

CFSTOM

INSTITUT FRANCAIS DE RECHERCHE SCIENTIFIQUE
POUR LE DÉVELOPPEMENT EN COOPÉRATION

B. P. 165
97323 CAYENNE CEDEX
TÉL. (594) 30.27.85
TELEX 910 608 FG

WORKSHOP 90

ÁREAS PRIORITÁRIAS PARA CONSERVAÇÃO NA AMAZÔNIA

PRIORITY AREAS FOR CONSERVATION IN AMAZONIA

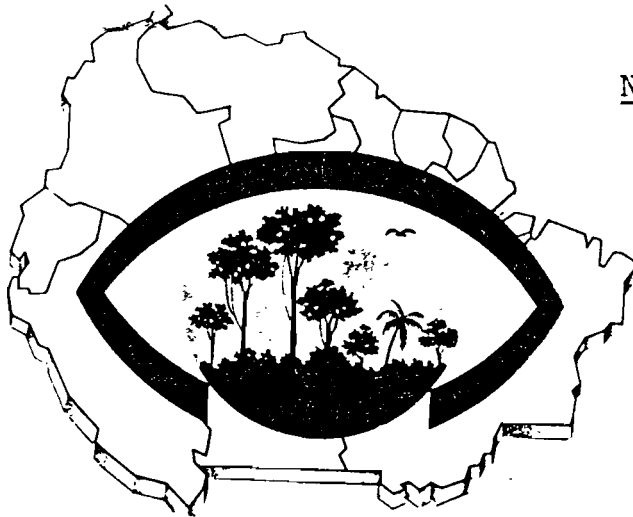
INSTITUTO NACIONAL DE PESQUISAS DA AMAZÔNIA — INPA
Coordenadoria de Cooperação Internacional — CCI

Alameda Cosme Ferreira, 1756 — Caixa Postal, 478
Tel. e Fax (092) 236-0255 Tel. Geral. (092) 236-9400
CEP: 69 083 Manaus-Amazonas-Brasil

PRIORITY CONSERVATION AREAS IN FRENCH GUIANA

Jean-Jacques de GRANVILLE

Cayenne,
November 1989



10 a 20 de janeiro/90.

TROPICAL HOTEL MANAUS

Manaus-AM-Brasil

CORRECTIONS

TEXT :

Title : "Priority areas for conservation in French Guiana ", instead of :
"Priority conservation areas in French Guiana ".

- Page 1, line 43 : "floristically", instead of "florisically".
- Page 2, line 29 : "Centers of diversity", instead of : "Species diversity and species distribution".
- Page 3, line 11 : "selected", instead of "chosen".
- Page 4, line 7 : "Guianan forest flora", instead of : "Guianan flora".
- Page 5, line 53 : "Centers of endemism", instead of : "Distribution patterns of endemic species".
- Page 6, line 22 : "reality", instead of : "reality".
- Page 6, line 25 to 41 (list) : replace by the new sheet.
- Page 15, line 28 : "declared" instead of : "ranked".
- Page 17, line 33 : "many activities", instead of : "many other activites".
- Page 19 and 20 (CONCLUSIONS) : replace by the new sheets

TABLE 2 :

- Page 1, line 12 : "Bonafousia morettii Allorge (+ Guyana and Suriname)",
instead of : "Bonafousia morettii Allorge".
- Page 1, lines 27/28 : Add : "149. Adenocalymna saulense Gentry".
- Page 3, line 23 : "Corythophora rimosa W.A. Rodrigues subsp. rubra Mori (+ Brazil : Amapa), "instead of : "Corythophora rimosa W.A. Rodrigues".

Page 4, lines 37/38 ; add : "150. Sorocea muriculata Miguel subsp. uaupensis
(Baillon) C.C. Berg with aberrant features".

Page 5, lines 34/35 ; add : " 151. Psychotria viridibractea Steyermark".

Page 5, end ; add : "SIMAROUBACEAE
152. Simarouba morettii Feuillet"

Page 6, lines 14/15 ; add : "153. Aegiphila membranacea Turczaninow
" 154. Cornutia pubescens Gaertner".

Page 7, lines 38/39 ; add : "155. Ischnosiphon enigmaticus L. Andersson".

Page 8, end ; add : "PTERIDACEAE
156. Adiantum cordatum Maxon (+ Panama)"

FIGURES :

Fig 1 : "French Guiana", instead of : "French Guyane".

Fig 9 : replace by the new figure

Fig 22 and legend : replace by the new figure

ADDITIONS :

Add tables 3 and 4

Please, replace the list lines 25 to 41 by the following one :

| | | |
|---|----|-----------------|
| 1. Saül area : | 40 | endemic species |
| 2. Montagne de Kaw/Cacao/Comté river : | 24 | " |
| 3. Sommet Tabulaire/Massif des Emerillons/ Monts Bakra : | 16 | " |
| 4. Saint-Elie track/Petit Saut : | 16 | " |
| 5. Montagnes Balenfois/Saut Pararé : | 12 | " |
| 6. Cayenne area : | 11 | " |
| 7. Mont Belvédère/Mont Saint-Marcel : | 10 | " |
| 8. Montagnes Bellevue de l'Inini : | 9 | " |
| 9. Monts Atachi-Bacca : | 8 | " |
| 10. Paul Isnard/Décou-Décou/Montagne Lucifer : | 8 | " |
| 11. Mana/Saint-Laurent : | 7 | " |
| 12. Trois-Sauts : | 6 | " |
| 13. Montagnes de la Trinité : | 6 | " |
| 14. Saint-Georges/Crique Gabaret : | 5 | " |
| 15. Tumuc-Humac : | 4 | " |
| 16. Mont Yaniwé : | 3 | " |
| 17. Piton d'Armontabo : | 3 | " |

PRIORITY CONSERVATION AREAS IN FRENCH GUIANA

French Guiana is situated between 2° and 6° North to the Amazon Basin, on the Guiana Shield constituted by the crystalline and metamorphic Precambrian base (fig. 1).

The climate is equatorial, hot and wet with a dry season in september and october, more accentuated on the coast than in the interior. Annual mean rainfall vary generally between 2,000 and 4,000 mm with extremes reaching locally 1,600 and 8,000 mm (fig. 2).

Lastly, the very low population rate (about 120,000 inhabitants on a 9 millions of hectares territory), the localization of people mostly along a narrow coastal area (more than half of them are concentrated in Cayenne vicinity and neighbourings), the lack of industry, a poorly developed agriculture and breeding give to French Guiana its peculiar features.

CHAPTER 1

FLORA AND VEGETATION TYPES AND PHYTOGEOGRAPHICAL CHARACTERISTICS OF FRENCH GUIANA

1. MAIN FLORA AND VEGETATION TYPES.

The conditions briefly exposed above lead to the persistence of an almost undisturbed forest cover on about 8 millions of hectares when low lying herbaceous natural or secondary formations occupy less than 5 % (principally swamps and savannas along the coast, granitic outcrops in the interior). The narrow coastal zone, formed by Quaternary marine alluvia is opposed to the huge hilly interior zone corresponding to the position of the Precambrian base.

1.a. The coastal zone (lowlands) can be divided in a "recent coastal plain" (less than 3,000 years old) covered by mangrove, different types of herbaceous swamps, marsh and swamp forests, mixed herbaceous and forest swamps, and a "former coastal plain" mostly covered by forests and small dry savannas regularly burned during the dry season. Only in north-western French Guiana (Saint-Laurent, Mana, Organabo) are found small patches of forest on white sand soils resulting of leached continental sediments overlaying the Precambrian base (GRANVILLE 1986 c).

1.b. The interior zone (uplands or inlands) is mostly covered by upland moist forest growing on red clayey or clayey-sandy ferrallitic soils on a sloped but rarely very steeply inclined relief, from sea level up to 500 meters, where multiconvex pattern corresponds to the meshes of hydrographic network. These evergreen, floristically rich forests,

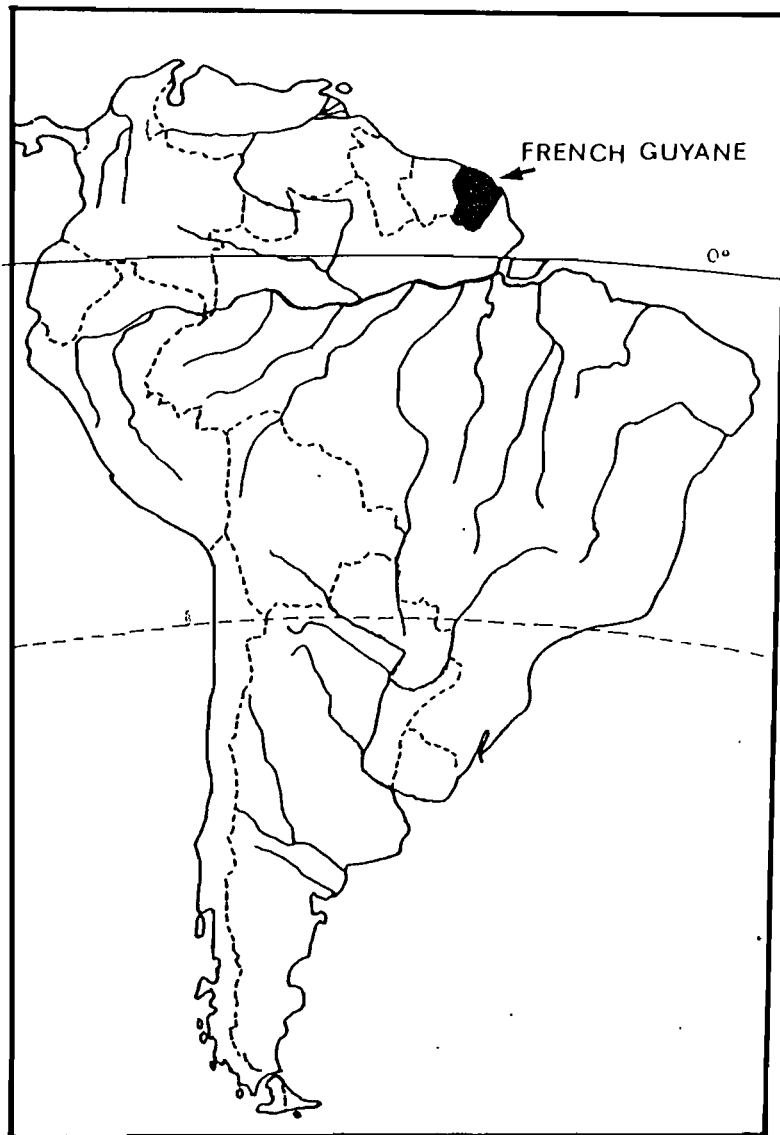


Fig. 1 : Location of French Guiana

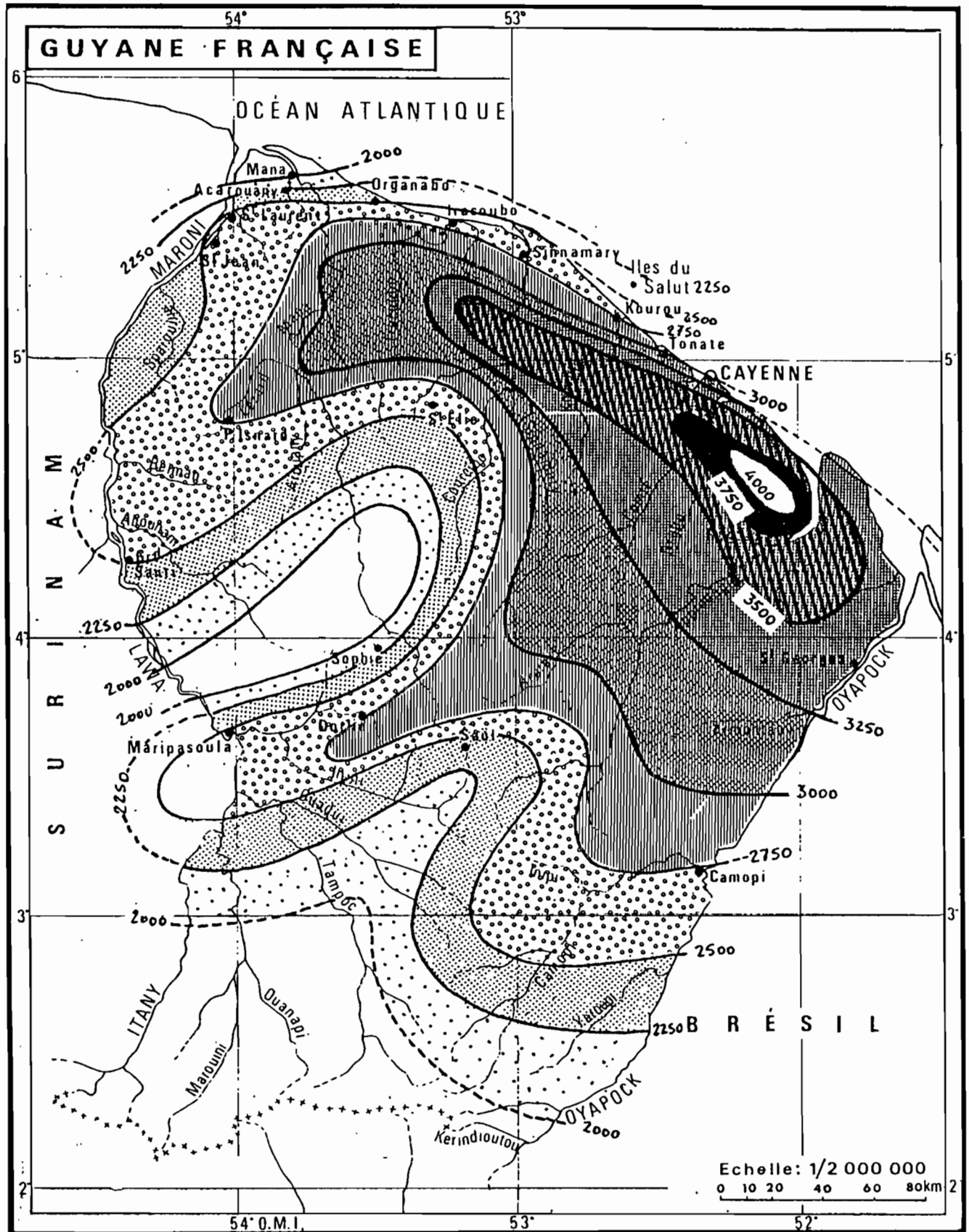


Fig. 2 : Annual mean rainfall (from J.-J. de GRANVILLE, 1982)

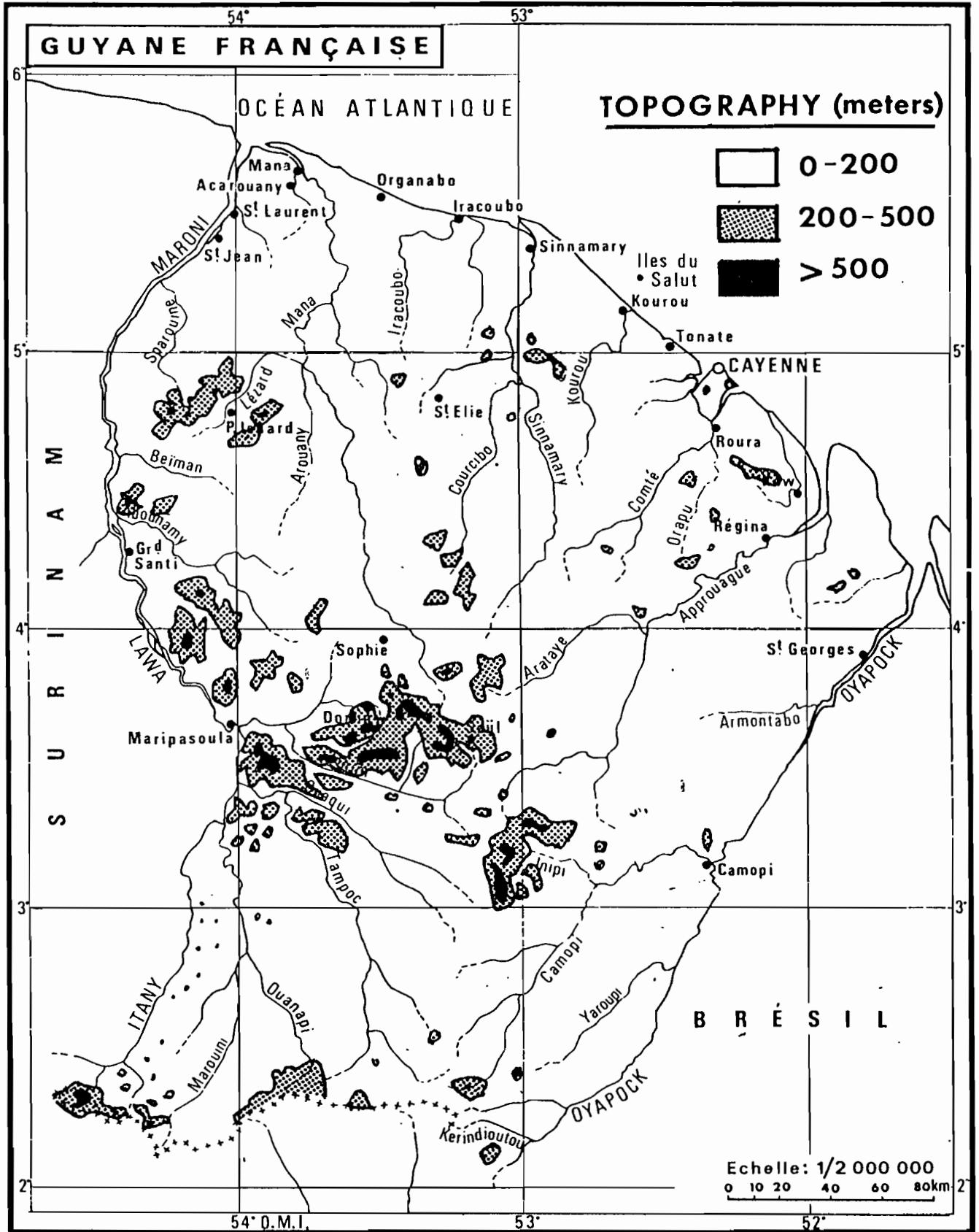


Fig. 3 : Topography of French Guiana (from J.-J. de GRANVILLE 1982)

