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Brazilian Federal Conservation Units: A Historical Overview of their Creation and of their Current Status

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ABSTRACT

This paper provides a historical overview of the formation of the system of federal conservation units existent in Brazil as of 2006 and examines selected aspects of their current status. The text focuses on the following dimensions of these units – the creation of multiple categories, legal bases, age, number, absolute and average sizes, distribution by regions and by biomes, according to groups and categories. Major findings are that (1) much progress has been attained in the creation of conservation units, in terms of legal bases, diversified categories, numbers and areas, and coverage of Brazilian regions and biomes; (2) there is a deficit to be filled by the creation of numerous units, in order to make the system more efficient and encompassing and to honour the commitments made in international forums; (3) despite this need for physical expansion, the rather extensive set of existing conservation units already demands more than the existing energy, expertise and funding to be adequately managed.

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1. INTRODUCTION

This paper analyses the historical process of the creation and management of Brazilian federal conservation units ('*unidades de conservação*', abbreviated hereafter as UCs) over the last 70 years. It also examines selected dimensions of their current status. Its goal is to provide a synthetic overview of several historical and current dimensions of Brazil's conservation unit system. The purpose is not to forward an hypothesis, but to provide an analysis of several matters pertinent to the scientific examination of conservation policies in general, and environmental protection policies in particular.

The paper is the result of a first-hand examination of the data contained in the encompassing 'Cadastro Nacional de Áreas Protegidas' (National Register of Protected Areas), organised by a team of technicians working under the leadership of the Brazilian Ministry of the Environment. The first version of this database was concluded in early 2006. The text also draws on sources that deal with the history of nature conservation in Brazil and on on-going research on Brazilian environmental protection policies.

The numbers of UCs in Brazil, and the territorial area protected by them, have grown rapidly over the last three decades, in federal, state and municipal levels of government. The growth and consolidation of these units are much needed in order to provide conditions for *in situ* conservation of biodiversity. This is specially the case in a country such as Brazil, given that it comprises a large, mostly tropical and humid territory, endowed by a wide variety of life forms spread throughout several biomes and ecosystems. This endowment usually places Brazil quite high – if not highest – among countries deemed as biologically 'mega-diverse'.[1]

At the same time, the country's territory and resources have gone through, and continue to endure, successive episodes of intensive use, conversion and degradation, giving way to productive activities, and urban and infrastructural development. This process is driven by a deeply rooted and relentless logic of 'development at any cost', based on short-term gains. The prevailing historical pattern of land use combines the identification, occupation, devastation, exploitation and 'abandonment' of successive frontiers of natural resources. Typically, such exploitation is short-lived or soon stagnates in the forms of degraded areas, low degrees of production and productivity and impoverished communities.[2]

Social actors that are markedly different from each other and/or engage in open conflicts over other issues may easily agree with each other in their common desire to exploit these resource frontiers. This consensus unites large commercial farmers and small family farmers; large farmers, landless workers and land reform settlers; federal, state and county legislators and planners, progressive and conservative political parties, placer miners and large mining companies; construction contractors, loggers and wood-based industries; the hydroelectricity generation sector and the consumers of this energy – and so on.

The drive of frontier occupation inhibits the emergence of environmental awareness among the general population. This is true even in the face of all the recent improvements in terms of environmental regulations, of a growing awareness of the value of well-preserved biomes and ecosystems and of an expanded concern with the rational use of resources. The grand territorial extension of Brazil and its rich endowment of natural resources therefore act more as *arrestors* than as *stimulators* of conservationist awareness and policies.

The movement in favour of the creation of UCs in Brazil over the last 70 years has not been particularly strong or even constant, but it has become increasingly effective. There have been significant efforts to 'neutralise' the 'hard' trend of careless exploitation of successive natural resources. This movement has allowed the survival or recovery of some stretches of territory and waters in which the processes of biological evolution can proceed without radical disturbances caused by many human activities.[3]

The creation of UCs, however, is not the only challenge of biodiversity protection. The several types of UCs, their growing numbers and areas, and their often conflictive relations with productive activities pose a series of questions that deserve attention. In fact, the complexity of a UC system grows exponentially with the number, area and categories of units to be managed. More resources are required to maintain and train personnel, tackle land tenure issues, build infrastructure, acquire equipment, enforce regulations, promote visitation and environmental education, and achieve the support of broader sectors of society. Also required is broad, integrated, long-term planning, based on principles and directives shared by different levels of government, institutions, civil society organisations, citizens and management personnel. This will not happen 'spontaneously', for the management of protected areas is still a relatively recent consideration for public authorities.[4]

On the other hand, dealing with the complexities inherent to a large and diversified system of UCs requires sound knowledge about its components and their mutual relations. This article intends to contribute to this knowledge by pulling together information and analysis concerning the historical development of the current Brazilian system of federal UCs. It focuses first on the diversification of UC categories and then on selected dimensions of these UCs – age, number, absolute size, average size, distribution by regions and distribution by biomes.

2. BRAZILIAN CONSERVATION UNITS – A BRIEF HISTORY OF THEIR DIVERSIFICATION

Some remote episodes and trends are worthy of attention because they affected the current profile of Brazilian conservation efforts. On a global scale, the creation of protected areas steadily turned into the most widely used strategy for nature

conservation since the second half of the nineteenthth century. The first modern protected areas were created to preserve terrestrial or aquatic areas endowed with exceptional natural characteristics – beauty, grandeur and species rarity. This included attempts to protect 'charismatic' samples of the fauna and flora, such as large trees (redwoods and sequoias) and animals with strong aesthetic appeal (whales, African herbivores and felines).[5]

Concern with the integrity of watersheds was a more pragmatic motivation for conserving some areas. This required the prudent use or even the reclaiming of stretches of rivers or sections of their basins. Sometimes these areas were used by city dwellers also for leisure and by scientists for research. The replanting of a part of the Tijuca Forest, between 1861 and 1889, in Rio de Janeiro, is a Brazilian illustration of how the concern with water supply for a large urban population generated the reclamation and the special management of an area that later became a national park.[6]

As time went on, new goals were added to the creation of protected areas. Accordingly, new categories emerged, with distinct purposes within the general goal of nature protection. This trend of creating new categories was sanctioned in international meetings (conferences on national parks have occurred since the 1960s), by the International Union for the Conservation of Nature – IUCN recommendations during the mid-twentieth century, and in the laws of many countries. Much more recently, in the 1990s, the trend was sanctioned on a global scale by the ambitious goals of the Convention on Biological Diversity: conservation of biodiversity, sustainable use of natural resources and fair and equal division of the benefits from use of genetic resources. These ambitious goals in themselves require numerous categories of protected areas.

The well-known starting point of modern policies for protected areas was the creation, in 1872, of the Yellowstone National Park, in USA. Since the end of the nineteenth century, national parks have multiplied throughout the planet and have become the most traditional and the best-known type of natural protected area, although they now have the company of biological reserves, wildlife refuges, national forests, natural monuments and dozens of other categories of protected areas. Each has different goals – including the sustainable productive use of selected natural resources, as exemplified by Brazil's rather famous extractive reserves.[7]

In Brazil, the first recorded proposal to create national parks was made quite early. In 1876, the engineer André Rebouças (1838–1898) revealed great foresight when he suggested the creation of national parks in two quite remote sites: one on Bananal Island (Araguaia River) and the other around the Sete Quedas Rapids (Paraná River). However, the first area created in Brazil for the explicit purpose of nature preservation was a state, not a federal park. Besides, it was not remote, but urban, located inside the city of São Paulo – the Parque Estadual da Cidade, now called Parque Estadual da Capital, created on February 10 1896, by State Decree 335. The first Brazilian national parks were created

only 60 years after Rebouças' early proposals, in the 1930s, but not in the places he suggested. They were the Itatiaia (1937) and Iguaçu and Serra dos Órgãos parks (1939). Later, national parks were indeed created in the sites mentioned by Rebouças in 1876 – the Araguaia National Park (1959) and the Sete Quedas National Park (1961). Unfortunately, this second park was eliminated in 1980, drowned by the huge artificial lake created behind the Itaipu hydroelectric dam.[8] Therefore, when the first Brazilian national parks were created, in 1937, there was already at least one much older and quite visible state park, located in São Paulo, the city that would soon become the largest in the country.

