

# Physiographic and Ecological Zoning of the Entire Brazilian Amazonia

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In the view of the importance of identifying subareas, or spatial cells, in the Brazilian Amazonia, we chose initially to list the popular names applied to each of these regions. To begin with, in the main axis of the vast Amazon basin, we can identify sectors of lowlands, based on popular language, such as “Upper Solimões,” “Middle Solimões,” “Middle Amazon,” “Lower Amazon” and “Marajoara Gulf.” However, the complexity of the great Amazon River plain, embedded among uplands<sup>1</sup> and low plateaus, is much greater than one might think. There is a strikingly large number of islands, side branches (*paraná*s), river estuaries turned into small bays (closed or semi-enclosed by recently formed shoals [*restingas*]) that create inland lakes. It should also be noted that compared to the transversal breadth of the floodplain, the river is very narrow – the ratio ranges from 1:3 to 1:5 at the most. Observations made possible by the Google Earth images reveal intricate hydrogeomorphological features throughout the voluminous river, from the Solimões all the way to the Marajoara Gulf.

Until the mid-20<sup>th</sup> century, regionalization of the huge vast spaces of the Brazilian Amazonia was based almost exclusively on the names of medium and large rivers, tributaries of the Amazon. The writer and educator Abguar Bastos, in a lecture to faculty and students of the Geography Department of the University of São Paulo, stressed the pragmatic regional toponymy for the features of the main watercourses and their respective long-drawn-out watersheds. In fact, with the exception of Bragantina (and the old Belém-Bragança railroad) and of Amazonian cities along the left bank of the middle river (Trombetas, Paru do Oeste and Maicuru rivers), located on upper edges of scarped uplands (Alenquer, Óbidos and Monte Alegre), all the other regions were given names of rivers and affluents – e.g., rivers of the “Xingu generation” (Tapajós, Xingu, Tocantins), so-designated by the Radam Project. This fact, encourages us to, likewise, identify the rivers of the “Purus generation” (Juruá, Purus and Madeira), as well as the aforementioned rivers of the “Trombetas generation” on the left bank of the Middle Amazon. Not to mention the transient rivers and lateral tributaries of each of these newly-grouped hydrographic basins, and last but not least, the great Negro River [black river], accrued by its color opposite, the great Branco River [white river], originating in Roraima.

The difficulties of discerning true ecological and economic regions in the immense territory of the Brazilian Amazonia have already been mentioned in our 1989 essay in *Estudos Avançados*. After reviewing the problem of the sub-areas and sectors of the great plains, we achieved a closer and more pragmatic framework for regional studies in Amazonia in the early 21st century. To aid university students, high school teachers and pre-college preparatory courses, we organized a map of sub-regional areas that we christened Amazonian spatial cells. Each of the sub-areas of this new design covers from 50,000 to 120,000 square kilometers. We were obliged to respect the old and non-adjustable sequence of the great river and its main tributaries from the south or north of the mega Amazon region. We deemed the regionalization of the great plain of the Amazon River was unduly simple (a west to east perspective, i.e., Upper Solimões, Middle Solimões, Middle Amazon, Lower Amazon and Marajoara Gulf) and decided to identify, in this traditional and elongated plain, certain spatial cells that display individuality and traditional socioeconomic importance in the settlement of the Brazilian population in the country's "Great North".

On the border with Colombia, where the so-called Upper Solimões originates, we find important frontier cities that merit further study from the economic, social and urban development viewpoint: Tabatinga, Benjamin Constant and São Paulo de Olivença. In the region of Manaus, where the Negro River meets the Lower Solimões, lies one the key nodal points to understanding the real development of the urban, economic and social worlds of the Amazonia. In the Middle Amazon, in the lower valley of the Madeira River, there is a demographic and economic nodal point that merits further studies and must be better understood in regional terms (Paraná do Ramos). Based on the confluence of large rivers in central Brazil, we can say that the middle valley of the Amazon extends from the meeting point of the waters of the Negro and Solimões Rivers to the region of Santarém, on the mouth of the Tapajós River (where the Lower Amazon begins), up to the vicinity of Porto de Moz and Ilha Grande de Gurupá. Further on is the Marajoara Gulf (which includes the large mouth of the Amazon between the state of Amapá and the extraordinary Marajó Island), the Breves Strait to west of the island (ending with the long stretches of the Bocas Bay); and to the east-northeast, the Pará River, the Lower Tocantins and Marajó Bay. This was an area of the greatest importance in the history of Amazonia and its sub-regional peculiarities, and contains the nodal points of Belém do Pará, Macapá/Porto de Santana and Jari, in addition to the small nodal sector of the region of Breves.

