Preface

Definition and Components of Coastal Wetlands

According to the Ramsar Convention (Ramsar 1971), wetlands correspond to the "areas of marsh, fen, peatland or water-covered surfaces, whether these salted natural or artificial, permanent or temporary, static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters," and "Wetlands may incorporate riparian and adjacent coastal areas and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands." In addition, the same Convention originally proposed a classification system for wetland type which considers three main categories: (1) marine and coastal wetlands, (2) inland wetlands, and (3) artificial wetlands.

For each of these categories, the Convention lists a number of subcategories, and in the case of marine and coastal wetlands, these include permanent shallow marine waters (in most cases less than 6 meters deep at low tide; bays and straits), subtidal seabed (fields of kelp, sea grass, and mixed tropical marine meadows), coral reefs, rocky marine shores (rocky islets and cliffs), sandy or pebble/rock beaches (barriers, banks, points, and sandy islets, as well as the systems of dunes), estuaries (permanent water of estuaries and delta systems), intertidal mud, sand or saline soils ("salt flats"), intertidal swamps and marshes (marshes and elevated areas flooded with salt water, halophyte meadows, salt marshes, fresh and brackish water areas flooded by the tide), intertidal forest wetlands (mangroves, "nipa" swamps, flooded forests, and floodable freshwater zones), brackish and saline coastal lagoons (lagoons with at least one relatively narrow connection to the sea), coastal freshwater lagoons (freshwater delta lagoons), karst, and other subterranean hydrological systems (marine and coastal).

The Ramsar categorization and definition of wetlands is extremely wide, and for it to be applied in Chile to define, for example, marine and coastal wetlands, it would include virtually all areas of the coastline. In fact, since the Ramsar definition is the official definition of wetlands in our country (Contreras 2006), some early efforts made by the government agencies, such as the Servicio Nacional de Pesca

(National Fisheries Service – SERNAPESCA 1999), applied the definition generating a list which has included virtually all coastal bays in the northern part of the country.

Apart from the definition of wetlands by the Ramsar Convention, there are a number of definitions (see Contreras 2006, Mitsh and Gosselink 2011), all of which differ in their operational degrees. For example, the National Academy of Sciences of the United States (NRC 1995) proposed a definition of "reference" for wetlands, which states that "wetlands are ecosystems that depend on the inundation or saturation of the substrate surface, be it constant or temporary, which determines the physical, chemical and biological characteristics of the ecosystem." In reference to this definition, the Academy established diagnostic characters of the state of the ecosystem soil (flooded) and the presence of hydrophytic vegetation. This definition contains the three common components that were recognized by Mitsh and Gosselink (2007) for almost all definitions of wetlands:

- The presence of water either at surface level or in the root zone.
- Unique conditions of different soil types and the rest of the emerged substratum.
- The presence of the characteristic biota adapted to wet conditions (e.g., hydrophytic plants) and therefore the absence of biotas intolerant to floods. The above three conditions arise from the interaction between (a) hydrology (i.e., water level, flow, frequency, etc.), (b) physicochemical environment (soil type, pH, potential redox, etc.), and (c) biota (vegetation, animals, bacteria, etc.). In the case of our country, La Comisión Nacional de Medio Ambiente (National Environmental Commission, CONAMA 2006), in the National Strategy on Coastal Wetlands, recognizes how small is the operational definition by RAMSAR and proposes, as an alternative, to consider as wetlands those "ecosystems associated with substrates of temporarily or permanently saturated water, which allows the existence and development of aquatic biota." In analyzing the requests for the incorporation of the Chilean wetlands to the RAMSAR Convention List (Valverde 1996a, b, c; Rojas and Tabilo-Valdivieso 2004; Vilina et al. 2004; Rodríguez and Contreras 2008a, b; Pool 2010a, b) and perhaps because one of the specific goals of the RAMSAR Convention is to protect the avifauna, it is clear that the most valued components of the aforementioned "aquatic biota" have been primarily birds, not making any mention of groups or important conservation efforts of fish, mammals, and, even less, the plant species.

