INVENTORY OF WETLANDS OF RIO GRANDE DO SUL (BRAZIL)

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Abstract

Wetlands in their natural state are a source of substantial benefits for society. The inventories of wetlands are necessary prerequisites for policy-making, conservation, utilization and planning at any country. The State of Rio Grande do Sul (Brazil) has a total of 3441 wetlands distributed into five classes: lakes and shallow lakes (1506 – 44%), rice fields (631 – 18%), intermittent lakes and intermittent shallow lakes (569 – 17%), floodplains (554 – 16%), and marshes (181 – 5%). The total inundation area of these wetlands is approximately 30.332 km^2, and the spatial distribution is quite heterogeneous. The regions of Coastal Plains, Central Depression, and the Pampas present the highest densities of wetlands. The median area of the inventoried wetlands was 0,17 km^2. Approximately 72% of the total wetlands identified were smaller than 1 km^2, while this proportion increased to 92% when ecosystems up to 10 km^2 were included. The wetlands are located from sea level to 1259 m altitude, and the media altitude was 40 meters. The knowledge concerning the inventory of wetlands of Rio Grande do Sul will provide several benefits to make wise decisions regarding the fate of wetlands.

Key words: *Inventory, classification, wetlands, Ramsar Convention, southern Brazil.*

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Pesquisas	Botânica	Nº 53	2003	p. 89-100

Resumo

As zonas úmidas em seu estado natural são fontes de benefício para a sociedade. Os inventários de zonas úmidas são requisitos necessários para as políticas de conservação e uso sustentado de qualquer país. O estado do Rio Grande do Sul tem um total de 3441 zonas úmidas distribuídas em cinco classes: lagos e lagoas intermitentes (1506 – 44%), arrozais (631 – 18%), lagos e lagoas intermitentes (569 – 17%), planícies de inundações (554 – 16%), brejos e pântanos (181 – 5%). A área total de inundação dessas zonas úmidas é aproximadamente 30.332 km^2, e sua distribuição é bastante heterogênea. As regiões da Planície Costeira, Depressão Central e Cuesta apresentaram as maiores densidades de zonas úmidas. A área média das zonas úmidas inventariadas era de 0,17 km^2. Aproximadamente 72% do total de zonas úmidas inventariadas era menor que 1 km^2, e esta proporção aumentava para 92% quando os ecossistemas acima de 10 km^2 eram incluídos. As zonas úmidas estavam localizadas desde o nível do mar até 1259 m de altitude, e a altitude média era 40 m. O conhecimento relacionado ao inventário de zonas úmidas do Rio Grande do Sul proporciona vários benefícios para as estratégias de conservação do estado e do Brasil.

***Palavras-chave**: inventário, classificação, zonas úmidas, Convenção de Ramsar, sul do Brasil.*

Introduction

Wetlands are amongst the most productive ecosystems on earth and are patches of high biological diversity (Hails, 1996; Barbier et al., 1996; Tiner, 1999). These ecosystems are transitional areas between dry and wet environments and share characteristics of both ecosystems (Shine & Klemm, 1999). In this context, the wetlands are important areas for conservation and preservation programs. Storage of water for supply, regulation of the water table, reduction on peak of run-off rates, flood control, nutrient retention, provision of habitat for birds and wildlife and recreation are other important wetland functions (Skaggs et al., 1994; Skinner & Zalewski, 1995).

The definition of wetlands more internationally accepted was provided by the Convention on Wetlands of International Importance especially, as Waterfowl Habitat, on February 1971. This definition provided a useful starting point for wetland identification, however, it becomes very general when the environmental characteristics of each region are included. Many countries such as United States (Cowardin et al., 1979), Spain (Bernaldez & Montes, 1989), and Australia (Paijmans et al., 1985) adopted different definitions of wetlands to include specific characteristics of their region. In Brazil, studies of wetlands stressing the classification of aquatic ecosystems are scarce (Lobo et al., 1991). The recognition of biodiversity and the dynamics of water flows are essential to provide an ecological classification in Brazilian lands that contemplates a high number of aquatic ecosystems. These informations are still scarce in Brazil, mainly related to inland

aquatic ecosystems. Most of the terms used to identify inland aquatic ecosystems are direct translation of English.