Two other early UCs are noteworthy because they also illustrate how soon the tendency to create several types of protected areas emerged in Brazil, besides highlighting the importance of state government initiatives and of scientific research for the selection of areas to be protected. Both were originally named 'biological stations' (probably a coincidence) and resulted from the fieldwork of foreign scientists active in Brazil. Alberto Loefgren (1854–1918), a Swedish botanist, was involved in the creation of the Biological Station in Itatiaia, on the border between the states of Minas Gerais and Rio de Janeiro, in 1914, precisely where the first Brazilian national park was established in 1937. The station supported the fieldwork of foreign and Brazilian scientists linked to the Jardim Botânico do Rio de Janeiro (Rio's Botanical Gardens) and the Museu Nacional do Rio de Janeiro (a natural history museum located in Rio). Although not a conservation unit proper, it helped protect the area of Brazil's first federal conservation unit. In a not too dissimilar vein, the German scientist Herman von Ihering (1850–1930) used his own money to establish the Alto da Serra Biological Station, located at the top of the Serra do Mar coastal ridge, above the small village of Cubatão, in the state of São Paulo. In 1909 he donated the privately owned area to the Museu Paulista, a São Paulo state natural history museum, which made it a state-owned conservation unit. The area also was, and continued to be, the object of regular incursions by Brazilian and foreign scientists.[9] Comparable federal biological preserves would be created only in the 1970s.

In 1934, again in the state of São Paulo, a new category of protected area was created: the Estação Florestal Experimental (Experimental Forest Station) Dr. Epitácio Santiago, through state Decree 24,104, 10 April 1934. (Much later, in 2001, it became a national forest, with the name Lorena National Forest.) Its mission was to research commercial tree planting and the industrial uses of wood. It was a predecessor of National Forests. Only in 1946 did Brazil create its first officially named, federally managed national forest: Araripe-Apodi, a huge tract located in a border area between the states of Piauí, Ceará, Rio Grande do Norte and Pernambuco. Dozens of federal National Forests exist now in Brazil.[10]

There are also cases of frustrated conservation initiatives in Brazil. In 1891, for example, Federal Decree 8,843 created an enormous and vaguely defined

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'Forest Reserve' in what currently is the extreme western state of Acre, with 2.8 million hectares. However, not a single initiative towards its implementation is known to have occurred and no agency claims that it exists. Paulo Afonso and Sete Quedas National Parks are other examples. The first was created in 1948, in the state of Bahia, and the second in 1959, in the state of Paraná. However, both were disbanded, in 1968 and 1980 respectively, submerged by the artificial lakes formed behind huge hydroelectric dams.[11]

In 1934, Decree 23,793 established Brazil's first Forest Code. It was the first legal text to mention national, state and county parks as conservation units. However, it also created four classes of native and planted forests that added to the variety of conservation units and policies over the following decades – 'protective', 'remaining' (both to be permanently preserved), 'model' and 'productive' (both subject to commercial exploration). 'Protective' forests were the predecessors of Permanent Preservation Areas (APPs), a class legally sanctioned much later as a type of protected area – although not conservation unit – by the second Forest Code, instituted by Law 4,771, in 1965, and still valid.[12] 'Model' forests were those managed and/or planted for commercial purposes, and were rare at the time. However, conceptually they were the predecessors of both national forests (created from the 1940s on) and of the vast expanses of private commercial tree plantations (that are not UCs) established since the late 1960s. 'Remaining' forests would be those specifically placed under the protection of conservation units. The 1934 Forest Code became the legal basis of several dozens of National Parks, National Forests and Protective Forests (sited on public lands) created before the 1965 Forest Code came into effect.

The 1965 Forest Code introduced new categories of UCs and a major conceptual innovation: the distinction between two 'families' of UCs. First, there were UCs for 'indirect use' (the old categories of national, state and county parks, and the new category of biological reserves), which did not allow the use of natural resources. Second, there were UCs for 'direct use' (old national forests, protective forests and remaining forests and new forest reserves and hunting parks), allowing the direct use of natural resources. From 1965 to 2000, dozens of UCs were created within this new framework.

Other categories of protected areas were instituted in the 1980s and 1990s. The first two came with Federal Law 6,902, in 1981: Ecological Stations and Environmental Protection Areas. In 1984, Federal Decree 89,336 created two more: Ecological Reserves and Areas of Relevant Ecological Concern. Resolution 12, December 14 1987, by the National Environment Council, recognized these last two categories as UCs. Curiously, though, the two categories created in 1981 were not granted this status at the same time, adding to the confusion. The category of extractive reserves first appeared in 1987, based on Ruling 627 by the Instituto Nacional de Colonização e Reforma Agrária – INCRA (the federal land reform agency), concerning a new type of rural settlement, but they were recognised as conservation units in 1990, through Federal Decree 98,897. In

1996, after a series of inconclusive initiatives by Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais – IBAMA (Brazil's major environmental agency), Decree 1,992 instituted the category of private natural patrimony reserve, a type of UC created on private lands by the initiative of their owners.

Therefore, Brazil reached the 1990s with numerous official categories of environmentally protected areas. At the same time, a wide consensus had emerged among the international conservation community about the importance of the protection of biodiversity and native landscapes, particularly in tropical countries like Brazil.[13] The profusion of categories seemed to indicate a shaky conservation policy. The many different types of protected areas had resulted from several factors, including the influence of the global scenario in favour of environmental conservation, the growing public interest in the matter, international pressures and, not least, competition between government agencies. Laws and directives to guarantee efficiency in the management of so many categories of protected areas were clearly lacking. The situation demanded an effort in systematisation.[14]

3. THE SNUC LAW – ORGANISING THE CATEGORIES OF CONSERVATION UNITS

The difficulty of the task of bringing order to the creation and management of protected areas in Brazil is clear from the almost eleven years of discussion of the bill drafted to create the so-called National System of Conservation Units Law (SNUC). The bill entered Congress in 1989 and was approved only on 18 July 2000, as Law 9,985), after protracted and noisy debates. It took another two years for the law to be regulated by Decree 4,320, finalised on 22 August 2002.[15]

One of the most controversial aspects of these debates was the need to distinguish between UCs, on the one hand, and other types of protected areas, such as APPs and Legal Reserves (LRs, also instituted by the 1965 Code), besides Indigenous Homelands and *Quilombo* Homelands, on the other.[16] These four types of protected areas compose a complex picture worthy of study in its own right. Perhaps this complexity determined that the SNUC law dealt almost exclusively with UCs, our major subject here. The law defines UCs as 'territorial space[s] and [their] environmental resources, including jurisdictional areas, with relevant natural characteristics, legally instituted by public authorities, with purposes of conservation and with defined limits, under a special managerial regime in which the proper protection guarantees are applied.'

The specific purpose of the SNUC Law was, therefore, to establish criteria and norms for the creation and management of UCs. This meant, above all, the precise definition of the different categories. In spite of the large number of pre-existing categories (in addition to the ones discussed in the previous

section, there were units named as forest parks, ecological reserves, ecological parks, forest reserves, road-parks etc.), many ended up being excluded from the SNUC Law and are not officially recognised as UCs. They must be officially renamed and their goals accordingly restated in order to fit into one of the SNUC categories.

The SNUC Law's major innovation, however, was splitting UC categories in two groups – 'fully protected' units, with the purpose of preserving nature and allowing only indirect use of natural resources; and 'sustainable-use' units, with the purpose of combining nature conservation and the sustainable use of a part of their natural resources (see Table 1). These two groups are reminiscent of the aforementioned 'indirect use' and 'direct use' units sustained by the 1965 Forest Code. The first group has five categories: Ecological Station, Biological Reserve, National Park – referred to as State Parks or County Natural Parks when created by the state or county – Natural Monument and Wildlife Refuge. Seven categories compose the second group: Environmental Protection Area, Area of Relevant Ecological Interest, National Forest – or State and County Forest – Extractive Reserve, Sustainable Development Reserve, Fauna Reserve, and Private Reserve of the Natural Patrimony.

This classification, which is still valid, had several advantages. First of all, it gave coherence to the myriad of conservation units and other types of protected areas created since the early twentieth century. Second, it expressed an institutional compromise between the goals of two strands of environmental activists – strict preservationists (who seek to protect biodiversity against human activities) and socio-environmentalists (who place 'traditional' communities' interests above those of the protection of biodiversity). These two currents of opinion have been in mutual antagonism for almost two decades, a disservice to the not very popular cause of conservation. However, with the new law there are now sufficiently well defined categories to account for a wide array of situations in which local communities are involved. Hopefully the two strands of environmentalists will be able to work more collaboratively from now on. Third, the classification is in line with criteria defined by the IUCN. This places the Brazilian system inside international standards and rules. It helps to obtain international funding and support, to organise joint research programmes, to exchange information and experiences, to set up agendas involving international and foreign agencies, to adopt specific management patterns and assists in the joint management of bi-national protected areas. Fourth, the SNUC Law is in tune with the basic purposes of the Convention on Biological Diversity: (1) conservation of biodiversity in its three fundamental levels (genetic diversity, species diversity and ecosystem diversity), (2) sustainable use of natural resources, (3) participation of society and (4) equitable distribution of the benefits achieved by UCs.

