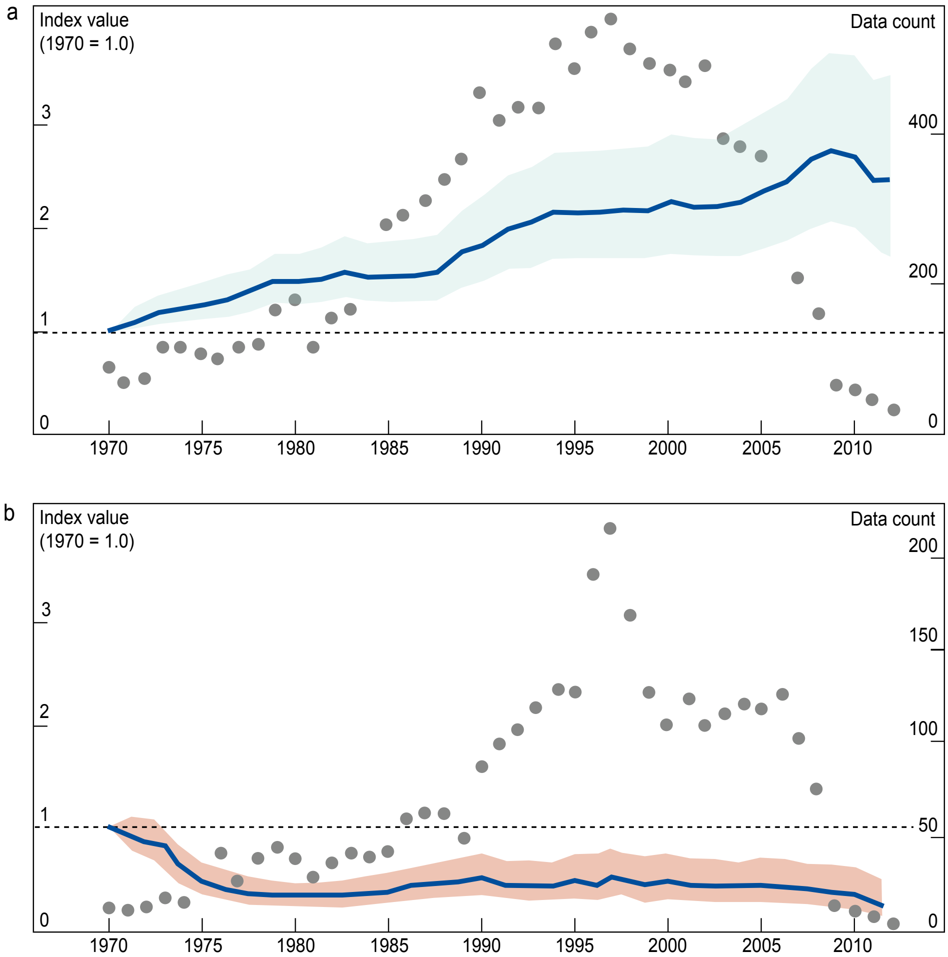
Index of change in abundance of populations in Ramsar Sites between 1970 and 2011. Light blue shading shows 95% confidence limits on index estimate (10,000 bootstrap repetitions). Index is set to 1 in 1970. Grey points show the number of data points per year contributing to the index (right axis). The populations included in the data set are birds, mammals, reptiles, amphibians and fish.

When disaggregated by region, however, the study shows significant differences in vertebrate population abundance in temperate Ramsar Sites (mostly located in Europe) and tropical Ramsar Sites (located across the Afrotropics, Neotropics and Asia) (Fig. 7).

Figure 7

Index of change in abundance of populations in Ramsar Sites between 1970 and 2011

adapted from CBD SBSTTA (2014)



