Resolution XI._

Guidelines on the implementation of methods to determine wetland water needs for maintaining their ecological functions

AWARE of the Preamble to the Articles of the Convention, which recognizes the fundamental ecological functions of wetlands as regulators of water regimes and as habitats supporting a characteristic flora and fauna, especially waterfowl;

RECOGNIZING that wetlands provide a wide range of ecosystem services that contribute to human well-being, that their conservation and wise use is essential for them to continue providing these services, and that wetlands are both a source of water as well as users of it;

PAYING ATTENTION to the issues of fundamental importance for the future of the Convention set out in Resolution X.1, which identifies the lack of water for wetlands and the growing demand for water abstraction as the main factors that generate on-going changes and cause the deterioration and disappearance of wetlands and their services;

RECALLING ALSO the Changwon Declaration on human well-being and wetlands (Resolution X.3) which recognizes that the increasing demand and over-exploitation of water threaten human well-being and the environment, and that there is often not enough water to meet our direct human necessities and at the same time sustain the wetlands that we need;

BEING AWARE of the need to manage and protect our wetlands in a wise manner, ensuring the amount of water necessary to maintain their ecological character, and thus improve the livelihood of people, in particular of those vulnerable, marginalized and dependent on wetlands;

ACKNOWLEDGING that information about the water needs of wetlands would contribute efficiently to their wise use, determining the necessary allocation of water for wetlands, and assessing the potential changes through appropriate monitoring programmes;

ALSO RECOGNIZING, that establishing wetland water needs would contribute to a better watershed management, subsequently harmonizing water use strategies with those related to land use, considering the importance of the global water cycle and the connection between ground-water and surface water in relation to its management and administration;

BEARING ALSO IN MIND the Resolution VIII.1 principles on international action related to development, and ALSO NOTING that the scientific methods used to support decisions related to wetlands on water resource management, including the appraisal of the environmental needs of water by wetlands, must be credible and backed by the opinion of the scientific community;

UNDERSTANDING that organizations with shared interests for data, information and knowledge (including indigenous and traditional knowledge) should intensify their efforts to try to acquire common approaches, harmonized and accessible so that knowledge and experience (e.g. on best

practices) can be exchanged more effectively, even through the use of appropriate applications of scientific information technology;

AWARE of all the technical and scientific guidelines and other materials prepared by the Scientific and Technical Review Panel (STRP) to assist Contracting Parties in the implementation of measures for the conservation and wise use of wetlands, and in water allocation decisions, in order to maintain the ecological character of wetlands;

THE CONFERENCE OF THE CONTRACTING PARTIES

REITERATES the commitment of the Parties through Resolution VIII.1 to ensure the appropriate allocation and management of water resources to maintain the ecological functions of wetlands in their territory, and to ensure that the principles included in the Ramsar Guidelines are incorporated into their national policies on water resources and wetlands;

WELCOMES WITH PLEASURE the "Guidance on the application of methods for determining the water needs of wetlands in order to maintain their ecological functions" provided in the annex to this resolution, and URGES Contracting Parties to make good use of it where appropriate, adapting it as necessary according to the conditions and circumstances of each country, within the framework of existing regional initiatives and commitments, and in the context of sustainable development;

REQUESTS Contracting Parties to prepare this guidance, and to draw the attention to it of relevant stakeholders with responsibilities in managing Ramsar sites and other wetlands, including wetland site managers, ministries, departments and government agencies, agencies responsible for water management and watershed management, non-governmental organizations and civil society, and FURTHER URGES Contracting Parties to encourage these stakeholders to take into account this Framework, together with the Ramsar Toolkit of Manuals for Wise Use, in decision-making and activities related to achieving the wise use of wetlands through the maintenance of their ecological character;

INSTRUCTS the Scientific and Technical Review Panel to continue to work on identifying appropriate methods for determining the water needs of wetlands, in order to provide the Contracting Parties in the shortest time possible with the technical tools to enable those responsible for water resource management to address decision-making in a rigorous and rational way;