Therefore, the SNUC Law solidified the Brazilian UC system. Some problems remain, but the law undoubtedly helped Brazilian UC policy reach maturity.[17] Hence, from a normative point of view, Brazil's efforts to organise the concepts,

TABLE 1. Categories of Brazilian Conservation Units, as defined by the SNUC Law (2000)

category	group	purposes
Ecological Station	fully protected	nature preservation and scientific research
Biological Reserve	fully protected	full preservation of the biota and other natural features, without direct human interference or environmental modifications, except for the recovery of altered ecosystems and the protection of biological diversity and ecological processes.
National Park, State Park or County Natural Park	fully protected	preserve natural ecosystems with great ecological relevance and scenic beauty; provide opportunities for scientific research, environmental education and interpretation, recreation and ecological tourism.
Natural Monument	fully protected	preserve rare and unique sites, endowed with great scenic beauty.
Wildlife Refuge	fully protected	preserve natural environments in which the existence and reproduction of fauna and flora are assured by specific features.
Environmental Protection Area	sustainable use	land use and settlement control; assure the sustainable use of natural resources.
Area of Relevant Ecological Interest	sustainable use	protect locally or regionally important natural ecosystems and regulate their use, seeking nature conservation.
National Forest, State Forest and County Forest	sustainable use	promote multiple sustainable uses of forest resources; scientific research, with emphasis on methods of sustainable use of native flora cover.
Extractive Reserve	sustainable use	protect the livelihood and culture of traditional extractive societies and assure the sustainable use of natural resources.
Sustainable Development Reserve	sustainable use	preserve nature and assure conditions and means necessary for the livelihood, life quality and exploration of natural resources of traditional populations; maintain and improve management knowledge and techniques developed by these populations.
Fauna Reserve	sustainable use	protect populations of native animal species, terrestrial or aquatic, resident or migratory, in order to allow for technical-scientific studies on their sustainable management.
Private Reserve of the Natural Patrimony	sustainable use	conservation of biological diversity and scenic values in private properties.

Source: Sistema Nacional de Unidades de Conservação – SNUC. Law 9.985, 18 July 2000; Decree. 4.340, 22 August 2002.

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policies and practices in relation to environmentally protected areas have built a solid foundation, both in terms of national laws and of the international commitments assumed by the country.

4. THE CURRENT SITUATION OF FEDERAL UCS

In this section and in those that follow, we focus on selected dimensions of the history and the current situation of the federal system of UCs.[18]

A. Number and types of units and amounts of protected areas

The number of federal UCs and the area protected by them over the last 70 years (roughly 1937 until 2006) reveal two major trends. There has been a constant growth in the number and in the cumulative area of federal UCs, mostly during the last three decades. Graph 1 and Table 2 (below) show the relevant data. Over the last 30 years, the large numbers and the larger absolute sizes of new UCs helped build strongly exponential growth curves. The 1970s, however, had by far the largest percentage increase (377 per cent) in UCs. Absolute growth was remarkable in two sub-periods: (1) the 1980s, when 92 UCs were created, for a total of 21.5 million hectares; and (2) the first half of the present decade (2000-2006), when 89 UCs were created, for a total of 23.9 million hectares.[19]
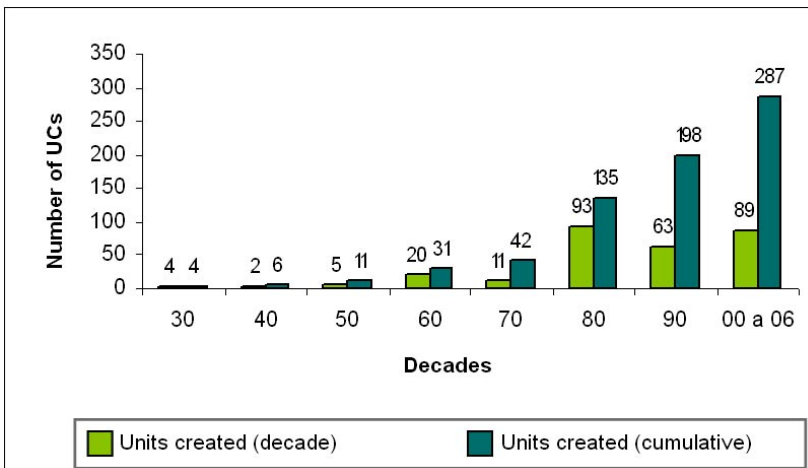
GRAPH 1. Brazil – Number of federal conservation units created, per decade (1930–2006)

Source: Ministry of the Environment

TABLE 2. Brazil – areas of federal conservation units created, per decade (1930–2006) (hectares)

period	area created	cumulative area of federal UCs	% of protected area added in the period in relation to previous total	cumulative % of the national territory covered by federal UCs (*)
1930–1939	209,020.29	209,020.29	---	0.024
1940–1949	40,022.57	249,042.86	19.14	0.029
1950–1959	576,662.94	825,705.80	231.55	0.09
1960–1969	681,095.84	1,506,801.64	82.48	0.17
1970–1979	5,680,696.38	7,187,498.02	377.00	0.84
1980–1989	21,509,799.85	28,697,297.87	299.26	3.37
1990–1999	16,843,326.48	45,540,624.35	58.69	5.34
2000–2006	23,987,762.68	69,528,387.03	52.67	7.69

(*) For the purpose of computing the figures in this column, the Brazilian national territory was considered as having 8,514,204.9 hectares.

Source: Núcleo de Geoprocessamento da Secretaria de Biodiversidade e Florestas, Ministério do Meio Ambiente (Ministry of the Environment)

The creation of federal UCs had a slow take-off for about 40 years (1930s through the early 1970s), picking up speed in the late 1970s. This pattern reflects the initial prevalence of a trend – deliberate or not – of creation of a small number of small national parks, near large and medium-sized urban centres located in the country's more densely populated coastal strip, and protecting mostly heavily forested areas. These units offered easy access, exceptional natural features (waterfalls, rapids, majestic peaks and mountains, geological formations and tall trees. – although they were not necessarily in a good state of preservation) and conditions favourable for scientific research. Since the late 1970s, however, other criteria have prevailed, accelerating the number of UCs and extending their individual and cumulative areas. This led to a new pattern – large numbers of larger units (both national parks and other categories), located in remote or frontier areas (non-coastal), and encompassing almost the full variety of Brazilian biomes and ecosystems.[20]

In the group of fully protected UCs, until the mid-1970s there were only National Parks. Only in 1974 was the first Biological Reserve established, with the name Poço das Antas (in the state of Rio de Janeiro). This reserve had a special significance, though, since it was created in connection with the first long-term Brazilian programme to save an animal species from extinction (the golden lion tamarin, *Leontopithecus rosalia rosalia*).[21] The first Ecological Stations appeared only in 1981. In late 2006, there were 62 National Parks, 29 Biological Reserves, 32 Ecological Stations and only 3 Wildlife Refuges. No natural monuments have been created, although a few are under study. The total number of fully protected federal UCs is 126.

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The pioneers of sustainable-use UCs were the Protective and National Forests. They started to be created in 1934 and most are now classified as National Forests. Only in 1984 were the first Environmental Protection Areas and Areas of Relevant Ecological Interest established. In 1990, extractive reserves were formally recognised as UCs, although some had been created a few years earlier. In late 2006 Brazil had 53 National Forests, 30 Environmental Protection Areas, 17 Areas of Relevant Ecological Interest, 50 Extractive Reserves and 1 Sustainable Development Reserve, for a total of 161 sustainable-use UCs. Fauna reserves have not yet been created. However, if we include the private reserves of the natural patrimony – 425 – sustainable-use UCs reach a total of 586.[22]

Graph 2 (below) displays the numbers of federal fully protected and sustainable-use UCs created per period, as well as their cumulative numbers. The data show that during the last two decades, approximately, the number of sustainable-use units has exceeded that of fully protected ones. This shows that the categories of the SNUC law have allowed a more balanced display of strictly preservationist units, on the one hand, and community-oriented units, on the other. Although tensions and conflicts will continue to arise between 'parks without people' and 'parks with people', the careful use of these categories can lead to effective environmental protection, allowing favourable conditions for leisure, research and environmental education, as well as for productive activities, particularly extractive or low-impact ones.
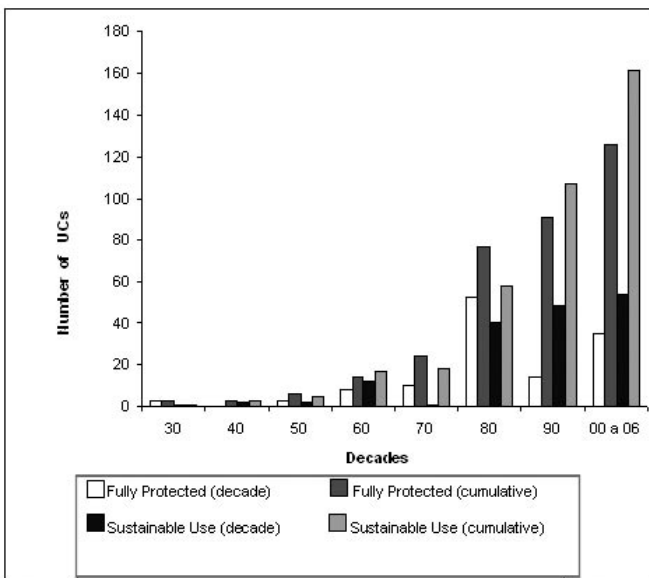
GRAPH 2. Brazil – Number of fully protected and sustainable-use conservation units created, per decade (1930-2006)

Source: Ministry of Environment

Let us now examine the matter of the areas of federal UCs. Table 3 displays data on the distribution (both in absolute and per centage terms) of the areas of fully protected UCs (N = 126) and sustainable-use units (N = 161), excluding private reserves.