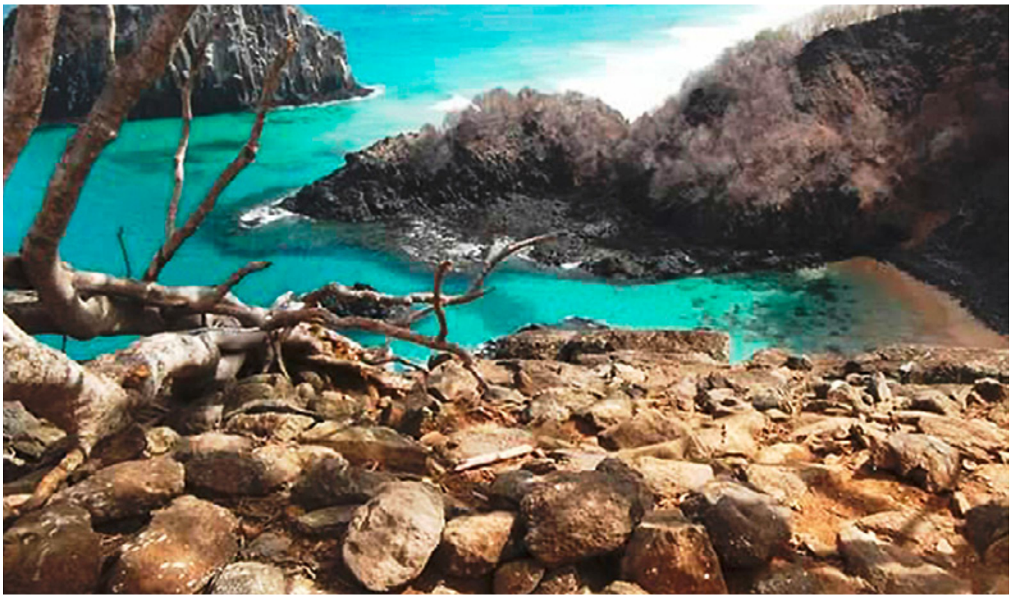
Index of change in population abundance of vertebrate populations in Ramsar Sites between 1970 and 2011 disaggregated into temperate (a. light blue shading) and tropical (b. orange shading). Index is set to 1 in 1970. Shading shows 95% confidence limits on index estimate (10,000 bootstrap repetitions). Grey points show the number of data points per year contributing to the index (right axis).

Ecosystem services trends

In a seminal paper in 1997, Costanza et al. estimated the global value of seventeen ecosystem services (across the categories of provisioning, regulating, supporting and cultural services; see Russi et al. 2013) and provided a broad-scale quantification to help influence policy decisions by taking into account the true value of nature. In 2014, Costanza et al. analyzed the loss of ecosystem services from 1997-2011 due to the change in area of different biomes, including wetlands. They estimated that over this time period losses due to changes in tidal marshes and mangroves were US$ 7.2 trillion per year. Changes in swamps and floodplains accounted for US$ 2.7 trillion losses of ecosystem services per year, while declines in coral reefs resulted in a loss of US$ 11.9 trillion annually.

While the aggregation of data to quantify global trends on ecosystem services portrays a dire situation, those statistics alone will likely not drive effective response actions. Rather, it is regional- and country-specific information that is needed to prompt national or sub-national responses. The United Nations Environment Programme (2014) reported that under a business-as-usual scenario, some 35% of mangrove cover in Southeast Asia could be lost over the time period 2000-2050. This would result in the loss of important ecosystem services, such as food and medicine, waste water filtration and storm protection, especially in Indonesia and Malaysia.

The Spanish National Ecosystem Assessment (2013), funded by the Ministry of Agriculture, Food and Environment, was conducted within the framework of the Millennium Ecosystem Assessment. The study concluded "that 45% of the ecosystem services assessed at the national level have been degraded or are being used unsustainably, with regulating services being the most negatively affected." In particular, coastal and inland wetlands were found to "have undergone considerable degradation of most of their services, with the only exception being cultural services enjoyed by the urban population." The assessment noted that while sufficient natural capital remains for the wellbeing of current and future generations, action must be taken to halt and reverse the degradation and loss of ecosystem services.



The Economics of Ecosystems and Biodiversity (TEEB) for Water and Wetlands (Russi et al. 2013) emphasized inter alia the critical importance of wetlands in the water cycle. The report found that “[w]ater-related ecosystem services and wetlands are being degraded at an alarming pace.” Wetland loss and degradation result in “an enormous social and economic impact (e.g. increased risk of floods, decreased water quality – in addition to impacts on health, cultural identity, and on livelihoods).” TEEB for Water and Wetlands called for the “full value of water and wetlands” to be integrated into decision-making and offered examples of how to do so.

The TEEB India Initiative is a notable example of an effort to make decision makers aware of the value of wetland ecosystem services (MoEFCC & GIZ 2014) at the country and site-level. The study “aims to demonstrate application of economics-based approaches to highlight the ‘hidden’ value of ecosystem services and consequences of their loss to human wellbeing.” Seven inland wetland sites have been identified to “demonstrate application of economic approaches to assess conservation-development trade-offs associated with management of these ecosystems,” and the forthcoming results should provide interesting lessons learned.