With regard to the plain of the Amazon River, however, as mentioned, a traditional regionalization has always existed (namely, Upper Solimões, Middle Amazon, Lower Amazon and Marajoara Gulf).

Without forgoing the historical and traditional names, we should remember that the extensive roadways built after the inception of Brasília created spatially small sub-areas in various Amazonian subspaces: the Jari Project, the Breves Strait, southeastern Acre (Rio Branco) and northwestern Acre (Cruzeiro do Sul).

The natural tendency of the new nodal points indicates that every state capital of the Brazilian Amazonia is quickly evolving into small subareas with unique and differentiated functions; this is particularly true of Rio Branco (Acre), Porto Velho (Rondônia), Boa Vista (Roraima) Macapá-Porto Santana (Amapá) and Palmas (Tocantins). Not to mention to the cities that acquired particularly important functions on account of their location – such as Marabá, Santarém, Brasileia, Imperatriz and Parintins – and the group of border cities between the Upper Solimões and Colombia that are becoming major urban centers in the farthest reaches of the Western Amazonia, near the border with Colombia and Peru.

It is worth noting that in the highly meandrous Purus and Juruá rivers, forests enjoy great spatial continuity, extending from out-of-water lands<sup>2</sup> and interfluves to convoluted plains, involving however ecosystemic changes that beg further study (floodplain<sup>3</sup> forests). In the plain of the Solimões and the Amazon rivers, there are numerous anastomosed minibiomes, represented by floodplains, riverside forests, philodendra, floodplain forests and shallow vegetation in remnants of sandy riverbanks.

For quite explicable geological and hydrogeomorphological reasons, the Marajoara Gulf is the most differentiated subcoastal region of the South America shoreline. To the north, the main mouth of the Amazon River, where a number of giant channels from giant estuarine paleodeltas still remain (from the big Gurupá island to the islands of Caviana and Mexiana) and where we currently acknowledge two terminal confluences of the Amazon (the northern and southern channels). After the ancient shattered delta of this great river, we must deal with the complicated features found west of Marajó Island, generically known as part of the Breves Strait. In that area to the west and northwest of Marajó, there is a complex junction of hydrological features of great geographical significance.

The first spatial cell chosen in the Amazon River axis begins in the Peru/Brazil border, where the Marañon River enters Brazilian territory through the so-called Upper Solimões. The region is also traversed by alluviums of the left bank of the Solimões: the Içá River, an extension of the Putumaio (Peru), and the Japurá River, issuing from the Caquetá River (Colombia).