TABLE 3. – Brazil: Distribution of the combined areas of federal conservation units, per group – situation in 2006 (hectares)

group	areas (absolute)	areas (per cent)
fully protected (126)	32,767,840.36	47.1
sustainable-use (161)	36,760,546.65	52.9
total	69,528,387.01	100.0

Source: Ministry of Environment

Thus, there is a relative balance between the combined areas of the two groups of federal UCs – 47.1 per cent versus 52.9 per cent. The large number of National Forests and the relatively large sizes of Extractive Reserves contribute the most to the slight predominance of sustainable-use units in terms of area. Among fully protected UCs, National Parks give the strongest contribution to this relative balance. Ecological Stations, on the average approximately as large as extractive reserves, give the second strongest contribution to this balance. Therefore, as far as their areas are concerned, federal UCs are almost evenly addressing human needs and the interests of biodiversity protection (see Table 4, below).

TABLE 4. Brazil: Distribution of the areas of federal conservation units, per category – situation in 2006

category	area (hectares)	% of the total area of federal UCs
national parks	21,739,151.95	31.27
biological reserves	3,934,749.64	5.66
ecological stations	6,948,693.76	10.00
wildlife refuges	145,245.00	0.20
natural monuments	0	0
areas of environmental protection	9,535,511.29	13.71
areas of relevant ecological interest	43,177.45	0.06
extractive reserves	10,045,319.09	14.44
national forests	17,071,803.80	24.56
sustainable development reserves	64,735.00	0.10
fauna reserves	0	0
total	69,528,387.02	100.00

Source: Ministry of the Environment

Data from Tables 5 and 6 (below) show the areas of federal UCs, created by decade, per categories. The data show that since the 1980s the tendency for

placing more areas under fully protected UCs was reversed. From this decade on, wider areas were put under sustainable-use UCs. In part, this expresses the growing influence of 'socio-environmental' concepts in UC policies and the consequent decline of the influence of the 'preservationist' perspective. The group of sustainable-use UCs, although 'younger' on average than those that are fully protected, has thus prevailed in terms of area. Another remarkable finding is the persistent creation, throughout the 70-year period, of National Parks and National Forests, the oldest categories. Their combined areas grew constantly and considerably. They can be considered the backbone of the system.

Table 5. Brazil – Areas of fully protected federal conservation units, per category, created per decade (1930–2006)

period	ecological stations	national parks	biological reserves	wildlife refuges	total
1930–1939	-	208,768,39	-	-	208,768.39
1940–1949	-	0.00	-	-	-
1950–1959	-	576,237.29	-	-	576,237.29
1960–1969	-	338,027.23	-	-	338,027.23
1970–1979	-	4,386,050.73	745,480.43	-	5,131,531.16
1980–1989	3,037,552.73	4,952,073.18	1,698,148.63	2.28	9,687,776.82
1990–1999	21,408.86	1,370,888.82	965,863.43	-	2,358,161.11
2000–2006	3,889,732.14	9,907,106.32	525,257.15	145,245.00	14,467,340.61

Source: Ministry of the Environment

TABLE 6.Brazil – areas of sustainable-use federal conservation units, per category, created per decade (1930–2006)

period	environ-mental protection areas	areas of relevant ecological interest	national forests	sustainable develop-ment reserves	extractive reserves	total
1930–1939	-	-	251.90	-	-	251.90
1940–1949	-	-	40,022.57	-	-	40,022.57
1950–1959	-	-	425.65	-	-	425.65
1960–1969	-	-	343,068.61	-	-	343,068.61
1970–1979	-	-	549,165.22	-	-	549,165.22
1980–1989	1,247,322.98	33,554.14	10,541,145.91	-	-	11,822,023.02
1990–1999	5,102,226.32	7,842.05	6,077,435.91	-	3,297,661.10	14,485,165.38
2000–2006	3,185,962.00	-	479,711.97	64,735.00	6,747,658.00	10,478,066.97

Source: Ministry of the Environment

Indeed, going back to Table 4, we can see that the category that holds the highest per centage of the total area protected by federal UCs is that of National

Parks, followed by National Forests. Together, they correspond to more than half (55.83 per cent) of the federally protected area. Environmental Protection Areas, Extractive Reserves and Ecological Stations form a second tier of UCs in terms of their cumulative areas. Their figures are fairly close to each others´ and together they contribute more than a third (38.15 per cent) of the total area protected by federal UCs. In spite of the large size of some biological reserves, they correspond to only 5.66 per cent of the total area protected by federal UCs. Areas of Relevant Ecological Interest, Sustainable Development Reserves and Wildlife Refuges cover only minute percentages.

The data in Tables 7 and 8 (below) allow the joint examination of the numbers and the areas of federal UCs, per category, and a ranking of the categories. Parks, National Forests and Extractive Reserves, for example, have the largest areas *and* the highest numbers of units. They are the protagonists of the system. Ecological Stations, Environmental Protection Areas and Biological Reserves play supporting roles. Areas of Relevant Ecological Interest, Wildlife Refuges and Sustainable Development Reserves have little weight in the system. Again we see a fairly balanced mix of the two groups of units.

In spite of the recent emphasis on the creation of sustainable-use units, National Parks display the largest average area among all categories, followed by Environmental Protection Areas and National Forests. Ecological Stations come next, in fourth place, surpassing Extractive Reserves and Biological Reserves. In terms of average sizes, therefore, fully protected units and sustainable-use units compete for the top of the ranking in the system. This affords further evidence of the balance between the purposes of full protection and sustainable use.

TABLE 7. Numbers and per centages of federal conservation units, per category – situation in 2006

category	number of UCs (absolute)	number of UCs (%)
national forests	63	21.86
national parks	62	21.60
extractive reserves	50	17.42
ecological stations	32	11.15
environmental protection areas	30	10.56
biological reserves	29	10.10
areas of relevant ecological interest	17	5.92
wildlife refuges	3	1.04
sustainable development reserves	1	0.35
total	287	100.0

Source: Ministry of the Environment

TABLE 8. Numbers and areas of federal conservation units, per category – situation in 2006

category	number of UCs	total area (hectares)	minimum area (hectares)	maximum area (hectares)	average area (hectares)
national forests	63	17,071,803.80	103,36	2,664,685.00	270,981.01
national parks	62	21,739,151.96	3,509,49	3,867,000.00	350,631.48
extractive reserves	50	10,045,319.10	601,05	1,288,716.20	200,906.38
ecological stations	32	6,948,693.76	27.82	3,373,266.93	217,146.68
environmental protection areas	30	9,535,511.30	949.89	1,592,550.00	317,850.37
biological reserves	29	3,934,749.64	548.00	940,358.00	135,681.02
areas of relevant ecological interest	17	43,177.45	9.61	15,000.00	2,539.85
wildlife refuges	3	145,245.00	142,00	128,521.00	48,415.00
sustainable develop-ment reserves	1	64,735.00	-	-	-
total	287	69,528,387.02	9.61	3,867,000.00	242,259.18

Source: Ministry of the Environment

As stated earlier, the total amount of areas protected by UCs has been growing considerably, especially over the last three decades. Despite this, there are gaps in terms of geographical and category distribution. This indicates clearly that there is a need to create more UCs. More pressing than this, however, is the full implementation of the SNUC Law, guaranteeing that the different categories of existing UCs will be well managed and coordinated among themselves. Correspondingly, it is important to pursue the goal of achieving a fair diversity of SNUC categories in all regions, biomes, ecoregions and ecosystems of the Brazilian territory, so that they may play their different roles in nature conservation.[23]

B. Regional Distribution

Another important dimension in the evolution of the Brazilian federal UCs system is regional distribution. In a country with such an extensive and ecologically varied territory, the matter of where to locate UCs is a major consideration for the overall quality of conservation policies. In geographical terms, federal UCs followed a general trajectory that started in several coastal zones to the East and followed several Western pathways, only belatedly reaching the huge Midwest heartland and the equally vast North and Northwest sections of the country. In terms of the country's human and economic geography, federal UCs expanded from urban-metropolitan regions to rural and frontier areas. This means that the first federal UCs were established close to coastal state capitals and other large

coastal or quasi-coastal urban centres. If we consider only national parks, of the 16 created between 1937 and 1961 three were coastal or nearly coastal and five were located inside large urban areas or in their areas of influence. Three others (Araguaia, Emas and Chapada dos Veadeiros) were set deep in Brazil's Midwestern heartland, but their creation was expedited so that they would be in the area of influence of the new national capital (Brasília), built in the second half of the 1950s. Thus, these three units do not genuinely express a policy of creating National Parks in the heartland. Even some inland parks created between 1937 and 1961 were relatively accessible from the coastline – Ubajara, Aparados da Serra, São Joaquim and Caparaó – considering the sheer size of Brazil. Among the three parks created in the early 1970s, one was definitely coastal (Serra da Bocaina), but the other two were located in the country's interior (Serra da Canastra and Tapajós).[24]

