The text that follows is a PREPRINT.

Please cite as:

Fearnside, P.M. and J. Ferraz. 1995. A conservation gap analysis of Brazil's Amazonian vegetation. Conservation Biology 9(5): 1134-1147.

ISSN: 0888-8892

The original publication is available from Blackwell Publishing Inc. at:
http://www.blackwellpublishing.com <Blackwell>

A CONSERVATION GAP ANALYSIS OF BRAZIL'S AMAZONIAN VEGETATION

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14 July 1994
1 April 1995
3 April 1995
12 April 1995
13 April 1995
2 May 1995

ABSTRACT

Vegetation types lacking protection in the existing conservation units of the nine states in the Brazilian Legal Amazon are identified, and locations are noted where examples of these types could be protected. Maps of vegetation, protected areas, and semi-protected areas, such as Amerindian and forestry reserves, are digitized and overlaid using a geographic information system. There are 28 natural vegetation types in the Brazilian Legal Amazon listed on the legend of the map used (scale: 1:5,000,000). Locations of areas for additional protection were selected using a minimum criterion of protecting at least one example of each vegetation type in each state (here called "vegetation zones"). There are 111 vegetation zones in the Legal Amazon, of which only 37 (33%) have some portion of their area protected. There are few protected areas in the most heavily deforested states along the southeastern fringe of the forest. In Maranhão, where 60% of the original forest had been lost by 1990, only 1 of 10 vegetation types is protected. Negotiating agreements with indigenous tribes, and to a lesser extent with extractivists who harvest non-timber products from the forest, represents a major opportunity for significantly increasing the area and representativeness of the conservation units. Additional conservation units need to be established quickly, before rapidly increasing deforestation and land prices preclude this opportunity; otherwise, significant vegetation types can be expected to disappear.

INTRODUCTION

Decisions on protecting natural ecosystems require information on the biological importance of different areas, as well as on political and social factors affecting each area. It is important to make the best use of available information to identify those areas of highest priority so that reserves can be established to protect biological and ecological diversity.

The present study applies one criterion for assigning priority on biological grounds: the vegetation type as classified on the map produced by the Brazilian Institute of Geography and Statistics (IBGE) and the former Brazilian Institute of Forestry Development (IBDF) (Brazil, IBGE & IBDF 1988). IBDF is now part of the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA), and the map is known as the "IBAMA map." Amazonian vegetation types from this map legend are defined in Table 1. This does not imply that other criteria should not also be applied, nor does it mean that areas not identified are unimportant. This study seeks to evaluate additional areas not already protected by the Brazilian government and assumes that areas already protected will continue to enjoy this status in perpetuity.

Natural vegetation types on the IBAMA map are used to define "vegetation zones," or the area within each of the nine states in Brazil's 5 X 10^6 km^2 Legal Amazon that is covered by one of the vegetation types. The areas of biological priority indicated by the vegetation zone criterion are not particularly large. Applying other criteria produces much larger areas of high priority. One reason for setting aside large areas is the need for redundancy; Brazil's record of sacrificing protected areas does not lead to confidence that all areas protected will survive indefinitely (see Fearnside & Ferreira 1985; Foresta 1991). Examples include the flooding of Sete Quedas National Park by the Itaipu Dam in 1982 and current plans to sacrifice the turtle protection functions of the Rio Trombetas Biological Reserve when the Cachoeira Porteira Dam is built (Fig. 1). A number of protected areas have illegal logging and goldmining activities within them (e.g. Peres & Terborgh 1994).

ESTABLISHING PRIORITIES

A problem in establishing objective criteria for assigning biological importance is the varying level of knowledge about different ecosystems and geographic locations in Amazonia. Most biological diversity is found in heavily collected areas (Nelson et al. 1990). An alternative criterion would give highest priority to areas that have had very little study because of a precautionary principle to avoid the loss of unknown but potentially valuable biodiversity.

The degree of threat posed by current exploitation and development activities varies greatly among regions and vegetation types. Threatened areas include the *várzea* (white-water floodplain) forest where the ease of water access combined with valuable timber species (such as *ucuuba* or virola: *Virola* spp.) have made this the primary source of timber in the region. In upland areas, locations of higher concentrations of valuable trees, such as Rondônia's stands of *cerejeira* or cherrywood (*Torresea acreana* Ducke) and *mogno* or mahogany (*Swietenia macrophylla* King) have made them a prime target for logging, including activity in Amerindian reserves (Fearnside 1990a). A combination of ranching development (largely for land speculation purposes) and charcoal production for pig iron smelting in the Grande Carajás Program area has focused pressure on the forest types of that area, including the vine forests of western Maranhão (see Fearnside 1989a,b). Plans for highway construction include the Trans-frontier Highway planned for strategic reasons to parallel all of Brazil's international borders in Amazonia (*Jornal do Brasil* 12 August 1991), and roads planned under the Calha Norte Program for military bases along the borders north of the Amazon River (Setubal et al. 1986). Settlement along these roads is to be promoted for strategic reasons (Setubal et al. 1986, see Fearnside 1990a). In the case of western Acre, soil quality is presented as a justification (Brazil, EMBRAPA 1988). These developments pose a threat to forests in the areas affected.

Ecotones between the various types of savanna and forest, classified as "areas of ecological tension" in the IBAMA vegetation classification system (Table 1), are under the greatest pressure. The transition between forest and *cerrado* (central Brazilian scrub savanna) is under great pressure because of its proximity to major centers of population and demand (including demand for timber and charcoal) in the south-central part of the country. Grain production, especially soybeans, has been rapidly increasing as a source of pressure on the forest/*cerrado* ecotones. These vegetation types are easier to clear than denser forest types. They have also not been sheltered from the expansion of government-subsidized ranching programs in recent years. The Superintendency for Development of the Amazon (SUDAM) at least theoretically suspended approval of new projects in "dense forest" areas in 1979, but projects continued to be approved in practice. On 12 October 1988 the *Programa Nossa Natureza* (Our Nature Program) again suspended incentives. On 16 January 1991 a law (No. 167) limited incentives, only to be reversed on 17 April 1991 (Decree No. 101); not until 25 June 1991 was a decree (No. 153) issued barring "concession of incentives that entail deforestation in areas of primary forest and destruction of primary ecosystems" (Article 15, paragraph 3).

Satellite data indicate the forest/cerrado transition zone is suffering the fastest deforestation (Fearnside 1990b, 1993a). Greatest pressure on the vegetation types located along the forest/cerrado boundary is also shown by a map analysis by Kangas (1990) using a 1:10,000,000 scale map of Holdridge life zones (Tosi 1983) and a series of simulated deforestation scenarios postulating various patterns of expansion of deforested areas from existing highways and towns.

OPPORTUNITIES FOR ECOSYSTEM PROTECTION

In addition to the varying levels of threats in different parts of the region, there are also varying levels of opportunity for creating protected areas. When opportunities present themselves, this factor must be weighed in decisions about protected areas. However, effort to establish new reserves should not be guided exclusively by pursuit of opportunities, as has often happened in the past. An overall strategy based on biological priorities must be drawn up.

One kind of opportunity arises from conflicting political claims to territory. Conflict between the States of Amazonas and Pará for várzea areas along the northern bank of the Amazon River is one example. Extractive reserves offer another major opportunity where products that are now marketable occur in relatively high density and where local populations of rubber tappers and other extractivists are organized to manage these resources (Allegretti 1990; Fearnside 1989c).

