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Legal protection assessment of different inland wetlands in Chile

Patricia Möller^{1,2*} and Andrés Muñoz-Pedrerros³

Abstract

Background: Inland wetlands are well represented ecosystems in Chile that are subjected to various pressures affecting conservation. Protection means legal and administrative initiatives which promote the protection and/or preservation of a wetland, either in its entirety, considering their areas of influence or its components.

Results: The aim of this work is to develop a methodology for estimating the value of protection of different types of inland wetlands in Chile. For this purpose: a) the Chilean regulations in relation to the issues of biodiversity, wetlands and water resources were compiled; (b) such legislation and its application were analyzed, (c) protection and restriction values of each legal standard was estimated, and then total protection value of standards applied to six types of wetlands in study. 47 legal rules related to protection of inland wetlands and eight directly or indirectly affecting conservation and wise use of wetlands were identified.

Conclusions: In Chile there is no specific statutory rules or regulations on wetlands. Current legal standards do not protect equally the different types of inland wetlands, being swamp forests, peatlands and brackish Andean lakes less protected. To improve wetlands conservation, incentives promoting wetlands destruction must be eliminated and promulgate specific regulations for proper management and conservation.

Keywords: Inland wetlands; Legal standards; Real protection; Wetland protection

Background

Chile is highly diverse in limnic systems mostly recognized as wetlands and defined as 'areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, static or flowing, fresh, brackish or salt waters, including areas of marine water where tide depth does not exceed the six meters' (Ramsar 2000). This long definition includes very heterogeneous areas, such as swamps, rivers, lakes, seashores, and others (Mitsch and Gosselink 2000). Wetlands are highly productive ecosystems (Novitzki et al. 1996) characterized by multiple roles, e.g. hydrological, biogeochemical, habitat conservation, and food webs (Woodward and Wui 2001), as well as providing goods and services relevant to human society (Barbier et al. 1997). In Chile, wetlands are estimated to cover 4,498,060, 7 ha equivalent to 5.9% of national territory (CONAF/CONAMA 1997).

Wetlands support high biodiversity and are presently recognized as the most threatened systems by human activities (Marín et al. 2006). It affects various types of wetlands in Chile (Muñoz-Pedrerros 2004, Peña-Cortés et al. 2006, Zegers et al. 2006, Figueroa et al. 2007). Particularly, freshwater aquatic fauna conservation is mostly affected, such as fishes (Vila et al. 2006), amphibians (Díaz-Paéz and Ortiz 2003, Veloso 2006), molluscs (Valdovinos et al. 2005), and decapod crustaceans (Bahamonde et al. 1998, Pérez-Losada et al. 2002). Inland wetland conservation is a global priority (Abell 2002, Dudley 2008). However, their particular territorial location and the difficulty to apply current protection categories make a difficult management as protected areas. As traditional ecosystem conservation methods are not well implemented in inland aquatic environments, different conceptual approaches are suggested (e.g. freshwater focal area, critical management zone, and catchment management zones (Abell et al. 2007)).

Governance concept applied to natural resources, mainly in waters, has become important (Iza and Rovere 2006). Governance is understood as the economic, political, and

* Correspondence: pmoller@ceachile.cl

¹Facultad de Ciencias, Universidad Austral de Chile, Casilla 567, Valdivia, Chile

²Programa de Humedales, Centro de Estudios Agrarios y Ambientales, Casilla 164, Valdivia, Chile

Full list of author information is available at the end of the article

administrative practice to manage every country affair. This includes mechanisms, processes, and institutions by which citizens express their interests, exercise their rights, meet their requirements, and mediate their differences. In this context, conservation of wetlands should be addressed under various environmental management tools as a permanent process, where various stakeholders and public, private, and civil society develop specific efforts to preserve, maintain, restore, and make a sustainable use of environment. Environmental management uses different and diverse origin instruments, which can be classified in four main categories (*sensu* Rodríguez-Becerra and Espinoza 2002): direct regulation, administration, economics, and education (including research, technical assistance, and environmental information). Direct regulatory tools which are also known as command and control regulations prevail in the environmental management and consist of mandatory regulations and standards, which establish environmental quality targets as well as management and preservation of renewable natural resources of environment. Legislation creates legal tools and standards to comply with principles and reach the aims (Asenjo 2006).

Brañes (2000) defines the environmental regulation as a set of standards dealing with legal protection of those conditions making every life to be possible, considering for this purpose relationships among many biotic and abiotic elements in the environment, such as system or ecosystem. To Fernández (2004), the environmental law gathers standards, regulations, and principles recognized as legally protected, safeguarding environmental systems, in a global and inclusive perspective that differ from merely legislation of environmental incidence.

It may be understood here that legal protection of wetlands is provided by all legal and administrative initiatives aimed to protect and/or preserve them. There are many legal standards that apply to inland wetlands in Chile, many of them are sectoral standards related to their components, ecological functions, and biodiversity, which would favor or regulate their status and permanence. Selection and analysis of these regulations will allow to provide foundations, which make possible assessment of legal degree protection that they provide to these systems and to integrity as ecological systems. In Chile, regulations addressed to the conservation of water resources as a whole have been mainly aimed to develop economic activities related to the exploitation of a natural resource. Until 1994, prior to the Environmental Basis Act (Act No. 19,300) enactment, there were only sector legal standards, without global environmental protection objective, where legal rules were mainly aimed to protect health of human life and only incidental protection of nature (Olivares 2010). Act No. 19,300 started regulation process of environmental standards, as well as the creation of institutions providing the state of management tools in this area (Rojas 2011).