REQUESTS Contracting Parties with wetlands located within shared river basins to work together to implement the "Guidance on the application of methods for determining the water needs of wetlands in order to maintain their ecological functions," within the context of water resource allocation management in trans-boundary basins, using the “Guidelines for international cooperation under the Ramsar Convention” (Resolution VII.19);

DIRECTS the Ramsar Secretariat, in collaboration with the Secretariat of the Convention on Biological Diversity, to bring the "Guidance on the application of methods for determining the water needs of wetlands in order to maintain their ecological functions," to the attention of other organizations responsible for managing water resources, relevant regional institutions, agencies and

river basin commissions, and other interested parties and organizations, using the partnership mechanisms established for this purpose in the framework of the joint Ramsar/CBD River Basin Initiative (RBI);

ALSO REQUESTS the Ramsar Secretariat to make the Guidance adopted in this resolution available to the subsidiary bodies and to the Contracting Parties of other multilateral environmental agreements (MEAs), especially to the Subsidiary Body for Scientific, Technical and Technological Advice (SBSTTA) of the CBD in regard to the maintenance of biodiversity of inland waters, and to the Committee on Science and Technology (CCT) of the UN Convention to Combat Desertification regarding the critical issue of water resource management for wetlands located in dry-lands;

CALLS on multilateral and bilateral donors to ensure that the assessment of water needs to maintain the ecological functions and production potential of wetlands are fully taken into account in the design, planning and implementation of river basin and water resource management projects, and consider the special circumstances and constraints of the countries concerned; and

ENCOURAGES Contracting Parties and other interested organizations to develop projects and other activities that promote and demonstrate good practice in determining the water needs of wetlands for the maintenance of their ecological functions, to make such examples of good practices available to other interested parties through the information exchange mechanisms of the joint Ramsar/CBD River Basin Initiative, and to report on achievements and lessons learned from these activities.

Annex

Guidelines on the implementation of methods to determine wetland water needs for maintaining their ecological functions

1. BACKGROUND

1.1. Ramsar Recommendations and Resolutions related to wetland water needs

The Convention has directly or indirectly addressed water related issues since it was adopted in 1971, although in the early stages the recommendations focused on problems related to the lack of water in certain wetlands. For example, the catastrophic drought in the Sahel and the severe consequences it had on the natural habitats of this region led to the first alarm call during the 2nd Meeting of the Conference of the Contracting Parties (COP2) that took place in Groningen, in 1984 (Recommendation 2.6).

In successive meetings of the Conference of the Parties problems caused by excessive water use directly affecting some Ramsar wetlands begun to be highlighted. Such was the case of the Azraq wetland (Jordan), where the 3rd Meeting of the COP warned of the serious changes the excessive extraction of groundwater was having on its natural properties (Recommendation 3.8). It was also the problems associated with the excessive water use that led to two separate calls during the 4th Meeting of the COP, the Doñana Ramsar site in Spain (Recommendation 4.9.1) and the wetlands of the Everglades National Park (Recommendation 4.9.2) in the USA. The damage caused at the Messolonghi lagoons in Greece, and the further potential threats from the Rivers Acheloos and Evinos (Recommendation 5.1.1) diversion schemes, were reported at the 5th Meeting of the COP, while at the 6th Meeting of the COP the Australian authorities were urged to consider prudent and feasible alternatives to the proposed major developments at several Ramsar sites or their catchments (Recommendation 6.17.4).

All of these initial recommendations highlighted the relevance of sound water resource management for the conservation of wetlands. However, it was at the 6th Meeting of the COP where explicitly and for the first time, it was acknowledged that wetlands require certain amounts of water in order to maintain their ecological character (Resolution VI.23).

Subsequently, Resolution VII.18[1] clearly refers to the water needs of wetlands in the context of watershed management, and highlights the importance of assessing their ecological needs as a basic component of watershed management decision making. In addition, in this Resolution a series of guidelines where approved to assist Contracting Parties in their efforts to maintain the natural hydrological regimes for the conservation of their wetlands.