Amerindian reserves represent a major opportunity for preserving natural ecosystems, provided these areas are used for this purpose. Amerindian reserves cannot now be considered to be protected in the absence of special negotiations with the tribes to declare parts of their reserves as conservation units. Indigenous peoples may not always use their reserves in environmentally benign ways. The best-known example is the nontraditional productive system of the Navajo in the southwestern United States, where overgrazing by sheep has led to severe soil erosion (Brown 1981: 48). Some examples already can be found in Brazil of tribes that would readily destroy their own reserves if given the chance. For example, tribes in Rondônia have agreed to allow goldminers and loggers to exploit tribal areas in exchange for a portion of the profits. Mahogany logging in seemingly isolated portions of the Cinta Larga reserve provides a graphic example (J. Ferraz, personal observation).

Indigenous peoples stand to benefit by negotiating to have all or part of their lands declared as protected areas, because this strengthens their claim to large areas of forest (which is continually under attack by politicians in Amazonia). The tribes should also gain some material benefit from protecting the forest, as compensation for environmental services that forest

provides. Negotiations would have to be done directly with the tribes; although the National Indian Foundation (FUNAI), a government agency within the Ministry of Justice, has legal authority over many tribal affairs, it has very little moral authority to speak for the tribes.

MATERIALS AND METHODS

We analyzed the 1:5,000,000 scale IBAMA vegetation map (Brazil, IBGE & IBDF 1988). The IBAMA vegetation map is a simplification of the 1:1,000,000 scale maps produced by the RADAMBRASIL Project (Brazil, Projeto RADAMBRASIL 1973-1983). The RADAMBRASIL maps were derived from 1:250,000 scale side-looking airborne radar (SLAR) imagery, in conjunction with field checking at approximately 3500 points at which forest inventories were conducted in the Legal Amazon. While the IBAMA map undoubtedly contains errors, and the present study cannot be more reliable than the map upon which it is based, the map provides a useful starting point for a kind of analysis that also needs to be applied to other existing and future maps. For protected and indigenous areas we used maps (also at a scale of 1:5,000,000) produced by Conservation International (1990a,b) for the Workshop-90 meeting held in Manaus in January 1990 (see Rylands 1990).

We analyzed the maps to identify areas that are already protected within each state and to identify areas of each vegetation zone that could be protected within the existing system of Amerindian areas. The maps were digitized and areas of each vegetation type by state and protection status were tabulated using the ARC/INFO geographical information system (GIS) at the U.S. Geological Survey's (USGS) Earth Resources Observation Systems (EROS) Data Center, Sioux Falls, South Dakota. Geographic (latitude-longitude) coordinates for features on the vegetation map were calculated from the polyconic projection of this map; for the other maps, coordinates could be obtained directly. The GIS was used to overlay the vegetation with three additional layers: states, indigenous areas, and parks and reserves. The resulting digital data for the Legal Amazon were projected onto the Lambert Azimuthal Equal Area projection to allow correct measurements of area.

Some slight differences between the vegetation map and the other maps resulted in "sliver" polygons along the edges of the map, but these were minor and tended to overlap. The cases in which the border of Brazil on the vegetation map was outside the border shown on the other maps were balanced by cases where the reverse was true. The vegetation map was clipped to conform to the protected area map, leaving any cases of areas that were in the protected area map but outside the vegetation map coded as "off map" and excluded from the analysis. The presence of sliver polygons indicates that there was not a perfect match between the

source maps. In most cases, errors were minor considering the size of the regions. The sliver polygons were distributed as follows: 41 polygons of 0-500 km^2, 5 polygons of 500-1000 km^2, and 1 polygon each of 1708 km^2, 2056 km^2 and 2124 km^2. An analysis of more detailed source maps would be needed to avoid these discrepancies.

It should be emphasized that the very coarse scale of the map used (1:5,000,000) means that many types of natural ecosystems are not represented: unique vegetation types either may be too small to appear at this map scale or may have been lumped with other categories in the map legend. In the future, more refined maps should be made to identify and protect these areas. Nevertheless, it is important to make a start by identifying the grossly apparent areas in need of protection using the present map scale. The results of the exercise must be regarded as a minimum, not as a proposal for sufficiently protecting biological diversity.

RESULTS AND DISCUSSION

1.) Original vegetation cover

The present extent of deforestation in relation to the original areas of forest cover is presented in Table 2 for the nine states of the Legal Amazon. By 1990, deforestation had reached 415.2 X 10^3 km^2, or 9.7% of the area originally forested as defined in Table 1; in 1991 the cleared area increased by an additional 11.1 X 10^3 km^2 to total 426.3 X 10^3 km^2 (10-11% of the originally forested area). Deforestation has advanced to alarming proportions in states such as Maranhão and Tocantins. The lower percentage affected in some other states, such as Pará and Mato Grosso, is a reflection of the immense land area of these states: because deforestation is unevenly distributed within these states, the impact on forest in the most affected areas is much greater than the percentage at the state level suggests. The prevalence of endemism means that such concentrated disturbances can have severe impacts on species restricted to these areas.

It is also important to remember the invalidity of the common but misleading practice of calculating the percentage deforested using as the denominator the land area of the political units, instead of the original area of forest. In the case of Tocantins, for example, only 8.5% of the state's land area was deforested by 1990 but in reality this represents 39.2% of the original forest. In Maranhão, 35.9% of the state's land area had been deforested by 1990, representing 60.2% of the forest.

2.) Deforestation extent in relation to protected areas

Parks and equivalent reserves in Brazilian Amazonia are a small percentage of the region (Table 3). As of 1992, only 13 million hectares, or 2.7% of the Legal Amazon had been set aside in reserves, even on paper. This represents 3.0% the natural vegetation appearing on the IBAMA map. Current plans identify a target of 17 million hectares, or 3.3% of the region. In contrast, preservation of 25% of the original vegetation of the region was recommended in 1979 by the Interministerial Commission on Forest Policy in the original version of the draft law drawn up by the commission (see Fearnside 1986). The areas in Table 3 refer to all types of vegetation, not only to forests. Some discrepancies exist between areas of conservation units measured from the maps (presented in Table 3) and those reported by other sources (Brazil, IBAMA 1989, nd [1991]).

The conservation situation would improve considerably if semi-protected areas were included. The term "semi-protected" is used here to refer to national forests, forestry reserves, extractive reserves and indigenous areas. These units presently provide some inhibition of disturbance, but lack legal requirements to prevent future exploitation and perturbation. Including semi-protected areas would increase the fraction protected in the Legal Amazon from 2.7% to 19.0% (Table 3). Incorporating indigenous and other semi-protected areas into a system of conservation units does not imply expelling the forest dwellers. On the contrary, not only do they have the right to inhabit their traditional homes, but their presence can potentially offer a better guarantee that the forest will remain standing than would transformation of these areas into parks empty of people, with protection against encroachment entrusted to IBAMA guards.

Commitments need to be negotiated with those responsible for these semi-protected areas (such as Amerindians, rubber tappers, and sectors of government tied to logging and forest management) to define the degree of disturbance that is acceptable and mechanisms for guaranteeing that these limits are not exceeded. At present, these areas cannot be considered protected. National forests and forestry reserves, for example, are intended for future logging. The extractive reserves that have been created are justified primarily by their role in environmental conservation. The reserves represent an important initiative for maintaining the forest under the guardianship of its inhabitants. However, care is needed to avoid loss of the systems' sustainability due to overly high expectations with respect to the capacity of these areas to absorb population flows or to produce wealth (Fearnside 1989c).

Most of the semi-protected vegetation is in indigenous areas and, unfortunately, a large part of this land still lacks legal recognition and demarcation on the ground. Many indigenous areas included in Table 3 still are not legally recognized, and some of

them have already been reduced by invasion and/or by government decrees.