Camacho-Valdez et al. (2014) also examined ecosystem services at a more local level in Southern Sinaloa, Mexico. They estimated variations in the value of ecosystem services from changes in wetland extent by “using remote sensing and GIS tools for the spatial representation and the value transfer method for the economic valuation.” The study found that a 10% gain in area of salt marsh/unconsolidated bottom from 2000-2010 resulted in a US$ 19 million increase in annual flow of ecosystem services from these areas. The authors stated that while “Landsat classifications can be used to obtain coarse estimates” of ecosystem services value changes, this approach can be “very valuable for policy formulation and conservation of wetlands” if accurately tied to local environmental conditions.

Future research and assessments/processes

There are several ongoing initiatives that can provide a more precise picture of the extent and state of the world's wetlands. While policymakers already have sufficient scientific information to understand the imperative to take appropriate actions to conserve wetlands, these initiatives will provide further information at the global, regional, country and basin scale.

- **Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES):** IPBES is conducting global, regional and sub-regional assessments, the scope of which will include the food-energy-water-livelihoods nexus, and thus should encompass wetlands and the ecosystem services they provide. The assessments are expected to be completed by the first quarter of 2018. In addition, the thematic assessment on land degradation and restoration, which is also expected to be completed by early 2018, will cover inland waters. Accordingly, several of the experts selected for the scoping phase of this thematic assessment had wetland expertise, including mangrove and freshwater wetland restoration experience. The Ramsar STRP Chair is an observer to the IPBES Multidisciplinary Expert Panel.

- **Transboundary Waters Assessment Programme (TWAP) River Basins Assessment:** This global, comprehensive baseline assessment, expected in 2015, will examine 276 transboundary river basins in 149 countries. It will include an assessment at the basin and basin country unit level of wetland disconnectivity, which is defined as "the proportion of wetlands occupied by dense cropland or urban areas, assuming that human occupancy results in severing the natural physical and biological interconnections between river channels and their floodplains" (TWAP RB interim report 2013). Ramsar STRP observers were involved in the review of the interim report, and Ramsar Sites were used as a secondary indicator of biodiversity importance of wetlands in deltas.

- **Global Mangrove Watch (GMW):** GMW is an international initiative led by the Japan Aerospace Exploration Agency (JAXA) in collaboration with the Ramsar Convention, Wetlands International, UNEP-WCMC and the universities of New South Wales (Australia) and Aberystwyth (UK). The GMW aims to provide annual maps about changes in the global mangrove extent by the use of the Japanese JERS-1, ALOS and ALOS-2 radar satellites (Lucas et al. 2014). A global mangrove baseline will be generated for the year 2010 at 25 m spatial resolution. Change maps will be subsequently generated for the years 1996, 2007-2010 and annually from 2014 for all mangroves in the tropics and sub-tropics. A global (visual) overview of the satellite data composites has already established significant areas of mangrove loss — such as in east Kalimantan due to aquaculture — but also expansion associated with, for example, increased sedimentation along coastlines. This analysis has highlighted the benefits of using these satellite time-series datasets for observing and describing the causes and consequences of change. The GMW

will address issues with existing global mangrove datasets (Giri et al. 2011, Spalding 2010) that are either based on relatively old data or are inconsistent across countries. Ultimately, it is envisaged that GMW products will be used to help inform environmental policy and provide new ways to track progress towards international biodiversity targets. At Ramsar STRP17, the GMW was selected as a pilot demonstration project to the Ramsar Global Wetland Observation System.

- **GlobWetland Africa Project:** GlobWetland Africa is a new initiative led by the European Space Agency (ESA) in close collaboration with the Ramsar Secretariat's regional team for Africa. It is a large earth observation application project that will facilitate the exploitation of satellite observations for the conservation, wise use and effective management of wetlands in Africa. The project will provide African stakeholders with the necessary earth observation methods and tools to better fulfill their commitments and obligations towards the Ramsar Convention, and in particular the inventory, assessment and monitoring of wetlands. The project will help African authorities to make the best use of satellite-based information on wetland extent and condition for better measuring the ecological state of wetlands and hence their capacity to support biodiversity and provide ecosystem services to human communities. The ultimate objective is to enhance the capacity of African stakeholders to develop national and regional wetland observatories, by fully exploiting freely available satellite data from the most recent and innovative space assets, with a particular focus on the Sentinel missions of the European Copernicus initiative that will open a new era for the systematic mapping, assessment and monitoring of wetlands. The project will develop a free-of-charge and open-source software platform for the production of earth observation-based geo-information maps and indicators, and will demonstrate its applicability over a representative set of African pilot wetlands and wetland-prone areas for different points in time. The project will also assist the African partners by providing technical assistance. Although targeted to the African continent, the GlobWetland Africa toolbox will be made available at no cost to the Ramsar community at large. The project has an overall budget of €1,500,000 entirely funded by ESA and is scheduled to start in the second quarter of 2015 for a duration of 3 years.