[1] Replaced by Resolution X.19

From the point of view of a conceptual approach, it was in Valencia, in 2002, during the 8th Meeting of the COP, when the allocation and management of water to maintain the ecological character of wetlands was addressed in a comprehensive way (Resolution VIII.1). Even though the methods to determine wetland water needs were not addressed in detail, other complementary aspects such as institutional, policy and legislation, and framework for decision making issues were considered. Also at this meeting the COP adopted two other resolutions directly related to water resource management: Resolution VIII.40 permitted the adoption of the first guidelines for rendering the use of groundwater compatible with the conservation of wetlands, while Resolution VIII.34 focused on the interdependence between agriculture activities and the wise use of wetlands.

Resolution IX.1 and its Annexes C, Ci, and Cii, provided additional scientific and technical guidance to the Ramsar Convention guidelines on water, river basin, and groundwater.

Finally, in 2008, "the Changwon Declaration on human well-being and wetlands" (Resolution X.3) includes a call to action introducing the priority actions to achieve some of the most basic objectives for the environmental sustainability on the planet. This Declaration recognises that the increasing demand and over-use of water threaten human well-being and the environment, and that often there is insufficient water to meet our direct needs and at the same time maintain the wetlands on which we depend.

1.2. The allocation of water for wetlands and its importance for the efficient implementation of the Convention

"An Integrated Framework for the Ramsar Convention's water-related guidance" (Resolution IX.1, Annex C) makes specific reference to wetlands requiring sufficient quantities of water in order to maintain their ecological character, to the point where the message is: "No wetlands, no water." In this context, the adequate amount of water allocated for wetlands, is a prerequisite for their conservation and wise use.

On the other hand, a number of Resolutions also require knowing the specific water needs of wetlands. This is an example of the situation encountered in integrated watershed management (Resolution X.19), management of groundwater (Resolution IX.1, Annex Cii), agriculture and water resource management (Resolution VIII.34), management planning (Resolution VIII.14), or indeed the resolution on water allocation for wetlands (Resolution VIII.1).

In a significant manner, "The Ramsar Strategic Plan 2009-2015" (Resolution X.1) specifies that the mission of the Convention is "the conservation and wise use of wetlands." Despite the great efforts and progress made by the Convention since its adoption to achieve this goal, the 2005 Millennium Ecosystem Assessment concluded that "the degradation and loss of wetlands is more rapid than that of other ecosystems." In this regard, it must be mentioned that the Strategic Plan identified the scarcity of water resources available for wetlands and the growing demand for water extraction as the two main factors causing continuous change, deterioration, and destruction of wetlands and the services they provide.

Determining wetland water needs also contributes in varying degree to the development and implementation of the strategies proposed in the Strategic Plan 2009-2015. Thus, for example, the efficient management of wetlands (Strategy 2.5 and 2.7) requires that the amount of water needed by

wetlands and their water sources be known. A well balanced offer and demand of resources requires quantitative assessments that include the ecological demand of wetlands. Thus, wetlands can be considered as an integral part of watershed management (Strategy 1.7). The inventory and assessment of wetlands (Strategy 1.1, 2.4 and 2.6) includes the hydrological regime of the wetland, the management objectives and the limits of acceptable change. It is clear that when the cause of degradation of a wetland is caused by the intensive use of water, its restoration will depend on the allocation of the appropriate water volume to recover its functions and ecological character (Strategy 1.8).

The above arguments confirm that water allocation needed to maintain the ecological functions of wetlands is, definitely, a key element for the implementation of the Strategic Plan 2009-2015, where it is considered as a crucial issue to achieve the conservation and wise use of wetlands, and ultimately for the effective implementation of the Convention.

2. WATER IS NECESSARY FOR THE CONSERVATION AND WISE USE OF WETLANDS

In article 1, paragraph 1 of the text of the Convention "wetlands" are defined as "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." This broad definition of wetland allows for the consideration of a large number and variety of ecosystems around the world, whose common feature is the presence of the element that characterises and describes them: water.