3.) Example reserves

Figure 2 shows areas that would satisfy the criterion of protecting at least some of each vegetation type within each state, assuming that already protected areas are maintained. The distribution of vegetation types among existing protected areas is specified in Table 4. Examples of reserves that would cover the remaining vegetation types are listed in Table 5. The dimensions of the areas indicated (Fig. 2) are modest; in a number of cases the vegetation in question exists in much larger areas. No attempt was made to establish criteria as to the area of samples that should be protected. Where possible, the example reserves were drawn to include several of the missing vegetation zones in a single contiguous area. No attempt was made to locate the areas with reference to opportunities for habitat protection, such as Amerindian reserves. In some cases where known conflicts with roads and development projects could be avoided by indicating more remote areas of the same vegetation type, this was done, but the areas do not avoid all such conflicts. It is important to remember that where biologically important areas coincide with areas of extensive deforestation, any remaining scraps of forest should be protected quickly. This is not to say that existing development projects in these areas should be abandoned.

Table 1 defines the 28 types of natural vegetation on the Legal Amazon portion of the IBAMA map (Brazil, IBGE & IBDF 1988) at a scale of 1:5,000,000. The area of natural vegetation of each type is presented by state in Table 6. The distribution of vegetation types in areas protected as Biological Reserves (BR), Ecological Reserves (ER), Ecological Stations (ES) and National Parks (NP) in each state is presented in Table 7. The areas refer to present vegetation (in accord with the map), which is different from original vegetation (as shown in Table 2). Of the 28 vegetation types, 10 (36%) have no area protected in the entire Legal Amazon.

Because Amazonia is so vast, the species and other characteristics of the ecosystems change from one part of the region to another, even within a given vegetation type. It is therefore important to adopt the criterion that a minimum goal be to protect at least one example of each vegetation type within each of the region's states. As can be seen from Table 7, this implies that 111 locations should be protected in the region (often several locations can be lumped into a single reserve, as in the 35 existing protected areas and 44 example reserves in Table 5 and Fig. 2). Of the 111 vegetation zones, only 37 (33%) have some part of their area protected to date, leaving 74 (67%) without any protection (Fig. 3).

The percentage of each vegetation type that is protected is also shown in Table 7. The dashes (--) in this table indicate vegetation types that do not exist in the state in question, while the 69 zeros and five other percentages < 0.50% indicate existing types for which no sample or only an insignificant sample is protected. Because the areas protected are sometimes quite small, the combination of existing and example reserves considered here (Fig. 2) is only a starting point for a strategy to adequately protect biodiversity in Brazilian Amazonia.

The states and the vegetation zones within them vary tremendously in size. The amount of land that should be protected in each vegetation zone in excess of minimum areas needed to maintain viable biological populations should be in some proportion to the size of the vegetation zones. Decisions on the size of new reserves will need to weigh various factors not quantified in the current paper, including the costs of establishing and maintaining protected areas in different locations, the merits of single large versus numerous small reserves, the limits of watersheds, and the defensibility of given locations against unauthorized access (see, for example, Peres & Terborgh 1994).

This paper has focused on biodiversity as the rationale for protecting areas of natural vegetation. This vegetation also plays important roles in global and regional climate regulation by storing carbon and recycling water. The priorities for conservation for climate regulation would be different, but establishing these priorities will depend on much of the same information presented here.

CONCLUSIONS

Only one-third of the terrestrial vegetation zones present in the Brazilian Legal Amazon are protected, considering as "vegetation zones" the area within each of the region's nine states that is covered by one of the region's 28 types of natural vegetation mapped by the Brazilian Institute for Environment and Renewable Natural Resources (IBAMA) at a scale of 1:5,000,000. Protecting an example of each type of vegetation within each state is recommended as a minimum goal.

To protect all 111 terrestrial vegetation zones present in the Legal Amazon, it would not be necessary to have a separate reserve for each because it is often possible to encompass several types in a single reserve. The present analysis indicates that only 38 (33%) of the vegetation zones have some area protected, which leaves 74 (67%) without protection. The situation is most critical in the contact areas between forest and cerrado in Maranhão, Tocantins and Mato Grosso. In Maranhão, only one of ten vegetation types presently has protection. The

states with the fewest vegetation zones protected are precisely those that have already lost the largest percentages of their forest cover.

In presenting results of a priority assignment exercise, care must be taken to avoid the implication that only these areas are needed. Powerful political and economic forces in Brazil are trying to remove restrictions on development in all areas outside narrowly defined reserves. In some cases, proposals would even revoke existing reserves to allow free exploitation of the entire region: the "Amazonian Code" proposed in July 1991 by Amazonas State Governor Gilberto Mestrinho states that "the areas of each state in the Amazon Region that, on the date of publication of this law, are under the effect of acts declaring permanent preservation will be the objects of revision, being submitted to new classification as specified in Article 18 of this Law [which states that all authority to create reserves will rest with the state legislatures]" (Mestrinho 1991: Chapter 5, Article 19). Recommendations of the present study emphatically do not imply that unrestricted development should be allowed in the remaining areas.

As much area as possible needs to be set aside for conservation purposes, and this needs to be done very quickly. Otherwise there will be no second chance for many biologically important areas. Continuation of current trends in Amazonia would mean that areas that should be protected would soon be claimed by legal or illegal settlers. Deforestation can physically remove the possibility of future protection by removing the vegetation in question, but long before this process is complete, dramatic increases are expected in the political and financial costs of setting aside protected areas. This could make it impractical to create many future reserves. The costs of procrastination are, therefore, very high.

The urgency of establishing protected areas before opportunities are lost requires that decisions be taken now on the basis of available information. The danger must be avoided of further postponing decisions on the grounds that more data must be collected to ensure that the best possible areas are chosen. The dictum of Julius Caesar could not be more appropriate: sometimes it is more important that a decision be made than that it be the best decision.

ACKNOWLEDGMENTS

This paper was a contribution to Workshop-90, held in Manaus, Amazonas, Brazil, 10-20 January 1990, and we thank the conference organizers for permission to publish it in this forum. Norman B. Bliss performed some of the statistical analysis at the U.S. Geological Survey's EROS Data Center, but all other parts of the paper represent the sole opinions of the authors.

We thank Maura Massago Cumagay, Christine Housel and Summer V. Wilson for help in drafting Figure 2.

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Figure Legends

Figure 1. Brazil's Legal Amazon region.

Figure 2. Existing protected areas (from Table 4) and areas satisfying the criterion for protecting an example of each vegetation type within each state (from Table 5).

Figure 3. Number of protected and unprotected vegetation types in the Brazilian Legal Amazon.