It was only after 1979 that locating UCs in the country's heartland or frontier areas became an explicit policy directive. This stemmed from the adoption of three new criteria for selecting UC sites: (1) protection of areas with well preserved ecosystems and landscapes, (2) ecosystem representation, in the context of the natural variety recorded in the entire national territory and (3) the relative scarcity of ecosystems and landscapes. These criteria were proposed in the first and second stages of the all-important *Plan for the Conservation Units System in Brazil*, drafted by technicians of the Brazilian Institute for Forest Development (IBDF) and an NGO (Fundação Brasileira de Conservação da Natureza) and applied since the late 1970s.[25] These criteria were intended to stimulate the creation of UCs that would (1) 'arrive early' in processes of frontier occupation, guaranteeing the preservation of fairly pristine ecosystems and landscapes, and (2) reshape the UC system so that it would be more in line with Brazil's rich natural variety.

This reversed the case-by-case or *ad hoc* creation strategy of federal UCs. They started to be located in relatively remote areas (not necessarily uninhabited), to have much larger sizes (following tenets of the emerging science of conservation biology) and to protect sections of the many different Brazilian biomes and ecosystems. Although this has become a common practice in Brazil and other countries in recent years, in the 1970s it was a remarkably innovative strategy.

The cumulative result of this new strategy is that the largest share of federal UCs, 109 (38 per cent), as well as most of the area protected by them (about 80 per cent), are now located in Brazil's North region (in which most of the Amazon Basin is located). This region was very poorly represented in the UC system before 1979. This change reflects a specific concern with the protection of the biodiversity of Brazil's 'last great frontier'. Following the North region in terms of specific weight in the UC system, come the Northeast (59 UCs, 20.60 per cent of the area), the Southeast (53 UCs, 18.47 per cent of the area), the South (34 UCs, 11.84 per cent of the area and the Midwest (19 UCs, 6.62

per cent). There are also 13 UCs (4.47 per cent) located on the borders of two or more regions.

Currently, there may even be a higher than desirable concentration of the number and area of federal units in the huge North region. There is certainly under-representation of the Midwest, but the fact is that the UC system now spans all of Brazil's five major geographical regions. This did not happen by chance. It was the result of careful planning, although somewhat plagued by discontinuous execution. In particular, in relation to the cumulative areas of federal UCs in the different regions, the 80 per cent figure for the North region must be evaluated jointly with two matters: (1) until the late 1970s large UCs (Brazil's largest UCs are located in that region) were not considered by Brazilian environmental managers to be of any particular advantage; and (2) severe limitations against of creating large units in the more densely populated Southeast, South and Northeast regions, on account of the denser settlement and a larger variety of established land uses.

C. Distribution by Biomes

One of the most important improvements in the concept of protected areas, and of UCs in particular, occurred when ecosystemic representation began to be used as a criterion for site selection. As stated above, early preservation and conservation initiatives throughout the world usually focused on rare or exceptional landscapes and/or on flora and fauna with great aesthetic appeal. Throughout the twentieth century, however, the emergence of the science of ecology, the improvement of mapping instruments on continental and global scales, the accumulation of knowledge about species, populations, communities and landscapes and about ecological processes, have changed the original focus. All landscapes, floral formations and animals have now gained 'citizenship', so to speak, and became worthy of conservationist efforts, including those lacking special aesthetic appeal.

In the international community of institutions, scientists and governmental technicians dedicated to conservation policies, this change was expressed in the deliberate creation of new units in locations, ecosystems or biomes previously 'forgotten' by the dominant aesthetic values. Deserts and mangroves are good examples. In Brazil, since the late 1960s at least, scientists such as Alceo Magnanini and part of the Instituto Brasileiro de Desenvolvimento Florestal – IBDF (Brazilian Institute for Forest Development)) technical staff were already concerned with the absence or scarcity of sections of various Brazilian biomes in the UC system – coastal mangroves and islands, *caatinga* (dry scrub forest), *cerrado* (tropical savanna), *pantanal* (swampland), besides several Amazonian ecosystems (*cerrados*, floodable, montane and highland forests, mangroves etc.). The aforementioned 1979 *Plan for the Conservation Units System in Brazil* was based on extensive field studies motivated by this concern

of Magnanini and his collaborators with the inclusion of 'missing' Brazilian biomes in the UC system.[26]

More recently, during negotiations prior to the signature of the Convention of Biological Diversity, in 1992, and in ensuing policies and actions, concern with ecosystemic representation in UC systems emerged as a world-wide consensus. This consensus was translated into commitments by the signing countries to spread their UCs among their different biomes. In this respect, Brazil committed itself to place under the protection of UCs a significant percentage of each of its biomes. This percentage was defined as 10 per cent and was written into the National Strategic Plan for Protected Areas (instituted by Decree 5.758, 13 April 2006).

This section examines the overlapping – or lack thereof – of federal UCs and Brazilian biomes (as officially defined by the Brazilian Census Agency – IBGE). This matter is somewhat related to the regional distribution of UCs examined above, but Brazilian biomes typically cut through official regional boundaries, giving a separate importance to the matter of biome representation. According to the *Mapa de Biomas Brasileiros* (2003), published by the IBGE, Brazil has six major 'continental' biomes. Their names in Portuguese are Amazônia, Cerrado, Caatinga, Mata Atlântica, Pantanal and Pampa (see Figure 1 and Table

FIGURE 1. Brazilian continental biomes

Source: IBGE – Mapa de Biomas Brasileiros, 2003.

9, below).[27] Their sizes vary greatly, as illustrated by the contrast between the extremes: the largest, Amazônia (49.29 per cent of the national territory), and the smallest, Pantanal (1.76 per cent).

Table 9 – Brazilian continental biomes – absolute and relative extension

Brazilian continental biomes	approximate area (hectares)	% of Brazil's national territory
Amazônia	419,694,300	49.29%
Cerrado	203,644,800	23.92%
Mata Atlântica	111,018,200	13.04%
Caatinga	84,445,300	9.92%
Pampa	17,649,600	2.07%
Pantanal	15,035,500	1.76%
Total area of Brazil	851,487,700	100.00%

Source: IBGE – *Mapa de Biomas Brasileiros*, 2003.

The Amazônia biome (mostly tropical rain forests) covers the entire territories of five states (Acre, Amapá, Amazonas, Pará e Roraima), most of Rondônia (98.8 per cent) and more than half of Mato Grosso (54 per cent), besides parts of Maranhão (34 per cent) and Tocantins (9 per cent).

Mata Atlântica (also mostly tropical and subtropical rain forests) occupies the entire territories of three states – Espírito Santo, Rio de Janeiro and Santa Catarina – 98 per cent of Paraná, besides smaller portions of 11 other states – Rio Grande do Sul, São Paulo, Minas Gerais, Bahia, Sergipe, Alagoas, Pernambuco, Paraíba, Rio Grande do Norte, Mato Grosso do Sul and Goiás.

Cerrado (sub-humid savannas) occupies the entire Federal District, almost all of Goiás (97 per cent), extensive sections Tocantins (91 per cent), Maranhão (65 per cent), Mato Grosso do Sul (61 per cent), Minas Gerais (57 per cent), besides smaller portions of six other states – Rondônia, Mato Grosso, Piauí, Pará, Amapá and São Paulo.

Caatinga (semi-arid scrub forests) covers the entire territory of Ceará, most of Rio Grande do Norte (95 per cent), Paraíba (92 per cent) and Pernambuco (83 per cent); large expanses of Piauí (63 per cent), Bahia (54 per cent), Alagoas (48 per cent) and Sergipe (49 per cent), besides small areas of Minas Gerais (2 per cent) and Maranhão (1 per cent).

Pantanal (seasonally inundated fresh water wetlands) occupies portions of only two states: 25 per cent of Mato Grosso do Sul and 7 per cent of Mato Grosso.

Pampa (temperate grasslands) is restricted to Brazil's southernmost state, Rio Grande do Sul. It occupies 63 per cent of its territory.