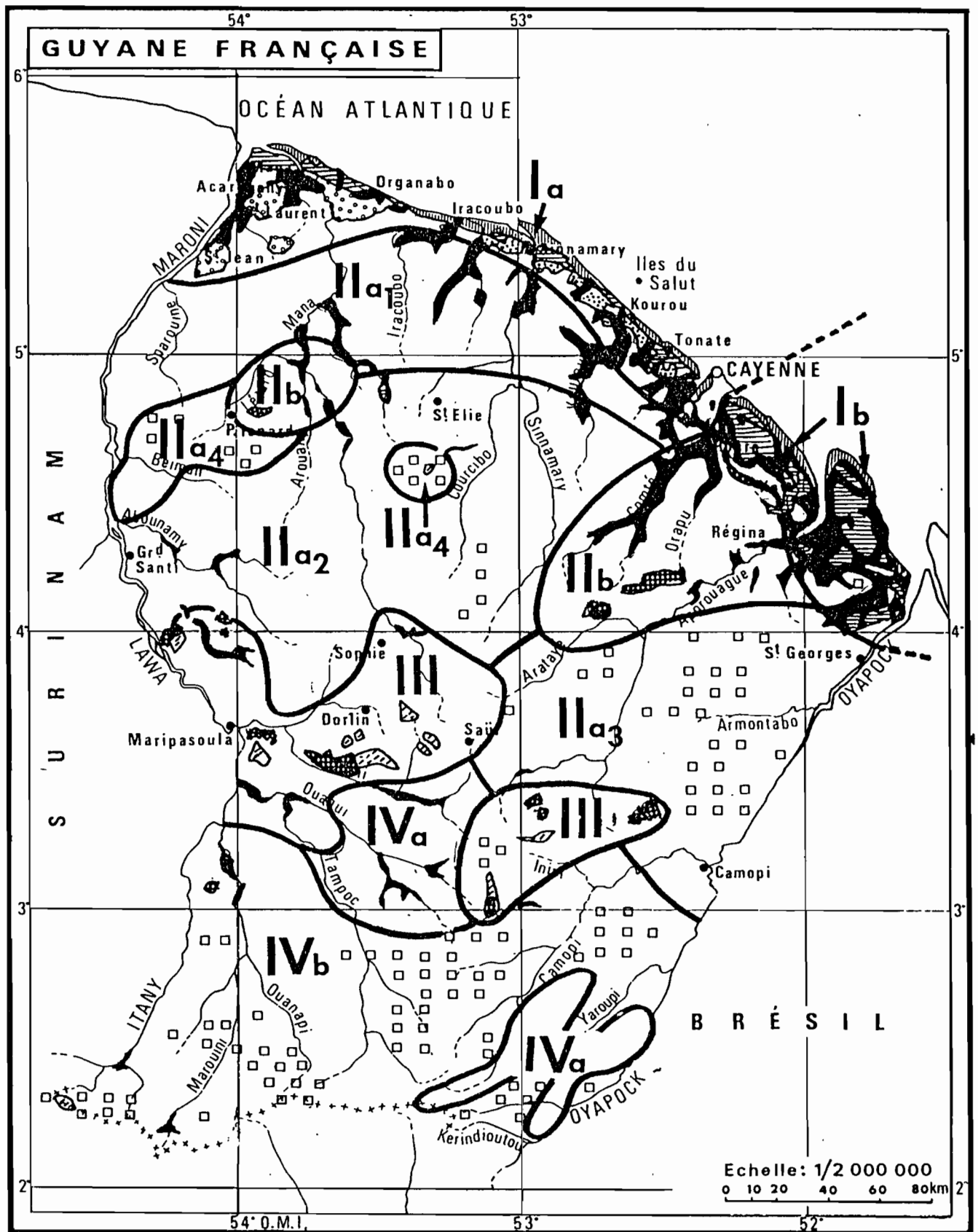











Fig. 4 : Flora and vegetation types (from J.-J. de GRANVILLE 1982)

| | |
|---|--|
|  | Mangrove |
|  | Herbaceous swamps |
|  | "Dry" savannas |
|  | White sand forest |
|  | Marsh forest and swamp forest |
|  | Forest on lateritic crusts |
|  | Rain forest on well-drained ferralitic soils (alt. 500m) |
|  | Cloud forest (alt. 500m) |
|  | Zone rich in rocky slopes and outcrops |

- I. COASTAL SECTION: Lowlands, on marine alluvia (mangrove, savannas, swamps and marshes, coastal forests, and transitional zones).
- Ia. *Lowland zones which have a tendency to be dry, west of Cayenne.*
 Vegetation: mangrove, savannas, secondary vegetation and cultivation, forests on sand with some xeric tendencies.
 Flora: very varied, particularly with Surinamian affinities; pantropical species frequent.
- Ib. *Humid zones in the lowlands, east of Cayenne.*
 Vegetation: mangrove, large marshes, swamp forests, "pinotières."
 Flora: varied, with Amazonian affinities.
- II. MEDIAN AND SUBCOASTAL SECTION: Northern Range and Central Massif (forest).
- IIa. *Zone with mean rainfall.*
 Vegetation: dense rain forest, more or less "fine."
 Flora: fairly species-rich; varied affinities.
- IIa1. Subcoastal forests on "Orapu" schists, generally "fine" and species-rich, Guianian-Surinamian floristic affinities.
- IIa2. Forests on the western median zone on crystalline base, "fine" to mediocre, fairly species-rich, varied floristic affinities, mainly Surinamian.
- IIa3. Forests of the eastern median zone on crystalline base, "fine" to mediocre, fairly species-rich; varied floristic affinities, mainly Amazonian
- IIa4. Forests of submountainous zones on uneven bases, generally very "fine" and species-rich; floristic affinities very varied, sometimes mountainous.
- IIb. *Zones with very high rainfall on varied bases and transitional zones. Extensive lateritic crusts of low altitude*
 Vegetation: Dense rain forest, generally very "fine."
 Flora: very rich due to the rainfall and the variety of habitats; very diverse floristic affinities.
- III. ININI-CAMOPI RANGE SECTION (forest), mostly on *roches vertes*. Zone of the extensive altitudinal crusts; habitats varied and contrasting; soils generally deep.
 Vegetation: dense rain forest, generally very "fine" and majestic; submountainous scrubby forest on lateritic crusts.
 Flora: very rich, bearing endemic hygrophile species on the summits; very diverse affinities, often Surinamian and mountainous.
- IV. MERIDIONAL SECTION: Southern Peneplain (forest).
- IVa. *"Flats" zones and extensive eluvial plains.*
 Vegetation: dense rain forest, often mediocre and scrubby.
 Flora: generally poor.
- IVb. *Hills and outcrops zone on crystalline base.*
 Vegetation: dense rain forest, more or less "fine"; mesophilic forest, bush and xeric herbaceous vegetation on the rock slopes and outcrops.
 Flora: fairly poor, becoming rich in the higher irregular zones and on the outcrops. Presence of endemic species on the latter. Very diverse floristic affinities (especially Amazonian for the forest species and coastal or mountainous for outcrop species)

Fig. 4 : Flora and vegetation types (from J.-J. de GRANVILLE 1982)

characterized by a high, dense canopy at 20-45 m and emergent trees up to 50-60 m, are the most common in French Guiana. Along creeks and rivers, patches or belts of swamp forest are often seen.

In central part of French Guiana and in some places of western side are found mountain ranges overtopping 500 m, up to 860 m. Most of them are table mountains overlain by a lateritic crust. These are the kingdom of lower montane moist forests: cloud forest rich in epiphytes in the higher valleys, liana forest on the summits (GRANVILLE 1988).

The far South is a peneplain on crystalline base rich in emergent rocky outcrops bearing a particular discontinuous vegetal cover: transition low forests and epipetric herbaceous and scrubby plant communities on almost bare rock. The highest and the most spectacular ones, reaching 700 m, are concentrated at the south-western Brazilian border ("Tumuc-Humac" area).

1.c. A map of flora and vegetation types has been drawn up from our field experience, physiognomy of vegetation, floristic inventory and gathering of all data acting on vegetal cover: topography and altitude, geology, geomorphology, soils, distribution of rainfall (GRANVILLE 1979, 1982). This map is given on fig. 4. Also floristic affinities and phytogeographical regions have been very roughly outlined.

Since 1979, many additional data, especially owing to the continuation of floristic inventory and settlement of a computerized treatment, allow to give much more details on flora, species diversity, species distribution and endemism (CREMERS & al 1988 a, HOFF & al 1989 b, HOFF 1990, HOFF & CREMERS 1990).

2. SPECIES DIVERSITY AND SPECIES DISTRIBUTION.

Floristic inventory carried out by ORSTOM since 1955 (CREMERS 1984 a), in complement of many old and historical herbarium collections and newly settled "AUBLET" Botanical Data Bank at ORSTOM (HOFF & al 1988, 1989 a, 1989b) show that French Guiana is characterized by a rather high species diversity: so far, 4,900 species (of which 4,000 vascular plants) are recorded in the data bank. Taking account of old, rare specimens and some other collections which could have escaped notice on one hand, and new species not yet described on the other hand, the flora of French Guiana is estimated to number about 6,000 species (of which 4,800 vascular plants. Approximately 12 vascular species new for Science and 200 ones new for French Guiana but already known from other countries, are found every year !

The most extensively spread vegetation type, the upland moist forest on ferrallitic soils (GRANVILLE 1988), would number 746 tree species (DBH > or = 10 cm) for the whole French Guiana (SABATIER, pers. comm.), while MORI (1987) gives an approximation of a total number of 531 tree species growing in Saül area in a broad sense (133,600 ha).

However, even if the upland moist forest of the interior seems rather uniform in regard to its general physiognomy and architecture, very conspicuous variations in

flora and in species richness can be revealed by more detailed studies and establishing distribution maps.

2.a. Fern species diversity :

A study based on a large sample of Pteridophyte herbarium specimens recorded in "AUBLET" Data Bank (HOFF & al 1989 a) is presently carried out by HOFF & CREMERS (1990). It aims to give a good account of diversity, biogeography and ecology of ferns in French Guiana : definition of the most species rich areas, their relationships between each other and with the other countries.

Example of ferns has been chosen because they constitute one of the most abundantly and well collected groups of plants in French Guiana. They represent about 6 % of vascular plant species.

A map established from the number of species recorded by 5.6 square kilometers quadrats (243 quadrats) shows that some areas are much more species diverse than others (fig. 5).

The highest species diversity is found in four areas :

1. Saül and the Central zone (206 species/quadrat),
2. Kaw/Saint-Georges (165 species/quadrat),
3. Montagnes de la Trinité/Paul Isnard (159 species/quadrat),
4. Tumuc-Humac and other granitic outcrops of southern border (161 species/quadrat).

The medium species rich areas (50 to 100 species per quadrat) are situated along the Maroni river (Apatou/Saint-Laurent), in the region South to Cayenne (Comté river/R.N.2 road from Cayenne to Régina) and in a large central mountainous zone (from Maripasoula to the higher courses of Mana, Sinnamary, Approuague and Inipi rivers).

The lowest diversity (less than 50 species per quadrat) is found along the coast (Kaw flood plain and other swamps, savannas, forests on alluvia, beaches...), in Kourou and Sinnamary rivers areas, along Lawa river and in south-eastern region (Yaroupi and higher Oyapock river, Trois-Sauts).

This study being based on collected and recorded herbarium specimens, some areas may seem to be low species rich because they are too poorly prospected (generally those which are difficult to reach, far from navigable streams or air-strips. Consequently, the continuation of floristic inventory may slightly modify later the map proposed by the authors.

2.b. Plant species diversity:

A more detailed map drawn by HOFF from 76 % of plant species recorded in "AUBLET" Data Bank including all the Pteridophytes but also 46 % of other plant specimens (29,230 specimens in total) is given fig. 6. In comparison with the former one, the high, medium and low species diverse areas are less obvious and appear more dissected owing to the lack of data for very large patches of forest still insufficiently prospected. Nevertheless, even if they appear much smaller, the high plant diversity sites coincide rather well with those obtained by the study of ferns distribution.

The striking species diversity observed in Saül area is

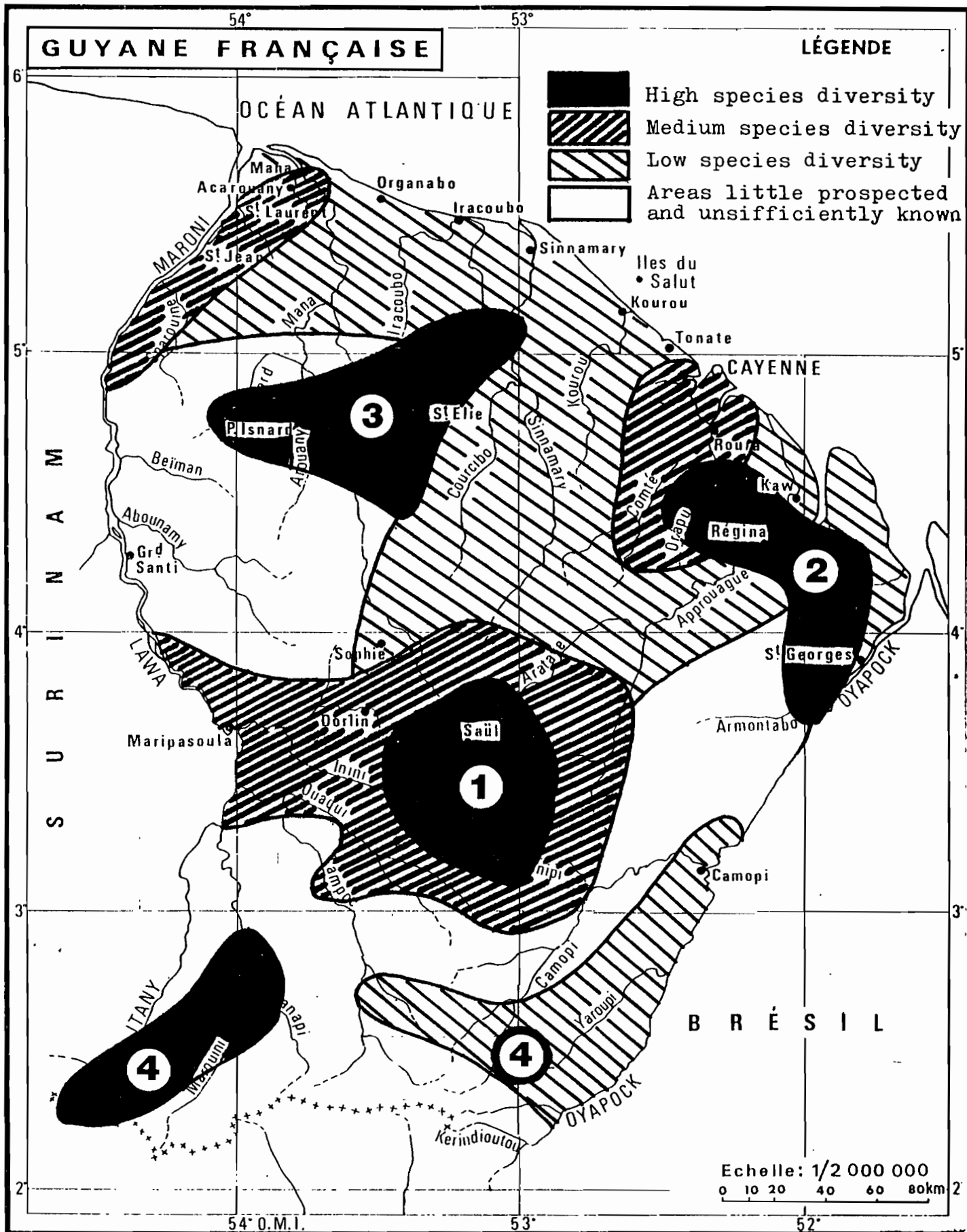


Fig. 5 : Distribution of Pteridophytes (from HOFF & CREMERS 1990)

1. Saül and central zone.
2. Kaw/Saint-Georges area.
3. Montagnes de la Trinité / Paul-Isnard.
4. Tumuc-Humac and other granitic outcrops of southern border.

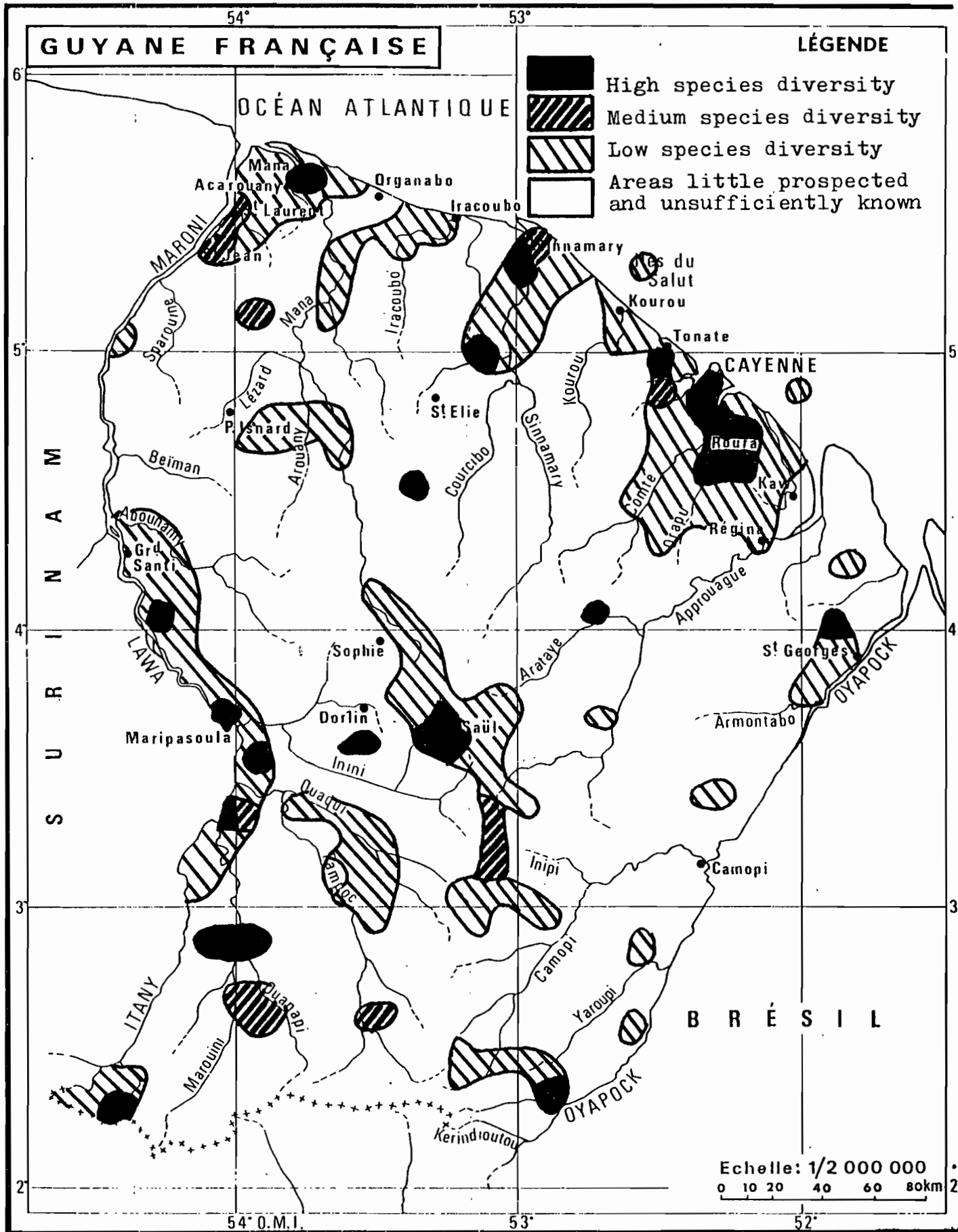


Fig. 6 : Distribution of plant species (from HOFF, pers. comm.)
 (map established from 29,230 herbarium specimens and 3,755 species)

clearly brought to light on table 1 in which a comparison is given between the total number of infrageneric taxa (sp., subsp., var.) existing in French Guiana and those recorded in Saül area. Though a few groups of plants only have been studied, 36 % (Melastomataceae) to 71 % (trees) of species of each group occurring in French Guiana has been found in Saül, so that more than half (60 %) of the Guianan flora is represented in Saül area

2.c. Environmental factors acting on species diversity :

The main factors acting on species diversity seem to be first topography and then geology (HOFF & CREMERS 1990). The very rugged places with bluffs, boulders, waterfalls, deep valleys, outcrops etc... having many different contrasted biotopes and microclimates are much more species rich than surrounding regularly hilly areas, large valleys, flood plains and coastal zone : the four richest above-mentioned areas (cf. 2.a) are mountainous zones. Moreover, the forests on basic volcanic bedrock (Saül, Kaw and southern part of Montagnes de la Trinité) are generally higher and floristically richer than the ones growing on crystalline bedrock (northern part of Montagnes de la Trinité, Tumuc-Humac). HOFF & CREMERS point out that climate has not a significative influence on species diversity : Kaw is in the most rainy area of French Guiana (more than 4,000 mm per year), Tumuc-Humac is the driest one (less than 2,000 mm) and both have a high diversity. However, we think that relative importance of different factors (topography, geology and climate) could vary from a region to another : for example, species richness could be induced mostly by the high annual rainfall in Kaw/Saint-Georges area and mostly by topography in Tumuc-Humac area.