TABLE 7: AREA AND PERCENTAGE OF PROTECTED VEGETATION ZONES IN THE BRAZILIAN LEGAL AMAZON

Vegetation type[a]		Area protected (km^2)									
Category	Code	Acre	Amapá	Amazonas	Maranhão	Mato Grosso	Pará	Rondônia	Roraima	Tocantins/ Goiás	Total Protected
Dense forest	Da-0	--	305	5,316	--	--	7	297	0	58	5,983
			3.38%	3.22%			0.01%	10.98%	0%	2.22%	2.31%
	Db-0	0	0	21,994	2,872	--	5,914	0	0	--	30,780
		0%	0%	3.58%	12.72%		3.60%	0%	0%		3.70%
	Dm-0	--	0	3,902	--	--	0	--	565	--	4,467
			0%	38.33%			0%		2.73%		13.00%
	Ds-0	0	59	3,614	0	0	7,999	558	4,954	0	17,184
		0%	0.06%	2.03%	0%	0%	1.94%	3.82%	5.92%	0%	2.10%
Subtotal		0	364	34,826	2,872	0	13,920	855	5,519	58	58,414
		0%	0.33%	3.60%	11.69%	0%	2.12%	4.41%	4.68%	1.02%	3.00%
Non-dense forest	Aa-0	375	--	99	--	--	0	0	--	--	474
		3.54%		0.15%			0%	0%			0.60%
	Ab-0	4,100	--	2,779	--	--	--	3,296	--	--	10,175
		3.58%		1.32%				8.03%			2.78%
	As-0	--	--	648	--	0	75	4,915	0	0	5,638
				1.73%		0%	0.03%	6.32%	0%	0%	1.05%
	Cs-0	--	--	--	0	0	0	--	--	0	0
					0%	0%	0%			0%	0%
	Fa-0	--	--	--	--	0	--	--	--	--	0
						0%					0%
	Fs-0	--	--	--	--	0	--	0	0	430	430
						0%		0%	0%	32.38%	1.25%
	La-0	--	--	601	--	--	--	--	0	--	601
				4.01%					0%		3.77%
	Ld-0	--	--	485	--	--	--	--	476	--	961
				1.30%					4.34%		1.99%
	Lg-0	--	--	0	--	--	--	--	0	--	0
				0%					0%		0%
	LO-0	--	--	15,029	--	--	--	--	1,296	--	16,325
				8.71%					4.29%		8.05%
	ON-0	--	--	--	--	0	0	0	0	--	0
						0%	0%	0%	0%		0%
	Pf-0	--	1,547	--	0	--	0	--	--	--	1,547
			84.86%		0%		0%				19.82%
	SM-0	--	--	--	0	--	--	--	--	--	0

				0%						0%
	SN-0	--	--	0	0	2,592	0	0	0	0	2,592
				0%	0%	1.82%	0%	0%	0%	0%	1.31%
	SO-0	--	796	0	--	0	0	2,993	0	0	3,789
			18.84%	0%		0%	0%	13.65%	0%	0%	2.59%
	Subtotal	4,475	2,343	19,641	0	2,592	75	11,204	1,772	430	42,532
		3.58%	38.73%	3.40%	0%	0.53%	0.02%	6.99%	2.55%	1.82%	2.30%
	Subtotal all forests	4,475	2,707	54,467	2,872	2,592	13,995	12,059	7,291	488	100,946
		3.15%	2.32%	3.52%	7.70%	0.51%	1.34%	6.71%	3.89%	1.66%	2.66%
Non-forest	Pa-0	--	5,739	54	0	0	0	1,569	--	--	7,362
			37.86%	0.42%	0%	0%	0%	18.06%			9.08%
	rm-0	--	--	--	--	--	--	--	0	--	0
									0%		0%
	Sa-0	--	--	0	0	1,336	0	3,513	--	0	4,849
				0%	0%	0.80%	0%	31.86%		0%	1.41%
	Sd-0	--	--	--	0	0	0	--	--	0	0
					0%	0%	0%			0%	0%
	Sg-0	--	--	--	--	854	0	--	0	0	854
						8.14%	0%		0%	0%	2.24%
	Sp-0	--	158	0	0	0	0	0	0	4,064	4,222
			1.57%	0%	0%	0%	0%	0%	0%	8.30%	2.35%
	ST-0	--	--	--	--	0	--	--	--	--	0
						0%					0%
	Td-3	--	--	--	--	--	--	--	0	--	0
									0%		0%
	Tp-3	--	--	--	--	--	--	--	0	--	0
									0%		0%
	Subtotal	0	5,897	54	0	2,190	0	5,082	0	4,064	17,287
		0%	23.41%	0.27%	0%	0.80%	0%	21.82%	0%	2.53%	2.49%
	Total	4,475	8,604	54,521	2,872	4,782	13,995	17,141	7,291	4,552	118,233
		3.15%	6.07%	3.48%	2.07%	0.61%	1.28%	8.48%	3.25%	2.39%	2.64%

(a) Vegetation presently unaltered according to 1:5,000,000 vegetation map (Brazil, IBGE and IBDF 1988).
"--" indicates that no vegetation of this type exists in the state;
"0" indicates that vegetation exists, but none is protected.

TABLE 6: AREA OF NATURAL VEGETATION PRESENT IN THE BRAZILIAN LEGAL AMAZON (km^2)

Category	Code	Acre	Amapá	Amazonas	Maranhão	Mato Grosso	Pará	Rondônia	Roraima	Tocantins Goiás	Total present
Dense forest	Da-0		9,011	164,876			76,570	2,704	3,326	2,610	259,097
	Db-0	16,408	2,184	615,203	22,586		164,091	2,066	10,248		832,786
	Dm-0		113	10,181			3,418		20,661		34,373
	Ds-0	518	99,220	178,103	1,988	23,154	413,345	14,607	83,692	3,055	817,682
	Subtotal	16,926	110,528	968,363	24,574	23,154	657,424	19,377	117,927	5,665	1,943,938
Non-dense forest	Aa-0	10,591		65,748			805	2,273			79,417
	Ab-0	114,380		211,052				41,064			366,496
	As-0			37,555		124,620	286,271	77,794	8,430	1,216	535,886
	Cs-0				3,666	736	5,386			115	9,903
	Fa-0					3,554					3,554
	Fs-0					24,317		7,718	1,041	1,328	34,404
	La-0			14,979					970		15,949
	Ld-0			37,405					10,967		48,372
	Lg-0			9,663					9,767		19,430
	LO-0			172,607					30,184		202,791
	ON-0					168,069	2,991	4,801	3,045		178,906
	Pf-0		1,823		2,089		3,894				7,806
	SM-0				384						384
	SN-0			1,082	6,570	142,778	27,812	4,781	904	14,465	198,392
	SO-0		4,226	27,350		22,124	59,734	21,932	4,286	6,551	146,203
	Subtotal	124,971	6,049	577,441	12,709	486,198	386,893	160,363	69,594	23,675	1,847,893
	Subtotal all forests	141,897	116,577	1,545,804	37,283	509,352	1,044,317	179,740	187,521	29,340	3,791,831
Non-forest	Pa-0		15,157	12,778	2,517	14,738	27,162	8,690			81,042
	rm-0								390		390
	Sa-0			1,531	55,758	167,534	5,686	11,028		102,445	343,982
	Sd-0				15,771	10,840	1,274			2,234	30,119
	Sg-0					10,490	5,057		15,481	7,113	38,141
	Sp-0		10,038	5,556	26,980	64,085	12,393	2,664	8,969	48,962	179,647
	ST-0					6,599					6,599
	Td-3								1,550		1,550
	Tp-3								10,671		10,671
	Subtotal	0	25,195	19,865	101,026	274,286	51,572	22,382	37,061	160,754	692,141
	Total	141,897	141,772	1,565,669	138,309	783,638	1,095,889	202,122	224,582	190,094	4,483,972

(a) Areas in km^2 measured from 1:5,000,000 vegetation map (Brazil, IBGE and IBDF 1988). These areas do not reflect losses due to recent deforestation.