- **Wetland Extent Index:** The proof of concept for this indicator of wetland change, using the methodology of the Living Planet Index applied to studies of wetland area, has been completed by UNEP-WCMC with support from the Ramsar Secretariat. It has been used in GBO-4 and the Ramsar Factsheets produced to mark the occasion of World Wetlands Day 2015. An article describing the methodology and initial results is expected to be submitted to a peer-reviewed journal in 2015 prior to Ramsar COP12. The index is built on a database of individual wetland extent trends, which if maintained can be used to generate updated indices at global and regional scales, and by wetland type, at regular intervals. Next steps, subject to the availability of resources, involve filling regional gaps, particularly for Latin America, identifying a mechanism for maintenance of the database and periodic updating of the Index.

- **GlobeLand30:** In September 2014, the People's Republic of China "donated to the United Nations the first open-access, high-resolution map of Earth's land cover, as a contribution towards global sustainable development and combating climate change" (Chen, Ban, & Li 2014). This global mapping effort, which relies on global earth observation data from 2000 and 2010, includes wetlands in its classification scheme. The project is the first ever to conduct global land cover mapping at a resolution of 30 m. Automated approaches using these data, however, have poor accuracy, "typically below 65%" (Chen et al. in press). Wetlands are particularly challenging because they consist of several types of sub-classes and the "spectral diversity within wetland is therefore significant." Thus, confusion may arise as "clear water from a reservoir, a river with a high sediment content, and a eutrophic lake may have very diverse spectral reflectance." Chen et al. concluded that accurate delineation of wetlands depends on "prior knowledge of wetland types, distribution, and temporal change patterns as well as the spectral characteristics."

- **GIEMS-D15:** Fluet-Chouinard et al. (2015) discussed the development of a global inventory of permanent and temporary surface waters. They noted that forthcoming "hydrologically-oriented satellite missions such as Soil Moisture Active Passive (SMAP) … and Surface Water and Ocean Topography (SWOT)" will help reach the goal for describing "surface water area at unprecedented spatial and temporal resolution." In the interim, the authors recommend further use of existing datatsets, and have developed GIEMS-D15. Supplementing the Global Inundation Extent from Multi-Satellites (GIEMS) dataset with data from the Global Lakes and Wetlands Database (GLWD), it delineates both permanent and temporarily inundated areas with their range of variation.

- **Ramsar Management Effectiveness Evaluation Tool (R-METT):** Draft Resolution XII.15 recommends that Ramsar Site managers consider using a Ramsar-adapted Management Effectiveness Tracking Tool (R-METT) to evaluate the Sites. Such a coordinated approach would assist assessment of regional and global wetland status and trends.

Conclusion

The Ramsar Convention calls on Contracting Parties "to stem the progressive encroachment on and loss of wetlands." At COP10 (2008), the Contracting Parties endorsed the Changwon Declaration on human wellbeing and wetlands, which presented priority action steps to achieve environmentally sustainable goals. At COP11 (2012), Resolution XI.9 reaffirmed "the Contracting Parties' commitment to avoiding negative impacts on the ecological character of Ramsar Sites and other wetlands as the primary step in strategies for stemming the loss of wetlands." Yet study after study demonstrates that wetland area and quality continue to decline in most regions of the world. Consequently, the ecosystem services that wetlands provide to people are compromised.

The data contained in this Briefing Note should serve as an urgent call for Contracting Parties to avoid further wetland loss and degradation and to strengthen wetland assessment, monitoring and restoration efforts in support of the wise use of all wetlands.