2.d. Comparison with the presumed Quaternary rain forest refugia and with the present day xeric flora refugia :

From floristic, topographic, climatic and pedological data, we proposed a map of presumed Pleistocene and Holocene rain forest refugia in French Guiana (fig. 7) : the areas supposed to have kept an evergreen rainforest cover during the recent Quaternary driest periods have a high probability to coincide with the present day most rainy ones, in particular with the Kaw/Régina area and with the largest mountain ranges remaining always very humid because of convection currents and dew. Moreover, the zones with deep ferrallitic soils without impermeable horizon, generally found on basic bedrock, now associated with highly stable forest, rich in species, are probably characteristics of areas which favour the maintenance of forest during dry periods. On the contrary, other areas can be eliminated from among the possible forest refugia : the coastal plain, the leached hydromorphic soils of river alluvia, the podzols, the continental leached or hydromorphic sandy-clayey eluvia, all soils with a compact impermeable horizon favouring savannization.

Consequently, we proposed... "the existence of a forest refuge between 22,000 and 13,000 B.P. which occupied the central and eastern zone of French Guiana, limited to the North by the Kaw Mountain and to the South by the Inini-Camopi mountain range. The eastern and western limits of this refuge are still

Table 1 : Species richness of Saül area compared to the whole French Guiana.

| <u>Plant taxa</u> | <u>Number of infrageneric taxa</u> | | <u>% in Saül area</u> |
|------------------------------|------------------------------------|------------------|-----------------------|
| | <u>French Guiana</u> | <u>Saül area</u> | |
| * MELASTOMATACEAE | 186 (4) | 67 (1) | 36 % |
| * ARECACEAE | 62 (4) | 28 (1) | 45 % |
| * RUBIACEAE | 243 (4) | 114 (1) | 47 % |
| * ORCHIDACEAE | 217 (4) | 108 (1) | 50 % |
| * LECYTHIDACEAE | 41 (4) | 28 (2) | 68 % |
| *** Pteridophytes | 295 (3) | 206 (3) | 70 % |
| *** Tree species (DBH 10) | 746 (5) | 531 (2) | 71 % |
| <u>Total</u> | 1790 | 1082 | 60 % |

* Saül vicinity (network of trails).

*** Wide Saül area.

Data from : (1) CREMERS & al. (1988 b).
 (2) MORI & al. (1987).
 (3) HOFF & CREMERS (1990).
 (4) HOFF & al. (1989)
 (5) SABATIER (pers. comm.)

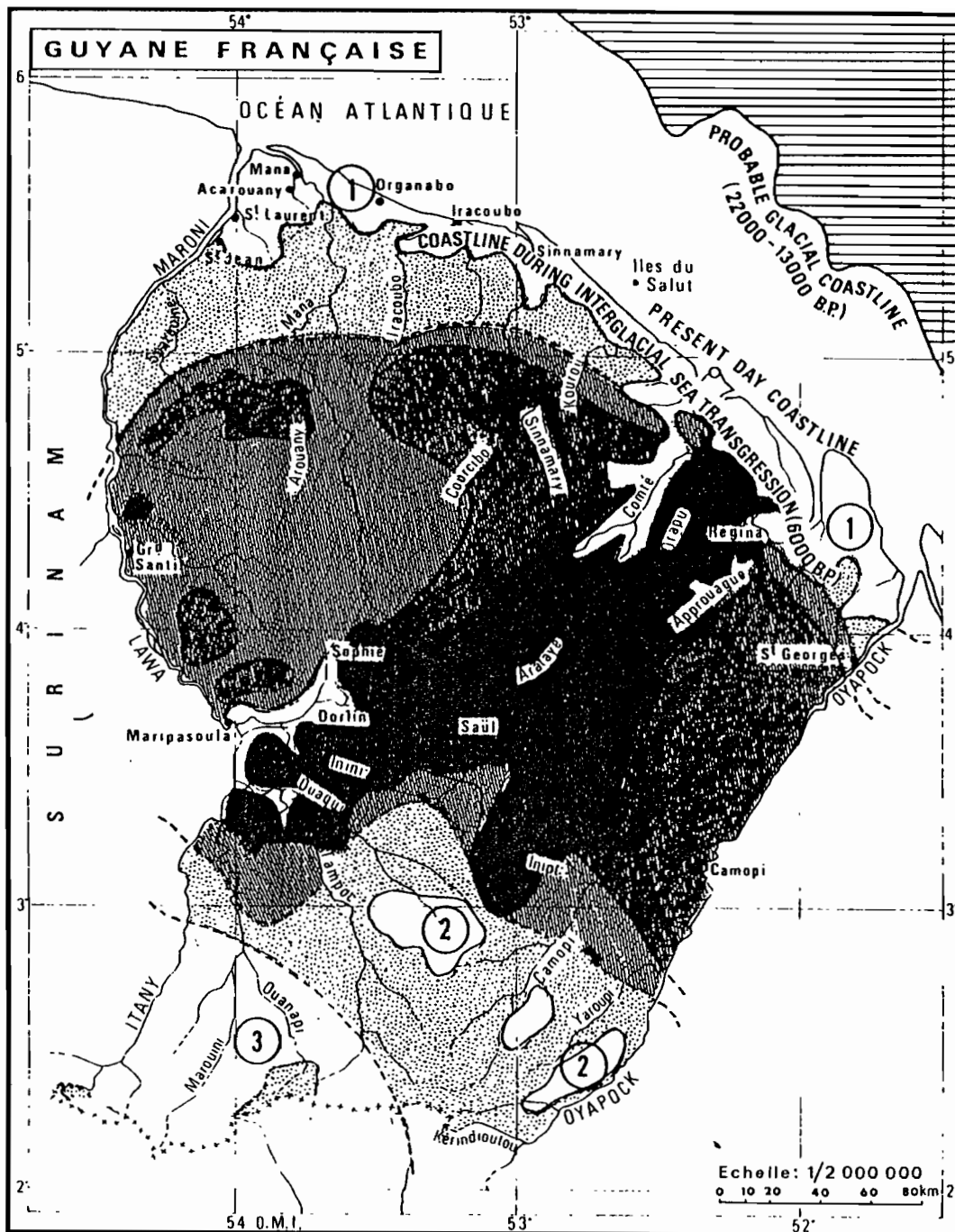







Fig. 7 : Presumed rain forest refugia -22,000-13,000 B.P. (from J.-J. de GRANVILLE 1982)

-  Very high probability continuous refuge zone
 -  High probability continuous refuge zone
 -  Average probability continuous refuge zone (or very high probability mosaic and network refuge zone)
 -  Low probability continuous refuge zone (or high probability mosaic and network refuge zone)
 -  Very low probability continuous refuge zone (or average probability mosaic and network refuge zone)
- 1 Coastal zone, flooded in 6,000 B.P
 - 2 Continental eluvia
 - 3 Zone which could have been part of a continuous forest refuge during the Pleistocene but probably savannized in the Holocene (3.300-2.800 B.P)

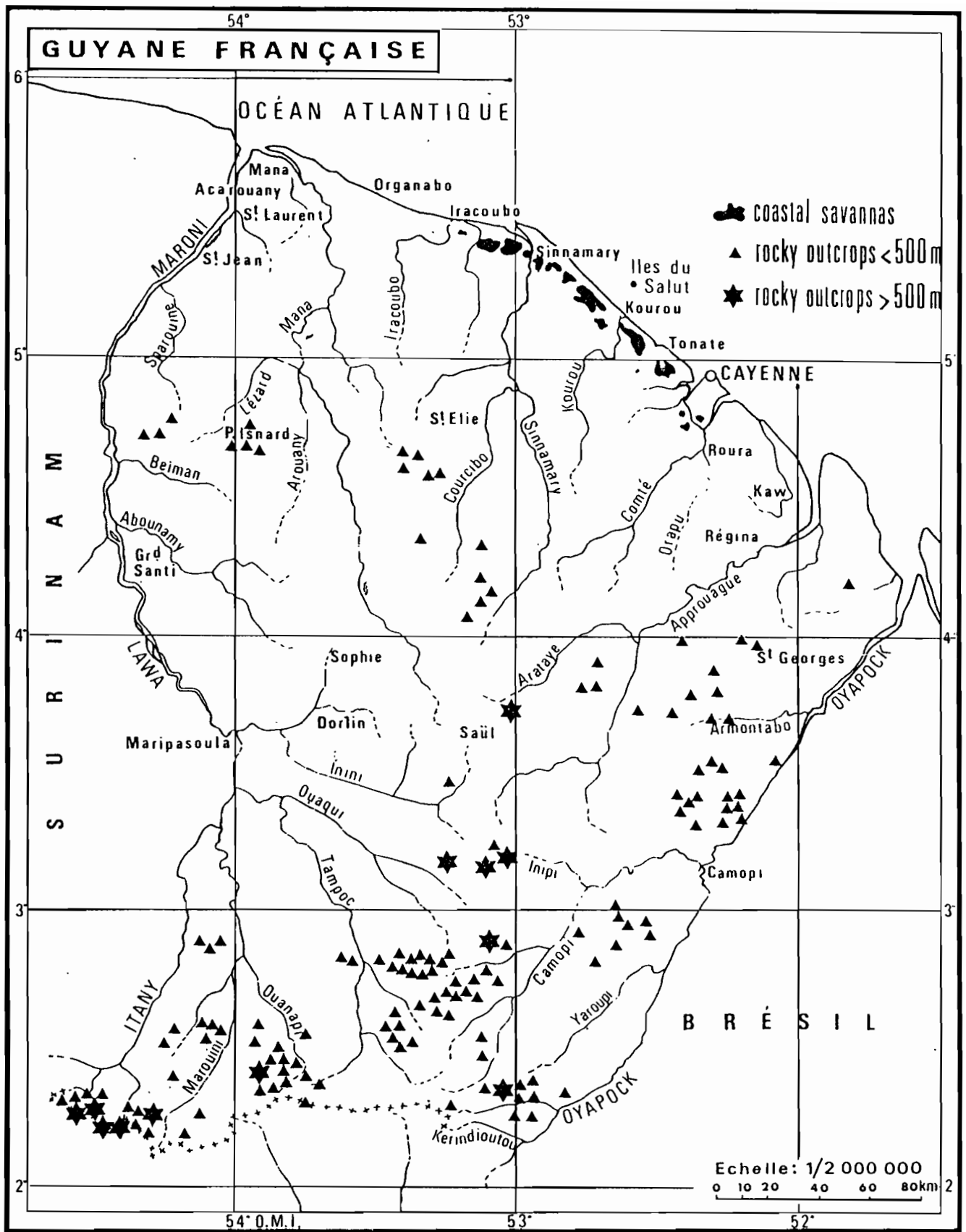


Fig. 8 : Present-day xeric flora refugia
 (from J.-J. de GRANVILLE 1982)

not well defined. To the West, the refuge reached the Maroni river at the level of Atachi Bacca Mountains, but it is possible that it also covered the multiconvex crystalline base to the North of the Inini-Camopi mountain range, near to the 5° parallel. To the East, it is quite likely that this refuge reached Brazil beyond the Oyapock, between Saint-Georges and Camopi. On the other hand, it is not absolutely certain that either the northern mountain range on schist, conglomerate and quartzite, or the southern peneplain rich in outcrops were part of this continuous forest refuge." (GRANVILLE 1982). Moreover, the high number of almost bare rocky outcrops in the extreme South-West (not far from Sipiliwini and Rio Branco savannas) seem to be witnesses of more recent dry episodes which could affect southern French Guiana.

The present day xeric flora refugia are the dry coastal savannas, the epiphitic plant communities of the canopy, the emergent rocks in the streams and the granitic outcrops (fig. 8).

Comparing these maps with the one established by HOFF & CREMERS for distribution of Pteridophytes, we notice that the present day highest species diverse areas seem to fit fairly well most of presumed Quaternary rain forest refugia on one hand and the one of present day xeric flora refugia constituted by the important south-western group of high granitic outcrops ("Tumuc-Humac" area) on the other hand. This is not surprising because the first ones are mostly rather high mountainous and/or very rainy zones while the second one is an extremely rugged area rich in many contrasted biotopes. Both are propitious for the maintenance of a high species diversity.

3. ENDEMISM OF FRENCH GUIANA.

3.a. Endemism rate :

The endemism of rain forest plant species in the three Guianas (French Guiana, Suriname and Guyana) is very roughly estimated to reach 35 % (GRANVILLE 1988). This study is based on the analysis of 251 species belonging to eight groups occurring particularly in forests : two families of trees of the canopy (Meliaceae, Caryocaraceae), one group of shrubs of the understorey (Apocynaceae subfamily Tabernaemontanoideae), the palms (Arecaceae), two families of herbs (Musaceae, Zingiberaceae), one family of vines (Passifloraceae) and a genus of ferns (Lindsaea). The proportion of endemic species is extremely variable according to the groups (9.7 % for the Meliaceae to 59.2 % for the Passifloraceae). This rather high endemism drops to 30 % if the Guayana Highland species are excluded and it would decrease again if only those occurring in French Guiana would be taken in account. In our floristic study on "Tumuc-Humac" dealing with 148 vascular plants growing in transition low forest and epipetric communities, we found 29 species (22 %) endemic to the Guianas from among only 4 are endemic to southern rocky outcrops (GRANVILLE 1978). Unfortunately, a treatment of data giving the general endemism rate of plant species restricted to French Guiana is not still available.

3.b. Distribution patterns of endemic species :

The following study is a first draft based on distribution of 150 species of vascular plants presumed to be endemic to French Guiana, or sometimes occurring also in adjacent Suriname and/or Amapa (table 2). Most of them are rare newly described species cited in recent monographs or represented by a type specimen in Cayenne herbarium (CREMERS 1984 b). However, further investigations can reveal the presence of some of them in adjacent countries so that, later, a few species apparently restricted to French Guiana can become endemic to the Guianas in a broader sense. Nevertheless, it is unlikely that they have a very wide distribution pattern in South America.

From the list established for these 150 species, only those collected in 5 or less than 5 localities in French Guiana have been written down on a map (fig. 9) : the purpose is to give a better pattern of endemism by elimination of all species found in many localities more or less scattered all over the country on one hand and of species which have a high probability to exist also in neighbouring countries on the other hand.

Though "...centers of species diversity and endemism may simply coincide with well prospected regions" (GRANVILLE 1988) in some cases, we think that floristic inventory is now full enough to give a fairly good account of the reality. According to the map, the areas where the highest number of endemic species have been collected are :

| | |
|--|----------------|
| 1. Saül area : | 34 endemic sp. |
| 2. Montagne de Kaw/Cacao/Comté river : | 24 " |
| 3. Sommet Tabulaire/Massif des Emerillons/Mt Bakra : | 15 " |
| 4. Saint-Elie track/Petit-Saut : | 15 " |
| 5. Montagnes Balenfois (Nouragues)/Saut Pararé : | 12 " |
| 6. Cayenne area : | 10 " |
| 7. Montagnes Bellevue de l'Inini : | 9 " |
| 8. Mont Belvédère/Mont Saint-Marcel : | 9 " |
| 9. Monts Atachi-Bacca : | 8 " |
| 10. Paul Isnard/Décou-Décou/Montagne Lucifer : | 8 " |
| 11. Trois-Sauts : | 6 " |
| 12. Montagnes de la Trinité : | 6 " |
| 13. Mana/Saint-Laurent : | 6 " |
| 14. Saint-Georges/Crique Gabaret : | 5 " |
| 15. Tumuc-Humac : | 4 " |
| 16. Mont Yaniwé : | 3 " |
| 17. Piton d'Armontabo : | 3 " |

The other endemic species are scattered throughout the country.

The distribution of endemic Passiflora species (FEUILLET 1986) shows concentric areas of centripetal increasing richness from a rather large subcoastal north-eastern zone up to the top of Kaw mountain (fig. 10). This distribution is in concordance with the one of annual rainfall, the richest area being also the more rainy one.

3.c. Comparison with the presumed Quaternary rain forest refugia and with the present day xeric flora refugia :

As already done for species diversity, a brief comparison with the map of distribution patterns of endemic species reveal that the highest endemism areas fit quite well the

Fig. 9 : Distribution patterns of endemic species in French Guiana.

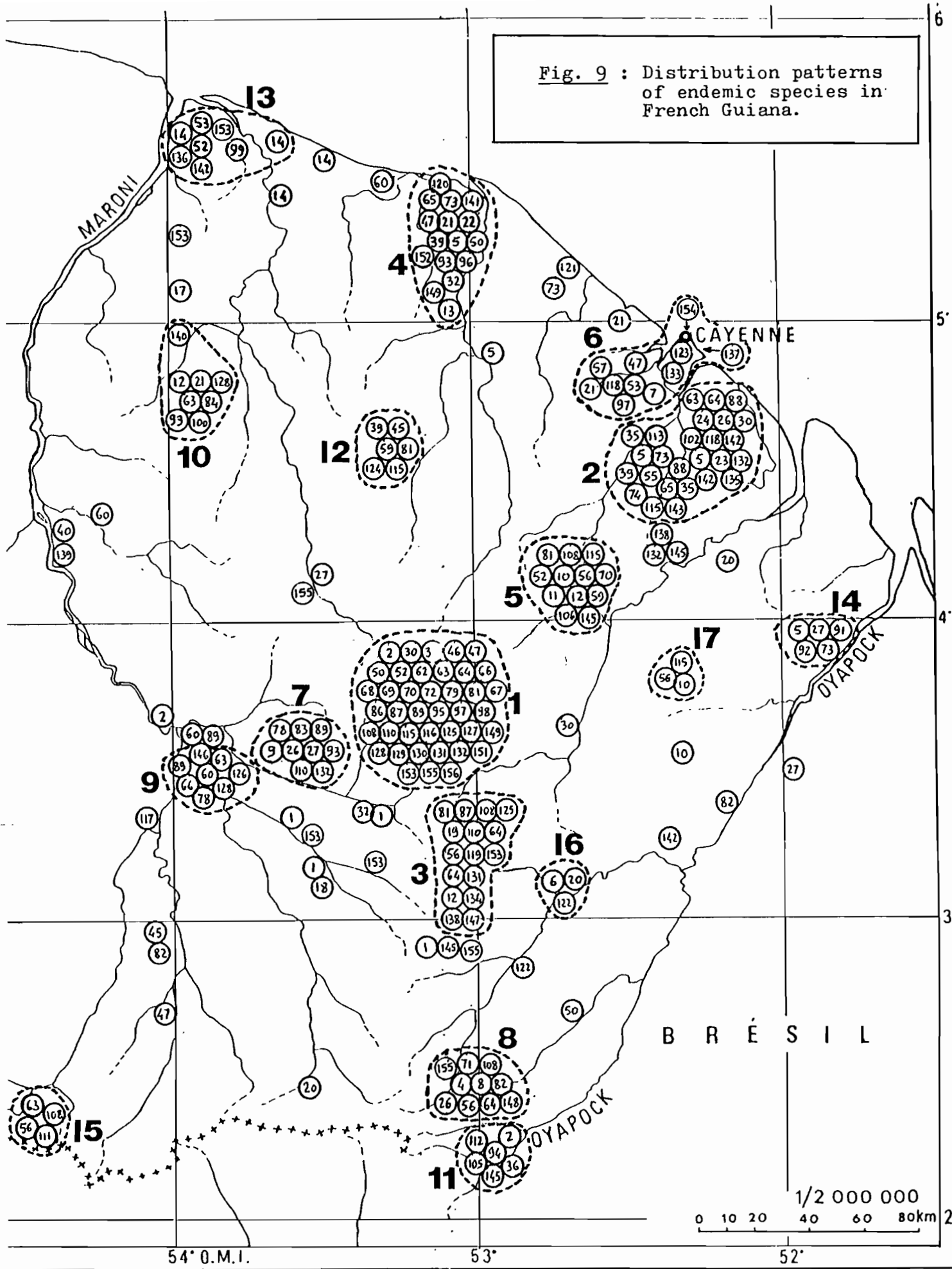


Fig. 9 : Distribution patterns of endemic species
in French Guiana (list of species : cf. tab. 2)

- Group 1 : Saül area.
- Group 2 : Montagne de Kaw / Cacao / Comté river.
- Group 3 : Sommet Tabulaire / Massif des Emerillons /
Monts Bakra.
- Group 4 : Saint-Elie track / Petit-Saut.
- Group 5 : Montagnes Balenfois ("Nouragues") / Saut Pararé.
- Group 6 : Cayenne area.
- Group 7 : Montagnes Bellevue de l'Inini.
- Group 8 : Mont Belvédère / Mont Saint-Marcel.
- Group 9 : Monts Atachi-Bacca.
- Group 10 : Paul Isnard / Décou-Décou / Montagne Lucifer.
- Group 11 : Trois Sauts.
- Group 12 : Montagnes de la Trinité.
- Group 13 : Mana / Saint-Laurent.
- Group 14 : Saint-Georges / Crique Gabaret.
- Group 15 : Tumuc-Humac.
- Group 16 : Mont Yaniwé.
- Group 17 : Piton d'Armontabo.