TABLE 5: EXAMPLE RESERVES FOR PROTECTION OF CURRENTLY UNPROTECTED VEGETATION TYPES

Example reserve no. (Fig. 2)	State	Name	Vegetation types (Codes from Table 1)
1	Acre	Extension of Serra do Divisor Nat. Park	Db-0; Ds-0
2	Amapá/ Pará	Serra do Tumucumaque	Dm-0 [Amapá]; Dm-0 [Pará]
3	Amapá	Lower Jari	Db-0; Ds-0*
4	Amazonas	Extension of Jutaí-Solimões Ecological Reserve	Aa-0*
5	Amazonas	Rio Demini	Lg-0
6	Amazonas	Extension of Abufarí Biological Reserve	Pa-0*
7	Amazonas	Campos de Humaitá/ Campos de Estanho	Sa-0; SO-0; Sp-0
8	Amazonas/ Rondônia	Várzea of Rio Machado/Ji-Paraná	Aa-0 [Rondônia]; Aa-0* [Amazonas]
9	Amazonas	Rio Juruena	SN-0
10	Maranhão	Mangroves of northern Maranhão	Pf-0
11	Maranhão	Extension of Gurupí Biological Reserve	Ds-0
12	Maranhão	Mangroves of	Pa-0; Pf-0

		São Luis	
13	Maranhão	Extension of Lençois Maranhenses	SM-0 Nat. Park [off map]
14	Maranhão	Rio Zutiua	Cs-0; SN-0
15	Maranhão	Boa Esperança	Sd-0
16	Maranhão	Rio Parnaíba	Sa-0; Sp-0
17	Mato Grosso	Aripuanã	As-0; Ds-0; ON-0; Sd-0
18	Mato Grosso	Serra do Roncador	SO-0
19	Mato Grosso	Upper Xingu/ Rio Sete de Setembro	Fa-0; ON-0; Pa-0
20	Mato Grosso	Pontes e Lacerda	Fs-0; Sp-0; ST-0
21	Mato Grosso	Rio Jauru	Cs-0; Fs-0
22	Pará	Rio Cumina	Sd-0; SO-0
23	Roraima	Prainha	As-0; SO-0
24	Pará	Várzea of Almeirim	Pa-0
25	Pará	Ilha Caviana	Da-0*; Pa-0; Sp-0
26	Pará	Ilha de Marajó	Da-0*
27	Pará	Mangroves of Baía de Marajó	Pf-0
28	Pará	Serra do Carajás	As-0*; Dm-0
29	Pará	Serra do Cachimbo	Cs-0; ON-0; Sa-0

30	Pará	Rio Benedito	SN-0; SO-0
31	Pará	Cerrado of Araguaia	Sg-0
32	Rondônia	Rio Abunã	Db-0
33	Rondônia	Upper Guaporé	Fs-0; Sp-0
34	Rondônia	Colorado d'Oeste	ON-0; SN-0
35	Roraima	Campos de Roraima	Sg-0; SN-0; Sp-0; Td-3; Tp-0
36	Roraima	Parima refugium	rm-0
37	Roraima	Northern extension of Caracaraí Ecological Station	As-0; La-0; Lg-0; ON-0
38	Roraima	Tacutu	Fs-0; SO-0
39	Roraima	Eastern extension of Caracaraí Ecological Station	As-0; Lg-0
40	Roraima	Rio Jauaperi	Da-0; Db-0
41	Tocantins	Bico de Papagaio	As-0; Cs-0; SO-0
42	Tocantins	Rio Araguaia	Ds-0
43	Tocantins	Central Tocantins	Sa-0; Sd-0; SN-0
44	Tocantins	Cerrados of Rio Sono	Sa-0; Sg-0

*These ecoregions have some small area protected in existing reserves (<0.5% of the area of the ecoregion): Aa-0 in Amazonas; As-0 in Pará; Da-0 in Pará; Ds-0 in Amapá and

Pa-0 in Amazonas. Two of these vegetation types require additional reserves (example reserves Nos. 43 and 44), while the others can be protected within the example reserves needed to protect vegetation types currently with no area protected.

TABLE 4: VEGETATION TYPES IN PROTECTED AREAS BY STATEState — Protected area — Natural vegetation present

State	Code[a] (Fig. 2)	Type	Name	Vegetation code from Table 1 (area in km²)
ACRE	ES06	Ecological station	Rio Acre	Ab-0 (984 km²)
	NP10	National park	Serra do Divisor	Aa-0 (372 km²); Ab-0 (3083 km²)
AMAPÁ	BR01	Biological reserve	Lago Piratuba	Da-0 (306 km²); Pa-0 (3031 km²); Pf-0 (473 km²); Sp-0 (159 km²)
	ES11	Ecological station	Maracá-Jipioca	Pa-0 (548 km²)
	NP01	National park	Cabo Orange	Ds-0 (59 km²); Pa-0 (2184 km²); Pf-0 (1080 km²); SO-0 (799 km²)
AMAZONAS	BR04	Biological reserve	Abufarí	Ab-0 (60 km²); Da-0 (3312 km²); Pa-0 (54 km²)
	BR07	Biological reserve	Uatumã	Not included on Conservation International map; total area = 10,100 km²
	NP02	National park	Pico da Neblina	Da-0 (22 km²); Dm-0 (3874 km²); Ds-0 (2699 km²); La-0 (597 km²); LO-0 (13,672 km²)
	NP03	National park	Jaú	Ab-0 (2699 km²); As-0 (643 km²); Db-0 (17,822 km²); Ds-0 (378 km²); Ld-0 (481 km²); LO-0 (1248 km²)
	NP04	National park	Amazônia	Db-0 (231 km²)
	ER01	Ecological reserve	Sauim-Castanheira	Not included on Conservation International map; total area = 1 km²
	ER02	Ecological reserve	Jutaí-Solimões	Aa-0 (98 km²); Da-0 (945 km²); Db-0 (1014 km²)
	ES05	Ecological station	Anavilhanas	Da-0 (449 km²); Db-0 (481 km²); Ds-0 (511 km²)
	ES12	Ecological station	Juami-Japurá	Da-0 (549 km²); Db-0 (2286 km²); LO-0 (123 km²)
MARANHÃO	BR03	Biological reserve	Gurupí	Db-0 (2936 km²)
MATO GROSSO	ES03	Ecological station	Ioué	SN-0 (1712 km²)
	ES09	Ecological station	Taiamã	Vegetation not available; total area = 143 km²
	ES10	Ecological station	Serra das Araras	Sa-0 (513 km²)
	NP07	National park	Chapada dos Guimarães	Sa-0 (820 km²); SN-0 (119 km²)
	NP08	National park	Pantanal Matogrossense	Sg-0 (852 km²); SN-0 (754 km²)
PARÁ	ES07	Ecological station	Jari	Da-0 (7 km²); Ds-0 (2010 km²)
	NP04	National park	Amazônia	As-0 (75 km²); Db-0 (5144 km²); Ds-0 (2987 km²)
	BR02	Biological reserve	Rio Trombetas	Db-0 (795 km²); Ds-0 (3036 km²)
	BR08	Biological reserve	Tapirapé	Vegetation not available; total area = 182 km²
RONDÔNIA	BR05	Biological reserve	Jarú	As-0 (2398 km²)
	BR06	Biological reserve	Guaporé	Da-0 (295 km²); Pa-0 (1560 km²); Sa-0 (1388 km²) SO-0 (145 km²)
	ES02	Ecological station	Cuniã	Ds-0 (192 km²); SO-0 (701 km²)
	NP05	National park	Pacaás Novos	Ab-0 (88 km²); As-0 (2490 km²); Ds-0 (363 km²); Sa-0 (2105 km²); SO-0 (2130 km²)
RORAIMA	ES01	Ecological station	Caracaraí	Ld-0 (475 km²); LO-0 (111 km²), plus the former Niquiá Ecological Station (no vegetation information available; not included on Conservation International map; total area = 2866 km²)
	ES04	Ecological station	Maracá	Dm-0 (564 km²); Ds-0 (421 km²); LO-0 (171 km²)
	NP09	National park	Monte Roraima	Not included on Conservation International map; total area = 1160 km²
TOCANTINS/ GOIÁS	ES08	Ecological station	Coco-Javaes	Not included on Conservation International map; total area = 370 km²
	NP06	National park	Araguaia	Da-0 (57 km²); Fs-0 (421 km²); Sp-0 (3981 km²)

Note: Sums of areas by state differ slightly from totals in Table 3 because an adjustment for state area has not been applied.
(a) Biological reserve = BR, Ecological reserve = ER, Ecological station = ES, National park = NP.