References

BioFresh. (2015). Global Freshwater Biodiversity Atlas. Retrieved from http://atlas.freshwaterbiodiversity.eu/

Camacho-Valdez, V., Ruiz-Luna, A., Ghermandi, A., Berlanga-Robles, C. A., & Nunes, P. A. L. D. (2014). Effects of Land Use Changes on the Ecosystem Service Values of Coastal Wetlands. *Environmental Management, 54,* 852-864.

Chen, J., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. *Nature, 514,* 434. doi:10.1038/514434c

Chen, Jun, Chen, Jin, Liao, A., Cao, X., Chen, L., Chen, X., He, C., Han, G., Peng, S., Lu, M., Zhang, W., Tong, X., & Mills, J. (In press). Global land cover mapping at 30 m resolution: A POK-based operational approach. *Journal of Photogrammetry and Remote Sensing.* doi:10.1016/j.isprsjprs.2014.09.002

Convention on Biological Diversity, 18th Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice, June 23-28, 2014, *Opportunities and Challenges for Harmonization of Global Indicators for the Convention on Biological Diversity and the Ramsar Convention on Wetlands,* UNEP/CBD/SBSTTA/18/INF/18 (June 13, 2014).

Costanza, R., de Groot, R., Sutton, P., van der Ploeg, S., Anderson, S. J., Kubiszewski, I., Farber, S., & Turner, R. K. (2014). Changes in the global value of ecosystem services. *Global Environmental Change, 26,* 152-158.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., Paruelo, J., Raskin, R. G., Sutton, P., & van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature, 387,* 253-260.

Dahl, T. E. & Stedman, S. M. (2013). *Status and trends of wetlands in the coastal watersheds of the conterminous United States 2004 to 2009.* US Department of the Interior, Fish and Wildlife Service & National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Retrieved from http://www.habitat.noaa.gov/pdf/Coastal_Watershed.pdf

Davidson, N. C. (2014). How much wetland has the world lost? Long-term and recent trends in global wetland area. *Marine and Freshwater Research, 65*(10), 934-941. http://dx.doi.org/10.1071/MF14173

European Environment Agency (EEA). (2015). Nutrients in freshwater (CSI 020/WAT 003). Retrieved from http://www.eea.europa.eu/data-and-maps/indicators/nutrients-in-freshwater/nutrients-in-freshwater-assessment-published-6

Finlayson, C. M. (2012). Forty years of wetland conservation and wise use. *Aquatic Conservation: Marine and Freshwater Ecosystems, 22,* 139-143.

Fluet-Chouinard, E. Lehner, B. Rebelo, L. M., Papa, F., & Hamilton, S. K. (2015). Development of a global inundation map at high spatial resolution from topographic downscaling of coarse-scale remote sensing data. *Remote Sensing of Environment 158,* 348-361. doi:10.1016/j.rse.2014.10.015

Garcia-Moreno, J., Harrison, I. J., Dudgeon, D., Clausnitzer, V., Darwall, W., Farrell, T., Savy, C., Tockner, K., & Tubbs, N. (2014). Sustaining Freshwater Biodiversity in the Anthropocene. In A. Bhaduri, J. Bogardi, J. Leentvaar & S. Marx (Eds.), *The Global Water System in the Anthropocene: Challenges for Science and Governance* (pp. 247-270). Switzerland: Springer International Publishing.

Giri, G., Ochieng, E., Tieszen, L. L., Zhu, Z., Singh, A., Loveland, T., Masek, J., & Duke, N. (2011). Status and distribution of mangrove forests of the world using earth observation satellite data. *Global Ecology and Biogeography, 20*(1), 154-159.

Great Barrier Reef Marine Park Authority. (2014). *Great Barrier Reef Outlook Report 2014.* Townsville: GBRMPA.

Guareschi, S., Abellán, P., Laini, A., Green, A. J., Sánchez-Zapata, J. A., Velasco, J., & Millán, A. (2015). Cross-taxon congruence in wetlands: Assessing the value of waterbirds as surrogates of macroinvertebrate biodiversity in Mediterranean Ramsar sites. *Ecological Indicators, 49,* 204-215.

International Rivers. (2015). The State of the World's Rivers. Retrieved from http://www.internationalrivers.org/worldsrivers/

Junk, W. J., An, S., Finlayson, C. M., Gopal, B., Květ, J., Mitchell, S. A., Mitsch, W. J., & Robarts, R. D. (2013). Current state of knowledge regarding the world's wetlands and their future under global climate change: a synthesis. *Aquatic Sciences, 75*(1), 151-167.