Inventories of wetlands provide an indication of the location of areas with high biological diversity and productivity (Taylor *et al.*, 1995; Pressey & Adams, 1995). The maps created from an inventory are useful for planning studies for conservation (Zalidis & Mantzavelas, 1996). Information concerning the distribution of wetlands assists the wise use of natural resources to reach decisions about wetland conservation (Taylor *et al.*, 1995). Many countries have already inventoried a great part of their natural aquatic ecosystems and many of these systems have been established as biodiversity reserves. The inventories of wetlands are scarce in Brazil (Diegues *et al.*, 1990; Maltchik *et al.*, 1999, 2000) and in the neotropical region (Scott & Carbonell, 1986). These surveys must be promoted in Brazil, mainly because we are referring to a country with the highest rates of biodiversity and freshwater ecosystems. The objectives of this study were to inventory and to elaborate wetlands maps of the State of Rio Grande do Sul (Brazil).

Material and methods

The inventoried region (Fig. 1) embraces the total area of Rio Grande do Sul (RS - 282.062 km²). The inventory was accomplished using 456 cartographic maps, to a semi-detailed scale (scale 1:50.000). These maps were issued between 1970 and 1980 by the Ministry of Defense and of the Brazilian Institute of Geography and Statistics (IBGE). These maps are the unique cartographical materials available in Brazil. They were developed using aerial photographs and allowing the identification of small wetlands (lower than 1 ha).

The wetlands of Rio Grande do Sul (RS) were located in the maps and the following data were recorded: name and class of wetlands, name of the cartographical map, latitude, longitude, altitude, inundation area and riparian vegetation.

The wetlands were divided into five classes (marshes, lakes and shallow lakes, floodplain, intermittent lakes and intermittent shallow lakes, rice fields). This classification is according to the classification established by the inventoried cartographic maps. The wetland class represents the sum of the five classes inventoried in the maps.

The geomorphological provinces of RS were defined according to Hausman (1995). The figures of maps were developed using the Program Corell Draw (8.0). Each square draw in the figures correspond to the density (number of the ecosystem and area) found in one map, and the tonalities change according to the density found.

Results

The State of RS has a total of 3441 wetlands distributed into five wetland classes: lakes and shallow lakes (1506 – 44%), rice fields (631 – 18%), intermittent lakes and intermittent shallow lakes (569 – 17%), floodplains (554 – 16%), and marshes (181 – 5%), (Fig. 2). The inundation area of wetlands was approximately 30.332 km^2. The lakes and shallow lakes presented the highest inundation area (13.559 km^2- 45 %), followed by rice fields (11.899 km^2 - 39 %), floodplains (3.406 km^2 - 11 %), marshes (1.378 km^2 - 5 %), and intermittent lakes and intermittent shallow lakes (90 km^2 - < 1 %) (Fig. 3).

The spatial distribution of wetlands is quite heterogeneous. While 177 wetlands were identified in the Rancho Velho cartographic map, the absence of wetlands can be the main hydrological characteristic in 36% of the cartographic maps. The Figures 4(a-f) and 5(a-f) show, respectively, the spatial distribution of the number and area of wetlands throughout the State of Rio Grande do Sul and identify the cartographical maps with highest densities of wetlands. Three regions were identified as presenting high density and high inundation area of wetlands: Coastal Plain, Central Depression, and the Pampas. The spatial distribution of floodplains, marshes and rice fields followed the same distribution of total wetlands. Both classes of lakes and shallow lakes showed a wider distribution model, including the northern region of RS, however the largest densities were found in the Coastal Plain, Central Depression, and Pampas.