On the other hand, the studies of wetland environment in general (Mitsh and Gosselink 2007) and of the coastal wetlands in particular (Silliman and Bertness 2009; Alberti et al. 2011; Botto et al. 2011) have focused on the analysis of ecosystems and communities. At the ecosystem level, it is known that plants in coastal wetlands have zonal spatial distributions that arise in response to marked gradients of physical factors (e.g., humidity, salinity, nutrient availability, temperature, etc.) that are especially seen from the lowlands (permanent flooding) to the upper parts of the coastal wetlands. At a community level, studies are focused on the interactions that determine the diversity and species composition and successional and production

processes of the organisms living in coastal wetlands. At both ecosystem and community levels, the main objective is to determine whether there are simple general rules governing the functioning of wetlands, which can be used for the management and conservation of these environments (Bertness et al. 2002; Silliman and Bertness 2003; Bertness et al. 2004). It has become apparent in this line of study that the particular characteristics of the hydrological regime, the soil or the biotic components of wetlands, determine an idiosyncratic ecosystem functioning which cannot be ignored, if we are to manage or conserve the ecosystem (see Farina et al. 2009).

In the particular case of our country, a series of indicators make clear that either hydrology, soil characteristic, or biotic composition determines the degree of idiosyncrasy of coastal wetlands, which can be very high and which should be taken into account when creating policies and management and conservation strategies. For example, in terms of hydrology and soil characteristics, it is well known that on the Southern Pacific Coast, the absence of an extended continental platform restricts the presence of coastal wetlands in tidelands, at the river mouths (West 1977 Bujalesky et al. 2001), and all throughout the region. Due to the lack of rainfall in the north, the river mouths remain closed for a long time, creating hypersaline conditions in wetland soils (Arana and Salinas 2003; San Martin et al. 2001). Below 28° S, the rain increases so the salt load is reduced, which is reflected in the composition of plants (Ramirez and Añazco 1982; San Martin et al. 1992; Hauenstein et al. 2002). In addition, it has been observed that unlike in Europe or on the Atlantic coast of South America, the fluctuations in the water level of some coastal wetlands of Chile do not depend on the changes in the tide but rather on the wind direction and dynamics (Dussailliant et al. 2009). The set of conditions described above may be the reason that, from a biotic point, unlike what is observed in other latitudes (Costa et al. 2003), coastal wetlands of Chile practically lack or have very low percentage of marine invertebrates (Farina et al. 2009).

Moreover, some earthquakes associated with the subduction of the Nazca tectonic plate, under the South America plate, which have occurred along the entire north-central coast of Chile, have generated significant changes in geomorphology, erasing sandbars and coastal dunes and/or producing significant elevations and sinking of the coastline (Castilla 1988), which undoubtedly affects greatly the coastal wetlands of our country.

With reference to the above, as a way of contributing to the sustainable management of coastal wetlands of Chile, in this book's edition, we have brought together as many scientists as possible from different disciplines who are actively conducting research in coastal wetlands of the country. As a result, we deliver the first analysis of the geographical representation and the environmental sensitivity degree of the coastal wetlands of Chile (Chap. 1). Afterward, we continue with the analysis of the available information on the specific components of the coastal wetlands of our country (first part of the book), and in addition, we also deliver case studies on particular wetlands of the northern, central, and southern coasts (second part of the book) to have a very good idea about geomorphology and hydrology (Chaps. 1, 2, 7, and 9), vegetation and flora (Chaps. 4, 5, 6, and 10), and the birds (Chaps. 3, 5, and 6) of the coastal wetlands of our country. Being acquainted with the impact of

the tsunami, associated with the earthquake on February 27, 2010, in a series of chapters, we implicitly or explicitly analyze the effect of this type of natural disturbance on biotic and abiotic components of the coastal wetlands of Chile (Chaps. 2, 6, 9, and 10). Thus, we leave registered the unique opportunity that was experienced by many of us working and conducting research on the coastal edge of our country, having been able to demonstrate, compare, and even contrast the magnitude of the impact, but even more importantly to show the dynamics of recovery of our natural systems to drastic disturbances associated with it.