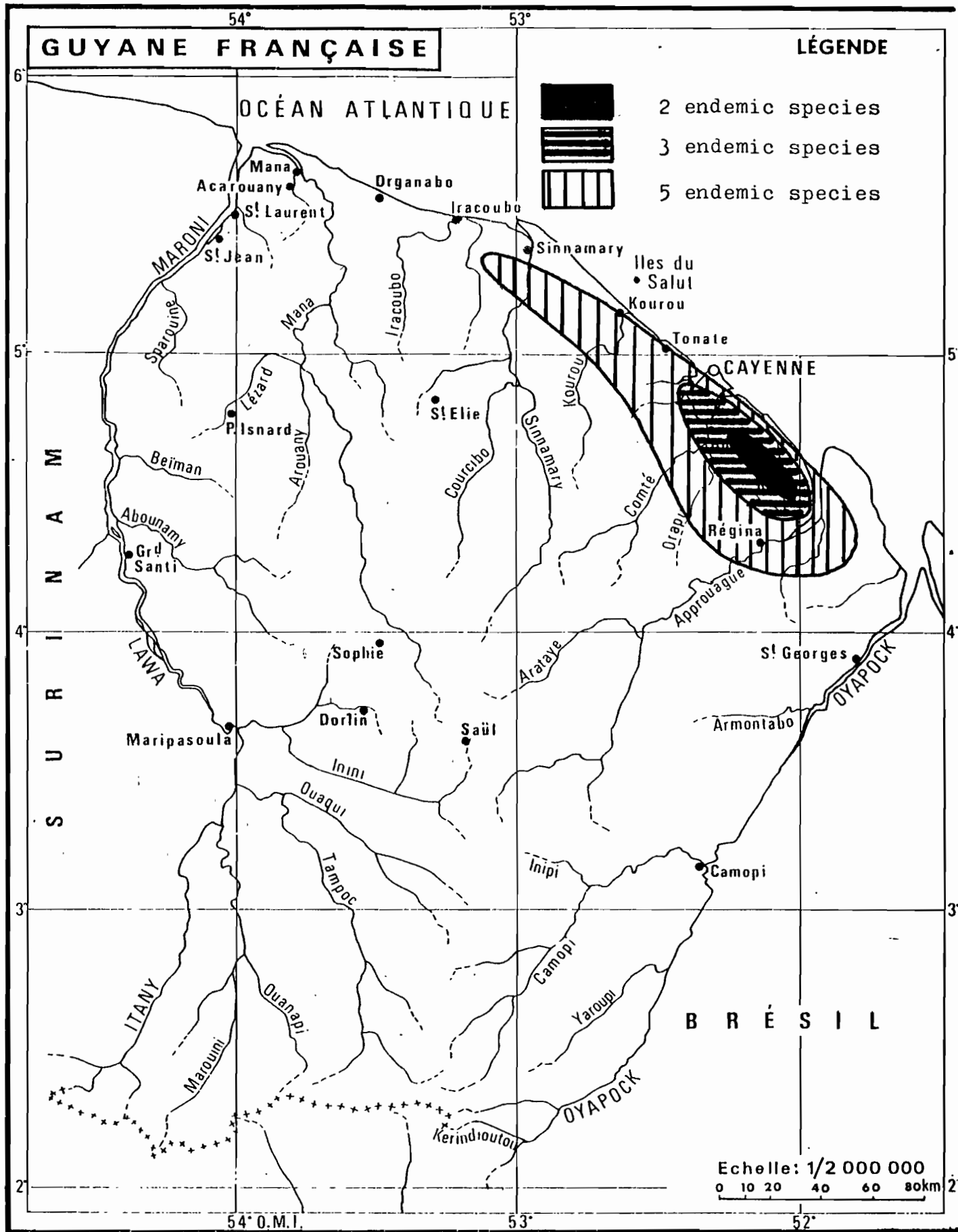


Fig. 10 : Endemism in relation with annual rainfall - see fig. 2 -
(from FEUILLET 1986)

proposed Quaternary rain forest refugia for the forest species on one hand, the present day xeric flora refugia for the savanna and epipetric species on the other hand (especially southern French Guiana). In both cases, environmental conditions, supposed to have little changed during a long time in these refugia, favoured survival of certain species less able than others to adapt themselves to variations of medium and to disseminate quickly, while they have been eliminated from other regions where vegetation changed from rain forest to dry forest or savannas and vice-versa.

4. FLORISTIC AFFINITIES WITH OTHER REGIONS.

According to HOFF & CREMERS (1990) who are studying fern distribution (cf. 2.a.), the four most species diverse areas which they have described differ each from other by their floristic affinities.

1. Saül area in a very broad sens, including the "Pic Matécho", the "Montagnes de l'Inini" and the central-southern range constituted by the "Sommet Tabulaire"/"Massif des Emerillons"/"Monts Bakra" group is clearly the most original in a floristic term: twenty species of ferns collected in French Guiana have been found in Saül area exclusively and the affinities with the three other species rich zones are rather low. The flora is mostly related to northern and north-western South America, especially to the Andes (Peru, Columbia) !

2. Kaw/Saint-Georges appears to hold the second rank for the originality of its flora mostly related, in French Guiana, to the coastal and subcoastal elements and, out of the country, to the flora of the Guiana Schield and of northern South America (including andean elements).

3. Paul Isnard/Montagnes de la Trinité has medium floristic affinities with the three other species rich areas and is principally related to the Guiana Schield flora up to eastern Venezuela.

4. The southern region, at least with respect to ferns, seems closely related to Saül area and has floristic affinities with the whole northern South America. In a study based on 200 vascular plant species growing only on southern outcrops, transition forest, shrubby and herbaceous epipetric communities (GRANVILLE 1978), we put on light that "Tumuc-Humac" granitic outcrops flora presents as many affinities with Guianan coastal savannas (25 species in common) as with Central Amazonia savannas (24 species in common) but has very few endemic elements (cf. 3.a.).

CHAPTER 2

POPULATION AND HUMAN IMPACT
ON NATURAL ECOSYSTEMS

As pointed out in the foreword, human impact on guianan forest ecosystem remained so far moderate and is still localized to the northern quarter of the country, along a very reduced network of roads and tracks (fig.11). Different kinds of interventions can be distinguished :

1. TIMBERS EXPLOITATION (fig. 12).

So far, silvicultural technics were little developed and only a few very small monospecific plantations of *Pinus caribea* had been tried a long time ago in coastal plain. Recent researches in forestry are carried out by I.N.R.A. (Institut National de la Recherche Agronomique) and by C.T.F.T. (Centre Technique Forestier Tropical) in order to improve natural tree populations from an economic point of view : modification of forest composition by elimination of "useless" trees and increasing regeneration of "useful" ones. A new programme of experimental silviculture has been started by O.N.F. in 1989 (O.N.F. 1989 b)

Nevertheless, almost the totality of timbers production still originates in traditional forest exploitation limited to picking in very extended concessions a few commercial species well known for their high technological qualities. Thus, about 20 to 30 species of trees are utilized. So, yielding is generally low (10 to 30 m³ of wood per hectare) in comparison with the total biomass of wood estimated to 300 to 400 m³ per hectare (GAZEL 1978).

These methods do not endanger forest survival but are very detrimental to forest ecosystems equilibrium, regeneration and fauna generally highly disturbed : noise of the engines, opening of tracks and trails immediately used by hunters, destruction of small and medium size trees by cutting down of tall ones, impoverishment in big trees, especially in economically important species, sometimes destruction of most standing reproductive trees of certain species....

About 25 timber claims, from 2,000 to 25,000 ha, in which permits for cutting down are delivered by O.N.F., fill a total area of more than 200,000 ha in the northern quarter of the country. Besides, some exploration permits, generally converted later in timbers exploitation permits are also delivered to foresters (about 40,000 ha in total). Total area of timber claims is slightly increasing since 1987 (152,435 ha) but has not yet reached the level of 1981 (294,619 ha) which was the highest one during the last 10 years (O.N.F. 1989 a).

Fortunately, the insane projects of paper industry sketched out in 1976-1977 dropped immediately: the idea had been expressed of huge *Pinus* plantations after destruction of natural forest by defoliant and fire, in up to 300,000 ha multinational concessions

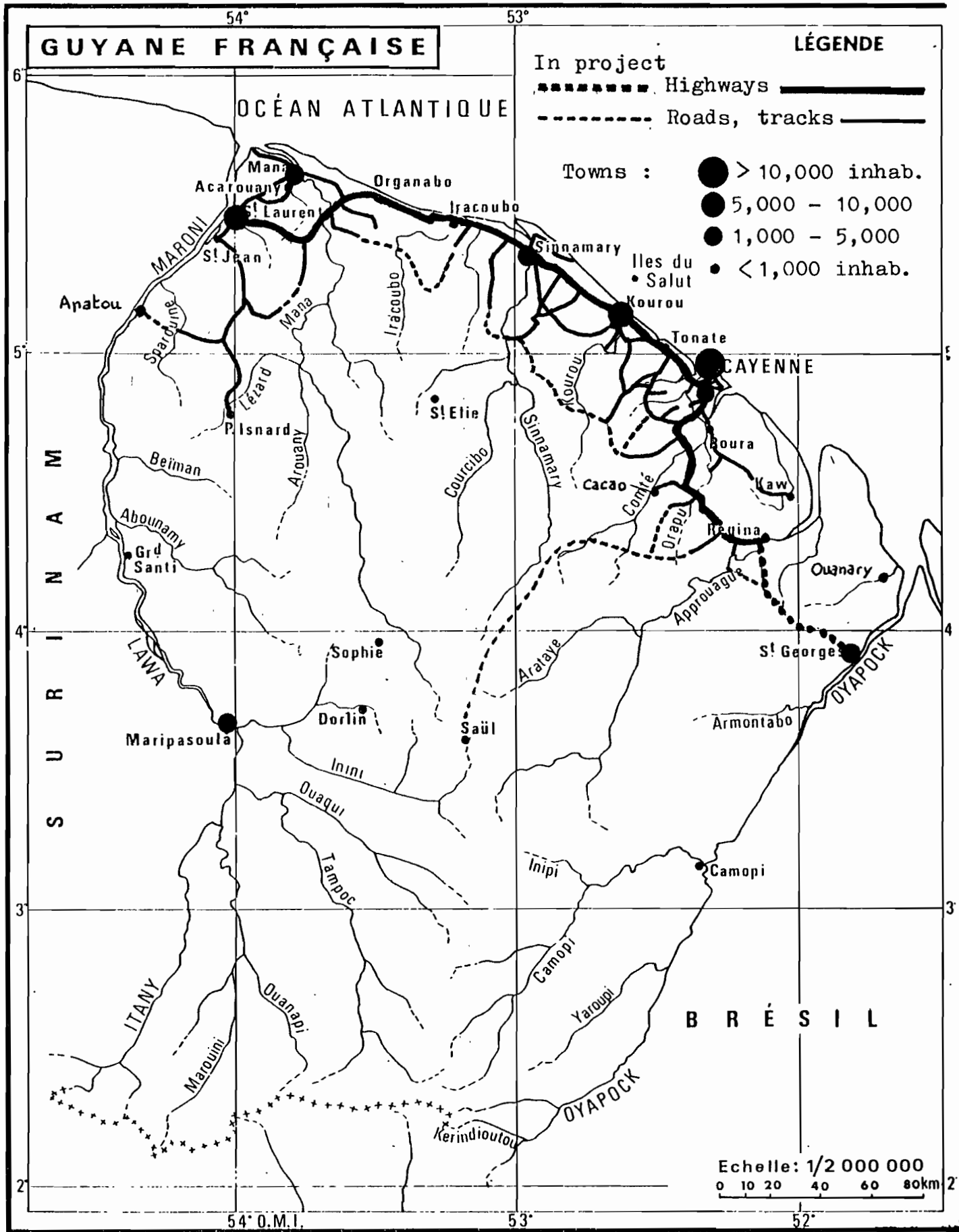


Fig. 11 : Population and roads

Fig. 12 : Timber claims

- Exploitation permits
- Exploration permits

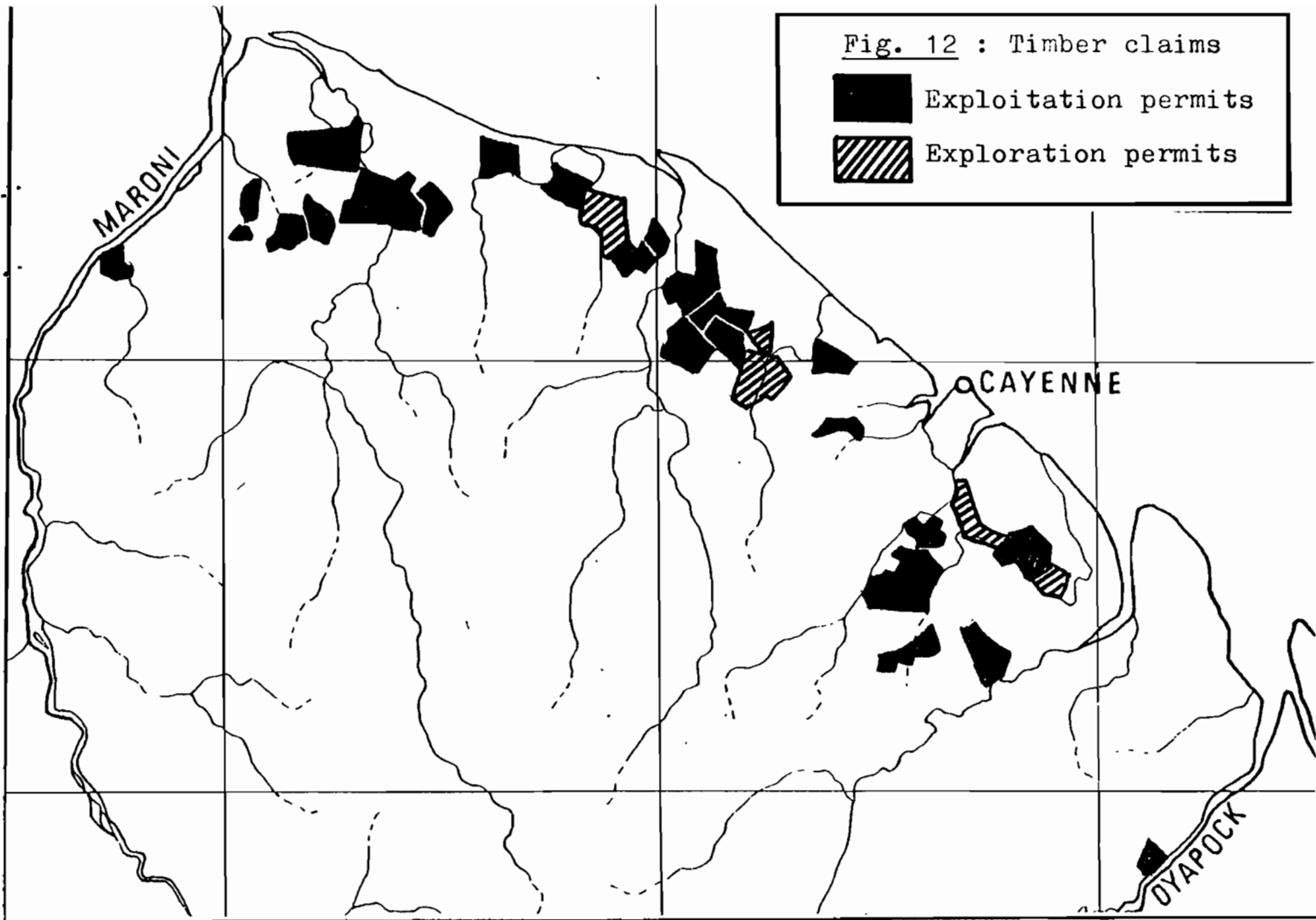
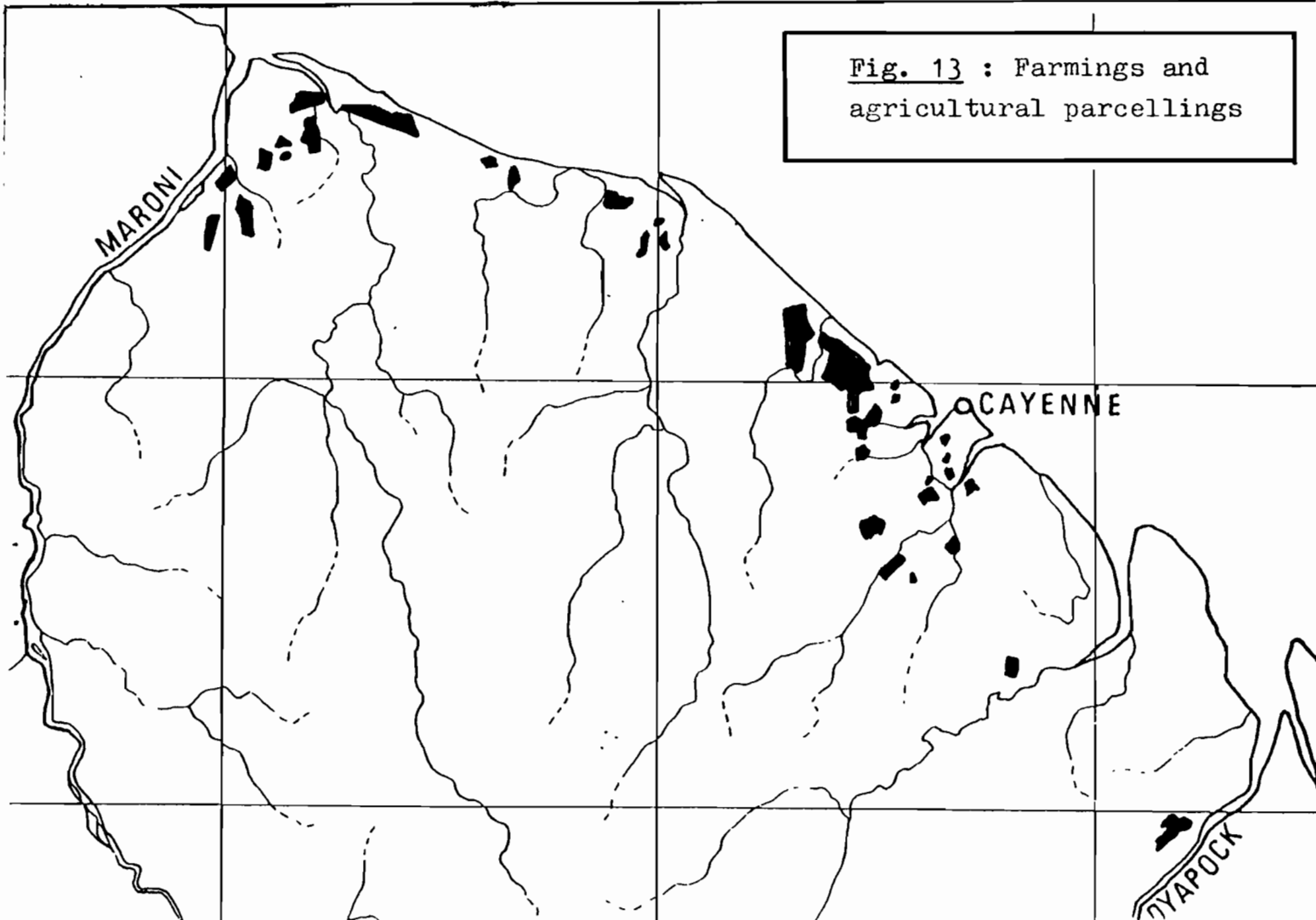


Fig. 13 : Farmings and agricultural parcellings



2. AGRICULTURE AND BREEDING.

2.a. Modern and/or mechanized agriculture (fig. 13).