The diversity of wetlands varied throughout the State area (Fig. 6). Only 19% of cartographic maps analyzed had more than 4 different wetland classes, and the highest percentage was located in the region of Coastal Plains. This percentage increased to 68% when 2 classes of wetlands were identified.

Tab. I shows the area, the altitude and the geographic location of the three largest wetlands of each class. The highest inundation areas were observed in lakes and shallow lakes and rice fields. The median area of the total inventoried wetlands was 0,17 km^2. Approximately 72% of the total wetlands identified had an area lower than 1 km^2, and this percentage increased to 92% when ecosystems up to 10 km^2 were included.

The wetlands of Rio Grande do Sul are located from sea level to 1,259 meters high, and the media altitude was of 92.4 meters (Tab. II). The marshes (12 m) and rice fields (65 m) presented the lowest mean altitude. Both classes of lakes and shallow lakes are located in regions of high altitude.

The riparian vegetation changed within wetland classes. Culture systems were the predominant riparian vegetation in three classes of wetlands (lakes and shallow lakes, marshes, intermittent lakes and intermittent shallow lakes). Floodplains and rice fields had forests as main riparian vegetation (Tab. III).

Discussion

The wetlands of Rio Grande do Sul are patches of high biodiversity, contributing as habitats for waterfowl (Scott & Carbonell, 1986; Belton, 1994), aquatic macrophytes (Irgang & Gastal, 1996) and other aquatic organisms. These aspects are fundamental for the establishment of guidelines under a political stance of sustainable development. The value of these ecosystems should not be characterized only by the high indexes of biodiversity, but by the amount of surface water and biological productivity.

In southern Brazil, only 1,22 % of the territory is characterized as protected area (702.215 km^2). The problem increases when we analyze the State of Rio Grande do Sul, where 0,55% of its territory is established as protected area (Costa, 1998). The spatial distribution of wetlands throughout the State is quite heterogeneous. These informations are fundamental for the elaboration of preservation plans and conservation strategies in the RS. Areas with larger concentration of original wetlands must be considered as strong candidates to become protected areas. The maps elaborated in this study identify these regions and should guide governmental agencies to establish politics related to conservation programs

In the State of RS, the highest density of wetlands was found in the regions of Coastal Plains, Central Depression and at the Pampas. The low altitude is a shared characteristic among the three regions. The mountains of the Coastal Plains are not elevated, and act just as water divisors (Rambo, 1994). The inundation process varies among regions. While in the Central Depression and Pampas, the events of flooding are a consequence of precipitation and river fluctuations, in the Coastal Plains these processes are consequences mainly of precipitation and the overflowing of lakes and shallow lakes.

The diversity of wetland types must be another guideline to establish protected areas in RS. Areas with higher classes of wetlands also must be strong candidates to become protected areas. In this case, again the Costal Plains, Central Depression and the Pampas are the geomorphological provinces with highest diversity of wetland types. In this context, these three provinces must be always recorded as priority regions to conservation.

One of the main limitations of this inventory is related with the date of the analyzed maps, since the most of them were issued between 1970 and 1980. The accumulated information could not represent the nowadays reality. However, comprehensive inventories of wetlands always have this type of limitation, mainly in countries of large extension. For example, the U.S. Wetlands Inventory was delayed more than 18 years to be finished, and much of inventoried wetlands become degraded or destroyed during the course of inventory compilation. In other hand, these maps are the unique available and issued by the Ministry of Defense and the Brazilian Institute of Geography and Statistics (IBGE). Despite many values may have been changed, these data still show the patches with largest chance to have wetlands. In the other hand, these results help to determine the

amount of wetlands lost in the last years. The high density of rice field in Rio Grande do Sul indicate that a large quantity of original wetlands was lost in the last years, primary to agricultural production. Studies related to rice field ecology must be promoted on research programs in Brasil.