Are these continental biomes equally contemplated by the distribution of federal UCs? By mid-2006, there was a total of 66,101,282.5 hectares protected by Brazilian federal UCs of all categories. UCs are present in all six continental biomes. However, their distribution is quite unbalanced. According to data from

the Ministry of the Environment, Brazilian biomes are protected by UCs in the proportions indicated in Table 10 (below):

TABLE 10. Areas of Brazilian biomes protected by federal conservation units – situation in 2005 (hectares)

| biomes	approximate area	approximate area under federal UCs	% of biome protected by federal UCs
Amazônia	419,694,300	52,120,672.56	12.41%
Cerrado	203,644,800	4,038,986.92	1.98%
Mata Atlântica	111,018,200	3,948,475.04	3.55%
Caatinga	84,445,300	1,238,577.21	1.46%
Pampa	17,649,600	466,362.70	2.64%
Pantanal	15,035,500	150,106.48	0.99%

Source: Ministry of the Environment

The six figures in the last column of Table 10 are quite uneven and the extremes are very far apart. Proportionally, Amazônia has about 12.5 times more protected area than Pantanal. Incidentally, Amazônia is the only biome for which Brazil has reached (and actually gone beyond) the minimum percentage of protected area (10 per cent) defined in the Convention on Biodiversity Protection. All other biomes are still fall far below this figure. Much remains to be done, therefore, in order to achieve a more balanced representation of Brazilian biomes in the federal UC system. Still, there has been an impressive improvement in the case of Amazônia, practically untouched by federal UCs until the mid-1970s. Although the Cerrado and Pantanal biomes are still too lightly covered with federal UCs, this coverage is also mostly recent.

A remarkable aspect is that, of these 287 federal UCs, 13 were located in transition areas between two biomes. These 13 units comprise a total of 2,071,134.30 hectares, amounting to a mere 3.13 per cent of the area protected by federal UCs. Therefore, most (96.87 per cent) of this protected area occupies sections dominated by single biomes (as opposed to transition areas between biomes).[28] We found no published explanation for the under-representation of these biologically rich transition areas. This issue is relevant because major Brazilian biomes have among them thousands of linear kilometres of transition zones, as can be promptly seen in Figure 1 (above). Especially for purposes of scientific research, these transitional areas are ideal for several types of studies about ecological processes and the expansion or contraction of biomes.

Graph 3, below, illustrates how the total area protected by federal UCs is distributed between Brazil's six continental biomes and the Marinho (marine) biome. It is again easily noticed that the distribution of the federal UC system is unbalanced, since Amazônia accumulates 83 per cent of the total protected area. Three of the seven biomes have only a trace participation. Even taking

into account that Amazônia is the largest biome and that the largest UCs are situated in it, the unbalance is still marked.
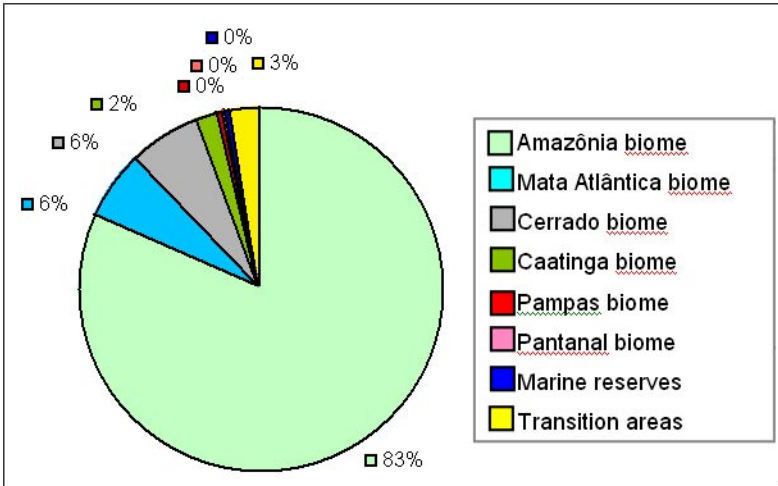
GRAPH 3. Brazil – Distribution of the area covered by Brazilian federal UCs, by biome (per cent) – situation in 2006

Source: Ministry of the Environment

There are further important observations to be made about the incidence of UCs in each biome.[29] The approximate area of the entire Amazônia biome is 6.5 million square kilometres and it spreads out well beyond Brazilian international borders. It covers two fifths of the South American land mass and 5 per cent of the terrestrial surface of the planet. 60 per cent of the biome is in Brazil and the other 40 per cent is divided between Bolivia, Peru, Ecuador, Colombia, Venezuela, Suriname, Guiana and French Guiana. This Brazilian portion of the biome is protected by 107 federal UCs that occupy 52,120,672.56 hectares, corresponding to 12.41 per cent of the biome's extension inside Brazilian borders. Out of these 107 UCs, 20,579,828.56 hectares (4.90 per cent) are in fully protected units and 31,540,844 hectares (7.51 per cent) are in sustainable-use units. There are 790,325,80 hectares of UCs that span Amazônia and Cerrado biomes simultaneously. These relatively bloated figures are in part explained by the strong international visibility of tropical rain forests among the community of conservation scientists and activists.

The Cerrado is Brazil's second largest biome, with an area of 203,644,800 hectares, about 23 per cent of the national territory. It also extends beyond Brazilian borders, into Bolivia and Paraguay. Three major Brazilian rivers have

their source inside the biome, corresponding to three of the country's largest hydrographical basins (Paraná, Araguaia/Tocantins and São Francisco). The biome has variable but substantial seasonal amounts of rainfall along most of its range, a fact that helps it sustain these networks of powerful and permanent rivers and a rich biodiversity. The Cerrado biome occurs in 45 federal UCs, with a total area of 6,464,856.3 hectares. Of these 45 units, 31 protect typical stretches of Cerrado, with an area of 3,870,452.07 hectares, while in the 14 other units there are also fragments of other biomes. Of these 31 units, 17 are for sustainable use (1,273,299.17 hectares) and 14 are fully protected (2,597,152.36 hectares), adding to a minimal 1.98 per cent of the total area of the Cerrado in Brazil (1.18 per cent in full protection units and 0.8 per cent in sustainable use units). The other 14 units that span Cerrado and one other biome correspond to 2,594,404.3 hectares of Cerrado and Amazônia, Cerrado and Caatinga, or Cerrado and Mata Atlântica. The Cerrado biome has been affected very strongly over the last three decades by the commercially successful expansion of agribusiness. The novel trend of seeking new croplands for the raw materials of biofuels is expected to have a strong additional effect on the integrity of the biome.

The Pantanal biome has approximately 15,035,500 hectares. It also runs beyond Brazilian international borders, spanning sections of Bolivia and Paraguay. In spite of the rich biodiversity of this floodplain/wetland area, it is affected by only two federal fully protected UCs, for a total of 150,106.48 hectares, only 0.99 per cent of the biome (the lowest figure for all biomes). In Mato Grosso, the Taiamã Ecological Station protects 14,277.41 hectares. Between the states of Mato Grosso and Mato Grosso do Sul there is the Pantanal Matogrossense National Park, with 135,829.08 hectares.

The Caatinga biome occupies 84,445,300 hectares, about 9 per cent of the Brazilian territory. It is the only exclusively Brazilian biome. This means that a considerable part of its biological patrimony is not found in any other country. 30 federal UCs, with a combined area of 4,157,050.34 hectares, protect it. Of these, 21 protect exclusively the Caatinga biome, with 1,238,557.21 hectares (1.46 per cent of the total area of the biome; 0.24 per cent in fully protected units and 1.22 per cent in sustainable-use units). The other 9 units protect areas that also include other biomes.

The Mata Atlântica biome covers about 12 per cent of the Brazilian territory and occupies a long, continuous portion of the Brazilian Atlantic coastline, penetrating inland sometimes just a few dozen kilometres, and other times a few hundred kilometres. This strip spans from the north of Rio Grande do Sul to Rio Grande do Norte, with a deeper inland penetration in the South and more shallow penetration in the Northeast. It stretches into the territories of Argentina and Paraguay. Although today it is mostly converted and degraded, it remains host to a very rich biodiversity (and to more than two thirds of the Brazilian GDP), as a result of variations in climate, altitude and latitude. As the largest continuous tract of tropical rain forests to be almost totally converted by

human action in historical times[30], it is one of the most endangered biomes in the world. According to data from the Ministry of the Environment, there are currently 88 federal UCs that protect exclusively stretches of the Mata Atlântica biome, with 3,498,475.04 hectares, and 8 other units that protect it in conjunction with sections of other biomes, for a total of 419,286.60 hectares. These 88 federal UCs cover only 3.55 per cent of the biome's area. Of these, 48 are fully protected, with 2,855,144.87 hectares (2.57 per cent of the biome), and 40 are sustainable-use UCs, with 1,093,330.17 hectares (0.98 per cent of the biome). The 8 federal UCs that contain Mata Atlântica along with other biomes are distributed as: 2 with Mata Atlântica and Caatinga biomes (6,755.96 hectares); 4 with Mata Atlântica and Cerrado (264,476.56 hectares); and 2 with Pampa and Mata Atlântica biomes (148,054.16 hectares).