Kleijn, D., Cherkaoui, I, Goedhart, P. W., van der Hout, J., & Lammertsma, D. (2014). Waterbirds increase more rapidly in Ramsar-designated wetlands than in unprotected wetlands. *Journal of Applied Ecology, 51*(2), 289-298. doi:10.1111/1365-2664.12193

Leadley, P. W., Krug, C. B., Alkemade, R., Pereira, H. M., Sumaila U. R., Walpole, M., Marques, A., Newbold, T., Teh, L. S. L, van Kolck, J., Bellard, C., Januchowski-Hartley, S. R., & Mumby, P. J. (2014). *Progress towards the Aichi Biodiversity Targets: An assessment of biodiversity trends, policy scenarios and key actions* (CBD Technical Series No. 78). Montreal, Canada: Secretariat of the Convention on Biological Diversity. Retrieved from http://www.cbd.int/doc/publications/cbd-ts-78-en.pdf

Lucas, R., Rebelo, L. Fatoyinbo, L., Rosenqvist, A., Itoh, T., Shimada, M., Souza-Filho, P., Thomas, N., Trettin, C., Accad, A., Carreiras, J., & Hilarides, L. (2014). Contribution of L-band SAR to systematic global mangrove monitoring. *Marine and Freshwater Research, 65*(7), 589-603.

MacKinnon, J., Verkuil, Y. I., & Murray, N. (2012). *IUCN situation analysis on East and Southeast Asian intertidal habitats, with particular reference to the Yellow Sea (including the Bohai Sea)* (Occasional Paper of the IUCN Species Survival Commission No. 47). Gland, Switzerland and Cambridge, UK: IUCN.

Mediterranean Wetlands Observatory. (2012). *Biodiversity: Status and trends of species in Mediterranean wetlands* (Thematic collection, Special Issue #1). Tour du Valat, France. Retrieved from http://medwet.org/wp-content/uploads/2012/12/MWO_2012_Thematic-collection-1_Biodiversity.pdf

Mediterranean Wetlands Observatory. (2014). *Land cover: Spatial dynamics in Mediterranean coastal wetlands from 1975 to 2005* (Thematic collection, Special Issue #2). Tour du Valat, France. Retrieved from http://medwet.org/wp-content/uploads/2014/10/MWO_2014_Thematic-collection-2_Land-cover-dynamics.pdf

Millennium Ecosystem Assessment. (2005). *Ecosystems and human wellbeing: Wetlands and water synthesis*. Washington, D.C.: World Resources Institute.

MoEFCC & GIZ. (2014). *The economics of ecosystems and biodiversity: TEEB India initiative: Interim report – working document*. Retrieved from http://www.ramsar.org/sites/default/files/documents/library/tii_interim_report_working_document_oct_2014.pdf

Murray, N. J., Clemens, R. S., Phinn, S. R., Possingham, H. P., & Fuller, R. A. (2014). Tracking the rapid loss of tidal wetlands in the Yellow Sea. *Frontiers in Ecology and the Environment, 12,* 267-272. http://dx.doi.org/10.1890/130260

North American Bird Conservation Initiative, US Committee. (2014). *The State of the Birds 2014: United States of America*. Washington, DC: US Department of the Interior. Retrieved from http://www.stateofthebirds.org/2014%20SotB_FINAL_low-res.pdf

The Ramsar Convention on Wetlands, The 10th Meeting of the Conference of the Parties to the Convention on Wetlands, Changwon, Republic of Korea, Oct. 28-Nov. 4, 2008, *Res. X.3: The Changwon Declaration on Human Wellbeing and Wetlands*.

The Ramsar Convention on Wetlands, The 10th Meeting of the Conference of the Parties to the Convention on Wetlands, Bucharest, Romania, July 6-13, 2012, *Res. XI.9: An Integrated Framework and Guidelines for Avoiding, Mitigating and Compensating for Wetland Losses*.

The Ramsar Convention on Wetlands, The 48th Meeting of the Standing Committee, Gland, Switzerland, Jan. 26-30, 2015, *Draft Res. XII.15: Evaluating and Ensuring the Effective Management and Conservation of Ramsar Sites*.

Russi, D., ten Brink, P., Farmer, A., Badura, T., Coates, D., Förster, J., Kumar, R., & Davidson, N. (2013). *The Economics of Ecosystems and Biodiversity for Water and Wetlands*. London and Brussels: Institute for European Environmental Policy; Gland: Ramsar Secretariat.