TABLE 3: PROTECTED AND SEMI-PROTECTED AREAS IN THE BRAZILIAN LEGAL AMAZON

State	Terrestrial area of state	Protected areas (10^3 km^2)					Semi-protected areas					Total (all types of areas) and percentage
		Ecological Station	National Park	Biological Reserve	Ecological Reserve	Total protected and percentage	National Forest	Forestry Reserve	Extractive Reserve	Indigenous Areas	Total	
Acre	154	984				4 439 2.9%			20 248	11 443	31 691	36 130 23.5%
Amapá	142		4 123	3 969	548	8 640 6.1%			8 052	9 588	17 640	26 280 18.5%
Amazonas	1 568	4 399	44 365	13 527	2 057	64 348 4.1%		36 980	3 994	287 015	327 989	392 337 25.0%
Maranhão	260			2 936		2 936 1.1%				18 505	18 505	21 441 8.2%
Mato Grosso	901	2 225	2 547			4 772 0.5%				111 285	111 285	116 057 12.9%
Pará	1 247		8 206	3 831	2 016	14 053 1.1%	3 021	11 363		161 998	176 382	190 435 15.3%
Rondônia	238	893	7 176	8 978		17 047 7.2%			10 346	39 974	50 320	67 367 28.3%
Roraima	225	5 192			1 156	7 508 3.3%				97 505	97 505	105 013 46.7%
Tocantins/ Goiás	273	370	4 460			4 830 1.6%				23 415	23 415	27 875 10.2%
LEGAL AMAZON	5 009	15 709	75 492	33 241	3 761	128 203	3 021	48 343	22 392	749 285	823 041	946 805
Percent of area of the Legal Amazon	100%	0.3%	1.5%	0.7%	0.1%	2.6%	0.1%	1.0%	0.4%	15.0%	16.4%	18.9%

Note: Areas measured from maps at a scale of 1:5,000,000 prepared by Conservation International, with the exception of extractive reserves, which are from Fearnside (1989c). Areas do not include portions covered by water according to Brazil, IBGE & IBDF 1988. Not all indigenous areas listed have legal protection. All categories include all types of vegetation (not only forest); only intact natural vegetation is included. In the case of reserves not included on the Conservation International Map (Uatumã Biological Reserve, Sauim-Castanheira Ecological Reserve, Caracaraí [Niquiá] Ecological Station, Coco-Javaes Ecological Station, Monte Roraima National Park), total area is used, possibly including water and non-natural vegetation.

TABLE 2: EXTENT OF DEFORESTATION IN THE BRAZILIAN LEGAL AMAZON

State	Original forest area (10^3 km^2) [a]	Original forest area (10^3 km^2) [b]	Deforested area (10^3 km^2) and percentage (%)				
			Jan. 1978	Apr. 1988	Aug. 1989	Aug. 1990	Aug. 1991
1	2	3	4	5	6	7	8
DEFORESTATION EXCLUSIVE OF HYDROELECTRIC DAMS							
Acre	154	152	2.6	8.9	9.8	10.3	10.7
			1.7%	5.8%	6.4%	6.8%	7.0%
Amapá	132	115	0.2	0.8	1.0	1.3	1.7
			0.2%	0.7%	0.9%	1.1%	1.5%
Amazonas	1,561	1,481	2.3	17.3	19.3	19.8	20.8
			0.2%	1.2%	1.3%	1.3%	1.4%
Maranhão	155	143	65.9[c]	90.8[c]	92.3[c]	93.4[c]	94.1[c]
			46.1%	63.5%	64.5%	65.3%	65.8%
Mato Grosso	585	528	26.5	71.5	79.6	83.6	86.5
			5.0%	13.5%	15.1%	15.8%	16.4%
Pará	1,218	1,139	61.7[c]	129.5[c]	137.3[c]	142.2[c]	146.0[c]
			5.4%	11.4%	12.1%	12.5%	12.8%
Rondônia	224	215	6.3	29.6	31.4	33.1	34.2
			2.9%	13.8%	14.6%	15.4%	15.9%
Roraima	188	164	0.2	2.7	3.6	3.8	4.2
			0.1%	1.7%	2.2%	2.3%	2.6%
Tocantins/ Goiás	58	59	4.2	21.6	22.3	22.9	23.4
			7.1%	36.7%	37.9%	38.9%	39.7%
Legal Amazon	4,275	3,996	169.9	372.8	396.6	410.4	421.6
			4.3%	9.3%	9.9%	10.3%	10.5%
FOREST FLOODED BY HYDROELECTRIC DAMS							
			0.1	3.9	4.8	4.8	4.8
			0.0%	0.1%	0.1%	0.1%	0.1%

DEFORESTATION FROM ALL SOURCES

	169.9	376.7	401.4	415.2	426.4
	4.3%	9.4%	10.0%	10.4%	10.7%

Source: Fearnside et al. (nd.), Fearnside (1993a) for 1988-1991 values; 1978 values remeasured by Skole and Tucker (1993) from Tardīn et al. (1980); see Fearnside (1993b).
(a) These original forest areas are measured from the IBAMA map (Brazil, IBGE and IBDF 1988).
(b) These original forest areas were measured by the National Space Research Institute (INPE). The forest areas in column 3 were defined by appearance on LANDSAT-TM images, and are the most consistent with the deforested area estimates in columns 4-8. They have therefore been used to calculate the percentages. The inconsistencies with the original forest area estimates from the IBAMA map (column 2) represent a major source of uncertainty in available information on deforestation percentages. The original forest areas in column 2 would imply that 10.0% had been lost by 1991, as compared to 10.7% using column 3.
(c) Maranhão values include 57.8 X 10^3 km^2, and Pará values include 39.8 X 10^3 km^2, of "old"(approximately pre-1960) deforestation, now largely under secondary forest.