In this context, the inventory of wetlands of Rio Grande do Sul provides several benefits to make wise decisions regarding the fate of wetlands, which must be highlighted: 1) wetland database and map; 2) the identification of patches with high biodiversity and productivity; 3) data to quantify the rates of wetland loss and to monitor occurred changes in the last 30 years; 4) incentive research programs related to wetland classification in Brazil.

Acknowledgements

This research has been supported by funds from UNISINOS (38.00.005/01-0) and CNPq (523706-95.2). We thank the 1º Divisão de Levantamento (Rio Grande do Sul) of Ministério da Defesa for the donation of 12 cartographic maps.

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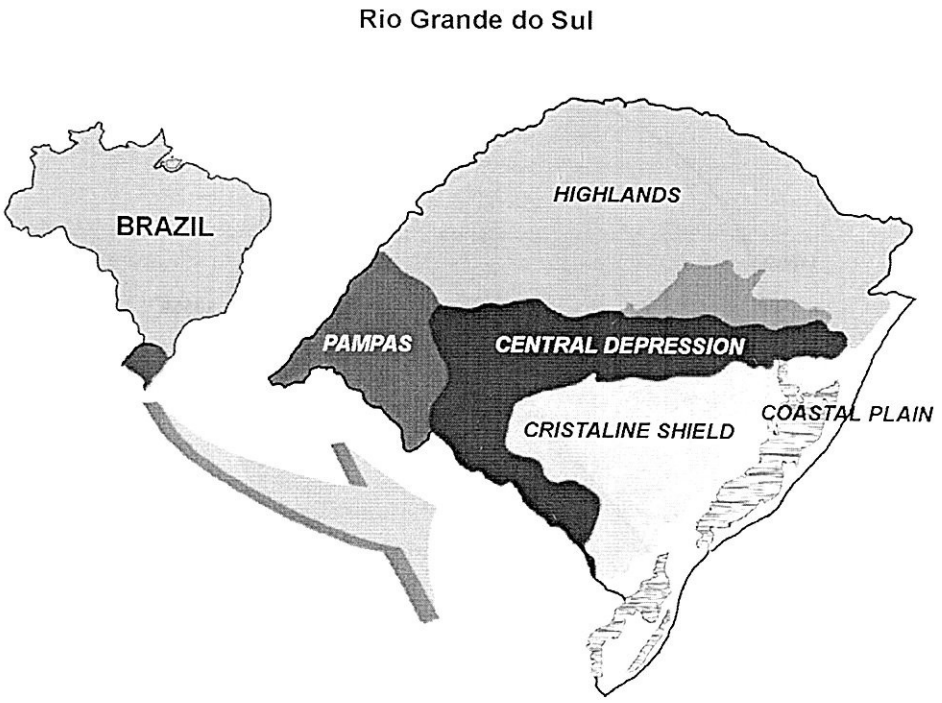

Figura 1: General location and the geomorphological provinces in the State of Rio Grande do Sul.