Much less extended than timber concessions, farmings and agricultural parcellings cover a total area of 40,000 ha of which only 13,000 are cultivated in reality (recession to 10,000 ha in 1989) ! All are distributed in coastal and subcoastal areas (data from D.A.F. : Direction de l'Agriculture et de la Forêt).

In spite of its small extent, this type of agriculture needs a total destruction of natural ecosystems : forests (most of agricultural parcellings like "Plateau de Nancibo", "Cacao", "Saint-Jean", "Paul Isnard", "Dégrad Saramacca"...), swamps (Mana rice polders) and savannas ("Matiti"). The majority of forest soils are chemically poor and many have a compact impermeable horizon having a lateral drainage with a lot of superficial water so that deforestation is often followed by a more or less unsuccessful and expensive agriculture needing fertilizers, and many of these areas, soon abandoned, are hardly recovered by a poor, secondary vegetation ("Plateau de Nancibo" is a good example of such a disaster). On the contrary, coastal marine alluvia are much more appropriate to agricultural valorization than forest soils so that one can hope that Mana rice culture has not replaced biologically rich swamp ecosystems for an unavailing result. As a matter of fact, in contiguous Suriname, only marine silt deposits have been used for agriculture. Unhappily, French Guiana coastal plain is much narrower than in adjacent countries !

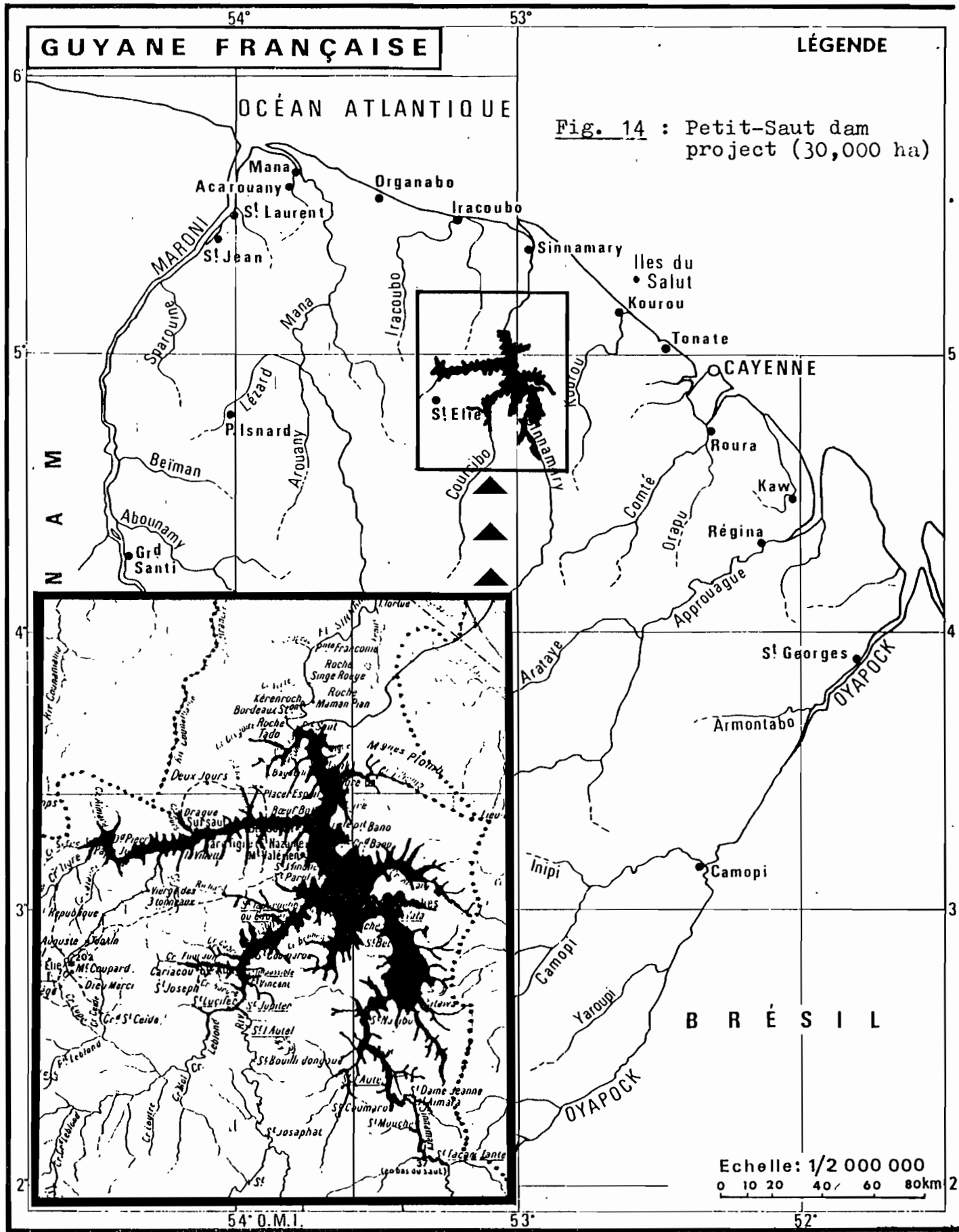
2.b. Traditional agriculture.

Traditional agriculture on small patches of burned forest (generally less than one hectare), called "abattis" in French Guiana, is commonly practised by Amerindians, Bush-Negroes and Creole inhabitants in surroundings of villages (fig.) : in coastal zone but also along Lawa, lower Oyapock and lower Approuague rivers, around Maripasoula, Saint-Elie, Saül, Camopi, on higher course of Oyapock river ("3 Sauts"), wherever people live. These small areas are cultivated during 2 or 3 years and then left to natural regeneration. Owing to the very low population rate in the interior, this practice has no important consequences on flora and fauna.

3. "PETIT-SAUT" DAM PROJECT (fig. 14).

So far, electricity is produced by diesel generators needing an expensive importation of fuel-oil. So, the State Company E.D.F. (Electricité de France) decided, five years ago, to study the possibility of building a hydro-electric dam on Sinnamary river in order to give energetic independence to French Guiana and to promote economic development. This project received the agreement of concerned authorities and works have begun.

The flooded area will reach 30,000 ha at the final stage (3.5 milliards of m³) and will have an extremely cut up,



indented outline owing to the very dissected hilly relief. We must emphasize the fact that the dam will not be deforested before flooding so that 30,000 ha of still undisturbed, almost unknown, species rich, rain forest will disappear in water ! Consequently, the impact on natural environment will be inevitably very important (E.D.F. 1989) and is presently studied by specialists of water, fauna and flora. The most important expected effects are organic matter degradation followed by a lack of oxygen in water and emission of hydrogen sulphide, important temperature gradient between surface and bottom, risks of diseases (malaria, bilharziöse). In spite of a saving programme for terrestrial animals, the greater part of fauna will be destroyed and floristic inventory of the area is still very superficial. We presume that several species will disappear : so far, two have been found only in the dam area (cf. chap. 1, 3.b.) but further investigations should reveal the presence of other endemic plants.

4. OTHER DAMAGES CAUSED BY HUMAN ACTIVITIES.

As fishing, hunting is a very usual practice in French Guiana, even by "professional" hunters now theoretically illegal : only for the latter a licence was necessary but new ones will not be delivered in the future. However, an important poaching is expected and laws are rarely respected in spite of a recent prefectoral order (june 1987) giving lists of integrally protected species, and of species allowed for hunting but not for sale and exportation (meat and living animals). Important decreasing of animal populations is already noted in coastal area, along roads, tracks and navigable streams, even far in the interior.

Mining is very poorly developed in French Guiana where only gold is regularly extracted but impact on environment remains negligible except in both industrial mines of Citron/Paul-Isnard and Saint-Elie. However, the existence of bauxite in some table mountains (Kaw and Atachi-Bacca in particular) constitute a heavy threat for some of the most original and species diverse forest areas if extraction was decided !

Savanna fires are every year lighted during dry season for many years and seem to be one of the factors maintaining the presence of coastal savannas. Fortunately, they are limited to fairly small areas along the road and, except dry transition forests and secondary vegetation, other types of vegetation are never damaged by fire.

Lastly, industry is so little developed that it does not constitute any danger of pollution for environment. Only the factory and testing bench for rocket carburants which will be soon built for the European space center are giving rise to new researches, carried out by ORSTOM scientists, on damages expected on vegetation.

CHAPTER 3

HISTORICAL RECORD OF PROJECTS
CONCERNING NATURE PRESERVATION
IN FRENCH GUIANA

1. A TORMENTED AND UNSUCCESSFUL TWENTY YEARS LONG HISTORY !

Owing to the very low population, the lack of roads, industry and mechanized agriculture, the notion of nature preservation in French Guiana began to come to mind quite late.

The first area set up as Natural Forest Reserve in 1942 was a small patch (166 ha) of interesting and fine forest close to Cayenne ("La Mirande", Matoury) transferred in 1967 to the State forest propriety (O.N.F. 1989 b).

Only in 1967, the term of "forest reserve" has been timidely approached by OLDEMAN, botanist at the Centre ORSTOM of Cayenne, and HALLE, from the University of Montpellier (France) who suggested to conserve an area along the road from Kourou to Dégrad Saramacca ("Montagne des Singes"), in the property of Guiana Space Center (fig. 15).

In 1970, a new project has been set up by ORSTOM and discussed with the local representatives of the following national organizations : D.D.A. (Direction Départementale de l'Agriculture), O.N.F. (Office National des Forêts), INRA (Institut National de la Recherche Agronomique). At that time, an area of 5,000 ha situated South to Cayenne (Rivière des Cascades) was proposed if a further botanical study could be realized and bring to light a sufficient floristic richness. This area should include an integral reserve and parts open to public. By the way, it has been suggested to study the possibility of later creation of bigger forest reserves in the interior : Saül, Crique Matarony, Monts Atachi-Bacca (short dated projects), Camopi, Tumuc-Humac and Southern border (long dated projects). Lastly, other natural small areas mostly intended for tourism were also proposed : Portal island, in the estuary of Lawa river and "Saut Maripa", near Saint-Georges, on Oyapock river (fig. 15).

So far, these projects aimed to conserve whole natural forest ecosystems. In 1972, the SEPANGUY (Société pour l'Etude, la Protection et l'Aménagement de la Nature en Guyane) and the SEPANRIT (Société pour l'Etude, la Protection et l'Aménagement de la Nature dans les Régions Inter-tropicales) promoted the creation of 2 avifauna coastal reserves with the scientific support of ORSTOM and National Museum of Natural History of Paris. These zones, closed to Organabo and Sinnamary, are said to be particularly important for reproduction of migrating birds, threatened by hunting (fig. 15). A coastal integral reserve was also proposed by ORSTOM near Mana (BLANCANEAUX 1973).

In 1974 and 1975, an ecological study of the Guianan sea shore, aiming to the creation of Natural Reserves, has been undertaken, giving effect to an agreement between ORSTOM and French Ministry of Environment (CONDAMIN 1974, 1975). four areas

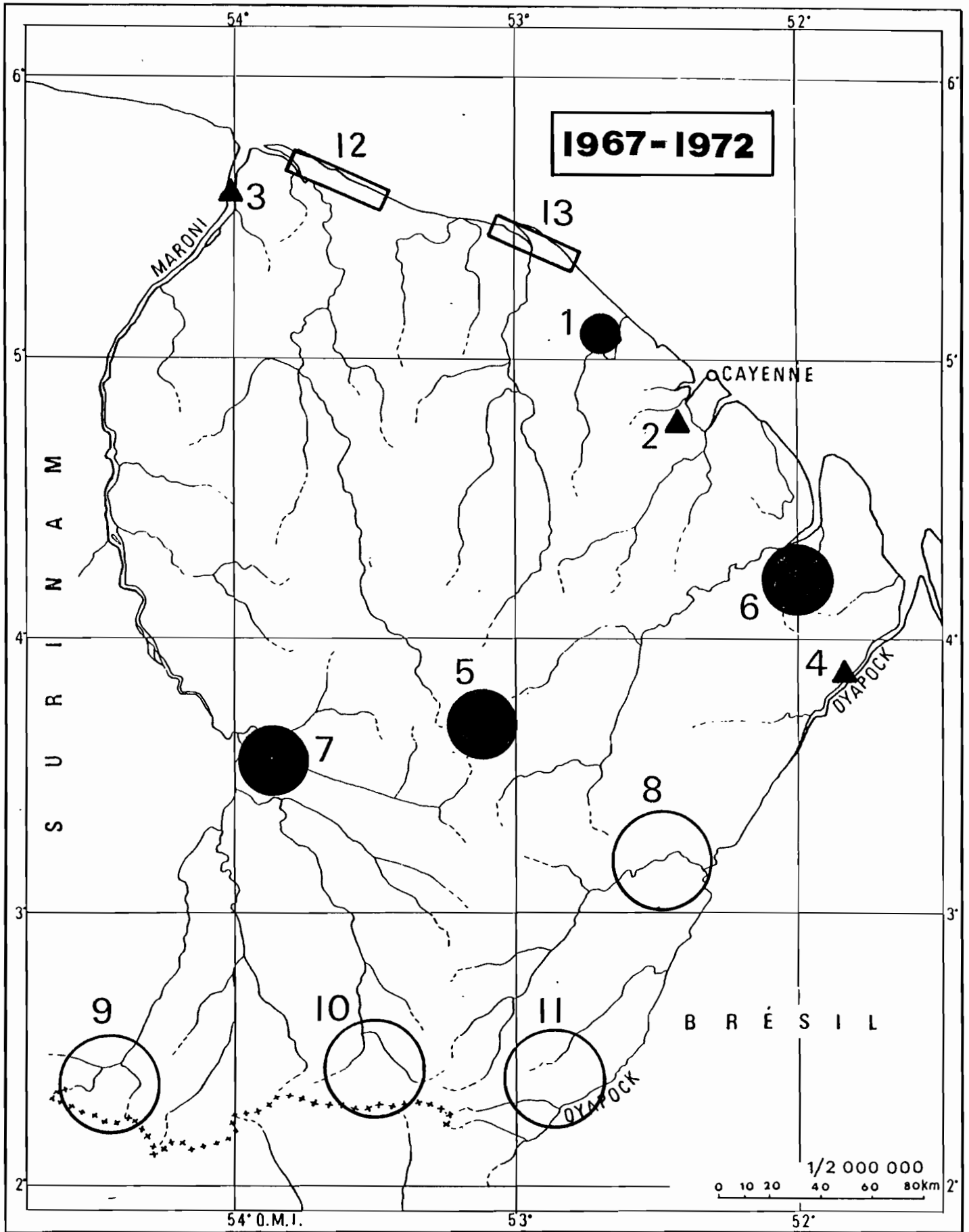


Fig. 15 The first forest reserve projects.

Fig. 15 : The first forest reserve projects.

1967 - 1. Montagne des Singes.

1970 - 2. Cayenne: Rivières des Cascades.

3. Saint-Laurent : Portal island.

4. Saint-Georges : Saut Maripa.

5. Saül.

6. Crique Matarony.

7. Inini : Monts Atachi-Bacca.

8. Camopi.

9. Tumuc-Humac.

10. Southern border.

11. Trois-Sauts.

1972 - 12. Organabo.

13. Sinnamary



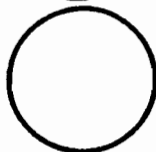
The first project.



Recreation parks for tourism.



Big forest reserves (short dated project).



Big forest reserves (long dated project).



Avifauna reserve projects

were retained to rank as Natural Reserves (fig. 16) :

- The "Sarcelle" savanna, along the estuary of Mana river, very rich in birds (especially Anatidae).
- A part of mangrove between Sinnamary and Iracoubo, well known for nidification of scarlet ibis (*Eudocimus ruber*).
- The "Plaine de Kaw", mainly constituted by extended marshes harbouring an original fauna, especially one of the last colonies of "black caiman" (*Melanosuchus niger*) which has been almost exterminated in the Amazon Basin (GASC & al. 1982, BEHRA 1989), and the bird *Opisthocomus hoazin*.
- The island "Grand Connétable" where many sea birds reproduce.

At the same time (GRANVILLE 1975), the knowledge of Guianan forest ecosystems and species richness was progressing well and allowed to elaborate a first draft of 15 "botanical and forest reserves" distributed in the whole territory of French Guiana, as representative as possible of existing plant communities and ecosystems (fig. 16). To the coastal areas already proposed by CONDAMIN were added inland and subcoastal forest ecosystems selected for their floristic originality or their species richness (mostly mountainous zones, sometimes swampy areas and forests on particular types of soil not extended in the country). These reserves were :

- The lower Mana river area (48,400 ha), with white sand soil forests very localized in North-western French Guiana, which is an extension of the "Sarcelle" savanna reserve proposed by CONDAMIN.
- The "Plaine de Kaw" (46,800 ha) exclusively constituted by herbaceous swamps, mangrove and swamp palm forest, also proposed by CONDAMIN for fauna conservation.
- The "Montagne des 3 Pitons" (3,600 ha) which is an outcrop with various vegetation types isolated in the swampy North-eastern French Guiana subcoastal zone.
- The Saint-Georges area (19,200 ha) : especially swamp forest with species rich Amazonian flora along "Crique Gabaret" river.
- The "Montagne Tortue" (3,800 ha) and "Crique Matarony" (19,600 ha) forests on schists and quartzites, one of the most rainy areas which could have been part of a forest refuge during the dry climatic periods of Pleistocene.
- The Paul Isnard area (56,400 ha), also a fairly rainy one, including "Montagne Lucifer" and "Massif du Décou-Décou".
- The "Montagnes de la Trinité" (20,000 ha), constituted by a rugged relief with outcrops on crystalline bedrock in their northern half, by a table mountain on basic volcanic rocks in their southern half.
- The "Monts Atachi-Bacca" (790 m, 34,400 ha) and "Sommet Tabulaire" (830 m, 145,000 ha) which take place among the highest tops of French Guiana, are big table mountains capped by a lateritic crust, covered by submontane cloud forest.
- The Camopi area (17,600 ha) including Mounts Alikéné, characteristic of eastern forests on crystalline base.
- The "Tumuc-Humac" area (90,800 ha), rich in big spectacular granitic outcrops, refuge of interesting xerophytic species.
- The large Saül area (133,600 ha) including different mountain ranges (Mt Belvédère, Mt Galbao, Mt Continent, Pic Matecho) is the most species diverse and also the richest one in endemic or rare species (cf. chap. 1 : 2 and 3). Moreover, the