However, Hermosilla (2004) estimates that while keeping current protection system and guarantees of property rights in Chile over the common well, effective protection to natural systems including wetland ecosystems will not be possible.

Prior this research, there was no compilation and analysis of rules applied to wetland systems which allows to determine real legal protection in taking care of conservation, but there are legal standards which should be assessed under this context, like those regulations enacted which damage preservation and rational use of inland wetlands. The rational use concept is defined by the Ramsar Convention as the maintenance of ecological features, achieved through the implementation of ecosystem-based approach, within sustainable development context.

Under the Chilean legal system, environmental heritage conservation is the rational use and exploitation or repair if any, of environment components, to assure sustainability and regeneration capacity (Act No. 19,300; Article 2b); however, it does not point out which are those components.

Some environmental components, those considered to be relevant issues for this study among them, are noted by Fernández (2004): a) land or sea waters, surface water or groundwater, streams or standing waters; b) land, soil and subsoil, including beds, bottom and subsoil of ground waters; c) flora and wildlife, land or water; d) microflora and fauna of land, soil and subsoil, streams or water bodies and beds, bottoms and subsoil of these streams or water bodies; e) genetic diversity and patterns and factors regulating flow; f) natural scenic beauty and rural or urban landscape; g) essential ecological processes. These basic components of the environment can be damaged when misused which results in extinction or serious damage, prevents regeneration, and causes environmental damage determined in law as 'any loss, decrease, impairment, or significant impairment associated to environment or to one or more of its components' (Act No. 19,300: Art. 2e).

Some of the elements or factors which could damage or degrade the environment are (to Fernández 2004): a) any kind of pollution; b) erosion, salinization, alkalization, infestation, flooding, sedimentation, and desertification of soil and land; c) logging or unreasonable and uncontrolled destruction of trees and shrubs as well as extractive forest use and other vegetation destruction; d) monocultures, overgrazing, and, as a whole, any cultural practice with harmful effects on the environment; e) sedimentation of water streams and lakes; f) harmful alterations of natural water flows; g) adverse changes and misuse of water beds; h) wild flora and fauna over-exploitation; i) elimination, destruction, or degradation of endangered species from flora and fauna habitat; j) wetland eutrophication origins; k) introduction or distribution of exotic plants or animals

coming from a national biogeographical province different to natural; l) introduction or spread of animal diseases or plant pests; m) use of non-biodegradable products or substances; n) the accumulation of waste or inappropriate waste disposal; o) visual landscape destruction or alteration, and, as a whole, any act or omission affecting negatively the basic composition, behavior, and natural potential of environment; threatening land genetic viability or affecting life, health, integrity, or development of man, plants, or animals. These environmental components and environmental degradation factors were considered in the analysis of rules to determine protection concept granted by the Chilean law to the rational use of wetlands. Thus, the aim of this work is to develop a multicriteria methodology to quantify the level of legal protection that different types of inland wetlands have in Chile.

Methods

Compilation and analysis of current standards

Compilation and analysis of current legislation related to wetlands and water resources, including legal standards with description and characterization, was carried out, consulting different sources of reference (e.g., CONAMA 1996a, 1996b, 1997a, 1997b, 2009, Castillo 1994, Gallardo 1985 Hermosilla 2004, Ortiz 1986, 1990, Valenzuela 1994,

Fernández 2004, Bravo 2010). Also, the website of the Library of Congress of Chile was reviewed (www.leychile.cl), which has a compendium of environmental legal standards and acts classified by topics. The review covered Chilean regulations until April 2012.

The identification of the corresponding legal standards was based on the interest of this study (e.g., fresh water fauna, water resources, wetlands, watersheds), selecting standards aimed at protecting and preserving aspects and components involved in direct or indirect conservation of inland wetlands. Legal standards in force which restrict conservation and protection of inland wetlands, as well as issues related to functionality and biodiversity, were also identified. Selected rules were hierarchically ordered according to Gallardo (1985).

Multicriteria method for legal protection assessment

Wetland legal protection will tend to protect and/or conserve, either entirely, in components or considering the influence areas. This protection was estimated with a multicriteria methodology developed according to the following procedure (Figure 1): (a) compilation and analysis of existing legislation related to inland wetland issues (aspects related to biodiversity conservation and rational use included); also, current regulations which restrict conservation and rational use of inland wetlands