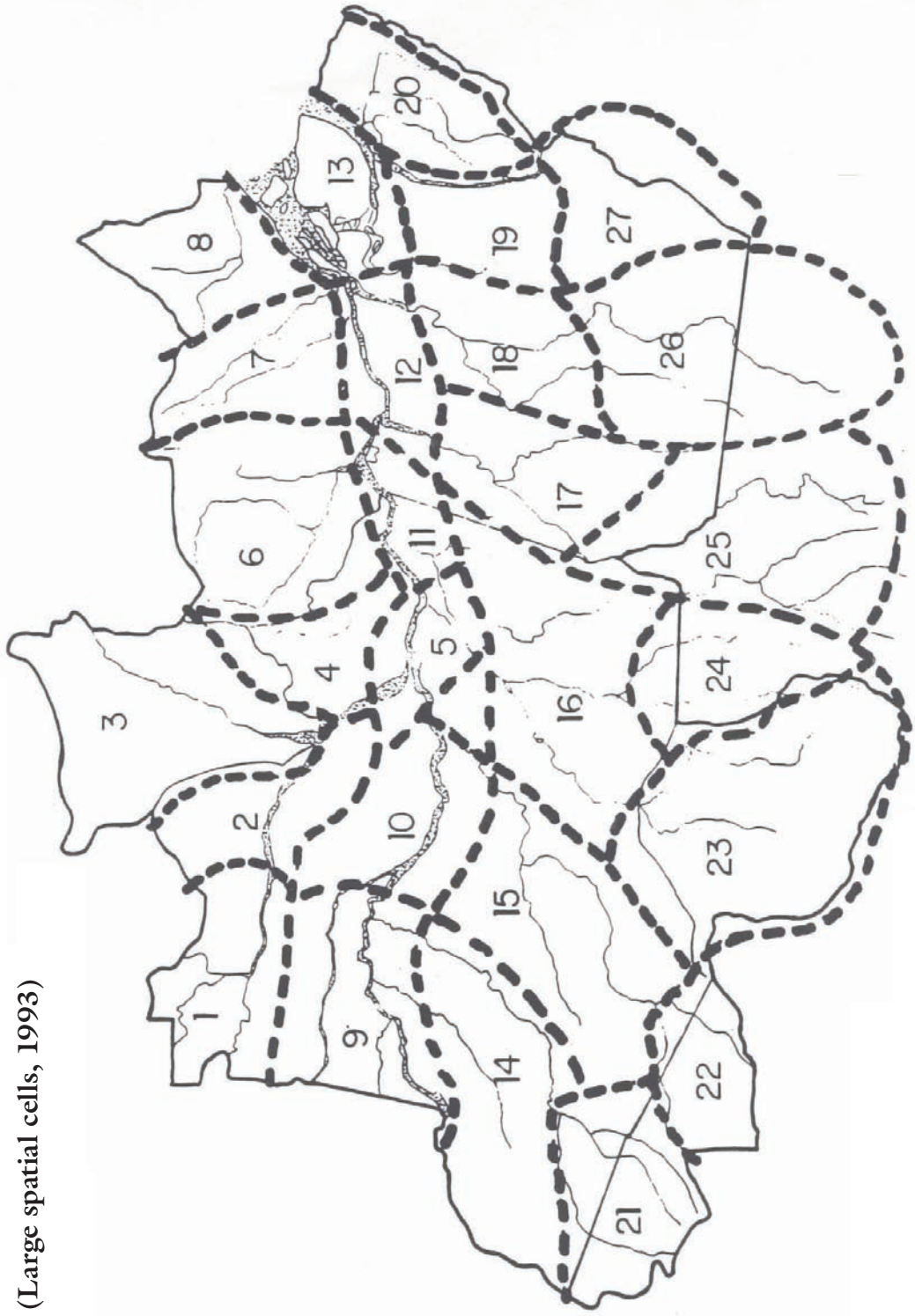
In our observational roadmap, after consulting various cartographic documents, we decided to identify, along the Amazon River axis, from west to east, the five aforementioned spatial cells, each one highly original.

The upper Solimões region involves the area between the two tributary valleys on the left bank of the main river: the Içá and the Japurá. On the mouth of the latter, in relation to the Solimões, is the area of the first West Amazonian spatial cell. It should be noted, however, that the upper Solimões receives, on its right margin, a complex drainage network comprising the Juruá River.

The region acts as a border nodal point, with one of the densest clusters of small towns and villages in the Amazon valley. Progressive study bases in the region would have to be established in Tabatinga, Benjamin Constant and São Paulo de Olivença. In order to encompass the subarea of the Japurá River valley,

**BRAZILIAN AMAZONIA DIVIDED BY SECTORS**

(Large spatial cells, 1993)



(Based on map of rural and urban distribution by Beatriz Célia C. de Mello Petey, 1960).

it would be necessary to work in several villages of this important tributary to the north of the Upper Solimões system. Tabatinga airport is key to reaching this area, but all regional research will depend on the traditional river-based transportation that characterizes the history of communications in Amazonia.

With regard to the Middle Solimões, finding bases for the regional research job is much simpler, and some cities clearly stand out: Tefé and Coari, as well as Manacá Purus.

The Middle Solimões, on the axis of the great valley, extends from mouth of the bar of the Juruá River to Paraná do Careiro, where the waters of the Negro and Solimões rivers meet. In this stretch, where we find the site of the city of Manaus, is the most important nodal point of the entire central and western portion of the Brazilian Amazonia. This is a unique situation in terms of this immense area, said to be undergoing a process of development within the context of a territorially complex but incontestably emerging country.

The Middle Amazon, always involving the edges of the left margin uplands, where the region's cities are typically located, stretches from Paraná do Careiro and the meeting of the waters (Amazonas state) to the bar of the Tapajós river, site of the important city of Santarém – to the north of which, in the rugged rim of the uplands, we find the most traditional urban trilogy of Amazonia (Pará state): Oriximiná, Óbidos, Alenquer and Monte Alegre, essential places to receive the research teams sent by Brazilian universities and institutions from the mid-south and west of the country, in projects of geographic reconnaissance of the middle valley of the Amazon.