Secretariat of the Convention on Biological Diversity. (2014). *Global Biodiversity Outlook 4*. Montréal.

Spalding, M., Kainuma, M., & Collins, L. (2010). *World Atlas of Mangroves* [Data set]. London: Earthscan. Retrieved from http://data.unep-wcmc.org/datasets/5

Spanish National Ecosystem Assessment. (2013). *Ecosystems and biodiversity for human wellbeing: Synthesis of key findings*. Madrid, Spain: Biodiversity Foundation of the Spanish Ministry of Agriculture, Food and Environment.

Strayer, D. L. & Dudgeon, D. (2010). Freshwater biodiversity conservation: recent progress and future challenges. *Journal of the North American Benthological Society, 29*(1), 344-358.

Transboundary Waters Assessment Programme. (2013, October). *TWAP FSP River Basins Component: Interim report – preliminary results*. Retrieved from http://twap-rivers.org/assets/TWAP_RB_Interim_report_prelim_results_15102013.pdf

UNEP. (2014). *The Importance of Mangroves to People: A Call to Action*. Cambridge: Duke, N., Nagelkerken, I., Agardy, T., Wells, S., & van Lavieren, H. Retrieved from http://www.unep-wcmc.org/system/dataset_file_fields/files/000/000/275/original/DEPI_Mangrove_ES_report_complete_Low_Res.pdf?1416237427

WWF. (2014). *Living Planet Report 2014: Species and spaces, people and places*. Gland, Switzerland.

Acknowledgements

We greatly appreciate the very useful comments provided by three reviewers, Lars Dinesen, Randy Milton, and Amiro Perez-Leroux. We are also grateful to Stuart Butchart, Jenny Merriman, Vicky Jones and Zoltan Waliczky for their comments, as well as to Louise McRae and Ben Collen for supplying background information on the Freshwater Living Planet Index. Thanks go to Erin Okuno for research assistance, and to Marcela Bonells of the Ramsar Secretariat for her continuous support.

The Ramsar Convention would also like to thank all entrants in the 2015 World Wetlands Day photo contest, whose work is featured throughout this document.

Co-Authors

Gardner, R.C., Chair, Ramsar STRP and Director, Institute for Biodiversity Law and Policy, Stetson University College of Law, Tampa Bay, USA; Barchiesi, S., IUCN Global Water Programme, Gland, Switzerland; Beltrame, C., Mediterranean Wetlands Observatory, c/o Tour du Valat Research Centre for the Conservation of Mediterranean Wetlands, Arles, France; Finlayson, C.M., Institute for Land, Water and Society, Charles Sturt University, Albury, Australia & UNESCO-IHE, Institute for Water Education, Delft, The Netherlands; Galewski, T., Mediterranean Wetlands Observatory, c/o Tour du Valat Research Centre for the Conservation of Mediterranean Wetlands, Arles, France; Harrison, I., IUCN Freshwater Fish Specialist Group/Conservation International; Paganini, M., European Space Agency; Perennou, C., Mediterranean Wetlands Observatory, c/o Tour du Valat Research Centre for the Conservation of Mediterranean Wetlands, Arles, France; Pritchard, D.E., Ramsar STRP invited expert; Rosenqvist, A., Japan Aerospace Exploration Agency (JAXA); Walpole, M., UNEP-WCMC, Cambridge, UK.

Citation

Gardner, R.C., Barchiesi, S., Beltrame, C., Finlayson, C.M., Galewski, T., Harrison, I., Paganini, M., Perennou, C., Pritchard, D.E., Rosenqvist, A., and Walpole, M. 2015. *State of the World's Wetlands and their Services to People: A compilation of recent analyses.* Ramsar Briefing Note no. 7. Gland, Switzerland: Ramsar Convention Secretariat.

About Ramsar

The Convention on Wetlands of International Importance, known as the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

The Convention's mission is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world."

Ramsar Briefing Notes are published by the Ramsar Convention Secretariat in English, French and Spanish (the official languages of the Ramsar Convention) in electronic format, and also in printed form when required.

Ramsar Briefing Notes can be downloaded from:
www.ramsar.org/library

Information about the STRP can be found at:
www.ramsar.org/about/the-scientific-technical-review-panel

For more information about Ramsar Briefing Notes or to request information on how to correspond with their authors, please contact the Ramsar Convention Secretariat at:
strp@ramsar.org

Ramsar
Convention on Wetlands