The Pampa (an indigenous name meaning 'flat land') biome is also known as Pradarias Sulinas (roughly Southern Prairies). It occurs only in the southernmost state of Rio Grande do Sul, extending into Uruguay and Argentina. There are 5 federal UCs in the Pampa, with 466,362.70 hectares, corresponding to 2.65 per cent of the biome. There are 318,308.54 hectares of sustainable-use UCs (1.81 per cent of the biome in Brazil). The Taim Ecological Station and the Lagoa do Peixe National Park, fully protected UCs, affect the other 148,054.16 hectares (0.83 per cent) of the Pampa biome.

Several patterns and some unique features appear in our analysis. We will stress only three important aspects of the distribution of federal UCs among Brazilian biomes. First, as mentioned earlier, only the Amazônia biome is adequately protected, in terms of having more than 10 per cent of its area under UCs. Second, the remaining biomes are well below this mark of 10 per cent of protected areas, a fact that points to the need for creating many more UCs. Third, a fair number of UCs protect combinations of biomes, but the vast transitional zones are under-represented.

Besides continental biomes, it is noteworthy that the Marinho biome, corresponding to the entire Brazilian coastline, also has UCs, although in a minimal proportion. In 2006, there were only 156,870.42 hectares of the Marinho biome preserved in UCs. 37,384.34 of these are under fully protected units. The remaining 119,486.08 hectares lie inside sustainable-use units. However, there are numerous types of habitats and landscapes along the 7,000 km-long Brazilian Atlantic coastline, generating an enormous variety of ecosystems subject to marine, estuary and lagoon processes. There are extensive mangroves, marshes, sandy beaches, rock formations, cliffs, coral reefs, calcium algae banks, dunes, sand strips, sandstone reefs, sand banks, sand bars, besides coastal and oceanic islands. The biological richness of Brazilian marine ecosystems translates into immense fishing, biotechnological and energy potentials. Therefore, this biome remains a 'frontier' for the creation of new UCs.[31]

5. CLOSING REMARKS AND CONCLUSIONS

The examination of just a few selected dimensions of the federal Brazilian UC system leads to the conclusion that basic actions and steps to build the system were taken over the last decades and that they have resulted in an extensive and rich system of protected areas. It is clear also that many new UCs remain to be created. This is not only because Brazil falls below the minimum percentages agreed upon at the global level in the Biodiversity Protection Convention for the protection of ecosystems and biomes, but also because existing units still have a generally skewed distribution in terms of categories, regions and biomes – not to mention many other problems not examined herein, such as land tenure issues, lack of personnel, poor funding and inadequate management.

The impressive increases in types of units, numbers of units and in the cumulative areas of federal UCs over the last 30 years, approximately, pose the equally pressing task of improving the management of existing units. The effective management of the UC system and the still distant possibility of integrated management of the many types of protected areas in Brazil (permanent preservation areas and legal reserves in private properties, indigenous and *quilombola* homelands, for example) could easily raise Brazil to the status of an international reference in nature conservation. This would require, of course, massive investments in conservation and something just short of a paradigm shift in Brazilian society at large. The prevailing political outlook of the general population would have to move from a near obsession with short-term economic growth achieved by means of the careless exploitation of natural resources (this obsession remains as strong as ever within the current coalition supporting President Luiz Inacio Lula da Silva), to a perception of the economic and social advantages of combining preservation with the conservationist use of natural resources.

NOTES

[1] An authoritative statement on megadiversity is available in Russel A. Mittermaier et al. (eds), *Megadiversity – Earth's Biologically Wealthiest Nations* (Portland: Graphic Arts Center Publishing Company, 2004). The strong relevance of Brazil for studies in the field of environmental history is argued by José Drummond, 'Brazil', in Shepard Krech III, J. R. McNeill and Carolyn Merchant (eds.), *Encyclopedia of World Environmental History* (New York: Routledge, 2004), 161–169.

[2] Warren Dean, *With Broadax and Firebrand* (Berkeley: University of California Press, 1995).

[3] A single, book-length text containing the history of UCs and other protected areas in Brazil is yet to be written. However, there are many studies on specific units, groups of units and conservation policies. An overview of the current situation of all types of conservation units in Brazil is José Augusto Drummond, José Luiz de Andrade Franco and Alessandra Bortoni Ninis, *O Estado das Áreas Protegidas no Brasil – 2005* (Brasília:

Centro de Desenvolvimento Sustentável – Universidade de Brasília, 2006), available at http://www.unbcds.pro.br/conteudo_arquivo/150607_2F62A6.pdf. On Brazilian national parks, see the classic Wanderbilt Duarte de Barros, *Parques Nacionais do Brasil* (Rio de Janeiro: Ministério da Agricultura, 1952); on the national parks of the state of Rio de Janeiro, see José Drummond, *Devastação e Preservação Ambiental* (Niterói: Editora da Universidade Federal Fluminense, 1997); for an overview of the process of creation of UCs in Brazil, see Maria Tereza Jorge Pádua, 'Sistema Brasileiro de Unidades de Conservação: de onde viemos e para onde vamos?', *Congresso Brasileiro de Unidades de Conservação*, Anais, Volume I (Curitiba: IAP/UNILIVRE/Rede Nacional Pró Unidades de Conservação, 1997); IBAMA/MMA, *Atlas de Conservação da Natureza Brasileira: Unidades Federais* (São Paulo: METALIVROS, 2004); deforestation and early calls for conservation are examined in Dean, *With Broadax and Firebrand*, especially Chapter 10, and in José Luiz de Andrade Franco, *Proteção à Natureza e Identidade Nacional: 1930-1940* (Doctoral Thesis, Universidade de Brasília, 2002); early appeals for conservation are discussed in five articles by José Luiz de Andrade Franco and José Augusto. Drummond: 'Alberto José Sampaio: um botânico brasileiro e o seu programa de proteção à natureza', *Varia Historia* 33 (2005): 129–159; 'Frederico Carlos Hoehne: a atualidade de um pioneiro no campo da proteção à natureza no Brasil', *Ambiente & Sociedade* VIII. 1 (2005): 141–166; 'Frederico Carlos Hoehne: viagem à Araucarilândia', *Desenvolvimento e Meio Ambiente* 11–12 (2005): 11–21; 'Armando Magalhães Corrêa: gente e natureza de um sertão quase metropolitano', *História, Ciências, Saúde: Manguinhos* 12, 3 (2005): 1033–1059; and 'Cândido de Mello Leitão: as ciências biológicas e a valorização da natureza e da diversidade da vida', *História, Ciências, Saúde: Manguinhos* 14, 4 (2007): 1265–1290. Some Brazilian states have updated information and analysis about UCs in their territories. For the state of Amapá, see José Augusto Drummond, Daguinete Maria Chaves Brito and Teresa Cristina Albuquerque de Castro Dias, *Atlas das Unidades de Conservação do Estado do Amapá* [CD-ROM] (Macapá: Secretaria de Meio Ambiente do Amapá; Gerência Executiva do IBAMA no Amapá, 2005); for the state of São Paulo, see Secretaria de Estado de Meio Ambiente do Estado de São Paulo, *Atlas das Unidades de Conservação Ambiental do Estado de São Paulo* (São Paulo, 2000); for UCs of the state of Goiás, see Juliana Ferreira Leite, *As Unidades de Conservação Estaduais: Uma Análise da Realidade Goiana* (Masters' thesis, Sustainable Development, Universidade de Brasília, June 2004) (available at http://200.130.0.16/biblioteca/JulianaLeite.pdf).

[4] Maria Cecília Wey de Brito, *Unidades de Conservação: Intenções e Resultados* (São Paulo: Annablume/FAPESP, 2000).

[5] Roderick Nash, *Wilderness and the American Mind* (3rd edn, New Haven: Yale University Press, 1982); John McCormick, *Reclaiming Paradise: The Global Environmental Movement* (Bloomington: Indiana University Press. 1989).

[6] José Augusto Drummond, 'The Garden in the Machine: An Environmental History of the Tijuca Forest (Rio de Janeiro, Brazil), 1862–1889', *Journal of Environmental History* 1, 1 (1996): 83–104.

[7] See McCormick, *Reclaiming Paradise*…; from the point of view of the history of ecological science and of environmental protection ideas, much relevant information and analysis is contained in Donald Worster, *Nature's Economy: A History of Ecological Ideas* (Cambridge: Cambridge University Press, 1998). Other texts pertinent to the development of the concepts of protected areas are Samuel P. Hays, *Beauty, Health and Permanence – Environmental Politics in the United States, 1955–1985* (Cambridge:

Cambridge University Press, 1987); Alfred Runte, *National Parks: The American Experience* (Lincoln: University of Nebraska Press, 1979). Management requirements for Brazilian extractive reserves and the prevalence of their social goals are spelled out in detail in Ecio Rodrigues, Alberto Costa de Paula e Carla Medeiros y Araújo (eds.), *Roteiros Metodológicos: Plano de Manejo de Uso Múltiplo das Reservas Estrativistas Federais* (Brasília: IBAMA/MMA, 2004). A recent historical and political overview of the development of Brazilian environmental concern and policies is Kathryn Hochstetler and Margaret E. Keck, *Greening Brazil: Environmental Activism in State and Society* (Durham, N.C.: Duke University Press, 2007).