It should be noted that the Middle Amazon region begins in the important and well-studied area of Paraná do Careiro (Hilgard O'Reilly Sternberg) and extends to the mouth of the Tapajós River (Santarém).

It is also worth mentioning that the typical Middle Amazon begins to the east of the Manaus nodal point, where the outstanding encounter of the waters of the Negro and Solimões rivers takes place. Actually, the Middle Amazon begins just downstream from Manaus, comprising the great and important region of Paraná do Ramos/Lower Madeira River/Tupinanbarana Island, containing two traditional urban concentrations of Amazonia: Maués and Barreirinha.

In the Lower Amazon, from Santarém to the Lower Jari, the research involved meticulous work until to the mouth of the Xingu River and the large Gurupá Island. With regard to the urban milieu from the Middle to the Lower Amazon, a basic social-ecological methodology is indispensable for a more integrated view of the entire regional space.

Finally, we reach the Marajoara Gulf, with its a maze of islets and small channels covering the entire western portion of Marajó Island, comprising the main mouth of the Amazon to the north, and the Breves Strait and estuarine delta of Bocas Bay to the southwest. The central base to study this maze of hydrogeomorphological, social and urban conditions areas must be located in the town of Breves, with incursions to Portel and Anajás.

In Marajó Island (northern sector), we can recognize the axis of the southern channel of the main mouth of the Amazon River, which passes through Afuá, Chaves, and the islands of Caviana and Mexiana. On the opposite side, the northern channel, extending from the left bank of the large Gurupá Island, through the terraces of Macapá, Porto Santana and Mazagão, casts the world's most extensive and voluminous nebula of clays into the Atlantic encircling Marajó. That is why the coastline of Marajó Island and Amapá has for many years been known as “*mar dulce*” [sweet sea].

It is easy to see that the northern channel of the Amazon is one of the remnants of the broad paleodelta that existed in the Quaternary (Pleistocene) from Gurupá to the aforementioned large islands of Caviana and Mexiana. In turn, the southern channel that passes north of Marajó, at the tangent of Caviana and Mexiana, behaves as another outlet of the Amazon River into the Atlantic.

A thorny problem in the northwest corner of Marajó is the existence of a shallow flooded plain between Anajás Island and the region of Curumá, up to São Miguel dos Macacos, traversed in the middle by a narrowed channel of the so-called Viera Grande Bay. It is in this north-south channel, extending to the villages of Antonio Lemes and Breves, that lies the main channel of the estuarine delta that protrudes to the Bocas Bay. By establishing the details of the maze of small riverine branches found between Anajás Island and Curana, we learn a waterlogged lake existed there until recently (it is now being progressively destroyed, the last stretch of “open river” occurring in the channel of the Amazon, embedded between a narrowed channel – Vieiro/Gram/Breves – and the out-of-water and hilly forests of Western Marajó. It seems that the region of the Breves Strait, had bipolar currents in earlier times: some northern-bound and many more southern/southeastern-bound, through the most representative deep-water estuarial delta of tropical Brazil.

This fact can be verified by the terminal name of the deltaic channels that are found there nowadays, popularly known as Bocas Bay [Bay of Mouths], derived, to be sure, from the traditional identification of the mouths belonging to a deep-water estuarial delta. This ecosystemic homogeneity of forested out-of-water lands is opposed by a complex set of minibiomes, from the islands of the main mouth to the Bocas Bay at the edge of the Breves Strait.

The southern sector of the Marajoara Gulf begins where the various branches of the Breves Delta end – or, in the parlance of the region Bocas Bay, a very voluminous channel about 22 kilometers wide, begins beyond the furthest boundaries of the existing deep-water estuarial delta.

It is easy to see that the popular name refers to the many mouths of the Breves Delta. Observations from satellite images and detailed topographic maps characterize this terminal deltaic region as a *finger delta*, i.e., a delta of multiple terminal branches interspersed with several elongated channels. After Bocas Bay, where southern- and southeastern-bound vessels coming from Breves must brave the strong waves that occur there, the waters flowing into the Pará river receive

midway the currents of the Lower Tocantins delta, ensue to the Guajará-Mirim Bay (opposite the city of Belém do Pará) and finally reach the coast of Marajó Bay, dominated by mangroves (an area ahead of the city of Soure). Soon the wide channel becomes the Pará, a name that in Amazonia means “sea river”. The fluvial sector that extends from the Breves Delta and Bocas Bay reaches the unreasonable width of up to 22 kilometers. This is an important fact that attests to the magnitude of the Breves paleo Strait during the period from 6,000 to 5,000 years ago, named *climatic optimum*, when the seas were three meters above their present level. Midway between Bocas Bay and Marajó Bay is the mouth of the Tocantins River, crossing another regional deltaic weft on right bank of the Pará River (Abaietetuba). Further downstream is the discharge of the Guamá River, near Belém do Pará. It should be remembered that, beyond the site of Belém do Pará, we find small sectors of tiny beaches (Mosqueiros) and ancient dunes prefixed by psammophilous vegetation (a subarea until recently surrounded by dense, biodiverse tropical forests).

