CONCEPTUAL FRAMEWORK ON WETLANDS IN BRAZIL: CHALLENGES AND EXPERT OPINIONS

APARATO CONCEITUAL SOBRE ÁREAS ÚMIDAS (WETLANDS) NO BRASIL: DESAFIOS E OPINIÕES DE ESPECIALISTAS

APARATO CONCEPTUAL SOBRE HUMEDALES (WETLANDS) EN BRASIL: DESAFÍOS Y OPINIONES DE EXPERTOS

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Abstract

Wetlands are complex ecosystems integrated by hydrological, climatic, geomorphological, pedological, and biochemical variables that play relevant environmental functions. The complexity found in wetland studies explains the difficulty of establishing consensus in its definition, both in scientific and legal terms. Research related to the conceptual basis is necessary to resolve problems in the definition and application of legislation regarding their protection. The geographer's vision, horizontal and multidisciplinary, is potentially useful for wetland research. In this context, this research aimed to develop a conceptual reference proposal, seeking to facilitate its application. Theoretical-reflective research was carried out on the definitions present in the scientific and legal literature, national and international, complemented and articulated with essential opinions of specialists. The proposal resulted in a conceptual synthesis that includes characteristics related to the formation, identification, and delimitation of wetlands, seeking greater agreement by various professionals and their application in the field.
Keywords: Wetlands, ecosystems, hydrogeomorphology.

Resumo

As Áreas úmidas (AUs) são ecossistemas complexos, integradas por variáveis hidrológicas, climáticas, geomorfológicas, pedológicas e bioquímicas, que desempenham funções ambientais relevantes. A complexidade encontrada nos estudos das AUs explica a dificuldade de estabelecer consensos na sua definição, tanto no meio científico quanto jurídico. No Brasil, ainda são poucos os estudos que buscam investigar as AUs sob o ponto de vista conceitual, o que causa problemas na concepção e aplicação da legislação referente à sua proteção. A visão do geógrafo, horizontalizada e multidisciplinar, é potencialmente útil para as pesquisas sobre AUs. Neste contexto, esta pesquisa teve por objetivo desenvolver uma proposta conceitual de referência, visando melhorar a compreensão do conceito e facilitar a sua aplicação. No desenvolvimento dessa proposta, foi realizada uma investigação e análise teórico-reflexiva das definições presentes na literatura científica e nos dispositivos legais, nacionais e internacionais, complementada e articulada com opiniões imprescindíveis de especialistas em AUs. A proposta resultou em uma síntese conceitual que inclui características relativas à formação, identificação e delimitação das AUs, para visar a maiores concordâncias por pesquisadores, analistas, técnicos e gestores de diferentes áreas do conhecimento e sua aplicação na área ambiental.
Palavras-chave: Áreas úmidas, ecossistemas, hidrogeomorfologia.

Resumen

Los humedales son ecosistemas complejos, integrados por variables hidrológicas, climáticas, geomorfológicas, pedológicas y bioquímicas, que desempeñan funciones ambientales relevantes. La complejidad encontrada en los estudios de los humedales explica la dificultad de establecer consensos en su definición, tanto en el medio científico cuanto jurídico. En Brasil, todavía son pocos los estudios que buscan investigar los humedales desde el punto de vista conceptual, lo que causa problemas en la concepción y aplicación de la legislación para su protección. La visión del geógrafo, horizontalizada y multidisciplinar, es potencialmente útil para las investigaciones sobre los humedales. Dentro de ese contexto, esta investigación tuvo por objetivo desarrollar una propuesta conceptual de referencia, buscando mejorar la comprensión del concepto y facilitar su aplicación. Para desarrollar esta propuesta, se desenvolvió una investigación y análisis teórico-reflexivo de las definiciones presentes en la literatura científica y de los dispositivos legales, nacionales e internacionales, complementada y articulada con opiniones imprescindibles de especialistas. La propuesta tuvo como resultado una síntesis conceptual que incluye características relativas a la formación, identificación y delimitación de los humedales, visando mayores concordancias de investigadores, analistas, técnicos y gestores de las diferentes áreas de conocimiento y su aplicación en el área ambiental.
Palabras clave: Humedales, ecosistemas, hidrogeomorfología.

Introduction

Wetlands cover about 11% of tropical surfaces (Mitsch; Gosselink, 2007) and about 20% of the Brazilian territory (Junk et al., 2014; Cunha et al., 2015). One of the most important ecosystems, wetlands support a specific diversity of fauna and flora, regulate groundwater recharge, flood, water quality, biogeochemical cycles, storages carbon, climate control and provide food and water (Barbier; Acreman; Knowler, 1997; Mitsch; Gosselink, 2007; Reddy; Delaune, 2008; Junk et al., 2014).

Until the mid-20th century, there was still no worldwide concern aboutwetlands. National policies encouraged their occupation and drainage, since they were seen as unprofitable and/ or unhealthy areas. It is estimated that about 50% of the world´s wetlandshave been lostdue to artificial drainage for agriculture use and urban development (Mitsch; Gosselink, 2007). The wetlands loss or degradation leads to numerous environmental impacts, such as biodiversity loss, water availability reduction and groundwater contamination. These problems highlight the need to define and investigate the wetlands importance and to establish management policies and conservation of the remaining areas.

The first international treaty that pointed out the wetlands valorization and discussion happened in 1971 at the Ramsar Convention. Initially, the aim was to protect the waterfowl habitats, but in the last decades, it has been extended to protect other aquatic species, the wetlands environmental relevance and, also the social dimension.

Brazil became a Convention member in 1993, ratified by Decree n. 1.905 in 1996 (Brasil, 1996), but little progress has been made to advance studies on Brazilian wetlands. It led to its marginalization in the conceptual and legal protection aspects. Thus, the Forest Code wetlands definition through Law n. 12.651 (Brasil, 2012), besides dissonant of scientific and legal formulations, in national and international levels, does not present protection criteria. On the contrary, the Code weakened the Brazilian Wetlands protection, signaling the urgent demand for scientifically based definition and classification proposals to support their legal and social recognition (Junk et al., 2014; Cunha et al., 2015).