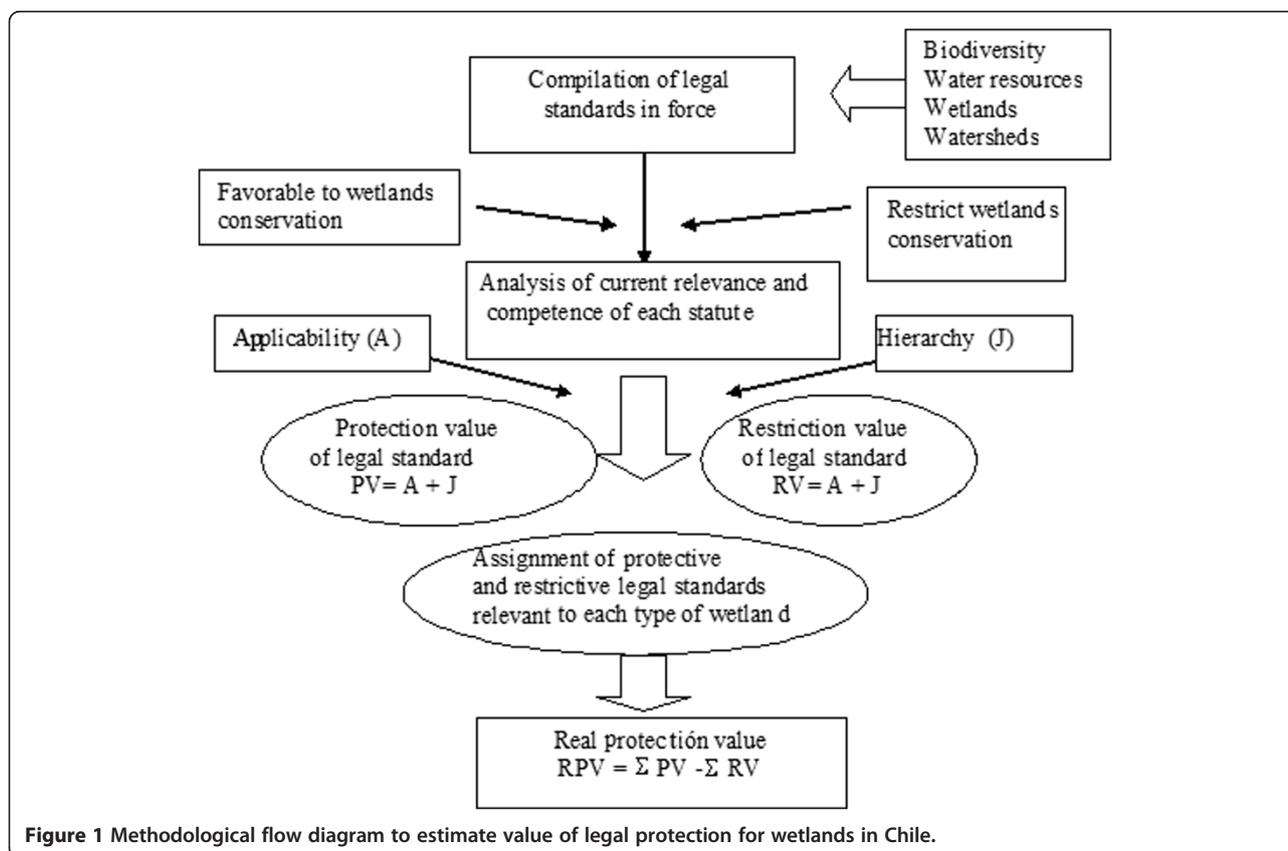


Figure 1 Methodological flow diagram to estimate value of legal protection for wetlands in Chile.

were identified; (b) estimation of protection value (PV) provided by each legal regulation that considers applicability and standard hierarchy; (c) estimation of restriction value (RV) provided by each legal regulation instrument that also considers applicability and legal standard hierarchy; and (d) finally, estimation of real protection value (RPV) by summing protection values (PVs) of each legal standard applied to wetland of interest and restriction values (RVs) applied to the same type of wetland.

Protection value (PV) calculation

Protection value considers applicability and legal standard hierarchy (Figure 1). Applicability (A) is given as expressly enacted for wetland conservation purposes (value 3); or if secondarily, it could be considered as it refers to conservation of some environmental components emphasizing the aquatic system as a natural system (value 2), or if it is only tangential or generically involved with conservation of any component without reference to the natural system (value 1). Legal standards applicability was assessed, considering the reference which protects or preserves. It was classified in three levels: a) wetland system, including reference to 'wetlands' 'aquatic environment', 'aquatic ecosystems', or 'biodiversity' concepts (in ecosystem level); b) components, e.g., water, flora, and plants, with reference to aquatic system (e.g., river or lake); and c) component, e.g., water, wildlife, flora, or vegetation, without reference to aquatic system. These three levels were assigned with values 3, 2, and 1 respectively, getting applicability of each of the legal regulations. Hierarchy (H) was assessed by assigning the maximum value (3) to legal regulations, an average hierarchy (value 2) to decrees with force of law and law decrees, and lower hierarchy (value 1) to standard rules (e.g., regulations, simple decrees, instructions, supreme decrees, resolutions). For details of this hierarchy, see Additional file 1.

Legal protection estimated value (PV) was calculated using the following formula: $PV = A + J$, where PV = legal protection value of each legal rule, A = applicability of standard to each wetland type, and J = hierarchy that the standard has in the law of Chilean legal system. Thus, the protection value (PV) of each legal instrument is deployed between 2 ($PV = 1 + 1$) (minimum protection) and 6 ($PV = 3 + 3$) (maximum protection). The sum of the variables considers that the weight of each is the same.

Restriction value (RV) calculation

It is estimated by analyzing protection restrictions of legal standards and the rational use of diverse wetlands. Applicability and legal hierarchy standards (Figure 1) were also considered. Applicability (A) was determined, considering what and how does it affect wetlands. The implementation effects are the complete wetland system

destruction or any structural component (value 3); collateral effect (value 2) and whether it may only eventually affect (value 1). Hierarchy (H) was valued in same way as the protection value. Restriction value (RV) was calculated as: $RV = A + J$, where RV = restriction value of each legal rule, A = statute applicability, and J = standard hierarchy. Thus, restriction value (RV) to each legal regulation is deployed between 2 ($RV = 1 + 1$) (minimum constraint) and 6 ($RV = 3 + 3$) (maximum constraint). The sum of variables considers the weight of each one to be the same. Integration of parameters included and their subsequent validation was done by a team of 11 experts using the method of Delphi (Linston and Turoff 1975). The group of experts included professionals from different disciplines, with over five years of professional experience, who in spite of not having legal formation, they were linked to these subjects. Criteria considered specialists in aquatic resources (4), relation with public institutions (3), and environmental management experience (5) (see shaping panel at Additional file 1). Work methodologies were workshops, documents, and questionnaire previously associated, which were duly submitted to experts to review and compile observations by using templates. Observations from experts were systematized and incorporated to a document which was forwarded for assent repeating procedure described to obtain consensus. The algorithm was applied to different types of inland wetlands of Chile.