The mangrove swamps at the mouth of the Pará River begin a few dozen kilometers east of Mosqueiros, in the area popularly known as Marajó Bay. We can surely recognize in this riverine arrangement the existence of an estuarine character in the watercourse as a whole, extending from the city of Belém to the Atlantic.

It is curious that the embouchure of the Pará River is more concretely an estuary than the wide embouchure of the Amazon, north of Marajó, where the exceptional volume of water and strong currents push into the sea a great mist of dissolved clays that protrudes toward the Atlantic shoreline, between Amapá and the northeast of Marajó, providing ecological support for different types of mangroves. While it is true that the west-east embouchure of the Amazon into the sea does not have the actual hydrological character of an estuary, it is certain that in the recent past deltaic conditions existed in the northern mouth of the Amazon, when sea levels were approximately three meters higher than the current average – a well-perceived fact in the syncopated array of the islands that remain, from Gurupá to Caviana/Mexiana.

The essential concern of geographic studies of the Marajoara Gulf naturally leads researchers to take a tour of the waters and deltaic structures surrounding the large island of Marajó. Marajó has been known as the largest continental island on the east equatorial side of South America.

Its nuclear area reaches approximately 50,000 square kilometers, from the east side facing the Atlantic to the complicated deltaic plains in the region of Breves, and in the interspace that extends from the north mouth of the Amazon to the confluence of the Pará. To the west, separated by a north-south line of ancient abrasion in the middle of the large island, we find dense biodiverse tropical forests that stretch westward in hilly out-of-the-water lands, while in the central-east and northeast we find floodplains that are topographically quite shallow and have undergone ecosystemic changes. These original and unique coastal plains differ from all other such seaside stretches in Brazil.

Therefore, only in the northeastern corner of the great island are there sandy areas, although very limited. The great masses of clay and very fine sand, brought by dissolution from the waters of the Amazon, penetrate the coastal seas, bulging toward the larger coast of the state of Amapá. As a result, Amapá does not have sandy beaches and remains a tourist attraction dominated by hilly out-of-water plains and watercourses that crisscross the area from the Tumucumaque Mountains, including the state's main river – Araguaari – and, in the north, on the border with French Guiana, the Oiapoque River. Lake Arari lies in the middle of Marajó, whose west face is an elongated inlet from a time when a shoreline of shoals and sublittoral seas once existed. The Line of Tordesillas passed there, near the towns of Marajoara and Santa Cruz do Arari.

When we resumed our socio-geographic studies of the Marajoara Gulf, we were certain that in order to do systematic research on that complex Amazonian region we would need to a preview of the entire regional space. Only in this way we might later understand the projection of human groups living in the two large embouchures of the Amazon River, including the two capitals and states located in that region, their villages, the inhabitants of the Breves Strait and the submersible fields of Marajó Island not to mention the small towns of Afoá, Chaves, Soure, Curralinho, Breves, Portel, Gurupá and Anajés.

With this goal in mind, we would identify the cities or villages that might serve as our research base in a particular milieu, including the availability of boats, guided hiking, and eventually the use of mules. In the fragmented paleodelta of the main mouth of the Amazon, Macapá-Porto Santana, Gurupá and Soure are essential places to obtain basic anthropogeographical, sociological and educational expertise, with special attention to public health, the educational system, the limited elasticity of jobs, and the strategies for survival. And always willing to listen to the expectations of the regional population, their yearnings and aspirations, that might later become the source of multiple small projects for social, socio-cultural and socioeconomic assistance.