Especially for legal purposes, wetlands are not easily defined because present diverse physical and biological conditions, varied dimensions and may be associated with anthropic influences (Mitsch; Gosselink, 2007). This complexity often results in unclear, restricted, generic or even contradictory definitions. Thus, the terms used in the wetlands descriptions and the definitions themselves are often followed by examples of swamps, mangroves and bogs, among others wetlands types (Cowardin et al., 1979).

Different knowledge areas need to be considered in order to better understand and define wetlands, since its functions are influenced by hydrological, hydrogeological, climatic, geomorphological, pedological, chemical and biological variables, as well for their different interaction forms (Lefor; Kennard, 1977; Tiner, 1999; Reddy; Delaune, 2008). According to Tiner (1999), wetlands definitions depend on the training and field experience of the researcher. For example, hydrologists tend to focus on the water regime and its relation to topography, while pedologists tend to focus on the study of hydromorphic soils or hydric soils presence. The botanists also tend to focus on the certain species or communities occurrence. Therefore, in order to advance the wetlands protection, it is essential a definition that encompasses its different categories, which is sufficiently precise and applicable and, at the same time, considers diverse research area.

In Brazil, there are few contributions to the study of wetlands in the Geography field. The studies are generally limited to a specific wetland in genetic and descriptive terms. However, the multidisciplinary view of geographers, which integrates environmental variables, has potential to contribute to the wetlands studies, according to their various disciplines

focus. In this sense, geographers can analyze the functional and/or landscape units in which the physical and human aspects interact in time and space. As such, Geography can contribute to advances towards definitions of wetlands and to comprehend the processes involved in their spatial distribution, structure and functioning.

In this context, the main objective of this research is to propose a comprehensive and objective definition of wetlands to facilitate its application and to contribute to the Brazilian wetlands research, protection and management.

Methodological procedures

This research began with a broad survey of the main definitions in the scientific and legal literature on the wetlands, nationally and internationally. A total of 30 definitions were selected, as presented in the section "Conceptual and theoretical basis and legal approaches to wetlands". The following questions were proposed: *What defines a wetland? Are wetlands always interfaces between aquatic and terrestrial systems? Is a water body a wetland or can it includes in a wetland? How is formed a wetland and how it remains active? What are the wetlands characteristics? Are these characteristics always present? What is relevant to identify and characterize for protection and management purposes?* These questions, together with a selection of potential wetlands illustrations, presented in the section "Wetlands considerations from the interviewee's perspective", formed a basis for interviews with wetlands research workers.

The interviewees were chosen from the Lattes Platform of the CNPq (National Council for Scientific and Technological Development), according to key words such as wetlands and flooded areas, as well as scientific formation (mainly in biological, ecological, agronomic, forest, geographical and geological sciences) and scientific publications related to wetlands. From more than 700 entries, 34 specialists were selected, of whom 29 had email address available. Of these, 9 accepted to participate, but only 5 remained for the interviews: 4 biologists and 1 geologist. They work in universities of Rio Grande do Sul and Minas Gerais states, as well in the National Institute of Wetlands (INAU) in Mato Grosso state. No geographer participated in the survey, reflecting the low participation of geography in the wetlands study at national level. The interviews, carried

out between November 2015 and January 2016, were conducted following a semi-organized scheme and were analyzed by the "Content Analysis" method in categories (see Gomes, 2017).

The definition of wetlands proposed was an attempt to analyze and integrate the theoretical references with the views of the experts, including characteristics that assume central role in the wetlands origin, configuration, identification and classification to allow its greater understanding.

Conceptual and theoretical basis and legal approaches to wetlands

The U.S. Fish and Wildlife Service (USFWS) presented one of the first wetlands definitions in 1956, in a publication commonly referred to as Circular 39 (Shaw; Fredine, 1956). This definition (No. 1, Table 1) emphasized aquatic habitats and included 20 types of wetlands, serving both wetlands scientists and wetlands managers (National Research Council, 1995; Mitsch; Gosselink, 2007). The definition distinguished wetlands from perennial streams, reservoirs and deep lakes, but not establishing a depth limit between wetlands and aquatic ecosystems. The definition covers emergent vegetation. Although not mandatory, this parameter assists in the distinction of wetlands, since it is generally typical of shallow water bodies and is associated with waterfowl habitats. The definition also distinguishes wetlands from surfaces with temporary waters that have little influence on the development of vegetation adapted to moist soils.

Attentive to the cooperation of waterfowl habitats, the Ramsar Convention used in the wetland definition (No. 2, Table 1) the six meters limitat low tide for coastal areas to protect grazing areas of aquatic birds (Junk et al., 2014). According to Scott and Jones (1995), countries that have acceded to the Ramsar Convention have difficulties in adopting this concept because, besides very broad, coral reefs often extend beyond six meters, complicating wetlands delineation.

In the United States, the formulation of laws and regulations required precise definitions and inventories for the identification and protection of important wetlands (Scott; Jones, 1995; Finlayson; Davidson, 1999). In 1979, the USFWS (Cowardin et al. 1979) presented a wetland definition (No. 6, Table 1) that replaced the one of 1956 and introduced

hydric soils and hydrophytes concepts to facilitate the development of regional lists and inventories for management and protection (National Research Council, 1995; Mitsch; Gosselink, 2007). However, that definition may exclude some wetlands types because there are ones that present rocky substrates without hydrophytes presence, the difficulty of define and precises cientifically the growing season and the fact that many important wetland functions occur during the non-growing season (National Research Council, 1995; Tiner, 1999). In addition, to define as mandatory the presence of vegetation can stimulate its suppression by landowners, as was verified in the USA (Mitsch; Gosselink, 2007).

The definition of Cowardin et al. (1979) also considers wetlands as transition areas between terrestrial and aquatic systems, which lead to understand that a wetland is a transitional system between land and waterbody. Until the end of the 20th century, wetlands were frequently considered as ecotones (Neiff, 2003), probably because many wetlands occur along flood plain sand have a specific composition of earth-water transition systems containing species from both systems (Tiner, 1999). However, Neiff et al. (1994) and Neiff (2003) argue that, depending on their physical context, extent and ecological complexity, floodplains form a unique system, since their structural and functional characteristics are proper and relatively stable over time and in space, as can be understood in its definition (No 14, Table 1). Lyon and Lyon (2011) (No. 21, Table 1) considers wetlands as a mixture of terrestrial and aquatic environments characteristics, which creates a specific habitat for life and its processes.