[8] André Rebouças, *Excursão ao Salto do Guaíra: O Parque Nacional* (Rio de Janeiro, 1876). For much earlier thoughts and actions by Brazilian and Portuguese nationals about the degradation of Brazilian natural resources, dated in late colonial and early post-colonial times, see the ground-breaking work of José Augusto Pádua, *Um Sopro de Destruição: pensamento político e crítica ambiental no Brasil escravista (1786–1888)* (Rio de Janeiro: Jorge Zahar Editora, 2002). On the Parque Estadual da Capital, see Maria Tereza Jorge Pádua, 'Sistema Brasileiro de Unidades de Conservação…', 216.

[9] On the creation of these two biological stations, see Dean, *With Broadax and Firebrand*; Wanderbilt Duarte de Barros, *Parques Nacionais do Brasi*; José Luiz de Andrade Franco and José Augusto Drummond, 'Frederico Carlos Hoehne: a atualidade'.

[10] On these and other Brazilian national forests, see IBAMA/MMA, *Atlas de Conservação da Natureza Brasileira: Unidades Federais* (São Paulo: Metalivros, 2004).

[11] José Augusto Drummond, *O Sistema Brasileiro de Parques Nacionais: análise dos resultados de uma política ambiental* (Niterói: EDUFF, 1997).

[12] APPs are composed of portions of all Brazilian private rural properties that are to be spared from productive uses, for the sake of conservation – river banks and borders, lake borders, steep slopes, mountain tops, etc.

[13] Among many texts that assigned the utmost priority to the preservation the world's tropical rainforests, see the influential productions of Norman Myers, *The Primary Source – Tropical Forests and our Future* (New York: Norton, 1985) and Edward O. Wilson, *The Diversity of Life* (Cambridge, Massachusetts: Harvard Univeristy Press, 1992).

[14] An annotated list of laws and regulations concerning the creation and management of UCs and the emergence of different categories of UCs appears in José Augusto Drummond and Ana Flávia Barros Platiau, 'Brazilian Environmental Laws and Policies, 1934–2002: a critical overview', *Law and Policy* 28, 1 (2006): 83–108 , http://papers.ssrn.com/sol3/cf_dev/AbsByAuth.cfm?per_id=565646; see also Maria Tereza Jorge Pádua, 'Sistema Brasileiro de Unidades de Conservação…'; IBAMA/MMA, *Atlas de Conservação….*

[15] An excellent insider's view of the congressional discussion of this bill and its transformation into law is provided by Maurício Mercadante, 'Uma Década de Debate e Negociação: a História da Elaboração da Lei do SNUC', in Antônio Herman BENJAMIN (ed.), *Direito Ambiental das Áreas Protegidas* (Rio de Janeiro: Forense, 2001), 190-231.

[16] Legal Reserves (LR) were defined in the 1965 Forest Code as minimum percentages of all private rural properties, which must be left by their owners under native flora cover. Percentages vary with the biomes in which the properties are located. They may be assessed in addition to aforementioned APP areas in each property. Until the 1990s, Indigenous Homelands had been the object of policies only loosely related to environmental policies, including UCs. Actually, the overlap of conservation units and these

homelands has been the single most conflictive aspect of many UCs located in Brazil's Amazonia and Midwest regions; on this matter, see Fany Ricardo (ed.), *Terras Indígenas & Unidades de Conservação – o desafio das sobreposições* (São Paulo: Instituto Socioambiental, 2004). *Quilombo* Homelands refer to land grants that are being made, over the last 15 years, to hundreds of communities (*quilombos*) descending from escaped Black slaves. Their relation with UCs has also been mostly conflictive and the notion of including them under the umbrella concept of protected areas is new and controversial, even among *quilombo* communities themselves.

[17] One pending problem – hopefully minor – is the resemblance between the goals of extractive reserves and sustainable development reserves. Both categories are designed to accommodate the permanence and the livelihood of the so-called traditional populations. There seems to be no need for the existence of both categories.

[18] The remaining sections are based mostly on an extensive database about Brazilian UCs, the most encompassing ever produced on the matter. It was pulled together in 2006 by a task force of professionals from the Ministry of the Environment and all state environmental agencies. This database has since been partially updated and organized in a searchable format. It can be found at http://sistemas.mma.gov.br/portalcnuc/index.ph p?ido=principal.index&idConteudo=5987&idEstrutura=119. Unfortunately, it has been available online only intermittently. This database covers 712 federal UCs existent in 2006. Our text focuses on only 287 federal UCs, however, excluding 425 units belonging to the category of private reserves of the natural patrimony, which are numerous, but quite young and mostly very small. They deserve a separate examination, sketched in Drummond, Franco and Ninis, *Estado das Áreas Protegidas…*

[19] The years 2007 and 2008 (not recorded in the database) have witnessed strong growth in the number and area of federal UCs. If this drive continues for the next two years, the decade 2001–2010 will most probably top all previous ones in the matters of the numbers of created units and the extension of their combined areas.

[20] Carla Morsello, *Áreas Protegidas Públicas e Privadas: Seleção e Manejo* (São Paulo: Annablume/FAPESP, 2001); Drummond, *O Sistema Brasileiro de Parques Nacionais….*

[21] The reserve was set up specifically for the release of captive-bred bands of tamarins and is currently considered 'full'. For several years now new bands of tamarins have been released in nearby private reserves.

[22] We also excluded from our analysis 11 national forests established between 1989 and 1990, since their creation decrees were revoked on account of their 100 per cent overlap with indigenous lands. Their situation is under a protracted review.

[23] An example of a strong degree of unbalance can be found among the UCs managed by the state of Bahia (one of Brazil's most biologically diverse states), also subject to the SNUC Law. In 2007, while the state had only three parks (fully protected), it had 28 environmental protection areas (sustainable use). See Lílian Maria Ferraz de Carvalho, *Gestão de áreas de proteção ambiental no Estado da Bahia: análise de um modelo em construção*. Master's thesis (Sustainable Development), Universidade de Brasília. Brasília, 2004; and José Alberto Castro Macedo, *Avaliação da gestão participativa dos parques estaduais da Bahia*. Master's thesis (Sustainable Development), Universidade de Brasília. Brasília, 2008.

[24] The matter of the regional distribution of Brazilian national parks is discussed in more detail in Drummond, *O Sistema Brasileiro de Parques Nacionais*...

[25] See IBDF and Fundação Brasileira para Conservação da Natureza, *Plano do Sistema de Unidades de Conservação do Brasil* (Brasília, 1979); and IBDF and Fundação Brasileira para Conservação da Natureza, *Plano do Sistema de Unidades de Conservação do Brasil- II Etapa* (Brasília 1982). These were inter-related 'master plans' – the first of their kind in Brazil – for the development of a system of federal conservation units, including new types of units and new criteria for site selection and management.

[26] See the pioneering work of Alceo Magnanini, *Política e Diretrizes dos Parques Nacionais do Brasil* (Rio de Janeiro: Instituto Brasileiro de Desenvolvimento Florestal, l970), a document that influenced the aforementioned 1979 and 1982 UC 'master plans'.

[27] There are two non-continental biomes, called Marinho (marine) and Oceânico (oceanic).

[28] Of these 13 units, 4 (with 790,325.80 hectares) are located between Cerrado and Amazônia biomes; 4 (861,518.82 hectares) lie between Cerrado and Caatinga biomes; 2 (6,755.96 hectares) lie between Mata Atlântica and Pampas; and 4 (264,479.56 hectares) are located between Cerrado and Mata Atlântica biomes.

[29] The following observations and figures related to each biome come from the aforementioned database: http://sistemas.mma.gov.br/portalcnuc/index.php?ido=principal.index&idConteudo=5987&idEstrutura=119.

[30] Dean, *With Broadax and Firebrand*...

[31] We excluded private, state and municipal UCs from this analysis, as well as indigenous and *quilombola* homelands. This is not to deny their importance for the full understanding of the situation of Brazilian UCs and related conservation policies. However, the data collected about them – and placed into the same database of the Ministry of the Environment that we used – are so extensive that they must be studied separately. Private UCs, for example, can play a fundamental role in involving private landowners in conservation issues. Several Brazilian states have numerous, well-designed and well-located public UCs and have adopted efficient management standards. Municipal UCs are also numerous, but they usually lack adequate design and management. Comprehensive information about them is still to be consolidated. Some indigenous and *quilombola* homelands have well-preserved ecosystems and landscapes and thus have a potential for being included in conservation policies. See Drummond, Franco and Ninis, *O Estado da Áreas Protegidas*... for several sections dedicated to private reserves, state and municipal UCs, indigenous homelands and *quilombola* homelands.