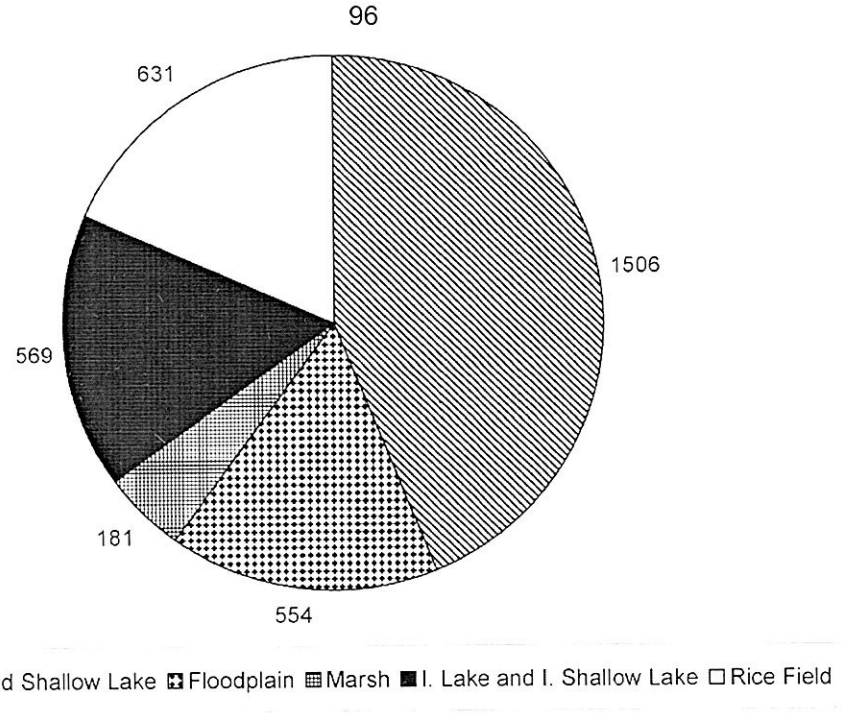

Figura 2: Distribution of numbers of wetlands per inventoried classes in Rio Grande do Sul. I = intermittent.

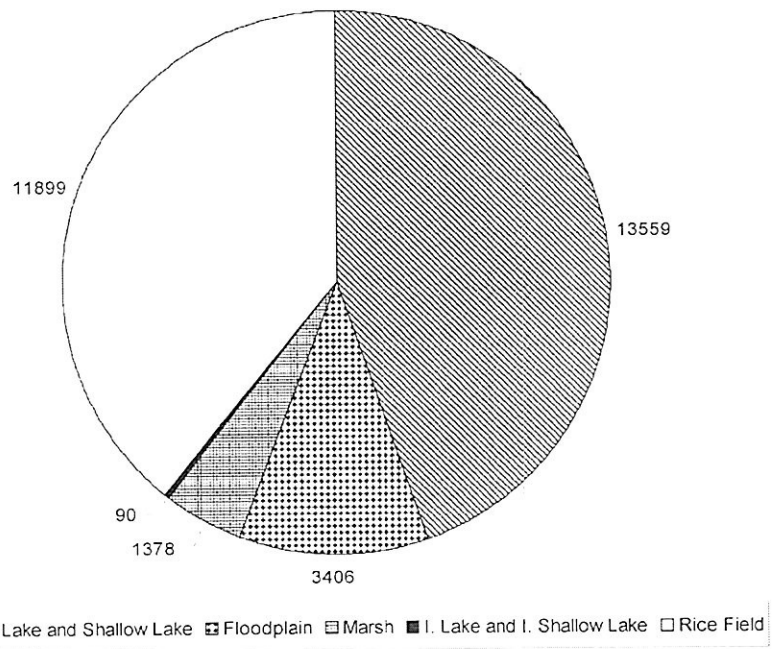

Figura 3: Distribution of area of wetlands (km2) per inventoried classes in Rio Grande do Sul. I = intermittent.

Tab. I: Area, altitude and position of three largest wetlands in the Rio Grande do Sul.

Wetlands Classes	Name of wetlands	Area (km^2)	Altitude (m)	Position UTM	
				mN	ME
Lake and Shallow Lake	Lagoa dos Patos	8570	0	6630	490
	Lagoa Mirim	2744*	10	6410	342
	Lagoa Mangueira	817	7	6330	330
Floodplain	Banhado do Arroio del Rei-	260	9	6346	310
		252	59	6722	560
		129	100	6718	674
Marsh	Banhado do Albardão	143	3	6380	355
	-	128	30	6722	390
	Banhado Maçarico	124	4	6718	366
I. Lake and I. Shallow Lake		18,3	13	6646	558
		14,86	70	6780,7	570,9
		7,92	6	6607	540,5
Rice Field	-	1582	10	6418	320
	Banhado dos Touros	953	13	6670	535
	Banhado dos Anastácios	788	122	6610	726

Tab. II: Altitude (m) of wetlands in the Rio Grande do Sul.