In 1995, the National Research Council (NRC) revised the scientific basis for identifying and delineating wetlands and formulated a concept of reference (No 15, Table 1). Although unusual, it is still considered the most comprehensive scientific definition, since it combines the basic processes that characterize wetlands and uses hydric soils and / or hydrophytic vegetation as common diagnostic features and not as absolute needs (Mitsch; Gosselink, 2007). In addition, it does not define wetlands as transition areas between terrestrial and aquatic systems because they consider the term controversial (National Research Council, 1995).

In Europe, the French National Museum of Natural History presented two definitions, one of them incorporated in its Water Law (No. 12, Table 1) and the other the most cited in scientific studies (No. 13, Table 1), which facilitate interpretation by including the spatial location

(O. Cizel, 2010). In Spain, the Catalan Water Agency has developed a definition (No. 8, Table 1) that allows the inclusion of deep water bodies. In Andalusia region, the Wetlands Government Plan, drawn up by researchers from different areas, presented a proposal for a reference definition (No.19, Table 1). The Plan recognizes that it is a great challenge to define and delineate wetlands since they are transition systems between aquatic and terrestrial environments and they are heterogeneous and very dynamic in terms of space and time. Thus, in order to arrive at a concept of wetlands, it is necessary first to start from what should be considered in its definition, and then to assume it. The Plan chooses the depth gradient as the important variable in the functioning of aquatic ecosystems, due to the action of gravity and the reach of light for the effects of photosynthesis. So, the Plan distinguishes the ecological characteristics of lakes, ponds and wetlands through a hypothetical model of a wet ecosystem around a deep lake starting from the minimum level of flooding of the lake in contact with the permanently unsaturated terrain. In this sense lakes have depths greater than 8 meters; lagoons depths between 2 and 8 meters; and wetlands depths up to 2 meters below the maximum flood level. However, the Plan emphasizes that, depending on the climatic variations of a region, the same wetland may present, over time, characteristics of moist soils, aquatic ecosystems and terrestrial areas (Junta de Andalucía, 2002).

The Andalusia Plan argues that the water, the depressed landform and the biota explain the differences between wetlands and other aquatic or terrestrial ecosystems. These factors, more than a sum in space and time, generate a complex system of physical and biochemical interactions, where the upper abiotic components influence the lower biotic components, which, on a smaller scale, also influence the higher ones. Thus, wetlands definitions should consider hydrological, geomorphological, pedological and biotic components, provide indicators to identify and delineate wetlands in the field and be operational in order to facilitate the establishment of integrated management and conservation actions (Junta de Andalucía, 2002).

In the southern hemisphere, the Australian Department of the Environment adopted a definition (No. 17, Table 1) that includes underground wetlands, which is not explicit in other definitions. In it surban wetlands management report, an aspect in its wetlands definition (No. 23, Table 1) is the presence of stagnant waters or waters that moves

very slowly, but not all concepts in the literature converge to this. In Brazil, the Forest Code wetlands definition (No. 27, Table 1) excludes permanently water covered wetlands and does not clarify if wetlands are only those flooded by watercourses. The National Institute for Science and Technology in Wetlands (INCT-INAU) expands on the concept (No. 29, Table 1) as opposed to the Code, but may raise questions about the different interpretations involved in the concept of "interface between terrestrial and aquatic systems" and in the term "hydric soil", as it is unusual in Brazil. The definition given by Esteves (1998) (No. 25, Table 1) includes both waterlogged areas and phytophysiognomies as wetlands types.

According to Table 1, wetlands concepts include common characteristics. The most important are the water presence and vegetation and soils specificities, followed by land form contexts. Nonetheless, the concept's formulations and the values given to these characteristics explain some differences between definitions and identification criteria.

N°	Definitions
	Internacional
1	Lowlands covered with shallow and sometimes temporary or intermittent waters. They are referred to by such names as marshes, swamps, bogs, wet meadows, potholes, sloughs, and river-overflow lands. Shallow lakes and ponds, usually with emergent vegetation as a conspicuous feature, are included in the definition, but the permanent waters of streams, reservoirs, and deep lakes are not included. Neither are water areas that are so temporary as to have little or no effect on the development of moist-soil vegetation. (Shaw; Fredine, 1956, p. 3).
2	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 6 m (Ramsar Convention,1971).
3	A wetland is an area dominated by specific herbaceous macrophytes, the production of which takes place predominantly in the aerial environment above the water level while the plants are supplied with amounts of water that would be excessive for most other higher plants bearing aerial shoots (Westlake; Szczepanski, 1988).
4	Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Wetlands generally include swamps, marshes, bogs, and similar areas (United States, 1977).
5	Areas of seasonally, intermittently, or permanently waterlogged soils or inundated land, whether natural or artificial, fresh or saline, e.g., waterlogged soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and their tributaries (Chiffings, 1977).

6	Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year (Cowardin et al. 1979, p.3).
7	Areas that have a predominance of hydric soils and that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions (United States, 1985).
8	Functional ecosystem units that present, over spatio-temporal terms, a positive water anomaly in relation to adjacent areas. The confluence of topographic, geological and hydrological factors makes this water anomaly to affect and to condition the geochemical and biological processes (Cataluña, 1985).
9	Land permanently or temporarily under water or waterlogged. Temporary wetlands must have surface water or water logging of sufficient frequency and/or duration to affect the biota (Paijmans et al., 1985).
10	Land that has the water table at, near, or above the land surface or which is saturated for a long enough period to promote wetland or aquatic processes as indicated by hydrlc soils, hydrophytic vegetation, and various kinds of biological activity which are adapted to the wet environment (Zoltai, 1988).
11	Land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment. (Tarnocai et al.,1988).
12	Wetlands are lands, whether or not harvested, usually permanently or temporarily flooded or gorged with fresh, salt or brackish water; vegetation, when it exists, is dominated by hygrophilous plants for at least part of the year (France,1992).
13	Wetlands are characterized by available fresh, brackish or salty water, permanently or temporary, on the surface or at shallow depth in the soil, often in the transitional position between terrestrial and aquatic environments. They are distinct by shallow water, hydromorphic soils or poorly developed soils, and or a vegetation where hygrophilous plants predominate for at least part of the year. […]. They are located at the edge of springs, streams, rivers, lakes and tides, in bays and estuaries, within deltas, valleys bottoms or depressions in slopes (O. Cizel, 2010, p.12).
14	Systems of sub-regional extent in which the spatial & temporal presence of a variable cover of water causes characteristic biogeochemical fluxes, soils of accentuated hydromorphism, and a biota whose structure and dynamics are well adapted to a wide range of water availability. They can be considered macrosystems whose complexity grows with hydrosedimentological variability and geographic extent (Neiff et al., 1994, p. 2).
15	A wetland is an ecosystem that depends on constant or recurrent, shallow inundation or saturation at or near the surface of the substrate. The minimum essential characteristics of a wetland are recurrent, sustained inundation or saturation at or near the surface and the presence of physical, chemical, and biological features reflective of recurrent, sustained inundation or saturation. Common diagnostic features of wetlands are hydric soils and hydrophytic vegetation. These features wiil be present except where specific physiochemical, biotic, or anthropogenic factors have removed them or prevented their development (National Research Council, 1995, p. 59).
16	A wetland is land that is transitional between terrestrial and aquatic systems, where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil (South African, 1998).