Wetlands studied

Six types of wetlands were selected based on representativeness and wetland they represented. Representation considered frequency, defined as abundance, in a survey of 1,215 inland wetlands (CEA/FIP 2010), with Scott and Carbonell records (1986); Schlatter et al. (2001); and Lopez-Lanus and White (2005), which was refined and grouped according to the type by Dugan (1992) and considerations by Ramsar (2000) and Ramirez et al. (2002). Based on the above, selected wetlands correspond to fluvial systems, lakes, and palustrine areas, which are: (a) rivers, (b) lagoons, (c) brackish Andean lakes, (d) high-altitude Andean peatlands called 'vegas' and 'bofedales', (e) freshwater swamp forests, and (f) permanent freshwater marshes and swamps also called locally as 'bañados' and 'ciénagas'.

Results

Legal standards for wetland protection

Standards were selected either since they address wetland as entirety natural system or they refer to some constituting component, such as water (in quality), aquatic life, wildlife, and others, as well as the environmental and aesthetic roles. Same way, those referred to any basin component with impact on aspects above

mentioned (conservation of watershed vegetation, woodland springs, and riparian zones) were also included. Those standards which currently or potentially damage wetlands or any of their components were also included. Rules were considered from current or potential application point of view. Forty-seven legal rules directly or indirectly related to the protection of wetlands were identified (for each rule purpose, see Additional file 1).

Protection value (PV) of legal standards

Each legal standard protection value is shown in Table 1, which presents 47 legal rules with each potential protection value, according to applicability and hierarchy. It can be observed that they mostly (30 standards) have protection values 2 or 3, it means low; and 11 standards have intermediate protection value (value 4) while only six standards have higher protection values (values 5 and 6). The total protection value given by adding all protection standards is 144.

Table 2 presents legal protection value provided by legal standards to different types of inland wetlands in Chile. Zero values indicate that standard does not apply. From 47 standards identified, 46 of them apply to rivers, providing total protection value of 141; 27 apply to brackish Andean lakes, providing total protection value of 80; 44 apply to lagoons, providing total protection of 134; 28 apply to peatlands ('vegas' and 'bofedales') with total protection of 83; 32 apply to swamp forests, providing total protection of 98; and 34 apply to marshes ('bañados' and 'ciénagas'), giving full protection of 102. As shown in Table 2, greater legal protection is provided in descending order: to rivers, lagoons, marshes, swamp forests, and finally, peatlands and brackish Andean lakes have the lowest legal protection values.

Restriction value (RV) of legal standards

Eight legal restriction standards considered affecting conservation, and rational use of wetlands (Table 3) was identified. Some of these standards are also included in the protection regulations since their articles incorporate both protection and restriction issues for wetland conservation. Legal restriction applicability was assessed considering what and how it affects the wetland system. In this case, unlike the rules of protection, three applicability levels were not identified, since every effect caused by standards are supposed to affect the entire system or biological diversity, which was also considered at ecosystem level, so all were assigned with value 3. Table 3 also shows restriction value to conservation or sustainable use that provides laws to wetlands, and Table 4 shows their application to different wetland types considered in this study. Zero values indicate that standard does not apply.

Restriction to sustainable use of wetlands established by legal standards to different types of inland wetlands reveals that the eight identified standards provide a total restriction value of 42. Wetlands mostly affected are rivers and swamp forests, both with five standards, and restriction values of 28 and 25, respectively, followed by lagoons with three rules and restriction value of 18 and marshes with two rules and a restriction value of 12. Least affected are brackish Andean lakes and peatlands to which a single standard applies, giving restriction value 6.

Real protection value (RPV)

Real protection value (RPV) was estimated once the number of legal rules applied to each type of wetland is established (Figure 1). This value is obtained by summing protection values (PVs), given by all legal standards applied to each type of wetland; and subtracting restriction values (RV), given by all legal standards that apply to the same wetland, as follows: $RPV = \Sigma PV - \Sigma RV$. Distribution of values is grouped into three ranges, giving following nominal values: value 1 to less protected wetlands, value 2 to intermediate protected ones, and value 3 to the best legally protected wetlands. The real protection value (RPV) given by the set of laws applied to different types of wetlands in the study is presented in Table 5. This (RPV) is deployed between 73 and 116. These values were grouped into ranges to where numeric values between 1 and 3 (Table 6) were assigned, being 3 the highest protection value and 1 the lowest protection value.

Real protection provided by laws is higher (value 3) in rivers and lagoons, intermediate (value 2) in marshes, and low (value 1) in brackish Andean lakes, peatlands, and swamp forest. So, the best protected wetlands, according to the number and legal hierarchy affecting direct or indirect protection, are rivers and lagoons. Wetlands with intermediate protection category are marshes and peatlands. Finally, the least protected are brackish Andean lakes, peatlands, and swamp forests.

Discussion

General review of legal standards affecting conservation of wetlands in Chile reveals that before year 2012, there were no laws addressed to wetlands as ecosystem, since they only involved some components (water, flora, wildlife). The first reference to wetland concept in the Chilean law, except acts related to Ramsar Convention adherence enacted in 1981, appears in 1994 with Act No. 19,300, one time mentioned.