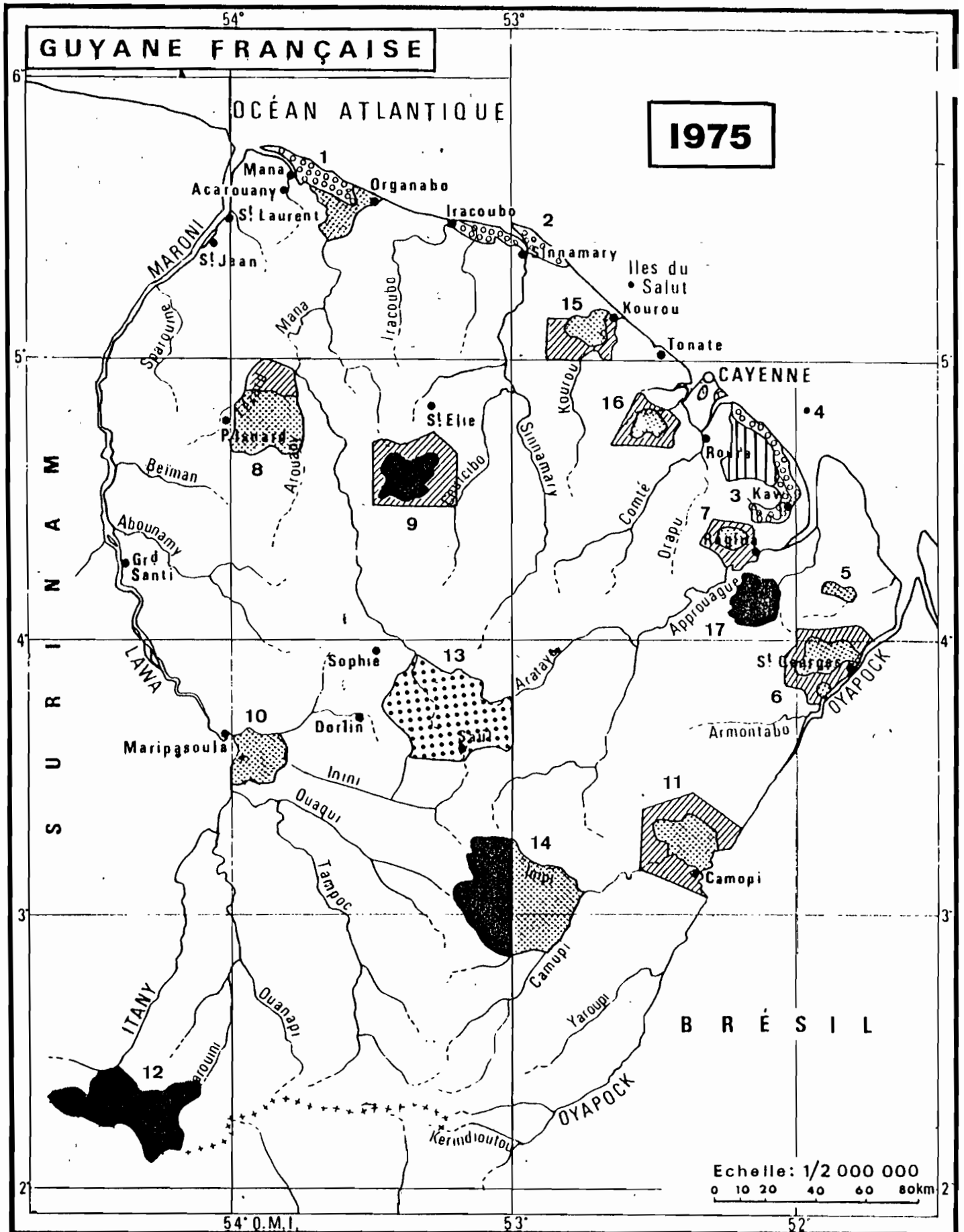
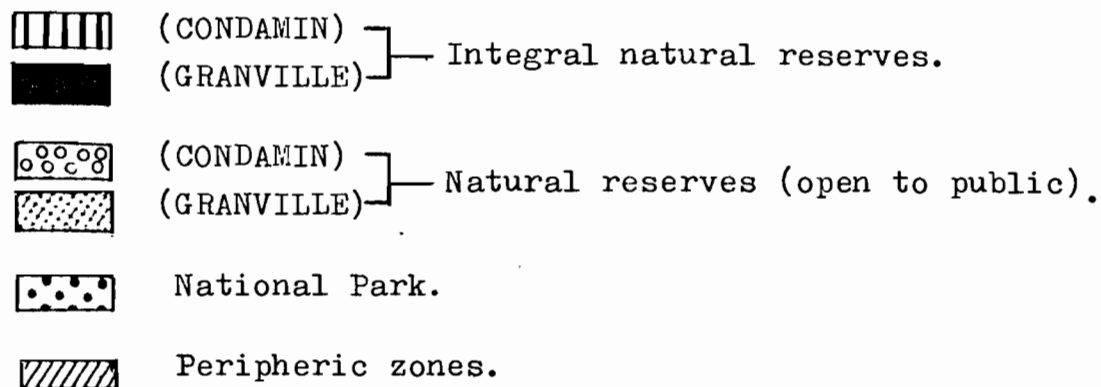


Fig. 16 : The detailed projects of CONDAMIN and de GRANVILLE

Fig. 16 : The detailed projects of CONDAMIN and de GRANVILLE.



1. Lower Mana river area ("Sarcelle" savanna).
2. Sinnamary and Iracoubo mangroves.
3. "Plaine de Kaw".
4. Island "Grand Connétable".
5. "Montagne des 3 Pitons".
6. Saint-Georges area ("Crique Gabaret").
7. "Montagne Tortue".
8. Paul Isnard area ("Montagne Lucifer", "Décou-Décou").
9. "Montagnes de la Trinité".
10. "Monts Atachi-Bacca".
11. Camopi area.
12. Tumuc-Humac area.
13. Saül area.
14. "Sommet Tabulaire".
15. "Montagne des Singes" (Kourou suburban park).
16. "Rivière des Cascades" (Cayenne suburban park).
17. "Crique Matarony.

forest is generally "fine" and high. So, many botanists and other scientists began to undertake researches on the remarkable types of forests, along a 70 km long network of marked out trails opened by OLDEMAN in 1965-1969.

- Lastly, two areas have been proposed as suburban forest parks of which flora and fauna should be preserved, but open to public for education, recreation and pedestrian excursions: the "Montagne des Singes" (17,000 ha) South to Kourou, and the "Rivière des Cascades" (5,400 ha), 20 km South-West to Cayenne.

In 1976, the French Minister of Environment visiting Cayenne announced that he was favourable to propose the status of National Park to 4 of the areas cited above: Kaw, Sinnamary/Iracoubo, Lower Mana and Saül, but this project failed down quickly.

Two years later (1978, 1979), several new unsuccessful propositions have been expressed by the Regional Representative of Architecture and Environment of French West Indies and Guiana (headquarters in Pointe-à-Pitre, Guadeloupe) who suggested a status of Natural Reserve for the lower Mana river and Sinnamary/Iracoubo areas, and proposed a National Park in the whole South half of French Guiana (fig. 17). The latter was immediately refused by local political elected members who considered that they had not been consulted enough about this project which they perceived as an unwarranted "colonial" intervention in their affairs. Concerning the lower Mana swamp area, the pegging out of polders for extensive rice culture, soon realized, has made impossible conservation of swamp ecosystems in a large part of this area.

After so many unfruitful projects obviously neither supported nor desired by Guianan population not yet sensitized to environmental questions, four years have passed without any other proposition raising.

So, from 1983 to 1985, we decided to restart our 1975 reserve projects, proved to correspond well to priority conservation areas. A new status, born from an agreement between French Ministry of Environment, French Ministry of Agriculture and O.N.F. (Office National des Forêts) would allow a prompt result owing to a reduced jurisdiction: the "Réserves Biologiques Domaniales", under State administration. With agreements and encouragements of General Direction of the O.N.F. of Paris, we prepared 8 detailed reports supported by scientific data and maps for those of the areas situated in northern French Guiana, much more threatened by economic development, agriculture and timbers exploitation, opening of road and tracks, than the ones situated far in the interior still well preserved by their natural isolation. The outlines and the surfaces of some of the 1975 projects were slightly modified (fig. 18):

- The lower Mana river project was reduced to its forest area, by elimination of rice polders settled in the coastal zone (27,200 ha instead of 48,400 ha).

- The Kaw area project, formerly constituted only by flood plain and swamp forest, has been extended to a part of Kaw mountain of which floristic and faunistic inventories revealed a particular richness and originality (61,975 ha instead of 46,800 ha). This improved project with an exhaustive floristic list of the area concerned has been presented later at the 1st Regional

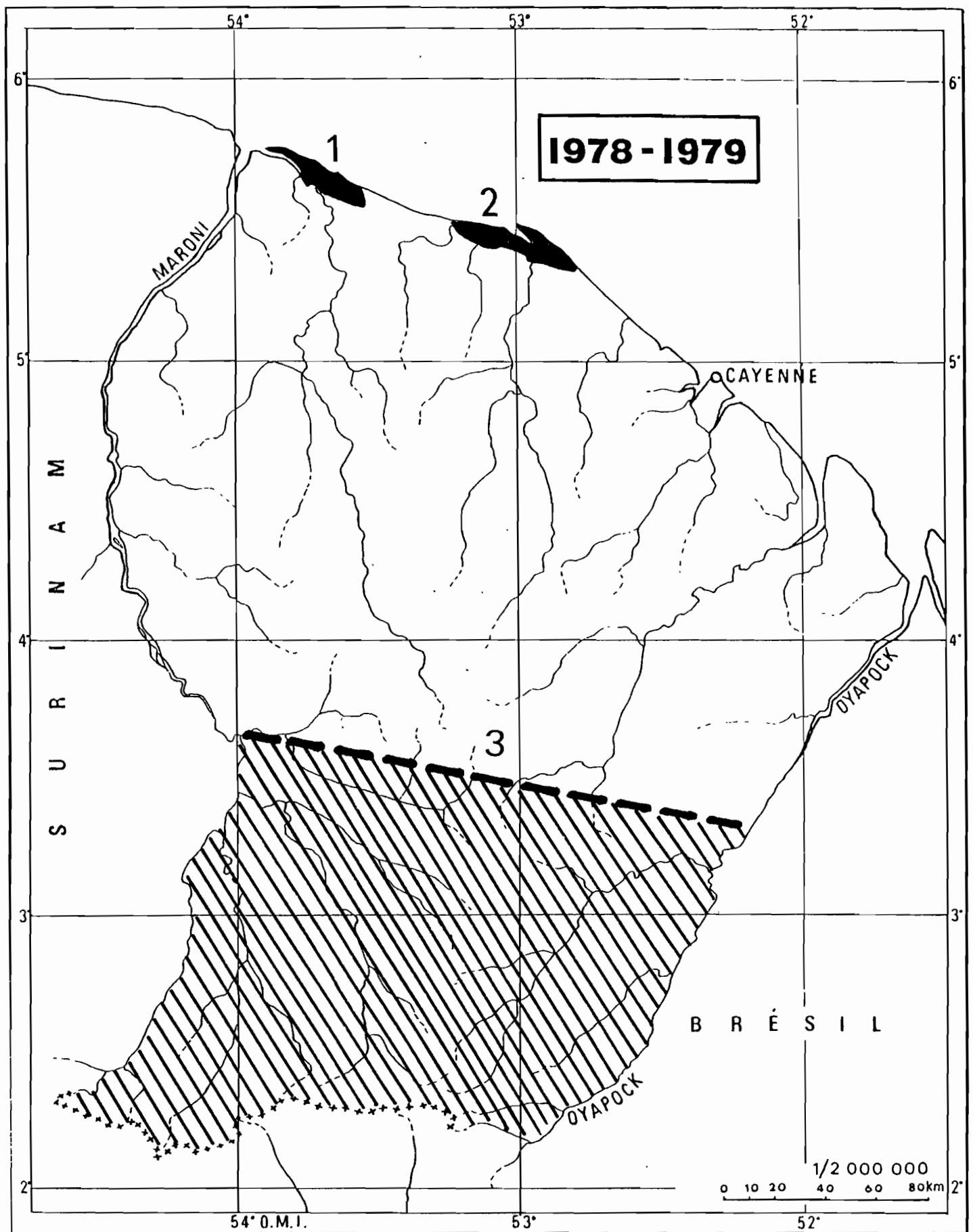


Fig. 17 : Propositions of Regional Representative of Architecture and Environment.

1. Lower Mana river Natural Reserve.
2. Sinnamary / Iracoubo Natural Reserve.
3. National Park.

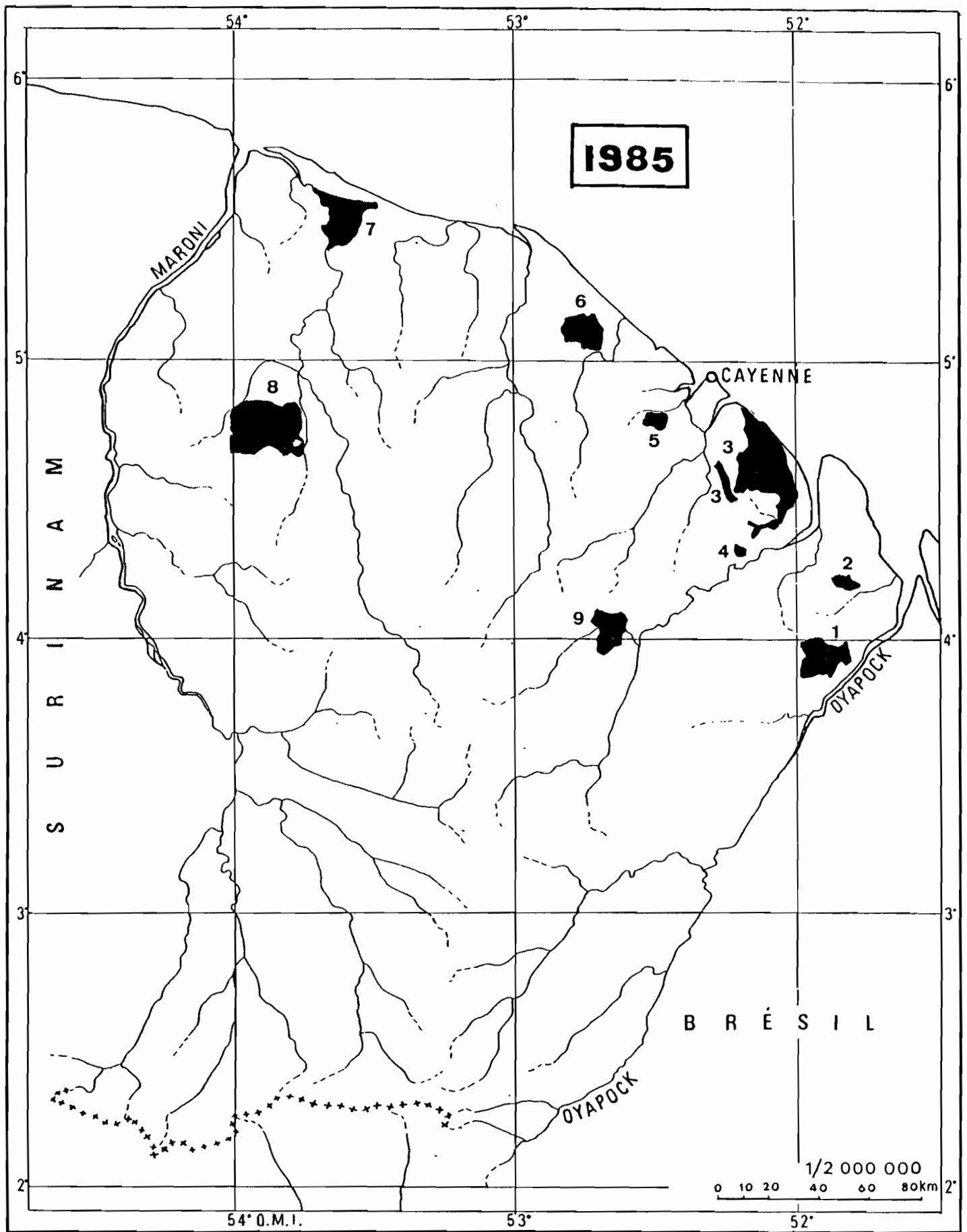


Fig. 18 : "Réserves Biologiques Domaniales" projects.

- | | |
|---------------------------|--------------------------|
| 1. Crique Gabaret. | 5. Rivière des Cascades. |
| 2. Montagne des 3 Pitons. | 6. Kourou. |
| 3. Kaw. | 7. Basse Mana. |
| 4. Montagnes Tortue. | 8. Paul Isnard. |
| | 9. Saut Pararé. |

Congress of Environment, in Cayenne (GRANVILLE 1986 a).

- Almost half of "Montagne Tortue" proposed reserve was cut down and retroceded to Army for a gun shooting range (2,200 ha instead of 3,800 ha).

- The Saint-Georges (Crique Gabaret) area was slightly reduced to the East and extended to the West (20,800 ha instead of 19,200 ha).

- The four other areas (Kourou/Montagne des Singes, Cayenne/Rivière des Cascades, Paul Isnard and "Montagne des 3 Pitons") were unchanged.

- Moreover, a ninth area has been added and proposed as a "Réserve Biologique Domaniale" : the "Saut Pararé" (16,700 ha) on Arataye river where a permanent field research station has been recently built by the National Museum of Natural History of Paris and C.N.R.S. (Centre National de la Recherche Scientifique), the studies on natural ecosystems, carried out there, needind an undisturbed environment, especially protected from hunting.

Unhappily, the set of documents for these 9 "Réserves Biologiques Domaniales", submitted to local Authorities' advice by Regional Director of O.N.F. (O.N.F. 1985), received an unfavourable reply for the same reasons than formerly and, therefore, have never been transmitted to Paris and dropped out once more !

2. AREAS RECENTLY PROTECTED, THEIR STATUS; NEW PROJECTS FOR THE NEAR FUTURE.

From 1987, after so many long tribulations, a few projects began to take shape.

2.a. Kaw area : the first conservation area in French Guiana ! (fig. 19 & 20)

The Kaw region is the first and still the only one which succeeded ! Nevertheless, three additional years have been necessary to obtain a final version and a suitable status. The "Réserves Biologiques Domaniales" did not seem to present sufficient safeguard : therefore, the Prefect of Cayenne asked to turn it into a Natural Reserve project (GRANVILLE 1986 b, GRANVILLE & TOSTAIN 1986)...rejected by the Regional Representative of Architecture and Environment who proposed the status of "Arrêté de Protection du Biotope" (GRANVILLE & TOSTAIN 1989), not so efficient than a Natural Reserve but easy to obtain in a short time. Finally, this project received the agreement of both concerned municipalities and was signed on September 4, 1989, by Prefect of French Guiana.

In comparison with the former project, the swamp area has been fairly increased to the East, reaching the Approuague river, and the forest mountainous zone has been modified owing to the recent attribution of a timber claim on the top of the mountain ! In compensation, the "Montagne Gabrielle" to the West and the "Montagne Favard" to the East of the range were united to the new conservation area. The total surface amounts approximately 76,800 ha of which 60,400 ha for the flood plain (zone 1) and 16,400 ha for the mountainous zone (zone 2).