17	Wetlands are areas of land where water covers the soil – all year or just at certain times of the year. They include: swamps, marshes; billabongs, lakes, lagoons; saltmarshes, mudflats; mangroves, coral reefs; bogs, fens, and peatlands. Wetlands may be natural or artificial and the water within a wetland may be static or flowing, fresh, brackish or saline. There are even underground wetlands (Australian Government, [2017?]).
18	A wetland is any area of temporarily or permanently waterlogged or inundated land, natural or artificial, with water that is standing or running, ranging from fresh to saline, and where inundation by water influences the biota and ecological processes at any time (Boulton; Brock, 1999, p. 3).
19	A wetland is an ecosystem or functional unit of a predominantly aquatic character, which is not a river, a lake or a marine environment, presenting a positive water anomaly with respect to a drier environment. The hierarchical confluence of climatic and hydrogeomorphological factors causes recurrent flooding conditions with shallow, permanent, seasonal or irregular waters and/or saturation conditions on or near the surface by the presence of groundwater sufficiently important to affect the biogeophysical-chemical processes. The minimum essential characteristic to identify a wetland is flooding with shallow waters (marsh formation) or recurrent saturation on or near the surface (wet soils), conditioning other fundamental characteristics of support, which are the presence of hydric soils and/or hygrophilous vegetation. Generally, these properties explain the existence of special communities of microorganisms and fauna, as well as different human activities and a landscape with a high degree of visual quality in relation to the environment (Gil, 2002, p. 81).
20	Wetland definitions, then, often include three main components: (1) Wetlands are distinguished by the presence of water, either at the surface or within the root zone. (2) Wetlands often have unique soil conditions that differ from adjacent uplands. (3) Wetlands support biota such as vegetation adapted to the wet conditions (hydrophytes) and, conversely, are characterized by an absence of flooding-intolerant biota (Mitsch; Gosselink, 2007, p. 27).
21	A wetland can be described as a mix of characteristics from terrestrial or upland areas and the characteristics of aquatic or water environments. In essence, a wetland is the edge or interphase between uplands and adjacent water areas. The water may be in the form of rivers, streams, creeks, lakes, ocean areas, or wet spots. As such, wetlands may be found almost anywhere. They will possess characteristics of both upland and aquatic environments and exhibit a mix of soil, plant, and hydrological conditions. This mix of characteristics creates a unique habitat for life and Earth processes, but the mix also makes wetlands hard to identify. This is due to the inherent gradation of these characteristics from uplands to the aquatic environment and the presence of both kinds of conditions in various combinations along that gradient. (Lyon; Lyon, 2011, p. 9).
22	An ecosystem that arises when inundation by water produces soils dominated by anaerobic processes, which in turn, forces the biota, particularly rooted plants, to adapt to flooding (Keddy, 2010, p. 3).
23	Wetlands commonly share four characteristics: (1) Shallow water is present, either at the surface or within the root zone, for at least some of the time; (2) The water moves very slowly or is static (i.e. wetlands are lentic environments), unlike the case with flowing-water (lotic) aquatic systems; (3) Water logging produces wetland soils that are reducing or at the least anaerobic, quite unlike 'normal' terrestrial soils that are oxic; and (4) Vegetation is adapted to water logging and/or flooding, and plants not tolerant of inundation are largely absent. Plants adapted to wet conditions are often called 'hydrophytes', and may be emergent or submerged (Paul, 2013, p. 73).
Brazil	
24	Areas episodically or periodically flooded by the lateral overflow of rivers or lakes and / or by direct precipitation or outcropping of the water table, so that the biota responds to the physical-chemical environment with morphological, anatomical, physiological and ethological adaptations, generating specific structures and characteristics of these communities (Junk et al., 1989).

25	Brazilian wetlands can be defined as zones in which the vegetation is tolerant or adapted to moist soils or to soils that are flooded daily or seasonally. These Brazilian ecosystems can be divided into four groups: 1) wetlands formed by plains flooded with river systems; 2) wetlands associated with ponds and lakes; 3) wetlands with high levels of water saturation and / or water accumulation of streams; 4) artificial wetlands (Esteves, 1998).
26	Wetland is a segment of the landscape formed by hydromorphic soils, defined as those that are naturally saturated by water, permanently or at any given time of the year, regardless of their current drainage and which, due to the process of their formation show, within 50 (fifty) centimeters from the surface, greyish, bluish or greenish colors and / or black colors resulting from the accumulation of organic matter (Paraná, 2008).
27	Swamps and land areas periodically covered by water, originally covered by forests or other vegetation forms adapted to the flood (Brasil, 2012).
28	Swamps and land areas naturally and periodically flooded, originally covered by forests or other forms of vegetation adapted to the flood (Minas Gerais, 2013).
29	Wetlands are ecosystems at the interface between aquatic and terrestrial environments, that may be continental or coastal, natural or artificial, permanently or periodically inundated by shallow water or consist of waterlogged soils. Their waters may be fresh, or highly or mildly saline. Wetlands are related to specific plant and animal communities adapted to their hydrological dynamics (Junk et al., 2014, p.12).
30	Transitional or interface environments between aquatic and terrestrial environments. They include all transitional ecosystems between the aquatic and terrestrial environments, natural or artificial, associated with the terrestrial and coastal water cycle, with the water level variable or relatively stable over time, where soils have a high degree of hydromorphism, conditioned by pluvial, fluvial, marine, subterranean water or combinations of them, with or without tides, with communities of plants and animals adapted to the water dynamics (Queiroz, 2015, p. 60).