Same way, wetland definition arises for the first time in 2011 by act of Supreme Decree N° 82, Soil, water, and Wetlands Regulations Act No. 20,283. This is the

Table 1 Applicability (A) of legal standards affecting Chile's inland wetlands depending on what it protects or preserves, hierarchy (J) and protection value (PV) of each legal rule, as well as its total value protection

Legal standard	What protects/preserves?	A	J	PV
Act N°19,300	Environment	3	3	6
DS N° 531 Washington Convention	Flora and fauna in protected area systems	1	1	2
DS N°141 CITES	Components (flora and fauna)	1	1	2
DL N° 3,485 Ramsar Convention	Systems (wetland)	3	2	5
DS N° 868 Migration of species	Component (fauna)	1	1	2
Decree N° 1,963 Convention in biodiversity	Biological diversity	3	1	4
Act N° 11,402 Barrier works and standardization of bank and channel	Reforestation river basin (headwaters)	2	3	5
Act N° 17,288 National Monuments	Sites (Research interests)	1	3	4
Act N° 18,892 Fishery and Agricultural Standards	Components (fauna, such as hydro-biological resources (fisheries and aquaculture))	2	3	5
Act N° 18,902 Sanitary health superintendency creation; liquid industrial residues control	Component (water quality for human purposes)	1	3	4
Act N° 19,473 Hunting Law	Components (fauna)	1	3	4
DFL N° 208 Provisions for development of fishing activities	Components (water quality, fish, and seafood)	1	2	3
DFL N° 701 About forest development	Components (soil for quality purposes/water quantity for irrigation and drinking)	1	2	3
Act N° 20,283 Native Forest Recovery and Forestry Development rule	Components (native forest associated to springs, natural bodies, and water courses)	3	3	6
Act N° 20,256 Recreational fishing standards	Ecosystem	3	3	6
Act N° 20,411 Prevents constitution of water rights	Components (aquifer)	1	3	4
DFL N° 725 Sanitary Health Legal Standards Art. 73	Components (quality/water quantity and human health)	1	2	3
DFL N° 1,122 Water Legal Standards	Components (water supply quantity for human use)	2	2	4
DS N° 1 Regulations for water pollution control	Components (water supply quantity for human use)	1	1	2
DS N° 5 Hunting law approval	Components (fauna)	1	1	2
DS N° 29 Approval of classification standards according to wild species conservation conditions	Components (wild species)	1	1	2
DS N° 30 Law 19,300	Systems (wetland)	3	1	4
DS N° 46 Groundwater emission standards	Components (water supply quantity for human use)	1	1	2
DS N° 33 Classification process of species according to conservation condition	Components (wild species)	1	1	2
DS N° 41 Classification process of species according to conservation condition	Components (wild species)	1	1	2
DS N° 42 Classification process of species according to conservation condition	Components (wild species)	1	1	2
DS N° 51 Classification process of species according to conservation condition	Components (ichthyofauna species)	1	1	2
DS N° 82 Soil, water, and wetlands legal standards Act N° 20,283	Systems (bodies and natural waterflows)	3	1	4
DS N° 90 Standards for liquid residues discharge into surface freshwater	Components (water quality in four types of use)	1	1	2
DS N° 95 Environmental Quality Standards Law	Components (water quality for human and environmental health)	2	1	3
DS N° 93 (2009) Native Forest Recovery Law	Components (native forest with soil, water, and wetland protection areas)	3	1	4
DS N° 193 Law Decree 701 General rules	Components (soil, courses and water bodies, flora and fauna)	1	1	2
DS N° 210 Reforestation and recreational fishing standards	Components (ichthyofauna)	1	1	2
DS N° 236 Standards for disposals not discharged to sewage network	Components (water quality for human consumption)	1	1	2
DS N° 238 Park and marine reserves standards (including inland waters)	Systems (wetland)	3	1	4
DS N° 320 Aquaculture environmental standards	Systems (river and lake)	2	1	3

Table 1 Applicability (A) of legal standards affecting Chile's inland wetlands depending on what it protects or preserves, hierarchy (J) and protection value (PV) of each legal rule, as well as its total value protection (Continued)

DS N° 430 Reviewed document for fisheries and aquaculture Law	Systems (river and lake)	2	1	3
DS N° 594 Health and work place environmental condition standards	Components (groundwaters and surface waters)	1	1	2
DS N° 351 Industrial liquid residues discharge depuration and neutralization standards	Components (groundwaters and surface waters)	1	1	2
DS N° 609 Standards for industrial liquid residues to sewerage	Components (surface water quality)	1	1	2
DS N° 4,363 Forest law approval	Components (native plants associated to wellsprings)	2	1	3
DS N° 2,374 Standards for forest exploitation in forest watersheds and dams	Components (forests in watersheds)	1	1	2
Decrete N° 878 Prohibition to extractive native fish in inland waters	Components (ichthyofauna)	1	1	2
NCh N° 1,333/87 Chilean standard for water quality	Components (water quality for aquatic life)	2	1	3
Secondary standards for environmental quality	Components (water quality for aquatic life)	3	1	4
Resolution N° 425 Groundwater exploration and exploitation standards	Components (water quality for aquatic life)	2	1	3
Resolution N° 197 Loa River reduction to new exploitation feeding	Components (water)	2	1	3
Total protection value				144

DS Supreme Decree, DL Law Decree, DFL Decree with Force of Law, NCh Chilean Standard, CITES Convention on International Trade in Endangered Species of Wild Fauna and Flora.

evidence of the lack of consideration and the late inclusion of these ecosystems in the country regulations.

There is a different legal protection to different types of inland wetlands since current legislation in Chile does not provide equal protection to the different types of wetlands. Lagoons and rivers have the highest legal protection values due to the large number of regulations applied favorably to these systems and fewer standards that affect them adversely. For marshes, the intermediate value of legal protection comes from that; in spite, there are a number of regulations favoring conservation, and there are a few restrictions affecting them.