Wetlands Classes	Mean Altitude (m)	Maximum Altitude (m)	Minimum Altitude (m)
Lake and Shallow lake	115	1259	0
Floodplain	98	1000	0
Marsh	12	170	0
I. Lake and I. Shallow Lake	172	1200	0
Rice Field	65	200	0
Total	92,4	1259	0

Tab. III: Riparian vegetation (%) of wetlands in the Rio Grande do Sul.

Wetlands Classes	Forest	Forest/ Culture	Culture
Lake and Shallow Lake	21	4	75
Floodplain	53	11	31
Marsh	20	14	66
I. Lake and I. Shallow Lake	14	3	83
Rice Field	56	29	15

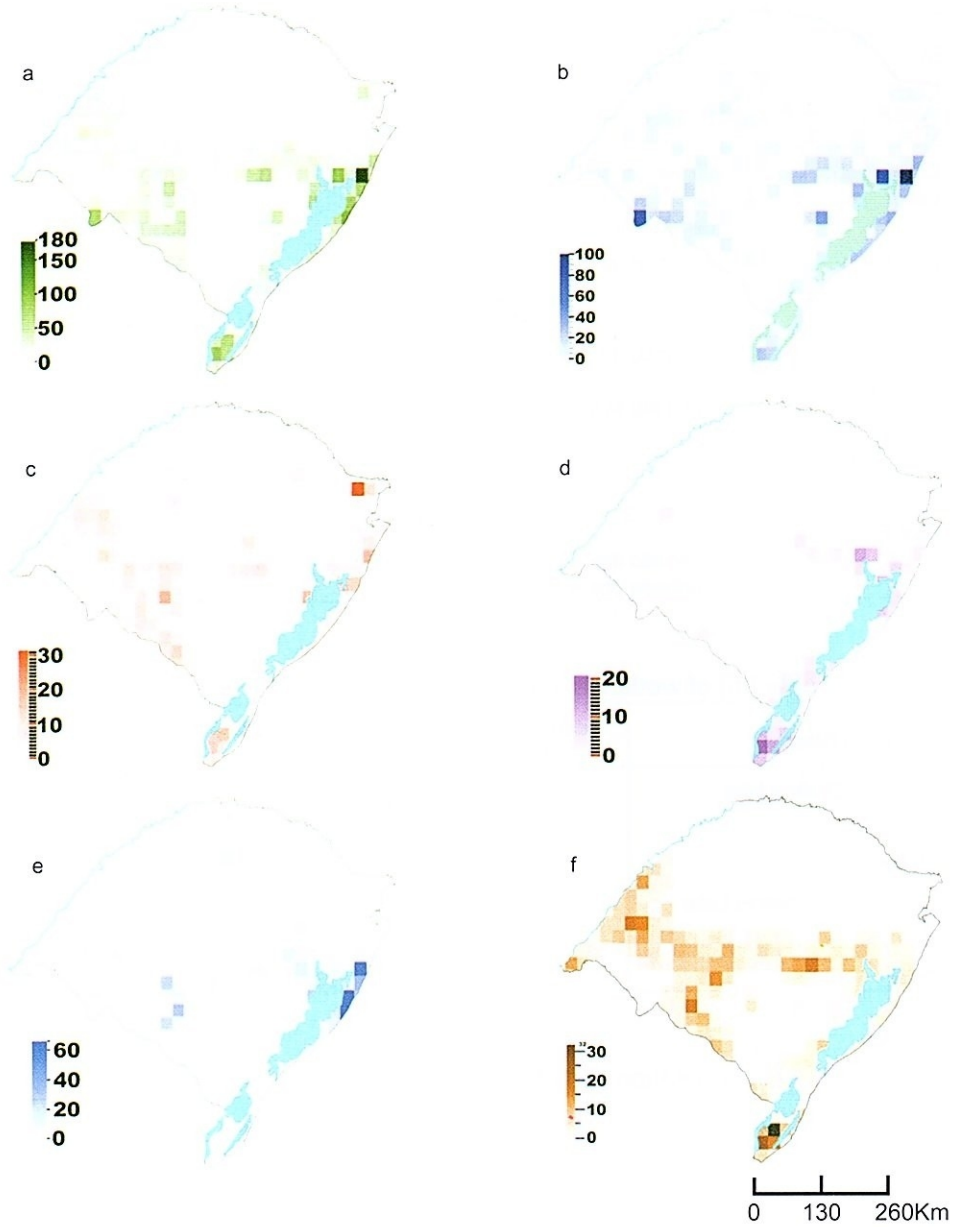

Figura 4: Spatial distribution (number of ecosystems) of wetlands (a), lakes and shallow lakes (b), marshes (c), floodplains (d), intermittent lakes and intermittent shallow lakes (e), and rice fields (f) along Rio Grande do Sul. The wetland class represents the sum of the five classes inventoried in the maps. Each square draw in the figures corresponds to the number of the ecosystem found in one map, and the tonalities change according to the density found.