In the context of the Convention, conservation and wise use of wetlands is defined as "the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development."[2]

By its very definition, to maintain the ecological character implies conserving the components, processes and benefits/services that characterise the wetland at a given time. However, the "ecosystem-based approach" which is part of the wise use definition, admits that wetlands do change[3] (including species composition and population density), that these changes are natural and unavoidable, and that therefore management objectives should not be thought of as fixed outcomes but, rather, as support for natural ecological processes.

Ecological processes occurring in wetlands (including nutrient recycling, productivity, succession processes, species competition interactions, etc) are controlled to a large extent by their hydrological regime, but not just any regime will do for the conservation of a wetland. Under natural circumstances, each wetland has its characteristic hydrological regime, changing with time but following patterns and variability ranges happening throughout the evolution of the wetland. In order to maintain the natural ecological processes the natural hydrological regime characteristic of each wetland must be ensured to some extent.

[2] According to Resolution IX.1, Annex A

[3] Ecosystems Approach, Principle 9, of the Convention on Biological Diversity

The importance of the natural hydrological regime in reference to the conservation status of wetlands has been highlighted in various Resolutions. For example, in the annex to Resolution VIII.1 it is specified that "to maintain the natural ecological character of a wetland, it is necessary to allocate water as closely as possible to the natural regime." In the guidelines directed to the Contracting Parties to integrate the conservation and wise use of wetlands into river basin management (Resolution X.19) it is also recommended that the precautionary principle be applied to ensure a natural situation as close as possible in case the exact water needs of wetlands are not known.

However, it is important to note that the purpose of the Convention is to include natural or near natural wetlands in the Ramsar List, but it also allows for the designation of purpose-built or artificial wetlands, provided that they meet at least one of the Criteria for designation. Thus, Ramsar sites cover a wide range of ecosystems and of management approaches, ranging from areas in good natural conditions where the preservation of their ecological integrity is the objective, to almost natural or artificial wetlands where conservation is integrated into human traditional lifestyles or even where sustainable extraction of resources occurs. In this sense it should be mentioned that the water needs of a wetland should match its conservation objectives.

3. THE STUDY OF WETLAND WATER NEEDS

3.1. The proposed wetland water needs

The variability in hydrological regime is a key aspect of wetland dynamics, which is the basis for ecosystem organization and functioning. This means that water allocation should adequately include different components and aspects of the hydrological regime in order to maintain the ecosystem components, processes and benefits/services.[4] Among the components of the hydrological regime consideration should be given at least to dry season events or minimum levels, to seasonal patterns throughout the year, and high volume events, all of it for conditions in dry, medium and wet years. In the case of natural or near natural wetlands, these elements of the hydrological regime must be determined from the magnitude, duration, frequency and time of occurrence of events in a natural estate.

According to the "Ecosystem Approach" Principle 7, appropriate temporal scales should also be applied to avoid discrepancies between the management time-frame and that of the ecosystem being managed. The time-scale for water allocation must be adequate to cover the most relevant ecological processes of the ecosystem, preferably on a monthly basis, or at least considering the different seasons throughout the year.

3.2. Indicators for which to establish wetland water allocation

The complexity of wetland ecosystems does not allow us to tackle the study of water needs for each and every one of their ecological features. Rather, certain "indicators" must be identified for which proposed water needs can be formulated. In this case indicators must be understood as those

[4] Definition of wise use in Resolution IX.1, Annex A

components, processes or benefits/ecosystem components which are sensitive to the wetland's hydrological dynamics and which to some extent represent the whole of it.

An important aspect for identifying indicators for which to formulate water allocation needs, relates to Ramsar's Criteria for Identifying Wetlands of International Importance. While each of these criteria are not exclusive, it can be assumed that some wetlands might be designated because they include threatened ecological communities or because they are critical for the survival of vulnerable, endangered or critically endangered endemic species. In other cases, wetlands might be designated because they provide habitat for plant and animal species at critical stages of their life cycle or during periods of adverse conditions. The designation might also be due to the direct importance of wetlands to aquatic birds, fish, or other taxa. For each of these cases, the study of wetland water needs should consider the specific requirements arising from these designation criteria for the Ramsar site in question.