Timber extraction, agriculture, mining and opening new

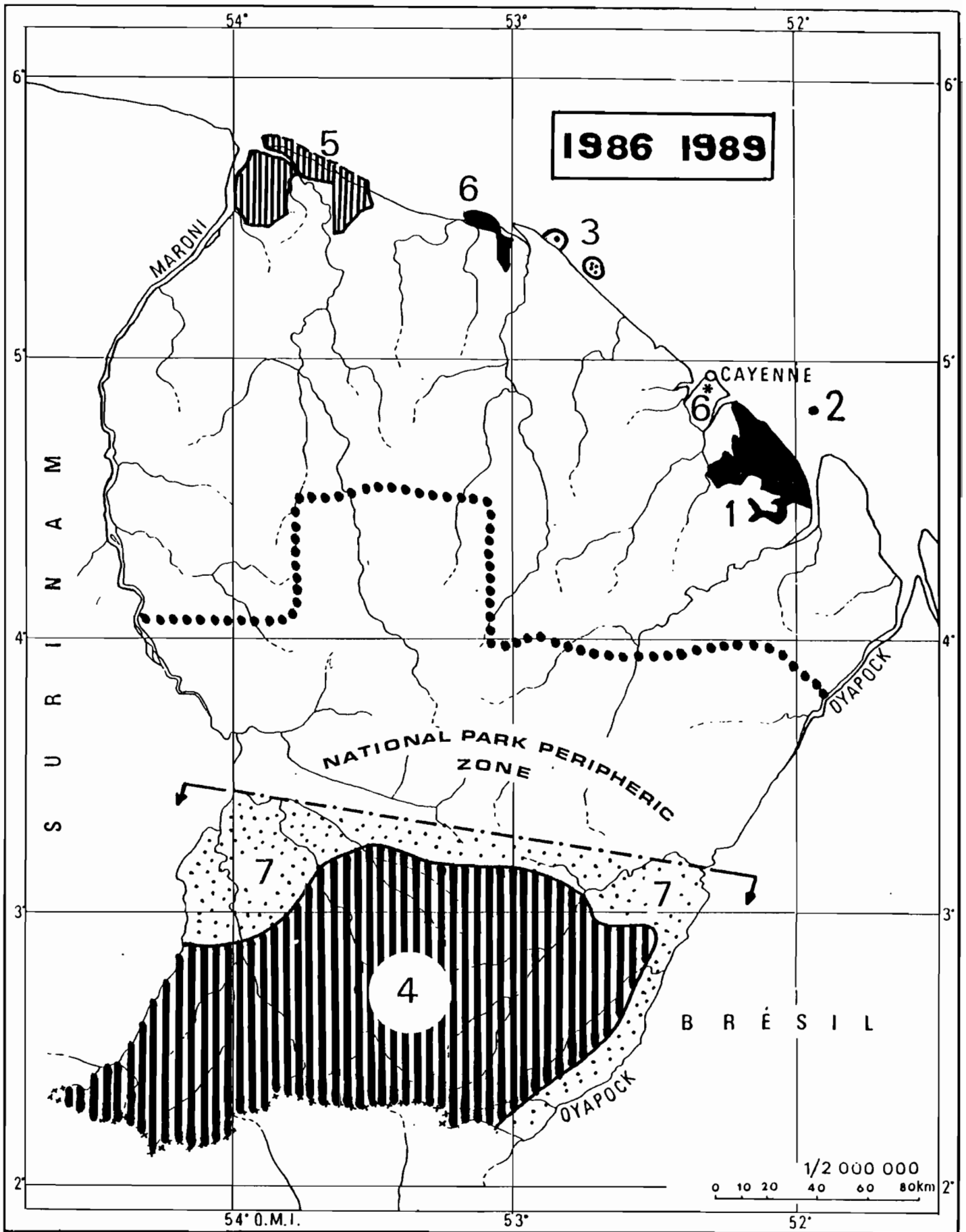


Fig. 19 : Protected areas (black and dotted areas) and new projects (hatched areas).

Fig. 19 : Protected areas and new projects.

Protected areas :

1. Kaw area ("Arrêté de Protection de Biotope, 1989)
6. C.N.G. ("Centre Nature Guyane, 1989).
7. Southern area under limited access control (prefectoral orders of 1970,1977,1978).

New projects :

2. Island "Grand Connétable" (Natural Reserve project, TOSTAIN).
3. Battures de Malmanoury (project of "Arrêté de Protection de Biotope", TOSTAIN).
4. National Park project (THIOLLAY).
5. Lower Mana river Natural Reserve and Regional Natural Park projects (FRETEY).
6. Project of Regional Arboretum, "La Mirande".

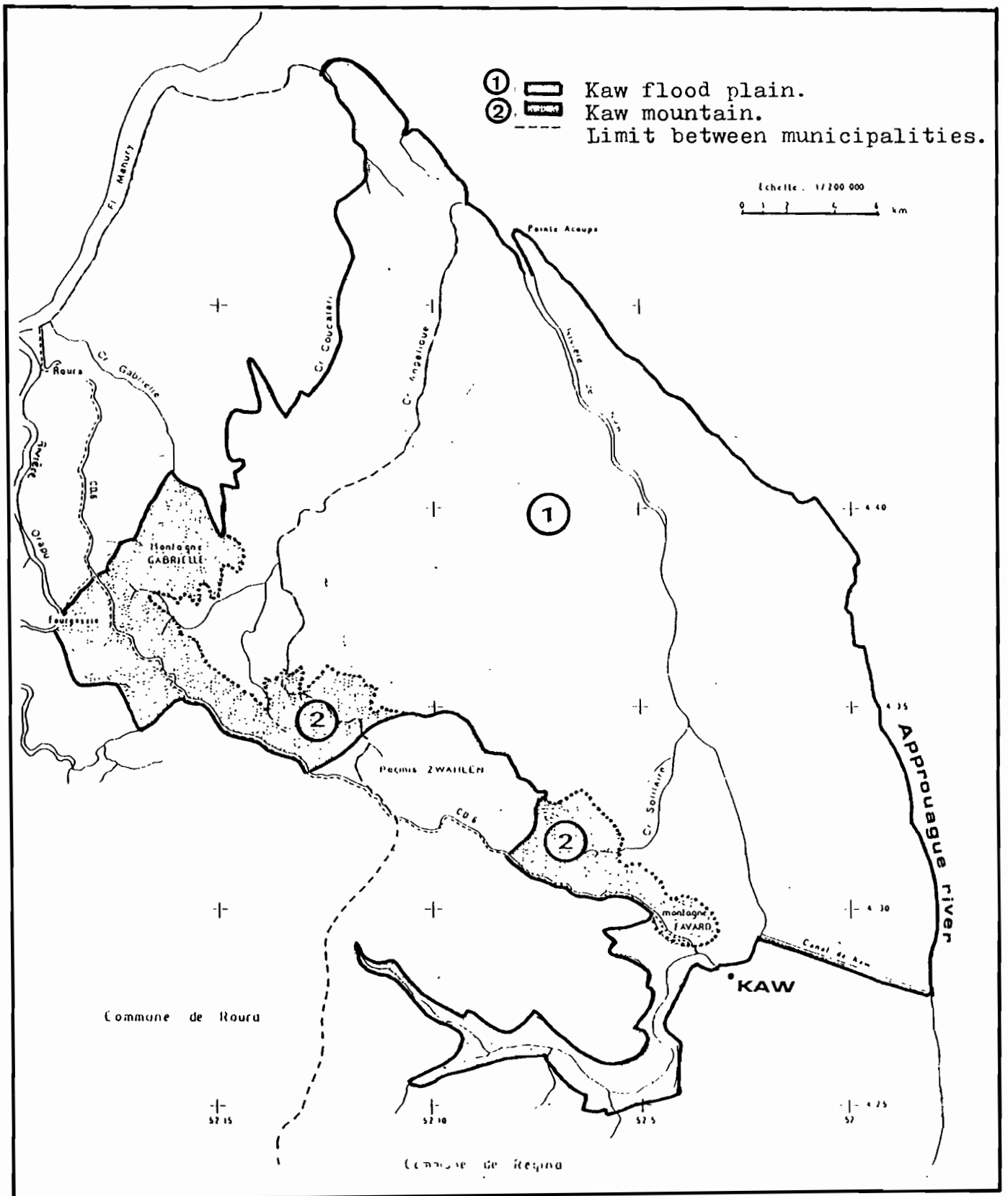


Fig. 20 : "Arrêté de Protection de Biotope" of Kaw area (1989).

tracks for vehicles are forbidden in the whole area. Moreover, some other interdictions aiming to protect fauna, especially the "black caiman", a relictual threatened species, apply to the flood plain (zone 1) in which landing of helicopters and flights at altitudes lower than 100 meters are forbidden : as a matter of fact, stationary flights at a very low altitude above the famous "Mare aux Caimans" lake, frequently asked by tourists, can destroy eggs, nests and juveniles during reproduction period. The use of hovercrafts and hydroplanes is also forbidden in all the swamps. Lastly, the power of outboard engines is restricted to 35 HP for those of the boats running on the high course of Kaw river, South to the village.

The state of conservation of flora is excellent in the whole reserve in which only timbers have been exploited a long time ago on the plateau (however never subjected to deforestation). The fauna is also in good conditions of preservation except along Kaw river where caimans have been destroyed by hunting, and along the road, on Kaw mountain, very frequently scoured by hunters and moth collectors using powerful U.V. lamps. Unfortunately, the status of "Arrêté de Protection du Biotope" aims to conserve the biotope but cannot provide any hunting interdiction !

Recent discussions have been opened with the purpose to turn the "Arrêté de Protection du Biotope" in a Natural Regional Park, including some other coastal areas of French Guiana. This status would combine conservation with human activities like tourism, education and production of local handicraft.

2.b. The island "Grand Connétable" soon ranked as a Natural Reserve (fig. 19).

This small rock island, 18 km far from the coast, already proposed as a Natural Reserve by CONDAMIN (1975), has been subjected to mining during last century. Nevertheless, it has always been known for the huge number of sea-birds nesting in its cliffs and masses of rocks or on the ground, principally : *Fregata magnificens* (400 pairs), *Larus atricilla* (1,100 to 1,600 pairs, 25 % of the Caribbean stock !), *Sterna maxima* (300 to 400 pairs, 50 % of the Caribbean stock if taking account of the population living in other islets of French Guiana), *Sterna sandvicensis eurygnata* (a threatened bird in the world of which 370 to 450 pairs are numbered on "Grand Connétable"), secondarily : *Sterna fuscata* (120 to 150 pairs) and *Anous stolidus* (less than 100 pairs). These data are given by O. TOSTAIN who visited regularly the island during the ten last years and noted that reproduction was endangered by intensive using of fledglings as fishing baits by Venezuelan trawlers ! Consequently, he prepared a project of Natural Reserve (TOSTAIN 1988 a), recently discussed, to which State and local Authorities are favourable so that a successful issue can be expected in 1990.

2.c. The "Battures de Malmanoury" will become also a protected area (fig. 19).

These tiny, scarcely emerging rock islets (4 to 5 meters above sea level) are situated 2 to 3 km far from the coast between Kourou and Sinnamary and are isolated on an extended muddy ground flooded at high tide. They harbour 4

species of nesting birds, theoretically all protected in French Guiana : *Larus atricilla* (150 to 200 pairs), *Sterna maxima* (90 to 600 pairs), *Sterna sandvicensis eurygnatha* (250 to 800 pairs), *Egretta coerulea* (a few ten pairs). Moreover, the islets are used by migrating birds, especially *Falco peregrinus tundrius* (living in Canada during arctic summer) and hundreds of thousands of North American waders. All these bird populations being more or less damaged by fishers (collect of eggs and fledglings, hunting), a status of "Arrêté de Protection de Biotope" has been proposed in order to prohibit navigation and anchoring within a 500 meters radius around the islets and also military shoot exercises during the reproduction periods (TOSTAIN 1988 b).

2.d. A new project of National Park in the South (fig. 20).

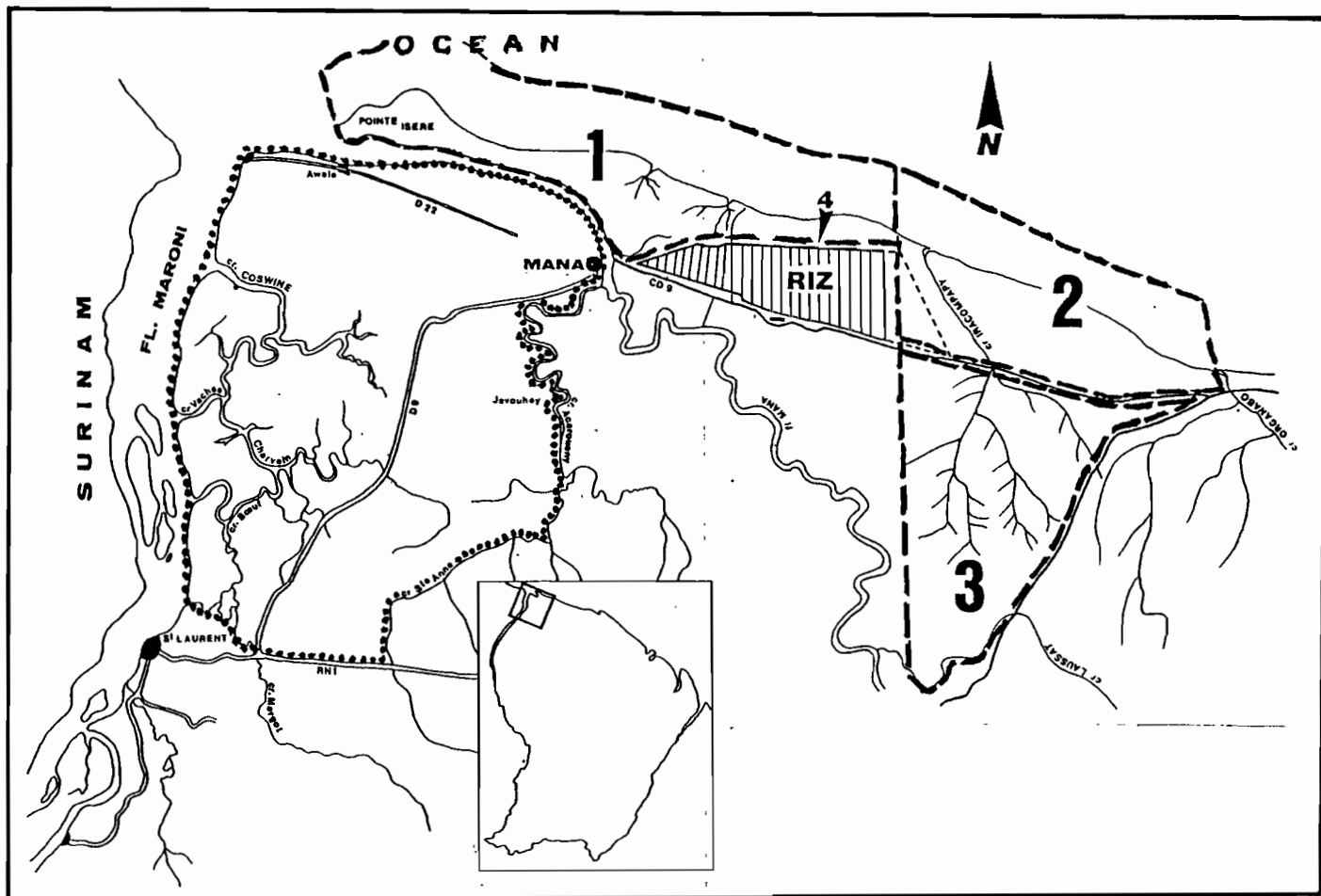
New propositions aiming to create a very large National Park have been drawn up by C.N.R.S. (Centre National de la Recherche Scientifique) with financial contribution of French Ministry of Environment and scientific support of ORSTOM (THIOLLAY 1986). The most southern quarter of French Guiana has been selected in order to increase the chances of success : area uninhabited, rarely and little hunted (only by indians and bush-negroes), poor in useful ores, far away from the coast and difficult to valorize by traditional means like extraction of timbers, agriculture and breeding (lack of roads, soils chemically poor exclusively on crystalline base, generally low concentration of very big trees and of well known commercial timbers). On the contrary, the region promises to be successfully valorized by development of tourism, pedestrian and river trips by pirogue crossing many white water rapids. Moreover, spectacular granitic outcrops are frequent in this area, offering splendid wide views. The Park would reach an area of 1,700,000 ha (a little bit less than 20 % of French Guiana), and a contiguous wide peripheric zone, along its northern border, intended to receive touristic equipments and accomodation, would include the 3 municipalities of Maripasoula, Saül and Camopi (all provided by airstrips) of which the economy would be restored by tourism.

Though this project has not been hostilely rejected like the first one in 1978-1979, it did not receive a very enthusiastic welcome neither from French government, nor from local Authorities, so that, for the last 3 years, it has come to a stanstill. Nevertheless, French Ministry of Environment is willing to establish a large conservation area in the interior but it seems that the status of National Park will not be retained.

2.e. The lower Mana river : new propositions (fig. 19 & 21).

In a recent detailed report (FRETEY 1989), a new programme of conservation and aménagement of this interesting coastal region is exposed : creation of a Natural Reserve along the right side of Mana river estuary and of a Natural Regional Park to the left side.

The main purpose of the Natural Reserve is to preserve swamp and beaches ecosystems harbouring many birds and constituting one of the most important sites in the world for marine turtles reproduction, especially *Lepidochelys olivacea* and the huge *Dermochelys coriacea*, the latter being entirely






-  Project of Natural Reserve.
-  Project of Natural Regional Park.
-  Existing rice polders.

Fig. 21 : New projects for lower Mana river area (FRETEY, 1989)

protected by law. This area is particularly endangered by proliferation of hunters, development of professional fishing prejudicial to marine turtles, dolphins and sea-cows, and by projects of extension of rice culture. The reserve would be divided into 3 zones encircling the existing rice polders. Fishing and hunting would be free only for residents of both nearest villages of Mana, Awala and Yalimapo in zone 1 and for those of Mana and Organabo in zone 3, whereas zone 2 would become an integral reserve.

The Natural Regional Park, stretching from Saint-Laurent to the South, to Mana and Amerindian villages of Awala and Yalimapo to the North would include several ethnic groups (Amerindian, Bush-Negroes, Creole, European, Asiatic) of which handicraft would be better marketed. However, the aim of the Park is to improve and to reorganize the already well developed but considerably increasing tourism induced for more than ten years by laying of giant marine turtles along the beaches between Yalimapo and Awala : 200 to 1,000 females are numbered every year in May and June on these beaches. A few years ago, a special equipment has been settled in Yalimapo by scientists in order to protect eggs of *Dermochelys coriacea* from predators : a lot of eggs are collected for a controlled hatching in incubator and the juveniles are then released in the ocean. A project of extension for eggs of *Lepidochelys olivacea* is presently discussed with collaboration of STINASU (Foundation for Nature Preservation in Suriname).

2.f. The C.N.G. (Centre Nature Guyane, fig. 19).

Created in 1989 in the coastal zone, covering an area of 21,000 ha (15,000 ha on municipality of Iracoubo and 6,000 ha on the one of Sinnamary), the C.N.G. is not a typical conservation

area and should promote many other activities in relation with environment. It has for purpose :

- The protection of this area offering various biotopes (mangrove, swamps, savannas and several types of forests).
- The promotion and realization of scientific researches on these ecosystems.
- The contribution to economic and social development of the region by applying and valorization of results.
- The scientific, technical and educational information.
- The formation of people to research and applied sciences.

The researches will be turned toward species ethology, farming of endangered animals to maintain species diversity and to limit poaching and illicit trading. Reintroduction of species in the C.N.G. area will be hopefully followed by reproduction and dispersion along the coast. The first operations to which the C.N.G. will collaborate are biology and farming of scarlet ibis and saving of fauna in the area soon flooded by "Petit-Saut" dam.

2.g. The "ZNIEFF" ("Zones Naturelles d'Intérêt écologique Faunistique et Floristique").

The "ZNIEFF" are areas remarkable by their ecology, their fauna and/or their flora, selected in France (including

overseas departments) from a programme of inventories managed by the "Secrétariat de la Faune et de la Flore", under the auspices of the National Museum of Natural History of Paris and French Ministry of Environment (BEAUFORT & MAURIN 1988) with the contribution of many people (scientists but also professors, students, amateurs etc...) well familiarized with the région they are working on. Data gathered from these investigations are recorded on formularies and then treated by computer. So far, about 1,700 "ZNIEFF" have been numbered in France and a Regional Scientific Board has just been created in Cayenne in order to undertake this programme in French Guiana.

2.h. Arboretum project (fig. 19).

A project of Regional Arboretum in "La Mirande" forest, at the same place where the first Natural Forest Reserve had been created in 1942, is presently studied by ORSTOM and local Authorities. Many seedlings of Guianan tree species are already cultivated in greenhouses in order to enrich this still quite undisturbed forest.

2.i. Control of access to the far South.