This book is a result of a series of seminars on the effects of the February 2010 earthquake and tsunami on the coastal edge of our country, the first meeting of Management of Wetlands (2010), and the first seminar on Coastal Wetlands of Chile (2011), in which both editors had actively participated as organizers. In those instances, we have converged academics and researchers from different the universities in the country with representatives of the private companies and public environmental authorities. Then and there, it has become clear that for coastal wetlands, one of the most unique environments, there is only a lot of scattered information, but no consolidated, modern research. The second issue that became apparent was that the policies and management of wetland conservation in Chile have not developed sufficiently. For example, although in the past the CONAMA has issued a "National Strategy for Conservation and Rational Use of Wetlands" (CONAMA 2005), currently, to recognize any significant change in the conservation of these ecosystems has not been possible beyond the publication of inventories, land cadasters, and environmental assessment guides (e.g., CONAF-CONAMA 1999, CEA 2006a, b), which may have a political and/or media value, but questionable worth and technical grasp.

The general objective of the "National Strategy for Conservation and Rational Use of Wetlands" (CONAMA 2005) is "to promote the conservation of the primary wetlands of Chile, its features and benefits in a framework of sustainable development." To achieve this goal, six specific objectives are proposed and are due to be implemented on the basis of 41 lines of action. Out of the six goals, perhaps the most challenging, in terms of management, is the fifth: "To develop and implement participatory planning tools and management for the conservation and sustainable use of priority wetlands." The 11 lines of this target action point to the management and conservation of priority wetlands, and/or representative wetlands of our country, specifying that a priority wetland must be defined by its "biodiversity and ecological system services" or that it shows "specific environment or condition." Both statements are very good in their intention but are absolutely irrelevant. To recognize any given ecosystem for its biodiversity or even only in environmental terms, we need a much deeper understanding rather than just delivering a land cadaster or a list of wetlands. This line of action could be applied in countries with a long history of research and naturalism, based on which it is possible to have an estimate of the conditions and representation of different physical and biological components of wetlands. Our country is far from that. In the Action Line 5 of this objective, the promotion of the new Ramsar sites is incorporated. In our country, beyond supporting the nomination of the new Ramsar sites, after the nomination and even the addition of sites to the National System of Protected Areas (SNASPE), the government management has not

gone beyond generating a large information vacuum on these wetlands. Therefore, the aim of adding more Ramsar sites in our country is not clear, and on top of that, what is even more worrying is the nonexistence of the necessary information to effectively determine whether wetlands on the Ramsar List actually correspond to the areas and have all the characteristics to be considered priority wetlands of the National Strategy. Based on this, the other lines of action, such as the assessment of the management of river basins containing wetlands (Action Line 2) and the implementation of mechanisms to monitor the evolution of wetlands (Action Line 7), both of which require a great economic effort and a high degree of political will to be implemented and maintained over time, clearly cannot be implemented in our country.

When comparing management tools and the scope of the "National Strategy for Conservation and Rational Use of Wetlands" (CONAMA 2005) with other government initiatives such as those proposed by the US Environmental Protection Agency (US EPA), some historical facts could be used to improve our environmental management in relation to wetlands. First of all, the strategy of the US agency is not directed toward wetlands as a complex natural system, but toward particular components of these ecosystems. For example, one of the mainstays of management and environmental management is maintaining the balance of natural systems and nutrients (EPA 2008). The overall goal of this program is to provide scientific guidance to assist states, tribes, territories, and other jurisdictions in assessing the nutrient status of wetlands and provide technical assistance to develop quantitative criteria for wetland systems. To do this, the agency has hired scientists and technicians who participated in the preparations and discussions of 20 modules, including the implementation, and who are serving as technical guides for the various aspects involved in the action (from design sampling, chemical analysis of the samples, to the prioritization and decision making).

The differences in outlook, when it comes to wetland management, by various environmental agencies, have been discussed at meetings and seminars that gave incentive for this book to be materialized. Parallel with the dialogue and recognition of the researchers, as well as the interaction between public and private actors involved in the research and management of wetlands in our country, the second objective of this book is to appeal to not only a more active approach in terms of discussion but also contribution toward improving environmental management in Chile. In those terms, this book marks the beginning of a "Research Network, Management and Conservation of Coastal Wetlands," consisting of representatives from the country's several universities and the company Arauco.

We hope that this book, beyond delivering a summary of the available information, will be a motivating factor for the academia, business, government, and public world representatives, all of which are invited to encourage study and research and to improve management and advance conservation of the coastal wetlands of our country.

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