Table 1 - Summary selection of wetland's concepts

Source: Gomes (2017, p. 51).

Wetlands considerations from the interviewee's perspective

All the answers considered the hydrogeomorphological factors that determine the formation of a wetland, some of which included aspects related to substrate, vegetation and / or climate:

> The determining features of wetlands would be landform, hydrology and climate, [...] but the climate influence in the broadest sense. When you have cliffs, if you have depression areas, it is possible to have wetlands. [...]. It may have anthropic factors, which may or may not be fundamental. When you create a dam, for example, can be originated wetlands around the dam. Perhaps, before, there was no wetlands, even having a river and a landform there. (Interviewee 1).

> Wetlands origin is determined by the landform and the water sources. The soil influences the time of water permanence. In another scale, climate determines the water availability. (Interviewee 2).

> The relief topography and the water table exfiltration determine wetlands origin, [...] but there might be water accumulation by rainwater. Vegetation and the soil type can influence [...], but the topography is more important. (Interviewee 3).

> [...] the most important factors are the conditions of non-outflow, the retention of this water at least one period of the year and the form and characteristics of the land surface. (Interviewee 4).

> Presence of water, existence of a community and species adapted to this system and a soil that allows the accumulation of water, at least part of the year. A landform that facilitates water accumulation and a water system that allows it to occur. In a floodplain, for example, the formation of wetlands is associated with floods occurrence. Thus, it is not the river depth that defines a wetland origin, but rather the adjacent morphology (Interviewee 5).

Considering the wetlands definition criteria, the interviewees cited the water presence, vegetation types and underground characteristics. Answers ranged from those where only one criterion is considered necessary, to those including all of them: water, adapted vegetation specie(s) and hydromorphic soil. Some interviewees questioned the requirement of hydromorphic soil because the time of its formation is relatively larger than a wetland, or because a hydromorphic soil could represent a paleosystem/condition, and / or because a wetland may have rocky substrates or sediments. Most of the interviewees agreed that to influence the vegetation type it is necessary the moisture presence at least during a minimum time, which is variable with each local context.

Figure 1 caused greater disagreement among the interviewees, since the concave slope morphology and water presence may indicate a wetland, but the soil and ephemeral rains raise doubts. In Figure 2, the area inside the channel and its surroundings was considered a wetland.

Figure 1 - Drainage headland, temporarily saturated; area with ephemeral rainfalland clay soils.
Source: GOMES (2017, p. 143).

Figure 2 - Small order channel,surroundingby temporary swamp, gray soil and plants adapted to humid environments.
Source: GOMES (2017, p. 144).

Regarding wetlands as transitional/ interface environments between aquatic and terrestrial systems, only one answer also indicate wetlands as aquatic ecosystems. The other interviewees agreed in considering wetlands as transitional environments, but this idea may have several interpretations because it considers spatial, temporal, spatial-temporal and/ or other features:

> When you talk about interface, the most common is that between terrestrial and aquatic systems, such as in the coastal zone that can have quite a lot of wetlands and in the case of floodplain systems. Also, it occur where there is a river that can sustain several lakes and these will have wet interface areas [...]. It can be spatial and temporal, usually this happens when there is a body of water nearby, I am moving in the time between a wetland and the dry area. [...]. .... Also may have a water table that rises and give place to a wetland..., when the table is down there is a dry wetland. I can see this as a temporal interface. [...]. It also happens in systems formed from precipitation [...]. It does not need to have an aquatic system that forms a wetland. [...]. In concept, a wetland is an interface between aquatic and terrestrial systems, it is important to be note; it is neither a terrestrial system nor an aquatic system. [...]. The swamp is a good example, it is always there, it is not pulsating, but we know that it is not a lake, but it is not terrestrial either. There is an ecosystem that corresponds to it, this is a very important criterion. It has vegetation and animals adapted to this system, which is neither aquatic nor terrestrial (Interviewee 1).

> I prefer to see a wetland as the entire aquatic environment, including the transitional environment, because it is a unique system from the point of view of its functioning.The Ramsar Convention established 6 meters deep to select which environments would be managed. This definition was made only for marine environments (Interviewee 2).

> They are transitioning areas between these two environments, involving biotic and abiotic factors of both ecosystems. [...] they are not aquatic environments, which present a specific fauna and flora in response also to the abiotic factors; and neither terrestrial, which also has different characteristics (Interviewee 3).

> It may be a spatial and temporal interface. It does not necessarily always have to be between the aquatic and terrestrial environments. [...]. It does not always have to be an ecotone. It has both characteristics, but it is not isolated. It can be more aquatic than just the transition. [...]. It may be an environment that has species that colonize wetland environments that are totally flooded for most of the year or all the year, and there are those wetlands species that are colonizers of humid environments a certain time of year and of dry environments in another period (Interviewee 4).

> This transition is spatial, but actually it is both, it occurs in time and space. [...]. They increase and decrease depending on the availability of water in that system, over time. [...]. The wetland is the transition, it is the interface area. A wetland is an ecosystem as well. It is not a river, a type of ecosystem; and neither a dry area, another type of ecosystem. It is a wetland, as if it was an ecotone between the two systems, but with its own species, forming a unique ecosystem. [...] you can have a wetland source by rain or groundwater and it is a transition, it transited from that environment that was terrestrial to an aquatic one. [...]. No need to have connectivity with the aquatic ecosystem. (Interviewee 5).

Spatial scale is one of the most relevant issues as wetlands can include water bodies and/or dry lands. All interviewees considered that Figure 3 is a wetland, while Figure 4, depending on the scale, is a wetland or incorporates wetlands.

Figure 3 - Karstic doline without connection to the deep water table; soil poorly drained and temporarily soaked by rain waters.
Source: GOMES (2017, p. 152).