Andean systems (brackish lakes and peatlands) present different condition; since in spite a few restriction standards affecting them, they are poorly protected by current legislation. Swamp forest is the most dramatic case; which in spite of important existing regulatory standards that should protect them, they are the most affected ones by the restriction rules. The greatest impacts are Act No. 18,450 which promotes irrigation and drainage and Decree Law No. 701 about forest development. These regulations subsidize up to 75% of activities which enable the poorly drained lands to become agricultural territory, which means the main threat to swamp forests of coastal watersheds in La Araucanía region (Urrutia 2005, García 2005) and its evolution towards greater fragmentation in recent years (Peña-Cortés et al. 2011).

Legal standards above mentioned are clear perverse incentives and disincentives to the rational use of wetlands in Chile.

One aspect considered relevant in the Ramsar Convention was to assess effectiveness of legislative and institutional measures related to promote the conservation

and the rational use of wetlands, are sectoral legal and institutional measures affecting wetlands such as financial and tax incentives to convert them. Nelson (1986) noted that wetland policies in the US and UK had administrative divisions with antagonistic competences. So, while the US Department of Agriculture provided incentives to drainage, the Interior Department was promoting conservation of wetlands, same way that the Ministry of Agriculture, Forestry, and Fisheries and the Nature Preservation Council faced each other in the UK. This problem was addressed in the US by removing some incentives for wetland drainage, which also included other conservation and education measures (Dahl 2000), reducing by 80% the wetland loss tendency between 1986 and 1997 compared to previous decade. Apparently, some Latin American countries have also advanced on this subject. For example in Ecuador, the legislation review by Echeverría (2008) about wetland management does not identify measures that indirectly support the loss or degradation of wetlands through negative incentives.

Review of some national reports presented by countries as contracting party in the last conference of the Ramsar Convention, held in Bucharest, Romania in 2012^a (COP11), allowed to know measures that countries reported as implemented regarding incentives which promote the conservation and the rational use of wetlands, as well as those intended to remove perverse incentives which discourage them.

USA is the American country with the highest amount of initiatives on this subject. Report to COP11^b indicates several provisions that discourage conversion of wetlands to cropland. The federal Swampbuster policy, provision of Food Security Law dated 1985, has eliminated the policy incentives and other mechanisms which have technically

Table 2 Protection value and number of legal standards to different types of inland wetlands in Chile

Legal standards/protection value	VP potencial wetlands	Rivers	Brackish Andean lakes	Lagoons	High-altitude Andean peatlands	Freshwater swamp forests	Permanent freshwater marshes and swamps
Act N° 19,300	6	6	6	6	6	6	6
DS N° 531 Washington Convention	2	2	2	2	2	2	2
DS N° 141 CITES	2	2	2	2	2	2	2
DL N° 3,485 Ramsar Convention	5	5	5	5	5	5	5
DS N° 868 Migratory species (Bonn Convention)	2	2	2	2	2	0	2
Decree N° 1,963 Convention on Biodiversity	4	4	4	4	4	4	4
Act N° 11,402 Barriers and river banks and streams	5	5	0	0	0	0	0
Act N° 17,288 National Monuments	4	4	4	4	4	4	4
Act N° 18,892 Aquaculture and Fishing Law	5	5	0	5	0	0	0
Act N° 18,902 Sanitary health superintendency creation; industrial liquid residues control	4	4	4	4	4	4	4
Act N° 19,473 Hunting Law	4	4	4	4	4	4	4
DFL N° 208 Provisions to fishing development	3	3	0	3	0	0	0
DFL N° 701 About forest development	3	3	0	3	0	3	3
Act N° 20,283 Native Forest and Forest Development Recovering Law	6	6	0	6	0	6	6
Act N° 20,256 Recreative fishing standards	6	6	0	6	0	0	0
Act N° 20,411 Prevent constitution water rights (Arica/Parinacota a O'Higgins)	4	4	4	4	4	4	4
DFL N° 725 Sanitary Code Art. 73	3	3	0	3	0	0	0
DFL N° 1,122 Water Code	4	4	4	4	4	4	4
DS N° 1 Aquatic pollution control rules	2	2	2	2	0	0	0
DS N° 5 Hunting law standard approval	2	2	2	2	2	2	2
DS N° 29 Approval of classification of species standards based on conservation conditions	2	2	2	2	2	2	2
DS N° 30 Act 19,300 Standards	4	4	4	4	4	4	4
DS N° 46 Groundwater discharge standards	2	2	2	2	2	2	2
DS N° 33 Classification process of species according to conservation condition	2	2	0	0	0	0	0
DS N° 41 Classification process of species according to conservation condition	2	2	0	2	2	2	2
DS N° 42 Classification process of species according to conservation condition	2	2	0	2	0	2	2
DS N° 51 Classification process of species according to conservation condition	2	2	2	2	2	0	2
DS N° 82 Act No. 20,283 Soil, water, and wetland regulations	4	4	4	4	4	4	4
DS N° 90 Standards to liquid residue discharge into surface fresh water	2	2	2	2	0	0	0
DS N° 93 (1995) Primary and secondary environmental quality standards	3	3	3	3	3	3	3
DS N° 93 (2009) Native Forest Recovery and Forestry Development rules	4	4	0	4	0	4	4
DS N° 193 DL N° 701 General rules	2	2	0	2	0	2	2
DS N° 210 Regulation of reforestation and planting for recreational fishing	2	2	0	2	0	0	0

Table 2 Protection value and number of legal standards to different types of inland wetlands in Chile (Continued)