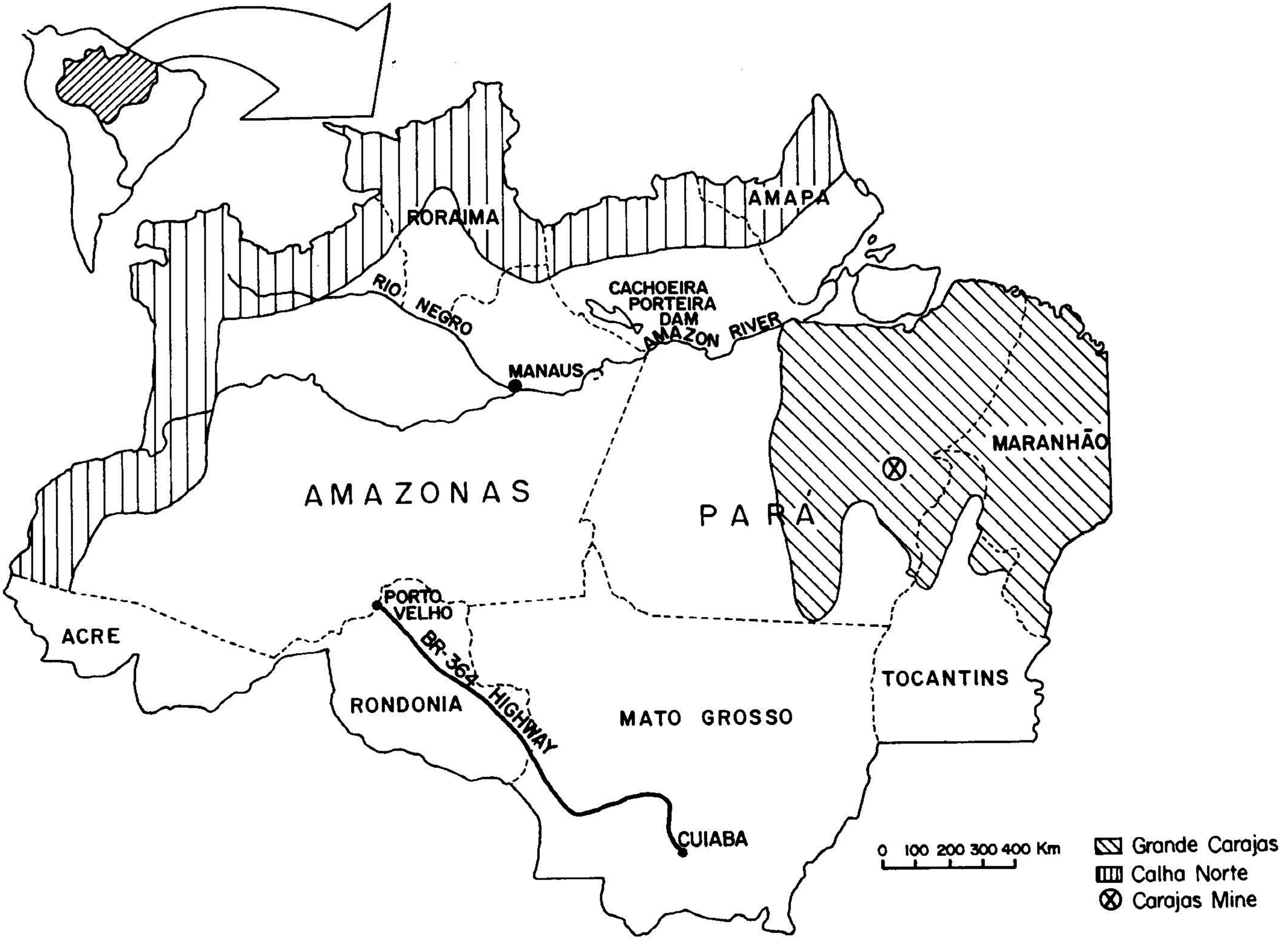
TABLE 1: VEGETATION TYPES IN THE BRAZILIAN LEGAL AMAZON

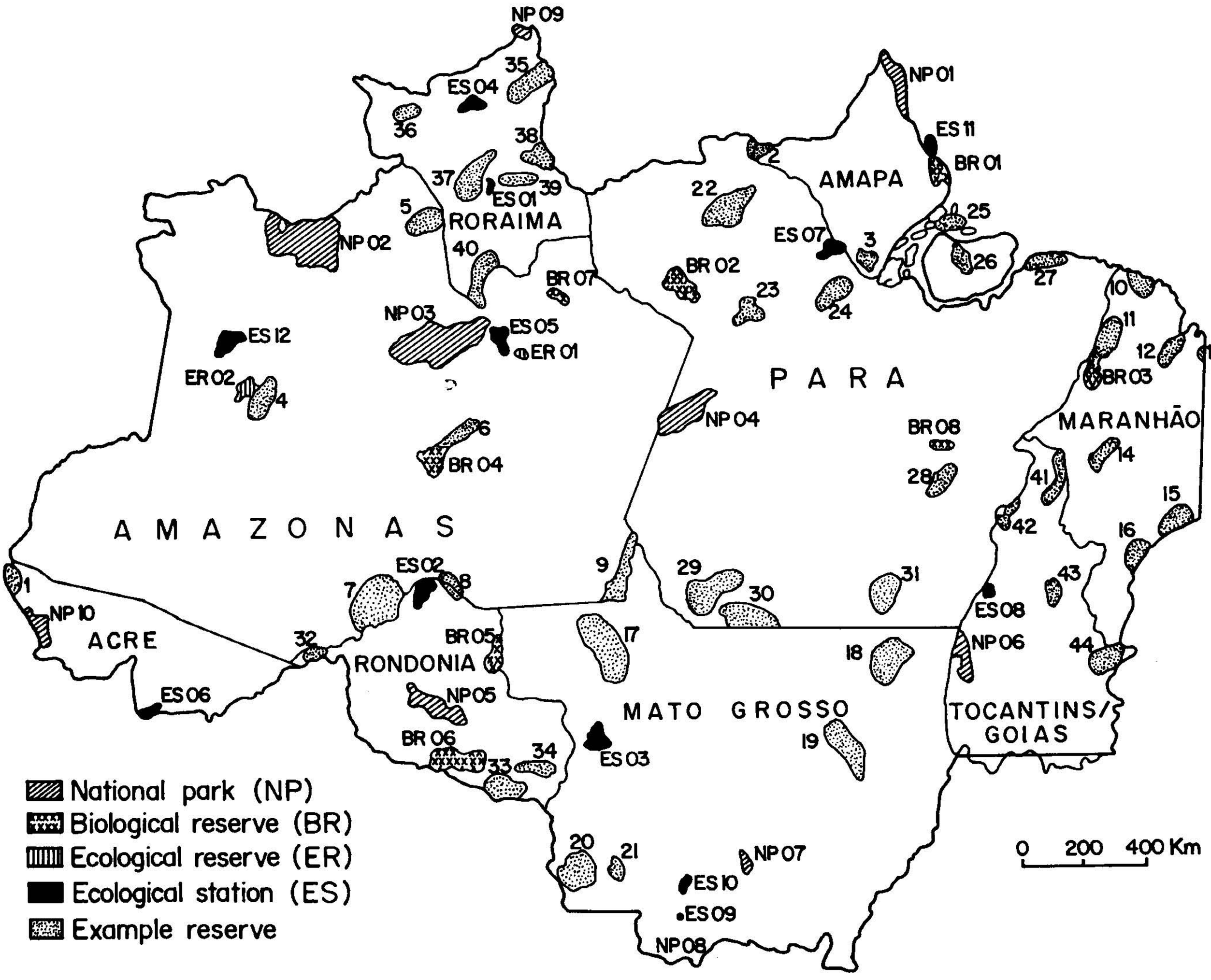
Category	Code	Group	Subgroup	Class
Dense Forest	Da-0	Ombrophilous forest	Dense forest	Alluvial Amazonian
	Db-0	Ombrophilous forest	Dense forest	Lowland Amazonian
	Dm-0	Ombrophilous forest	Dense forest	Montane Amazonian
	Ds-0	Ombrophilous forest	Dense forest	Submontane Amazonian
Non-dense forest	Aa-0	Ombrophilous forest	Open	Alluvial
	Ab-0	Ombrophilous forest	Open	Lowland
	As-0	Ombrophilous forest	Open	Submontane
	Cs-0	Seasonal forest	Deciduous	Submontane
	Fa-0	Seasonal forest	Semideciduous	Alluvial
	Fs-0	Seasonal forest	Semideciduous	Submontane
	La-0	Woody oligotrophic vegetation of swampy and sandy areas		Open arboreous
	Ld-0	Woody oligotrophic vegetation of swampy and sandy areas		Dense arboreous
	Lg-0	Woody oligotrophic vegetation of swampy and sandy areas		Grassy-woody
	LO-0	Areas of ecological tension and contact		Woody oligotrophic vegetation of swampy and sandy areas--ombrophilous forest
	ON-0	Areas of ecological tension and contact		Ombrophilous forest--seasonal forest
	Pf-0	Areas of pioneer formations		Fluvio-marine influence
	SM-0	Areas of ecological tension and contact		Savanna--dense ombrophilous forest
	SN-0	Areas of ecological tension and contact		Savanna--seasonal forest
	SO-0	Areas of ecological tension and contact		Savanna--ombrophilous forest
Non-forest	Pa-0	Areas of pioneer formations		Fluvial influence
	rm-0	Ecological refugium	High altitude	Montane
	Sa-0	Savanna	Cerrado	Open arboreous
	Sd-0	Savanna	Cerrado	Dense arboreous
	Sg-0	Savanna	Cerrado	Grassy-woody
	Sp-0	Savanna	Cerrado	Parkland
	ST-0	Areas of ecological tension and contact		Savanna--steppe-like savanna
	Td-3	Steppe-like savanna	Roraima grasslands	Dense arboreous
	Tp-3	Steppe-like savanna	Roraima grasslands	Parkland

Source: Brazil, Instituto Brasileiro de Geografia e Estatística (IBGE) & Instituto Brasileiro do Desenvolvimento Florestal (IBDF) 1988.