A more detailed reconnaissance of a mega-region like the Brazilian Amazonia has many unthought-of cultural implications. It is not only a matter of identifying the names of natural or cultural assets that dot large spaces of an extensive equatorial territory with apparent ecosystemic homogeneity, but, much more than that, it is a matter of knowing how to use the current argument that led to the organization of nature reserves, Indian reservations, architectural constructions from different periods, schools and hospitals, public parks, scientific institutions, river ports and harbors, bridges and reservoirs, large hydroelectric power plants, urban centrophraphy, and markets and wharves for food-carrying vessels. And also of knowing that the “student neighborhood” of Manaus was the first settlement for indigenous children in Amazonia, replicating in a different time than the pioneer function of the church and school in São Paulo de Piratininga's Pátio do Colégio during the Luso-jesuitic colonization of the 16<sup>th</sup> century. In this fashion, the granting of landmark status to some remaining



cultural assets Amazonia was of great educational, historical and systemic significance for the teenagers who will one day become adults, parents and citizens prepared in the context of a larger Brazil. One of the greatest sources of human wealth in the Brazilian Amazonia is the existence of indigenous groups who are heir to a particular pre-history of the tropical South American world. Idiotic politicians, however, and people with links to neo-capitalism never seem to display a bioethical purview of the human groups that constitute the “refuges of men” in various corners of Amazonia. The greatest nonsense in the history of Brazilian (un)intelligence was actually articulated by someone: “Brazil is underdeveloped because of the Indians, the descendants of runaway slaves, and the Judiciary...”. This fact alone should require that such personages be recycled in bioethics – in real anthropoethics. And the reproof is equally valid for administrators, politicians, farmers and habitual land grabbers that live in remote and marvelous Roraima.

Not infrequently, hybrid sites have been found in Amazonia that are valuable geological and geomorphological relicts of vegetation found in minibiomes (rupestrian biomes; sand biomes; enclaves of *cerrados*<sup>4</sup>; minienclaves of *cerradinhos*<sup>5</sup>; glades; and rocky hillocks involved by or covered with cactaceous plants). It is important to note that prehistoric men had already acknowledged the originality of some of these exceptional features, as can be seen in cave inscriptions made a few millennia ago in paleo-inselbergs and in occasional ruiniform topographies (such as Pedra Pintada, in north-central Roraima, and the inscriptions in ruiniform turrets in Monte Alegre). The exuberance of the varied cactaceous vegetation, occurring on the walls of a crystalline hillock in the current urban site of Mucujai must be granted immediate landmark status protection by the authorities of IPHAN (Instituto do Patrimônio Histórico e Artístico Nacional = Institute of National Historic and Artistic Heritage), in collaboration with the renewed IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais = Brazilian Institute of Environment and Natural Resources). The latter is, above all, responsible for protecting the dunes identified in southeastern Roraima. Ancient photographic portraits of Pedra Pintada are evidence of the importance of that paleo-inselberg, which emerges above the sedimentary cover of the Boa Vista formation, in an area of gentle, shallow, sandy hills of the so-called “*lavrado*”<sup>6</sup>. Pedra Pintada must receive landmark status protection before callous people remove all the cacti or tear down the rupestrian inscriptions. Narrow strips of *cerrado* in arenaceous, white earth terraces, should be spared, as happened between Santarém and Alter do Chão (we also find significant sandy terraces in the vicinity of the Balbina). Important stretches of meadows and *campinaranas*<sup>7</sup> that occur in various sectors of Amazonia deserve representative preservation. Likewise, under intelligent planning, the sandy paleochannels of great rivers that changed their position in the uplands also require protection, including the paleochannel of the Tocantins, east of Marabá, and the paleochannel of the Araguari, in Amapá.

Selected teams must carry out more detailed studies on the region of the old Serra Pelada, in Amapá; on the ancient massif in the Carajás Mountains, with their forested contours and cymes of meadows and local cacti in metallogenic soils; and on the rocky, aluminum-producing sectors found in the environs of Oriximiná.

## Notes

- 1 *Tabuleiros* in Portuguese: land surfaces 20 to 50 meters high, usually with flat tops and not far from the coast.
- 2 *Terras firmes* in Portuguese. Literally “firm lands”, that is, forested areas of Amazonia that are too high to be flooded during seasonal inundation.
- 3 *Florestas de várzea* in Portuguese. “Várzea” refers to areas of forested land that are regularly inundated by seasonal river floods. Typically, it refers to areas flooded by white water rivers, contrasted with areas flooded by black water rivers, which are called igapós.
- 4 *Cerrado*: open plain dotted with patches of dry, sparse but varied wooded vegetation (from tropical broadleaf woodlands to scrublands to savannas).
- 5 *Cerradinho*: cerrado unsuited for any type of agriculture.
- 6 *Lavrado*: a barren, desolate plain.
- 7 *Campinarana*: a meadow being taken over by thickets and trees.

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