DS N° 236 Regulation not discharged sewage disposal to sewer networks	2	2	2	2	2	2	2
DS N° 238 Regulation for parks and marine reserves (including inland waters)	2	2	2	2	2	2	2
DS N° 320 Environmental aquaculture rules	2	2	0	2	0	0	0
DS N° 430 Consolidated, coordinated, and systematized document on fishery law	3	3	0	3	0	0	0
DS N° 594 Rules for health and environmental conditions in work places	2	2	2	2	2	2	2
DS N° 351 Rules for neutralization and depuration of liquid industrial residues	2	2	2	2	2	2	2
DS N° 609 Standard for sewerage industrial liquid residues discharge	2	2	0	2	2	2	2
DS N° 4,363 Approves final text forestry law	3	3	0	3	0	3	3
DS N° 2,374 Regulation to forest exploitation in forest watersheds and dams	2	2	0	2	0	2	2
Decree N° 878 Native fish extraction prohibition in inland waters	2	2	2	2	2	2	2
NCh N° 1,333/87 Chilean water quality standards	3	3	0	3	3	3	3
Secondary environmental quality standards	4	4	0	4	0	0	0
Resolution N° 425 Establish groundwater exploration and exploitation standards	3	3	3	3	3	3	3
Resolution N° 197 Declares Loa River reduction and feeders for new farms	3	0	3	0	3	0	0
<i>Total standards</i>	47	46	27	44	28	32	34
<i>Total legal protection value</i>	144	141	80	134	83	98	102

DS Supreme Decree, DL Law Decree, DFL Decree with Force of Law, NCh Chilean Standard, CITES Convention on International Trade in Endangered Species of Wild Fauna and Flora.

and economically allowed the destruction of wetlands, acting and separating those who make it from other agricultural policy benefits. Federal efforts to restore wetlands have increased from 1987, with legal standards of critical preservation and restoration with two programs which stopped and even reversed loss as Wetland Conservation (WC) provisions of Agricultural Law in 1985 and the Wetlands Reserve Program (WRP) of Agricultural Law in 1990 (Coperland 2010).

In national report, Canada^c indicates that measures to eliminate perverse incentives in some provinces consist of wetlands filling prevention rules which enable marginal agricultural soils and balance benefits provided by wetland drain restoration projects with cleaning, storage, and discharge of water functions fulfilled by wetlands. The UK^d works reforms to agricultural policy to have a positive impact on marsh wetlands used for grazing by agri-environment patterns, management agreements, and other keeping administration systems.

The China^e report indicates that diverse level governments and their departments have a strict control over every kind of activity that damages wetlands by enacting 11 provincial (autonomous regions) wetland conservation regulations, which prohibit several activities and

perverse incentives. People convocation has taken the surveillance and control in the implementation of those laws at various levels. Australia^f has already indicated in the COP10 national report 2008 about the National Water Initiative, Water for Future, and Water Law 2007 developed to stop perverse incentives in the water management. Same way, New Zealand^g declared in national report that they have eliminated subsidies to land development.

In South American countries^h, Bolivia, Colombia, Peru, and Chile state, they did not take measures to promote incentives to encourage conservation and rational use of wetlands. Countries showing incentives are Costa Rica by promoting private refuges, territory tax payment exemption, and payment for environmental services; Ecuador by applying tax exemption to rural land containing wetlands and monetary incentives to private owners and community which preserve Andean wetlands; and Argentina and Venezuela by providing financial incentives for conservation and planning in land management.

Regarding measures to remove perverse incentives, Bolivia, Brazil, Costa Rica, and Peru declare that they have not taken them. Ecuador and Venezuela note that they count with these measures. Uruguay, Colombia, and Chile indicate that these measures are being planned

Table 3 Legal restriction standards which affects the rational use of inland wetlands in Chile, applicability (A) in terms of how and what affect to wetlands, hierarchy (J) and restriction value (RV) of each legal standard and total restriction value

Legal standard	Standard objective	How affect	What affect	A	J	RV
Act N° 18,248 Mining Law	Property acquisition of a mining concession enables to request the mining right's constitution and water right ownership. Written permission by governor is required for mining operations at lower distance than 50 yards in flood barriers, waterways, and lakes for public use.	Intervention to wetland systems, which may completely affect structure	Every type of wetlands (rivers) and lakes	3	3	6
Act N° 20,256 Standards for recreational fishing	Development of recreational fishing activity, and the economic and associated tourist activities.	Introduction of alien species affects biodiversity and system as a whole	Rivers and lakes	3	3	6
Act N° 11,402 Barriers and standardization of banks and river flows	Barrier works as well as standardization of banks and beds of rivers, lagoons and tidelands carried out with legal involvement can only be executed and planned by sanitary authorities of Public Works Ministry. Extraction of gravel and sand from beds of rivers and streams should be carried out with municipality permits, which may charge duties or subsidies.	Regularization of channels and gravel mining extraction affecting the aquatic system structure	Rivers, lakes, and streams	3	3	6
Act N° 18,450 Rules for private irrigation and drainage development	Cost analysis benefits, construction, and rehabilitation of irrigation as well as drainage works to enable agricultural soils with poor drainage.	Drainage of wetlands results in complete destruction system	Swamp forests, marshes, and swamps	3	3	6
DFL N° 235	Incentive system to degraded soil recovering, proposing regulation of channels as management practices.	Regulation of channels affects the aquatic system structure	Water flows (rivers)	3	2	5
DFL N° 701	Afforestation development to soil recovery, making economic exploitation available.	Forest development results in swamp forest destruction (replacement by exotic species)	Swamp forests	3	2	5
Decree N° 193 General standards DFL N° 701	Assess lands suitable to forestry for quality forest development benefits, those corresponding to Ñadis soils.	Development of forest Ñadis soils results in destruction, affecting swamp forest (replacement by exotic species)	Swamp forests	3	1	4
Decree N° 98 Act N° 18,450	Defined as drainage of structures, elements, and tasks aimed to evacuate soil waters excess on surface or subsurface with restriction factor to culture development.	Wetland draining results in complete destruction of system	Swamp forests	3	1	4
<i>TOTAL RESTRICTION VALUE</i>						42

DFL Decree with Force of Law.