Figure 4 - Permanent or temporary marginal ponds and plants adapted to humid and aquatic environments.
Source: Available at:< <http://planetaagora.blogspot.com.br/2014/02/2-de-fevereiro-dia-mundial-das-zonas.html>. Accessed on: 23 Nov. 2017.

Depending on the contexts and characteristics, wetlands can behave as water bodies at least part of time. There is no way to define limits of depth, flow speed and time of water permanence as wetlands criteria. Some interviewees also stressed that it depends on the species characteristics that will colonize the environment:

> There are water bodies that we can consider as permanent and there are others that are an interface between the permanent water body and the continent; and will have clearly defined ecological functions [...]. I will take, for example, the mangrove areas [...]. It has permanent water; the water speed will vary very often. At some point in the day you will have a important speed, in others waters will be stopped. As this occurs daily, I am using it as an example. In this case, it is a wetland; it is a water body that is inside the wetland. In this sense, it can have a body of water inside a wetland. In the Pantanal, for example, I can even have channels that can flow to both sides. Sometimes they are full of water, 3 meters inside, and they run a lot. These channels are part of the wetland. The Cuiabá and Paraguay rivers are not wetlands, they are going to fill these channels for 4 or 5 months, they are fundamental aquatic systems. [...]. However, it depends a lot on the scale we are looking at. The entire Pantanal ecosystem it is a wetland, even with a river in it. There, the scale is very important. You need to have flexibility when looking. [...]. For example, this system of do lines (figure 3) filled by rainwater is part of the wetland because it is not an aquatic ecosystem that forms the interface and it is not the water table [...].

Now, in a few years you can have purely aquatic systems. It filled with water, approaches its edge and if it is large enough, it will generate an interface zone. However, when the water is shallow they are all wetlands. [....]. For me, a clear feature of the wetlands, not a determining factor, is that they often have a rapid evolution (Interviewee 1).

An enclosed, lacustrine environment, for example, I would say that if it is small and tends to evaporate and greatly diminish its water depth, I would consider a wetland. Nevertheless, if it were more stable and larger, I would call it lake. A lake, which has little variation in water level, I would consider a wetland as far as amphibian plants are concerned ... because it is very difficult, it is not possible to value height and speed because these vary with luminosity, with the type of plant, soil structure. (Interviewee 3).

I would comprehend the water bodies in the wetlands ecosystems as in the "*veredas*", [...] I would also include the dry areas in the "*murundus*" fields, [...] are part of their ecosystems. [...]. For vegetation there is a water depth limit for the species, for example, that are rooted. It has a gradient as far as it can be rooted and has a stem where it will surpass the water level. However, there are also plant species that are floating [...] and others submerged [...]. There are examples of species that colonize rapids areas, so it is not an impediment to change from pools waters to rapids waters. Of course, you will decrease species that are adapted to these conditions. (Interviewee 4).

I do not think that rivers, lakes and ponds are wetlands, but they are part of an ecosystem that make up the wetlands [...] because in this particular case you are talking about scale right?. [...]. The river is one thing, it is there, it is an environment in itself, but its interface with the adjacent area is what people would classify a wetland. [...]. Because, for me, the wetland is an environment that offers availability, opportunity for the species to live there. [...] The basin of Paraguay is the ecosystem of the Pantanal, a wetland. Within this ecosystem there are wetlands, rivers, spring areas, land areas, which are different systems, but which form part of this basin. [...] Inside the "*veredas*", you have wetlands and the river, that is, it has aquatic environment inside, [...], which is not a wetland. Now it is part of a larger ecosystem that is called a "*vereda*", which has its own scale, and the "*vereda*" has several types of wetlands, the river is aligned within the "*vereda*", but the river is the river, has specific legislation for it, while the wetland does not. (Interviewee 5).

The interviewees considered the delineation of the wetlands the most complex issue and for protection purposes. It still includes, according to some of them, areas that contribute to its hydrological maintenance and the environmental services provided.

Conceptual proposal for wetlands

Table 2 presents a summary of the hydrological, pedological, vegetative, geomorphological and spatial-temporal scale factors in the origin, definition, identification and delineation of wetlands.

Hydrology	Wetlands may or may not have a water surface. When they exist, they are generally shallow, but there is no way to establish limits in terms of depth and dynamics. Substrate moisture may be variable, but is at or near the surface and is sufficient to define a wetland, to indicate processes and characteristics typical of wetlands. The difference between water bodies and wetlands lies in the ecological characteristics and functions of these two ecosystems.
Plant species	Plant species are aquatic amphibians and / or macrophytes. Their presence does not have to be permanent or obligatory, varying according to the hydroclimatic regime and the substrate. In addition, if only this aspect were considerate, the removal of vegetation could be stimulated.
Soil	Hydromorphic soils do not always indicate wetlands, as there are wetlands formed on rocky substrates or sediments, there are wetlands whose soils are in the early stages of formation and there are hydromorphic soils that represent paleoenvironments.
Landscape	Wetlands occur in landscape that allow a greater accumulation of water, such as flood plains, depressions and drainage headwaters. The landform helps in understanding the hydrological functioning, the location and delineation of wetlands in the landscape.
Scale	Scale is critical when identifying and delineating a wetland because, depending on the spatial extension, the wetland may contain water bodies and / or dry areas. In addition, along with the hydrogeomorphology, the scale allows to evaluate the hydrological functioning of a wetland.
Interface	Wetlands can present several "interface types", such as spatial, temporal, space-temporal, no terrestrial and nor aquatic systems, system with characteristics of terrestrial and aquatic environments, ecotone, unique ecosystem and others.

Table 2 - Main wetlands issues

Source: Adapted from Gomes (2017).

As a conclusion, a conceptual proposal for wetlands was formulated:

> Wetlands are permanently or temporarily saturated, waterlogged and / or flooded systems, formed on land forms and substrates that allow a greater accumulation of surface and / or subsurface waters, long enough to promote physical, chemical and biological

processes in environments with deficiency or absence of oxygen, usually indicated by plant species adapted to these conditions and / or by soils with hydromorphic characteristics. Anthropogenic interference can influence their formation, such as wetlands in marginal areas of reservoirs. According to the spatial scale considered in the hydrologic dynamics analysis, wetlands may include permanently dry and / or aquatic areas, which are fundamental for their ecological maintenance (Gomes, 2017, p.166).