3.3. Desired state of ecological features

In order to formulate water allocation it is necessary to have a clear definition of the desired state of relevant features in the wetland. There are several options to determine the desired state of features of the ecological character of wetlands. As seen in the previous section, the first choice should consider maintaining the criteria for its designation as a wetland of international importance. Thus, for example, water allocation for a wetland designated for supporting over 1% of the individuals of the population of a species or subspecies of waterfowl (Criterion 6) must be consistent with this criterion and provide sufficient quantity and quality of habitat to maintain the population level.

In other cases, the desired state of the features of a site may be a direct result of the legal framework affecting the wetland (including protected areas or wildlife conservation legislation), or of a public participation process. In this sense it should be mentioned that throughout its history, the Ramsar Convention has recognised as essential the involvement and participation of communities in the decision-making on site management (among which is the desired state of ecological character.)

When the desired state of the features of a site is not attainable through these means, the annex to Resolution VIII.14 indicates that the "favourable conservation status" of habitats and species is a good starting point and is applicable to all features of any Ramsar site.

4. METHODOLOGICAL APPROACHES FOR THE STUDY OF WATER NEEDS OF WETLAND ECOSYSTEMS

4.1. Methodological approaches in the context of ecological character of a Ramsar site

Tools and techniques developed by scientists to determine the amount of water required by ecosystems are in general called "calculation methods." In the context of the Ramsar Convention, the calculation methods shall determine the hydrologic regime necessary for wetlands to maintain their ecological character.

As noted in the previous section, the first step when studying water needs involves identifying the relevant ecological features which must be maintained in the wetland. Figure 2 is a simple

conceptual model[5] that synthesizes much of the ecological character of a Ramsar site, as defined in Resolution IX.1, Annex A.

In general, it could be said that wetland ecosystems[6] are composed of a physical (A) and a biological element represented by plant, animal and microorganisms (B) interacting as a functional unit. In this physical environment the role of the hydrological regime stands out, and its particular dynamics (the result of groundwater discharge, surface contributions, evaporation losses, etc) results in a fluctuating regime of the piezometric levels in the aquifer (2) and a flooding regime (1) that will vary according to the characteristics of the basin (3). This active hydrological dynamics activates the ecological processes and provides habitat conditions for animals (4, 5, and 7), plants (6) and microorganisms to interact, organize, change, fluctuate and evolve. The suitable ecological and hydrological functioning of wetlands provides society with its many goods and services, including the conservation of biological diversity (C).

According to the indicators used to formulate water allocation, the calculation methods can be classified into hydrological methods (I), hydraulic methods (II), hydrobiological methods (III), methods of valuation of ecosystem services (IV) and holistic approaches (see Figure 2). Hydrological and hydrobiological methods as well as holistic approaches are described in greater detail below. In the case of valuation methods of ecosystem services, please refer to the Ramsar Technical Report No. 3.

[5] In the annex to this resolution it is mentioned that elaboration of simple "conceptual models" together with a brief account of the most relevant features, the processes, and the functioning, could be a powerful tool to support the ecological character descriptions of sites.

[6] This definition is coherent with the ecosystem definition found in article 2 of the Convention on Biological Diversity.