TABLE 8: PERCENTAGE PROTECTED OF VEGETATION IN THE BRAZILIAN LEGAL AMAZON

Vegetation type		Percentage of the area present that is protected									
Category	Code	Acre	Amapá	Amazonas	Maranhão	Mato Grosso	Pará	Rondônia	Roraima	Tocantins Goiás	Total Protected
Dense forest	Da-0	--	3.38	3.22	--	--	0.01	10.98	0.00	2.22	2.31
	Db-0	0.00	0.00	3.58	12.72	--	3.60	0.00	0.00	--	3.70
	Dm-0	--	0.00	38.33	--	--	0.00	--	2.73	--	13.00
	Ds-0	0.00	0.06	2.03	0.00	0.00	1.94	3.82	5.92	0.00	2.10
	Subtotal	0.00	0.33	3.60	11.69	0.00	2.12	4.41	4.68	1.02	3.00
Non-dense forest	Aa-0	3.54	--	0.15	--	--	0.00	0.00	--	--	0.60
	Ab-0	3.58	--	1.32	--	--	--	8.03	--	--	2.78
	As-0	--	--	1.73	--	0.00	0.03	6.32	0.00	0.00	1.05
	Cs-0	--	--	--	0.00	0.00	0.00	--	--	0.00	0.00
	Fa-0	--	--	--	--	0.00	--	--	--	--	0.00
	Fs-0	--	--	--	--	0.00	--	0.00	0.00	32.38	1.25
	La-0	--	--	4.01	--	--	--	--	0.00	--	3.77
	Ld-0	--	--	1.30	--	--	--	--	4.34	--	1.99
	Lg-0	--	--	0.00	--	--	--	--	0.00	--	0.00
	LO-0	--	--	8.71	--	--	--	--	4.29	--	8.05
	ON-0	--	--	--	--	0.00	0.00	0.00	0.00	--	0.00
	Pf-0	--	84.86	--	0.00	--	0.00	--	--	--	19.82
	SM-0	--	--	--	0.00	--	--	--	--	--	0.00
	SN-0	--	--	0.00	0.00	1.82	0.00	0.00	0.00	0.00	1.31
	SO-0	--	18.84	0.00	--	0.00	0.00	13.65	0.00	0.00	2.59
	Subtotal	3.58	38.73	3.40	0.00	0.53	0.02	6.99	2.55	1.82	2.30
	Subtotal all forests	3.15	2.32	3.52	7.70	0.51	1.34	6.71	3.89	1.66	2.66
Non-forest	Pa-0	--	37.86	0.42	0.00	0.00	0.00	18.06	--	--	9.08
	rm-0	--	--	--	--	--	--	--	0.00	--	0.00
	Sa-0	--	--	0.00	0.00	0.80	0.00	31.86	--	0.00	1.41
	Sd-0	--	--	--	0.00	0.00	0.00	--	--	0.00	0.00
	Sg-0	--	--	--	--	8.14	0.00	--	0.00	0.00	2.24
	Sp-0	--	1.57	0.00	0.00	0.00	0.00	0.00	0.00	8.30	2.35
	ST-0	--	--	--	--	0.00	--	--	--	--	0.00
	Td-3	--	--	--	--	--	--	--	0.00	--	0.00
	Tp-3	--	--	--	--	--	--	--	0.00	--	0.00
	Subtotal	--	23.41	0.27	0.00	0.80	0.00	21.82	0.00	2.53	2.49
	Total	3.15	6.07	3.48	2.07	0.61	1.28	8.48	3.25	2.39	2.64


RORAIMA
AMAPA
RIO NEGRO
CACHOEIRA PORTEIRA DAM
AMAZON RIVER
MANAUS
MARANHÃO
AMAZONAS
PARÁ
PORTO VELHO
BR-364 HIGHWAY
ACRE
RONDONIA
MATO GROSSO
TOCANTINS
CUIABA
0 100 200 300 400 Km
Grande Carajas
Calha Norte
Carajas Mine


NP 09
35
ES 04
36
38
37
ES 01
39
5
RORAIMA
NP 02
40
BR 07
NP 03
ES 05
ER 01
ES 12
ER 02
4
6
BR 04
AMAZONAS
NP 04
NP 01
ES 11
BR 01
AMAPA
2
22
25
ES 07
3
26
27
BR 02
23
24
10
11
12
13
PARA
BR 03
MARANHÃO
BR 08
28
14
41
15
42
16
43
ES 02
7
8
9
29
30
31
ES 08
NP 10
ACRE
1
32
BR 05
RONDONIA
17
18
NP 06
44
ES 06
NP 05
MATO GROSSO
TOCANTINS/
GOIAS
BR 06
34
33
ES 03
19
20
21
NP 07
ES 10
ES 09
NP 08
National park (NP)
Biological reserve (BR)
Ecological reserve (ER)
Ecological station (ES)
Example reserve
0 200 400 Km

RORAIMA

4

14

AMAPA

3

5

AMAZONAS

7

10

PARA

2

14

MARANHAO

1

9

ACRE

2

2

RONDONIA

6

7

MATO GROSSO

3

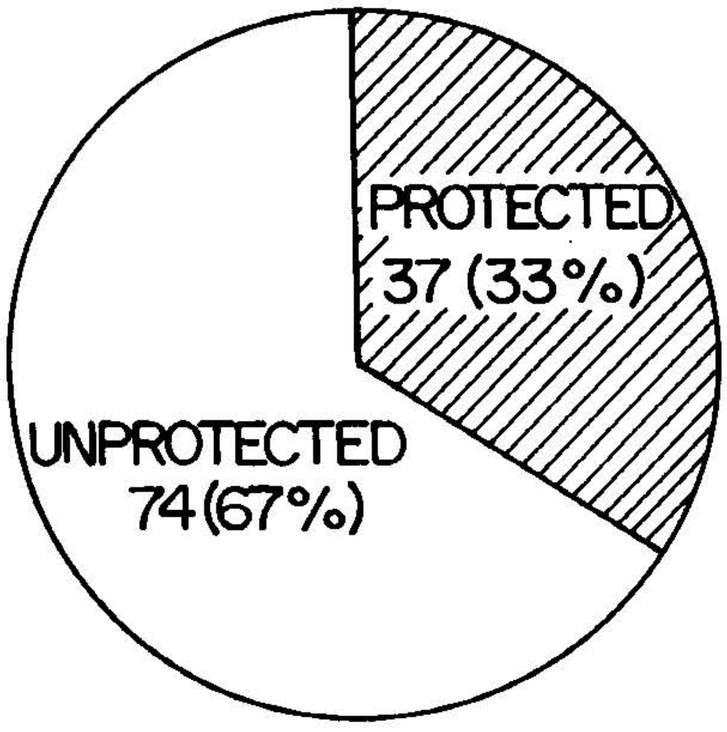
11

TOCANTINS/
GOIÁS

3

8

Legal Amazon
(111 Vegetation Zones)



0 200 400 Km