Table 4 Restriction value and number of legal standards to different inland wetlands in Chile

Legal standards	Wetland potential	Rivers	Brackish Andean lakes	Lagoons	High-altitude Andean peatlands	Freshwater swamp forests	Permanent freshwater marshes and swamps
Act N° 18,248 Mining Code	6	6	6	6	6	6	6
Act N° 20,256 Recreational fishing standards	6	6	0	6	0	0	0
Act N°11,402 Barriers and works for bank and channel standardization	6	6	0	6	0	0	0
Act N° 18,450 Standards for private investment in watering and drainage systems	6	0	0	0	0	6	6
DFL N° 235	5	5	0	0	0	0	0
DFL N° 701 Forest development	5	0	0	0	0	5	0
Decree N° 193 General rulesDL N° 701 About forest development	4	0	0	0	0	4	0
Decree N° 98 Act N° 18,450 Development of private investment in watering and drainage systems	4	0	0	0	0	4	0
<i>Total number of standards</i>	8	5	1	3	1	5	2
<i>Total value of legal restrictions</i>	42	28	6	18	6	25	12

DL Decree Law, DFL Decree with Force of Law.

Table 5 Nominal and numerical real protection granted by legal rules to different types of inland wetlands in Chile

Type of wetland	Total protection value	Protection value	Total restriction standards	Restriction value	Real protection value	Numeric protection value
Wetlands	47	144	8	42	102	3
Rivers	46	141	5	28	113	3
Brackish Andean lakes	27	80	1	6	74	1
Lagoons	44	134	3	18	116	3
High-altitude Andean peatlands	28	83	1	6	77	1
Swamp forests	32	98	5	25	73	1
Permanent freshwater marshes and swamps	34	102	2	12	90	2

and involve payments for environmental services and penalties for damage to the ecosystem. They consider compensatory wetland restoration. Analysis of measures reveals that these have to do with the creation of new incentives rather than eliminating those perverse incentives which favor, fill, and convert wetlands to agricultural soils or urban with bonus or by other means (see national reports of countries mentioned¹).

Table 6 Nominal and numerical protection value granted by law to different types of wetlands

Nominal value	Rate	Real protection number value	Type of wetland
Low protection	≤87	1	Brackish Andean lakes High-altitude Andean peatlands Swamp forests
Intermediate protection	88–102	2	Permanent freshwater marshes and swamps
High protection	≥103	3	Rivers and lagoons

Based on the formerly mentioned, three actions must be implemented in Chile to improve conservation and rational use of wetlands: 1) Repeal rules which promote destruction of wetlands through incentives. 2) Discuss a special law for proper management and conservation of wetlands, including tax incentives and the corresponding regulation to operate. 3) Prioritize conservation actions for wetland types with low protection value such as swamp forests, peatlands, and brackish Andean lakes.

Conclusions

In Chile practically, there are no specific legal regulations on wetlands; there are only some decrees which applied indirectly to these ecosystems, addressed only to some components (water quality and quantity and wild species), without ecosystem approach. Current legal regulations in Chile do not allow a proper protection of wetlands and rational use as mandated by the committed country as a member of the Ramsar Convention. In Chile, to improve wetland conservation conditions, every incentive promoting

wetland destruction must be eliminated; promulgate specific regulations for proper management and conservation of wetlands including tax incentives and corresponding operating regulations; and favor conservation actions to less protected wetland, such as swamp forests, peatlands, and brackish Andean lakes.

Endnotes

^ahttp://www.ramsar.org/library/field_documents%253Afield_language/english-1/field_tag_body_event/cop11-bucharest-2012-415

^b<http://www.ramsar.org/sites/default/files/documents/pdf/cop11/nr/cop11-nr-usa.pdf>

^c<http://www.ramsar.org/sites/default/files/documents/pdf/cop11/nr/cop11-nr-canada-e.pdf>

^d<http://www.ramsar.org/sites/default/files/documents/pdf/cop11/nr/cop11-nr-uk.pdf>

^e<http://www.ramsar.org/sites/default/files/documents/pdf/cop11/nr/cop11-nr-china.pdf>

^f<http://www.ramsar.org/sites/default/files/documents/pdf/cop11/nr/cop11-nr-australia.pdf>

^g<http://www.ramsar.org/sites/default/files/documents/pdf/cop11/nr/cop11-nr-newzealand.pdf>

^hhttp://www.ramsar.org/library/field_documents%253Afield_language/espa%C3%B1ol-4/field_tag_body_event/cop11-bucharest-2012-415/field_tag_countries/neotropics-15?search_api_views_fulltext=&items_per_page=20

Additional file

Additional file 1: Complementary background.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

PM developed the methodology, conducted legal review and drafted the manuscript. AM participated in the design of the methodology, in writing and revision of the manuscript. Both authors read and approved the final manuscript.

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Author details

¹Facultad de Ciencias, Universidad Austral de Chile, Casilla 567, Valdivia, Chile.

²Programa de Humedales, Centro de Estudios Agrarios y Ambientales, Casilla 164, Valdivia, Chile. ³Núcleo de Estudios Ambientales NEA, Escuela de Ciencias Ambientales, Facultad de Recursos Naturales, Universidad Católica de Temuco, Casilla 15-D, Temuco, Chile.

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