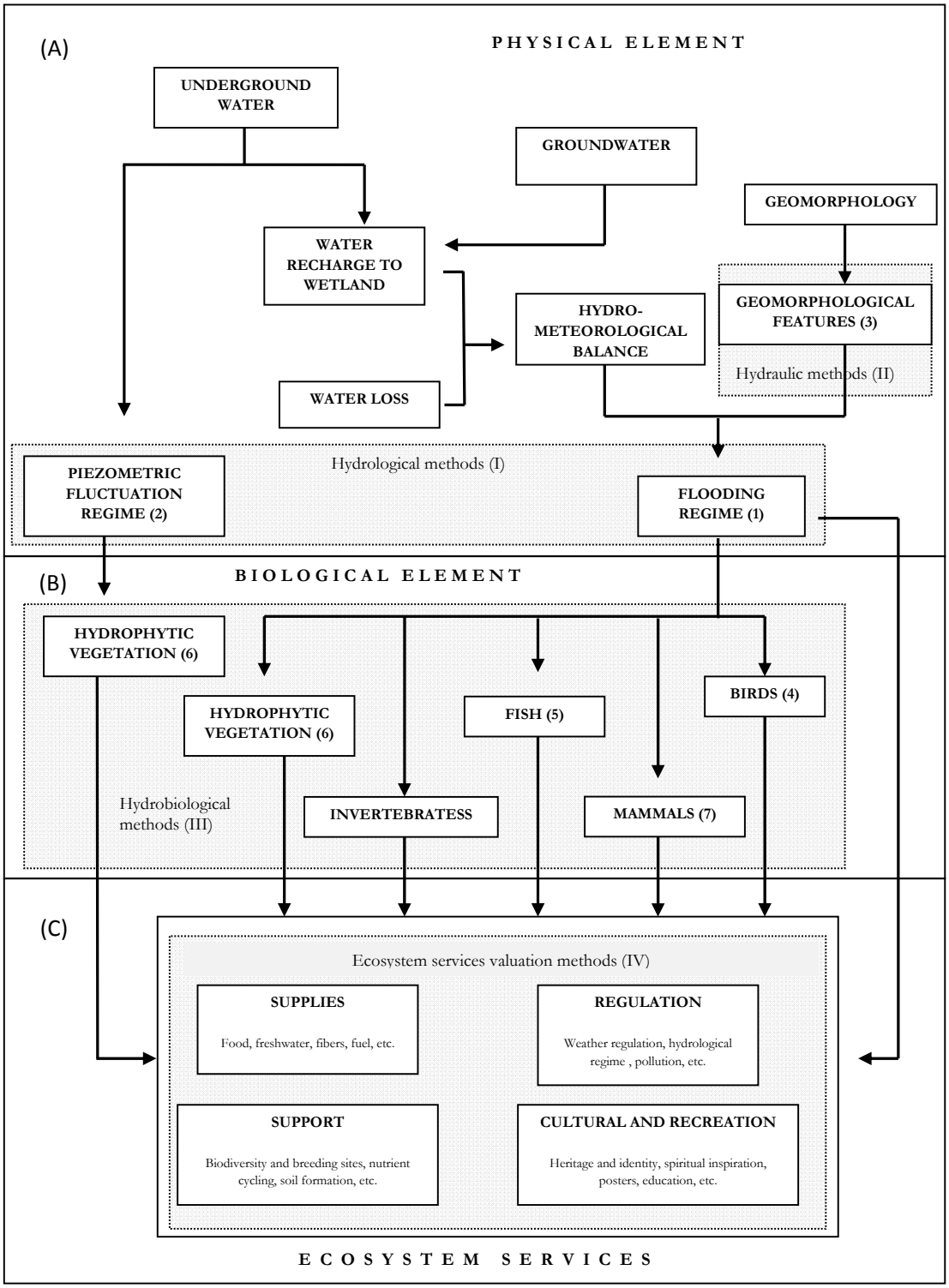

Figure 2: Simplified conceptual model showing the features of the ecological character of a wetland.

4.2. Types of calculation methods

4.2.1. Hydrological methods

These methods are based on the natural hydrological regime being a key variable in the dynamics and functioning of wetlands.[7] Historical flood data register the variability of the ecosystem for a key variable in their structure, i.e. water. When these methods are applied, water allocation is estimated based on those components and aspects of the hydrological regime that are responsible for the ecosystem dynamics, reflecting the natural hydrological regime in a greater or lesser extent depending on the desired level of conservation for the wetland.