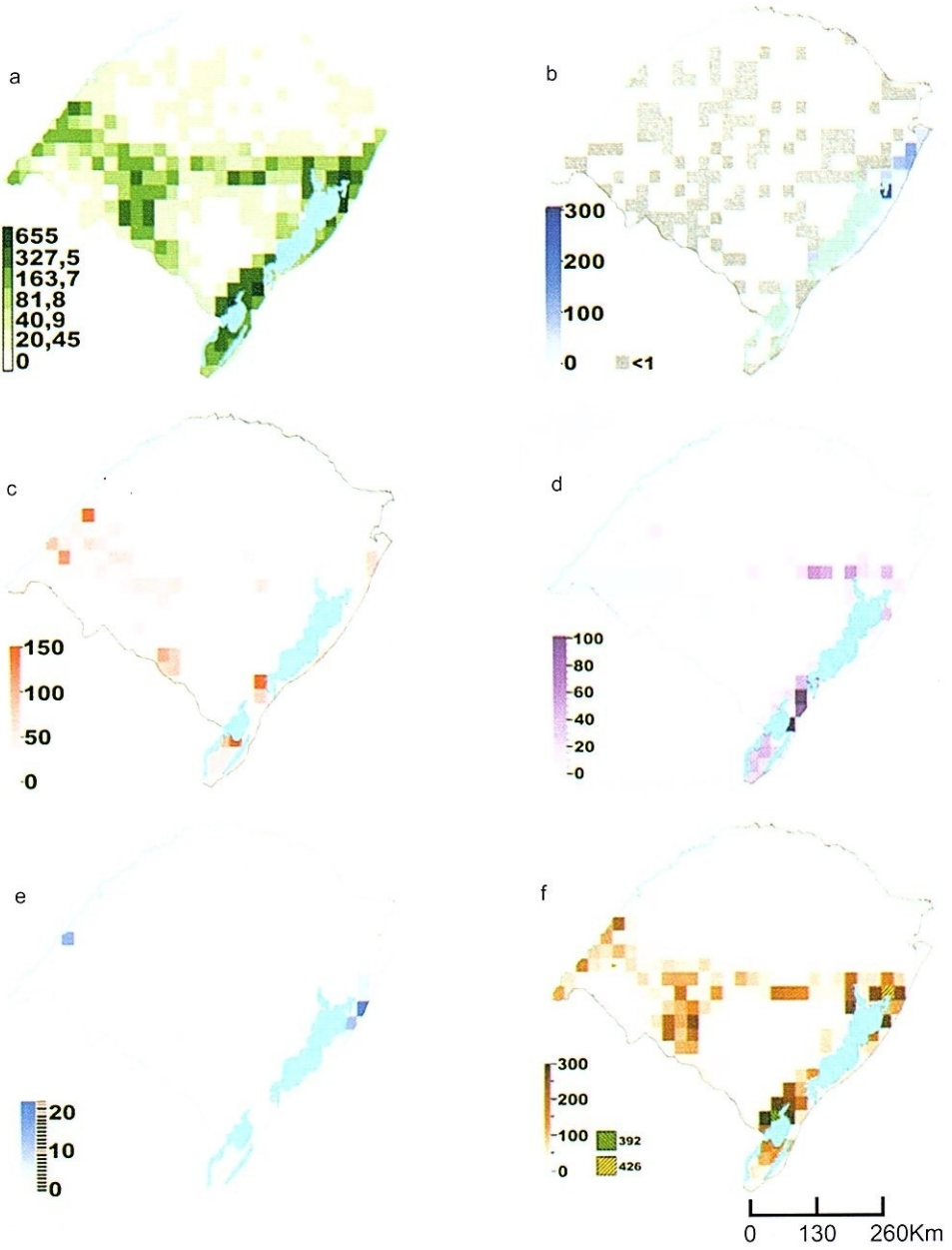

Figura 5: Spatial distribution (km2) of wetlands (a), lakes and shallow lakes (b), marshes (c), floodplains (d), intermittent lakes and shallow lakes (e), and rice fields (f) along Rio Grande do Sul. The wetland class represents the sum of the five