Final considerations

Research related to the Brazilian wetlands has been increasing, but disagreement concerning definition criteria remains strong. The development of legal instruments for wetlands protection and management depends, besides social and political actions, on a clear better understanding of its ecological and social values. This conceptual proposal was an attempt to advance the discussions about wetlands, towards more understanding and applications of wetlands knowledge for protection and management of Brazilian wetlands.

References

AUSTRALIAN GOVERNMENT. Department of the Environment and Energy. *About Wetlands*.What are wetlands? [2017?]. Disponível em: <http://www.environment.gov.au/water/wetlands/about>. Acesso em: 01 mar. 2017.

BARBIER, E. B.;ACREMAN, M. C; KNOWLER, D. *Economic valuation of wetlands:* A guide for policy makers and planners.1. ed. Switzerland: Ramsar Convention Bureau, 1997. Disponível em: < https://www.researchgate.net/publication/246010067_Economic_valuation_of_wetlands_a_guide_for_policy_makers_and_planners >. Acesso em: 05 maio2017.

BARDIN, L. *Análise de conteúdo*. 4. ed. Lisboa: Edições 70, 2008. 223 p.

BOULTON, A. J.; BROCK, M. A. *Australian Freshwater Ecology:* Processes and Management. Gleneagles Publishing: Adelaide. 1999, 300p.

BONI, V.; QUARESMA, S. J. Aprendendo a entrevistar: como fazer entrevistas em Ciências Sociais. *Revista Eletrônica dos Pós-Graduandos em Sociologia Política da UFSC*, Florianópolis, v. 2, n. 1, p. 68-80. 2005. Disponível em: < https://periodicos.ufsc.br/index.php/emtese/article/viewFile/18027/16976>. Acesso em: 05 ago. 2015.

BRASIL. Decreto nº 1.905, de 16 de maio de 1996. Promulga a Convenção sobre Zonas Úmidas de Importância Internacional, especialmente como Habitat de Aves Aquáticas, conhecida como Convenção de Ramsar, de 02 de fevereiro de 1971. *Diário Oficial da República Federativa do Brasil*, Brasília, DF, 17 maio 1996.

BRASIL. Lei nº 12.651, de 25 de maio de 2012. Dispõe sobre a proteção da vegetação nativa e dá outras providências. *Diário Oficial da República Federativa do Brasil*, Brasília, DF, 28 maio 2012.

CATALUÑA (Comunidad autónoma española). Ley 12/1985, de 13 de junio, de Espacios Naturales. Fecha Publicación DOGC 30/11/1994.

CHIFFINGS, A.W. An inventory of research and available information on wetlands in Western Australia. Dept. of Conservation and Environment, Wetlands Advisory Committee. 1977. Disponível em: < https://library.dpaw.wa.gov.au/static/FullTextFiles/004047.e.pdf> Acesso em: 10 ago. 2015.

COWARDIN, L. M, et al. Classification of wetlands and deepwater habitats of the United States. *US Department of the Interior. Fish and Wildlife Service. Washington, DC. Office of Biological Services*. FWS/OBS-79/31. Dez. 1979.

CUNHA, C. N.; PIEDADE, M. T. F.; JUNK, W. J. *Classificação e delineamento das áreas úmidas brasileiras e de seus macrohabitats.* Cuiabá: EdUFMT, 2015. 165 p. Disponível em <http://cppantanal.org.br/wp-content/uploads/2017/04/E-book-Classificacao-e-Delineamento-das-AUs.pdf> Acesso em: 02 fev. 2015.

UNITED STATES. Clean Water Act, Section 404, 1977. Establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. *U.S Army Corps of Engineers: U.S. Environmental Protection Agency.*1977. Disponível em: <https://www.epa.gov/cwa-404/clean-water-act-section-404>. Acesso em: 23 mar. 2015.

_____. Food Security Act of 1985 (P.L. 99-198). Provides a 5-year framework for the Secretary of Agriculture to administer various agriculture and food programs. *United States Department of Agriculture.*1985. Disponível em: <https://www.ers.usda.gov/webdocs/publications/41995/15133_aib498_1_.pdf?v=41055>. Acesso em: 23 mar. 2015.

ESTEVES, F. A. Considerations on the ecology of wetlands, with emphasis on braziliam floodplain ecosystems. *Oecologia Brasiliensis*, Ecophysiological strategies of xerophytic and amphibious plants in the neotropics, Rio de Janeiro, v. 4, p. 111-135, 1998.

FRANCE. Loi n° 92-3 du 3 janvier 1992 sur l'eau. Consacre l'eau en tant que patrimoine commun de la Nation. 1992.

FINLAYSON, C. M; DAVIDSON, N. C. Global review of wetland resources and priorities for wetland inventory. *Supervising Scientist*. Supervising Scientist Report 144 / Wetlands International Publication 53, Canberra, 1999. Disponível em: < https://www.environment.gov.au/system/files/resources/b7be7f68-4522-4aa5-8e86-de5cabd21645/files/ssr144-full-report-web.pdf > Acesso em: 02 mar. 2017.

GOMES, C. S. *Bases teórico-conceituais e subsídios para a classificação hidrogeomorfológica das áreas úmidas em Minas Gerais*. 2017. 212 f. Dissertação

(mestrado) – Departamento de Geografia – Universidade Federal de Minas Gerais, Belo Horizonte, 2017.

JUNK, W. J.; BAYLEY, P. B.; SPARKS, R. E. The Flood Pulse Concept in River Floodplain Systems. *Canadian Journal of Fisheries and Aquatic Sciences,* Special Publication, n.106, p. 110-127, 1989.

JUNK, W. J; et al. Definição e Classificação das Áreas Úmidas (AUs) Brasileiras: Base Científica para uma Nova Política de Proteção e Manejo Sustentável. In: *Classificação e Delineamento das Áreas Úmidas Brasileiras e de seus Macrohabitats*. Cuiabá: Ed UFMT. 2014. Disponível em: < http://cppantanal.org.br/wp-content/uploads/2017/04/E-book-Classificacao-e-Delineamento-das-AUs.pdf >. Acesso em: 02 fev. 2015.