There are many hydrological methods based on the natural hydrological regime used to formulate wetland water allocation. It is recommended that those methods which do not gather fundamental aspects of ecosystem dynamics (such as seasonal and interannual hydrological variability), or those which do not formulate water allocation at a time-scale adequate for the management of the Ramsar sites, be discarded. By contrast, those methods based on the characterisation of the "natural disturbances regime" and the "natural range of variability" usually receive the greatest scientific support.

Among the most promising methods are those that characterise the natural range of variability of wetlands based on the analysis on percentiles. These methods adequately reflect the wetland hydroperiods when applied to a hydrological series at a monthly scale. Because of the high interannual variability of many wetlands it is advisable to separate at least dry and wet cycles in order to cover a wider range of environmental conditions.

Another promising hydrological approach, complementary to the previous one, is based on the characterisation of the natural disturbances regime through the analysis of events. Periods of minimum and maximum volume in wetlands represent ecological events of great significance for them. For example, periods of desiccation in temporary pools must be maintained for their sustainable management when designated as Wetlands of International Importance (Resolution VIII.33). In this case, desiccation events are identified based on the frequency, the duration and the time when they occur under natural conditions.

Among the advantages of hydrological methods is the analysis capability and its temporal resolution (all components of the hydrological regime at the required time-scale can be identified.) It is also noteworthy the fact that it is an analytical approach which is used in the rest of the methods as a variable for reference.[8] Hydrological methods are appropriate when an initial estimate of the water needs of wetlands, or a rapid assessment, are necessary. It is also an appropriate approach when dealing with wetlands designated as wetlands of international importance based on the hydrological importance criterion (Criterion 1).

Among the limitations for the application of hydrological methods is the scarce availability of hydrological series for wetlands, covering a sufficiently long period (preferably 30 years) and responding to the natural hydrological conditions. However, these limitations are being overcome

[7] For further details see section 3.

[8] Both hydrobiological simulation methods and holistic approaches use hydrological analysis to formulate and contextualise water allocation.

with the development of hydrological simulation models and the retrospective analysis of satellite images. It is also important to note that among other constraints is the fact that water allocation based exclusively on hydrological data usually lacks the biological and ecological justification at a local level.

4.2.2. Hydrobiological methods

The habitat of a species is understood as "the description of an area, where in a given space and time, an organism lives or may live." Geographical, climatic and biological features important for the distribution or organisms are typically used to describe a habitat. Although it is almost impossible to describe all the variables, the habitat of a species could be adequately represented by selecting some of them. There is no doubt that in the case of aquatic species, physical variables relative to water (depth, flood duration, time of flooding, etc) become especially relevant.

Hydrobiological models (also called habitat simulation methods) analyse the response of certain species against hydrological conditions. These models are based on the fact that species have a range of preferred habitat conditions, or in other words, they have some tolerance within certain habitat parameters. The limits of these preferences can be determined for each species through their detailed study. Finally, based on the topographic features of wetlands and the flooding regime, the potential amount of habitat available to these species can be determined.

The simulation model for wetland habitat consists of two main components. The physical model for a wetland predicts the depth, duration and time of flooding based on a given flood regime. On the other hand, the habitat model indicates the potential area that species or communities would occupy based on the given flood regime.

In order to apply the hydrobiological methods it is necessary to identify the species or biological groups, whose interest and reference value is significant enough for the elaboration of the wetland water allocation. In this regard mention should be made of the importance of applying these methods (where possible) to biological components used for the designation of wetlands of international importance,[9] i.e. criteria based on species and ecological communities (Criteria 2, 3 and 4), birds (Criteria 5 and 6), fish (Criteria 7 and 8), or to any animal taxon other than the previous ones (Criterion 9).

In using these taxa it should be noted that there is more national and international experience on the exploitation of fish species in rivers, while for the rest of the wetland types there is more information on water requirements of plant species and communities.