classes inventoried in the maps. Each square draw in the figures corresponds to the area found in one map, and the tonalities change according to the density found.

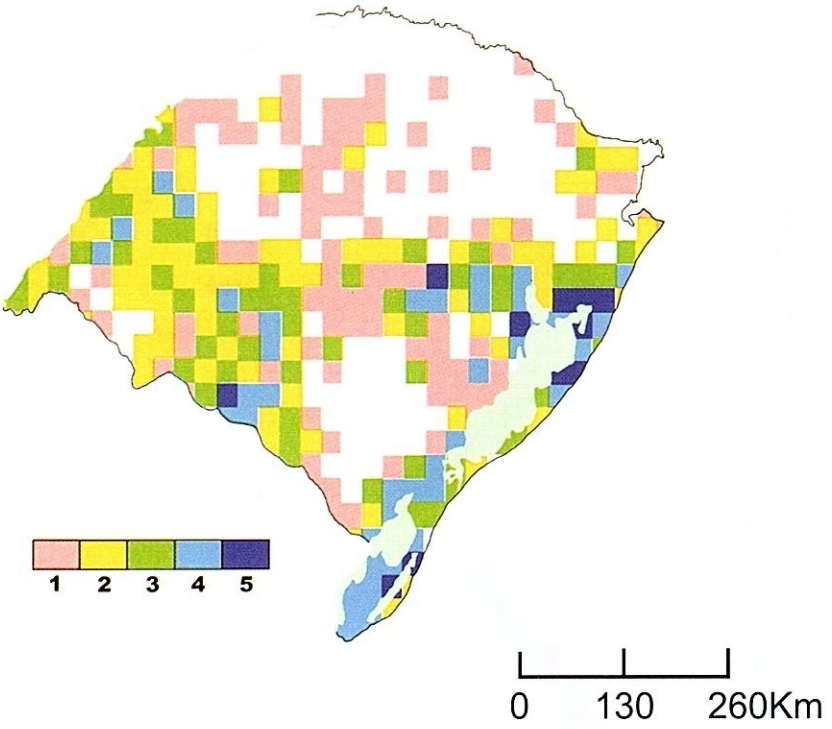

Figura 6: Spatial distribution of richness of wetlands per inventoried carthographical map.