GIL, I. N. *Plan Andaluz de Humedales:* 10° aniversario de la aprobación. Sevilha, Espanha: Junta de Andalucía,Consejería de Agricultura, Pesca y Medio Ambiente, 2002. 34p. Disponível em: <https://www.juntadeandalucia.es/medioambiente/portal_web/servicios_generales/doc_tecnicos/publicaciones_renpa/memoria_humedales_10_aniversario/10_aniversario_pah.pdf>. Acesso em: 12 abr. 2016.

KEDDY, P.A. *Wetland Ecology:* Principles and Conservation. Cambridge University Press: Cambridge, IK, USA, 2010. 497p.

LEFOR, M. W.; KENNARD, W. C. Inland Wetland Definitions. *Connecticut Institute ff Water Resource*, Report n 28, nov. 1977. Disponível em: < http://opencommons.uconn.edu/cgi/viewcontent.cgi?article=1026&context=ctiwr_specreports > Acesso em: 06 jun. 2017.

LYON, J. G.; LYON, L. K. *Practical Handbook for Wetland Identification and Delineation,* 2. ed. CRC Press. 2011. 189 p.

MINAS GERAIS (Estado). Lei Florestal Mineira nº 20.922, de 17 de outubro de 2013. Dispõe sobre as políticas florestal e de proteção à biodiversidade no Estado. *Publicação – Diário do Executivo* – Minas Gerais 17 out. 2013.

MITSCH, W. J.; GOSSELINK, J. G. *Wetlands.* 4. ed. John Wiley e Sons, Inc. US, 2007. p. 582.

NEIFF, J. J.; IRIONDO, M. H.; CARIGNAN, R. Large tropical south american wetlands: an overview. In: *The Ecology and Management of Aquatic-terrestrial Ecotones.* Proccedings Book, University of Washington, 1994. p. 156-165.

NEIFF, J. J. Planícies de inundação são ecótonos? In: HENRY, R. (Org.). *Ecótonos nas interfaces dos ecossistemas aquáticos*. São Carlos: Rima, 2003. p. 29- 46.

NRC, National Research Council. *Wetlands: Characteristics and Boundaries.* National Academy Press: Washington, DC, 1995. 306 p.

O.CIZEL, GHZH. Groupe d'Histoire des Zones Humides. *Protection et gestion des espaces humides et aquatiques*. Guide juridique, Pôle-relais Lagunes, 13 Agence de l'eau RM&C, 2010.

PARANÁ (Estado). Res.Conjunta IBAMA/SEMA/IAP nº 05, de 28 de março de 2008. Define critérios para avaliação das áreas úmidas e seus entornos protetivos, normatiza sua

conservação e estabelece condicionantes para o licenciamento das atividades nelas permissíveis no Estado do Paraná.Diário Oficial da União nº 83, 2 maio 2008.

PAUL, S. *Workbook for managing urban wetlands in Australia*. Sydney Olympic Park Authority, 2013. Disponível em: <http://www.sopa.nsw.gov.au/__data/assets/pdf_file/0020/804521/Editors,_Contents,_Foreword,_Preface_and_Disclaimer.pdf> Acesso em: 5 jun. 2017.

PAIJMANS, K., et al. *Aspects of Australian wetlands.* Ed: CSIRO Division of water and Land Resources Technical Papel n °44, Canberra, Australia, 1985.

QUEIROZ, M. L. *Nascentes, Veredas e Áreas Úmidas: Revisão Conceitual e Metodologia de Caracterização e Determinação: Estudo de Caso na Estação Ecológica de Águas Emendadas - Distrito Federal.* 2015. 148 f. Dissertação (Mestrado em Geociências Aplicadas) Instituto de Geociências, Universidade de Brasília, Brasília, 2015. Disponível em: <http://repositorio.unb.br/bitstream/10482/20429/1/2015_MarinaLimaQueiroz.pdf> Acesso em: 5 jan. 2016.

RAMSAR CONVENTION. Convention on Wetlands of International Importance especially as Waterfowl Habitat. Ramsar (Iran), 2 February 1971. UN Treaty Series No. 14583. As amended by the Paris Protocol, 3 December 1982, and Regina Amendments, 28 May 1987. Disponível em: <http://www.ramsar.org/sites/default/files/documents/library/current_convention_text_e.pdf> Acesso em: 01 mar. 2017.

REDDY, K. R; DELAUNE, R. D. *Biogeochemistry of Wetlands:* Science and Applications. New York*:* CRP PRESS, 2008. 800p.

SHAW, S. P.; C. G. FREDINE. *Wetlands of the United States: Their Extent, and Their Values for Waterfowl and Other Wildlife.* Editora: U.S. Dept. of the Interior, Fish and Wildlife Service. Circular 39. Washington, DC, 1956.

SCOTT, D. A.; JONES T. A. Classification and inventory of wetlands: A global overview. *Vegetatio*, v.118, n.1-2, p 3-16, 1995. https://doi.org/10.1007/BF00045186

SOUTH AFRICAN. Act n. 36 of 1998. Provide for fundamental reform of the law relating to water resources; to repeal certain laws; and to provide for matters connected therewith. *Statutes of the Republic of South Africa - Water*, n. 28, p. 1201-1399.

TARNOCAI, C et al. The Canadian Wetland Classification System. In: *Wetlands of Canada*, National Wetlands Working Group and Canada Committee on Ecological Land Classification Series 24, Ottawa: Canadian Government Publications and Polyscience Publications, 1988.

TINER, R.W. *Wetland Indicators:* A Guide to Wetland Identification, Delineation, Classification, and Mapping. New York : CRC PRESS,1999. 418p.

WESTLAKE, D. F., KVET, J.; SZCZEPANSKI, A. *The Production Ecology of Wetlands: The IBP Synthesis*. London*:* Cambidge University Press, London, 1988. Disponível em: < http://assets.cambridge.org/97805211/13304/frontmatter/9780521113304_frontmatter.pdf >Acesso em: 03 set. 2015

ZOLTAI, S. C. Wetland environments and classification. In: *Wetlands of Canada*, National Wetlands Working Group and Canada Committee on Ecological Land Classification Series 24, Ottawa: Canadian Government Publications and Polyscience Publications, 1988.

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Authors Contributions

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