Among the advantages of the use of these methods we can highlight their predictive power, which results in their huge potential to formulate different scenarios of wetland water needs. Furthermore, these methods can be used in combination with other models to predict the biological consequences

[9] Annex to Resolution VII.11 on the Strategic framework and guidelines for the future development of the List of Wetlands of International Importance

of a particular management situation and its implications for other water users or in economic terms. For this reason, hydrobiological methods are particularly suitable in cases of critical water use conflicts. The detailed study of biological species or groups, particularly in those cases of rare or threatened taxa, provides the best information for their conservation when they are affected by water use. Equally important is its relevance when justifying water allocation by simulating the biological criteria used for the designation of wetlands of international importance.

Among the limitations of the hydrobiological methods is the high cost in time and resources to develop the biological and hydraulic studies that are required. In many cases water allocation based on hydrobiological methods have considered a single species, without addressing the complex processes that take place in wetlands, nor the rich diversity of other species. In fact, in wetlands with high biodiversity it is difficult to find a species that represents the entire ecosystem.

4.2.3. Determining water needs based on a holistic approach

Unlike approaches based solely on species conservation, holistic approaches are based on the wetland as a whole, attempting to know the response of the whole based on the analysis of different components or crucial ecosystem processes, species included.

These holistic approaches do not respond to any particular method but rather, to a type of approach or vision, where different fields of knowledge (including hydrology, hydraulics, geomorphology, ecology, botany, ichthyology, entomology, water quality, etc) are organized within a framework to adopt water allocation in a comprehensive and explicit manner, towards the implementation of the environmental objectives of the wetland and its long-term conservation.

This means that hydrological and hydrobiological methods described in previous sections are not excluded in the holistic approach but rather, that these methods are part of a wider conceptual and working framework covering the entire ecosystem at different spatial and temporal scales.

Without doubt the most outstanding advantage of these approaches lies in the fact they addressing wetland ecosystems as a whole, focusing on their mid- and long-term conservation. Among other advantages there is also the participation of experts in the various subject areas, including in many cases local experts as well, who give these methods a good scientific credibility. For this reason they are also useful estimates in situations where there are conflicts with other water users. In situations where there is insufficient data these types of approaches may also be useful since they count with the knowledge of experts.

Among the disadvantages of holistic approaches the high cost in comparison to the hydrological methods is the most outstanding. The excessive use of experts' information has also been criticized in some cases where no specific information was available for the local features.

4.3. The application of the calculation methods

As outlined in section 4.1., the calculation methods should determine the hydrological regime necessary for wetlands to maintain their ecological character. This means that whatever methods are applied they should at least determine drought or minimum levels, the seasonal patterns throughout

the year, and high volume events, all of it for years under dry, medium and wet conditions (section 3.1).

As seen in the previous section, there are different methods to determine the water needs of wetlands, and all of them have advantages and disadvantages. The final selection of one method over another depends on the specific characteristics of the wetland (ecological, economic, and social), and on the context of the decisions to be adopted (general resource planning, monitoring, managing conflicts between users, wetland restoration plans, etc)

Nevertheless it is convenient to remember that the methods presented above are neither exclusive, nor should they necessarily provide conflicting results. Rather, notice should be taken that the analysis and the information used by each one of them is different (some are based on a few variables, while others use several variables and sophisticated models.) This implies that water allocation resulting from each method will have a greater or lesser uncertainty in the results and, equally important, they can be defended with a greater or lesser number of arguments.

This has resulted in the selection of methods based on risk becoming a common practice. The logic behind this practice is that the methods to be used will be more sophisticated depending on the risk considered (environmental, social, or economic) when assigning more or less water to the wetland.

Under this approach the use of hydrological methods exclusively, would be justified in sites where water resources are not under great pressure. In this case water allocation might serve just as an indicator of the monitoring of the quantitative status of water in the wetland. In the case of wetlands where water resources are under increased pressure, it is advisable to have complementary environmental, social and economic information to justify the decisions on water allocation for the wetland. In these cases the use of a holistic approach that involves the participation of experts from different disciplines provides strong arguments when decisions are taken. Finally, in the case of wetlands where rare or endangered species are present, it is also important to have available reliable information on the effects of different management scenarios. In these cases, hydrobiological models are proposed as the best alternative.