Lastly, it is advisable to notice that a prefectoral order, in force since 1970, controls access of people (except Amerindians and Bush-Negroes) South to a potential line joining Itany and Ouqui rivers confluence to Camopi (fig. 19). Nevertheless, special permissions are delivered to Administration and to medical, scientific and military services. Formerly, this decree had for purpose to limit expensive searches of "adventurers" badly trained lost in the far South. Then, it has been maintained principally in order to protect small indian communities living on Itany and higher Oyapock rivers from tourism and European diseases. By the way, professional hunters and other types of expeditions are not allowed to go beyond this limit so that this decree constitutes also a good protection for Nature.

CONCLUSIONS

From this study, it follows that some areas are much more original and species diverse than others in French Guiana. The striking concordance of data from endemism, species richness and presumed Quaternary refugia enables to draw up a map of priority areas for conservation by combining and overlapping the following elementary maps : highest endemism, high vascular plant species diversity, altitude overtopping 500 meters, annual rainfall of more than 3 500 mm and presumed Pleistocene rain forest refugia (fig. 22). On the final map, the darkest areas correspond to the most interesting ones from a floristic point of view and should be protected as soon as possible. Moreover, these areas have also been selected with the purpose to include all vegetation types existing in French Guiana (tables 3 and 4). A comparison with the former reserve projects shows that, during the last 20 years, researches on flora confirm that most of areas already proposed a long time ago for preservation had been rather well defined.

Indubitably, priority has to be given to Saül area, extended to the whole extremely interesting central mountain ranges from "Monts Atachi-Bacca in the West to "Sommet Tabulaire" in the South-East and "Pic Matécho" in the North. This large zone should be preserved from hunting and from any timber, agricultural and mining concession. On the contrary, it could be valorized by development of tourism in Saül vicinity where a remarkable network of marked out trails is already well used and appreciated by many people : a booklet on Saül area, including maps of the trails, names and uses of labelled trees, will be soon published. Moreover, an illustrated practical flora of the area is prepared by the New York Botanical Garden and ORSTOM (publication scheduled in 5 years). So, the status of National Park or equivalent seems to be the most suitable.

The other priority areas for conservation are :

- Kaw region (already protected);
- The lower course of Sinnamary river, including Saint-Elie track and "Petit Saut" dam project, where scientific researches and tourism can also be developed,
- The "Montagnes de la Trinité", which could belong to a larger continuous area reaching the former one to the North and including Saint-Elie village,
- The lower Mana river area (in project), in continuation with the "Galibi" reserve in Suriname,
- Paul Isnard with the surrounding mountains,
- The area in the North of Saint-Georges ("Crique Gabaret", up to the "Montagne des 3 Pitons"), which could be extended to the Brazilian side of the Oyapock,
- Both Southern areas situated in the West ("Tumuc-Humac" up to Southern Suriname, and higher Marouini river outcrops) and in the East (Trois-Sauts, "Mont Saint-Marcel" and "Mont Belvédère" outcrops),
- "Saut Pararé"/"Montagnes Balenfois" area, in the North of the Arataye river, including the field research stations.

We think that these areas constitute a minimum in a Nature preservation project aiming to save species and ecosystem diversity in French Guiana. Former propositions of which purpose was to conserve the whole Southern half in a huge National Park and to deliver the whole Northern half to human activities and exploitation of natural resources do not take account of biological reality and should be rejected. Nevertheless, if efficient steps to ensure conservation of Northern areas above cited are taken, there is obviously no disadvantage to protect the whole South ! In any case, the decree limiting access of public to the South should be maintained.

French Guiana has the chance to possess one of the last undisturbed tropical rain forests of the world of which progressive degradation and destruction, foreseeable with fast increasing population, economic development and local political ambitions, would be particularly distressing : some Guianan politicians project to build, in location of Saül (now only 40 inhabitants), the "Brasilia of French Guiana"! The opening of a road is already undertaken...

Knowing that traditional exploitation of natural resources (timbers, agriculture and breeding) are generally more expensive than profitable in this country, an economic development based on Nature preservation should be promoted (CLAVEL & al. 1978, THIOLLAY 1986) : tourism, scientific research and education etc... Moreover, floristic and faunistic inventory is still unfinished and new scientific equipments settled at ORSTOM (teledetection laboratory, "AUBLET" Data Bank) will allow to progress faster in the knowledge of Guianan natural ecosystems.

The will of French Ministry of Environment to delimit protected areas, the appointment of a representative of Environment in French Guiana now proceeding, the most recent decisions concerning Nature preservation, especially the "Arrêté de Protection de Biotope" of Kaw area, the "Centre Nature Guyane" and both projects of islands "Grand Connétable" and "Battures de Malmanoury" betokens a progressive change in general opinion : some elected members, Regional and Departmental Assemblies, first fiercely opposite to projects coming from Europe, begin to be sensitized to the necessity of a "development" in accordance with Nature conservation. So, we can hope that some of priority areas for conservation above proposed will have a successful issue.

Fig. 22 : Priority areas for conservation in French Guiana.

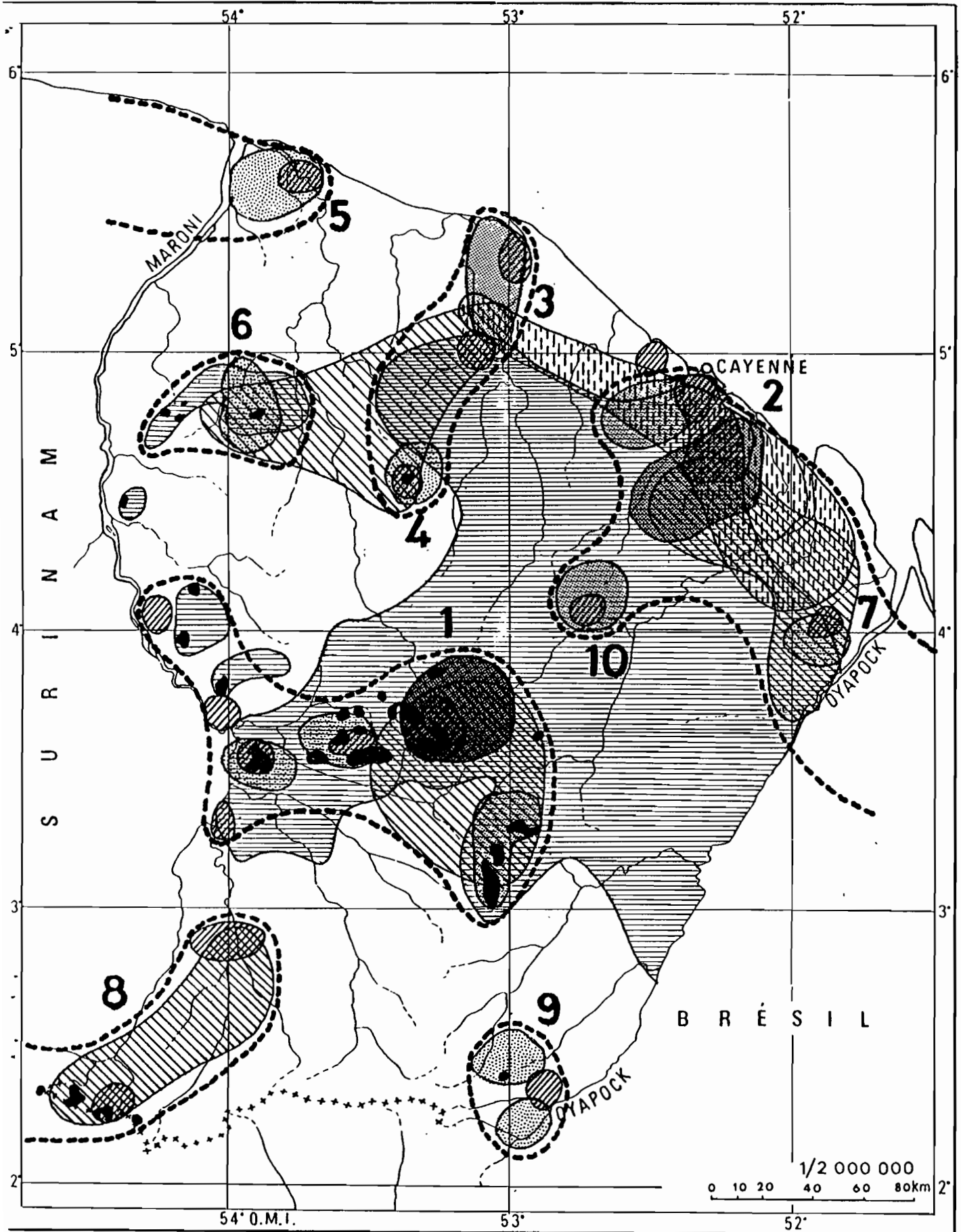
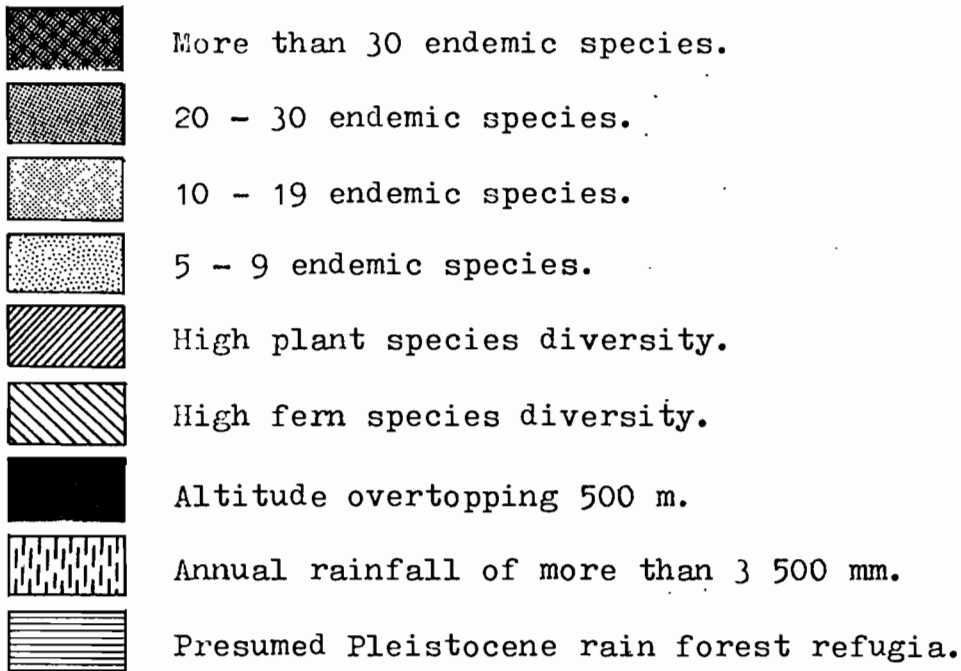


Fig. 22 : Priority areas for conservation in French Guiana



"Saül-Maripasoula" :

1. Saül-Maripasoula area and central mountain ranges.

"Kaw-Oiapoque" :

2. Cacao/Kaw/"Montagnes Tortue" area.
7. "Crique Gabaret"/"Montagne des 3 Pitons".

"Sinnamary-Saint-Elie" :

3. Saint-Elie track/"Petit Saut" dam project.
4. "Montagnes de la Trinité".

"Galibi" :

5. Lower Mana river area.

"Paul Isnard" :

6. Paul Isnard/"Massif du Décou-Décou"/"Montagne Lucifer".

"Tumuc-Humac" :

8. Tumuc-Humac and higher Marouini river outcrops.

"Mont Belvédère-Trois Sauts" :

9. "Trois Sauts" area : "Mont Saint-Marcel" and "Mont Belvédère" outcrops.

"Montagnes Balenfois" :

10. "Saut Pararé"/"Montagnes Balenfois".

| | <u>Upland moist forests</u> | <u>Marsh and swamp forests</u> | <u>Lower montane moist forests</u> | <u>Forests on lateritic crust</u> | <u>White sand forests</u> | <u>Herbaceous swamps</u> | <u>Mangrove</u> | <u>Coastal savannas</u> | <u>Outcrops epipetri vegetation</u> |
|--|-------------------------------------|--|--|---|-----------------------------------|------------------------------|-----------------|-----------------------------|---|
| " <u>Saül-Maripasoula</u> " (area 1) | +++ | + | +++ | +++ | | | | | + |
| " <u>Kaw-Oiapoque</u> " (areas 2, 7) | +++ | +++ | | +++ | | +++ | +++ | | + |
| " <u>Sinnamary-St-Elie</u> " (areas 3, 4) | +++ | ++ | ++ | + | | + | ++ | ++ | ++ |
| " <u>Galibi</u> " (area 5) | + | ++ | | | ++ | ++- | ++ | | |
| " <u>Paul Isnard</u> " (area 6) | +++ | + | ++ | ++ | | | | | |
| " <u>Tumuc-Humac</u> " (area 8) | +++ | + | + | | | | | | +++ |
| " <u>Mont Belvédère- Trois Sauts</u> " (area 9) | +++ | + | + | | | | | | ++ |
| " <u>Montagnes Balenfois</u> " (area 10) | +++ | + | | + | | | | | + |

Table 3 : Main primary vegetation types occurring in the proposed areas for conservation.

Table 4 : Importance of the proposed areas for conservation in terms of floristic and ecology.

| | <u>Endemism</u> | <u>Species diversity</u> | <u>Diversity of ecosystems</u> |
|---|-----------------|--------------------------|--------------------------------|
| " <u>Saül-Maripasoula</u> " (area 1) | +++++ | +++++ | +++ |
| " <u>Kaw-Oiapoque</u> " (areas 2, 7) | +++++ | ++++ | +++++ |
| " <u>Sinnamary-St-Elie</u> " (areas 3, 4) | ++++ | ++++ | +++++ |
| " <u>Galibi</u> " (area 5) | ++ | ++++ | +++ |
| " <u>Paul Isnard</u> " (area 6) | ++ | ++++ | + |
| " <u>Tumuc-Humac</u> " (area 8) | + | ++++ | ++ |
| " <u>Mont Belvédère-Trois Sauts</u> " (area 9) | ++ | +++ | ++ |
| " <u>Montagnes Balenfois</u> " (area 10) | +++ | ++++ | ++ |

REFERENCES

- BEAUFORT, F. & H. MAURIN (1988 a) : Le Secrétariat de la Faune et de la Flore et l'Inventaire du Patrimoine Naturel. Programmes d'inventaire Réseau Faune-Flore et Publications. Services réalisés pour le compte du Ministère de l'Environnement, Direction de la Protection de la Nature. Muséum National d'Histoire Naturelle. Secrétariat de la Faune et de la Flore, Paris, 214 p.
- BEAUFORT, F. & H. MAURIN (1988 b) : Le Secrétariat de la Faune et de la Flore et l'Inventaire du Patrimoine Naturel. Objectifs, Méthodes et Fonctionnement. Services réalisés pour le compte du Ministère de l'Environnement, Direction de la Protection de la Nature. Muséum National d'Histoire Naturelle. Secrétariat de la Faune et de la Flore, Paris, 119 p..
- BEHRA, O. (1989) : Compte rendu succinct d'observations et commentaires sur les caïmans noirs (*Melanosuchus niger*) de Guyane Française. Laboratoire des Reptiles et Amphibiens, Muséum National d'Histoire Naturelle, Paris, 4 p., 2 maps.
- BLANCANEAUX, P. (1973) : Propositions de projets de réalisation de réserves naturelles intégrales sur le littoral Nord-Ouest de la Guyane Française. Colloque SEPANRIT, Paris, January 1973. Bulletin de Liaison SEPANRIT 5, 6, CEGET-C.N.R.S., Talence : 47-56.
- CLAVEL, P.; J.-P. PROFIZI & B. SALLEE (1978) : Comment éviter le massacre de la forêt guyanaise ? Suggestions pour un développement de la Guyane Française fondé sur la conservation de sa forêt. D.E.A., Université des Sciences et Techniques du Languedoc, Montpellier, France : 48 p., 11 tab. & fig.
- CONDAMIN, M. (1974) : Etude écologique du littoral guyanais en vue de la création de Réserves Naturelles. Rapport de situation et d'étude. ORSTOM, Cayenne : 73 p., 2 fig., 1 tab.
- CONDAMIN, M. (1975) : Projets de Réserves Naturelles sur le littoral guyanais. Ministère de la Qualité de la Vie. Direction de la Protection de la Nature. ORSTOM, Cayenne, 95 p., 44 fig., 10 maps.
- CREMERS, G. (1984 a) : L'Herbier du Centre ORSTOM de Cayenne (CAY) a 25 ans. Taxon 33 (3) : 428-432.
- CREMERS, G. (1984 b) : Espèces nouvelles de Guyane Française : richesse de l'herbier de Cayenne (CAY). Studies on the Flora of the Guianas 11. Proceedings C 88 (1) : 15-37.
- CREMERS, G.; C. FEUILLET; J.-J. de GRANVILLE & M. HOFF (1988a) : Liste des espèces de Phanérogames et de Ptéridophytes de Guyane Française d'après l'Herbier du Centre ORSTOM de Cayenne. ORSTOM, Cayenne : 54 p.
- CREMERS, G.; C. FEUILLET; J.-J. de GRANVILLE; M. HOFF; C.A. GRACIE & S.A. MORI (1988b) : Inventaire des Phanérogames et des Ptéridophytes de la région de Saül (Guyane Française). Communication de "AUBLET", la Banque de Données Botaniques de

l'Herbier du Centre ORSTOM de Cayenne n° 11. ORSTOM, Cayenne.

Electricité de France (1989) : Aménagement hydro-électrique et environnement. Barrage de Petit-Saut en Guyane Française. E.D.F., Paris, Marseille, Cayenne : 20 p.

FEUILLET, C. (1986) : Passifloraceae : Distribucion y afinidad de las especies de las Guyanas. Comm. IV Congreso Latinoamericano de Botánica, Medellin, Columbia.

FRETEY, J. (1989) : Projet de Réserve Naturelle de Basse Mana et d'un Parc Naturel Régional pour la zone du Bas Maroni. Paris : 32 p., 5 fig., 3 maps.

GASC, J.-P.; J. FRETEY; J. LESCURE & F. BEAUFORT (1982) : Note Scientifique sur les Caïmans de Guyane. Muséum National d'Histoire Naturelle, Secrétariat de la Faune et de la Flore, Paris : 3 p.

GAZEL, M. (1979) : Exploitation forestière. In : Atlas de Départements Français d'Outre-Mer. IV : la Guyane. C.N.R.S. - ORSTOM, Paris, Talence.

GRANVILLE, J.-J. de (1975) : Projets de Réserves Botaniques et Forestières en Guyane. ORSTOM, Cayenne : 29 p., 16 maps.

GRANVILLE, J.-J. de (1978) : Contribution à l'étude de la flore et de la végétation des inselbergs des Tumuc-Humac (Guyane Française). In : J.-J. de GRANVILLE : Recherches sur la Flore et la Végétation guyanaises. Thesis, Université des Sciences et Techniques du Languedoc, Montpellier (France) : 17-168.

GRANVILLE, J.-J. de (1979) : Végétation, plates 12, 13. In : Atlas des Départements Français d'Outre-Mer. IV : la Guyane. C.N.R.S.-ORSTOM, Paris, Talence : 1-4, 4 color plates, 10 fig.

GRANVILLE, J.-J. de (1981) : Les divers types de couverture végétale en Guyane, quelques aspects de leur exploitation. 7th Colloque SEPANRIT, Basse-Terre, Guadeloupe, 1980. Bulletin de Liaison SEPANRIT n° 11, CEGET-C.N.R.S., Talence : 1-31, 4 fig.

GRANVILLE, J.-J. de (1982) : Rain Forest and Xeric Flora Refuges in French Guiana. In : G.T. FRANCE : Biological Diversification in the Tropics. Proc of the Fifth International Symposium of the Association for Tropical Biology. Macuto Beach, Caracas, Venezuela, Feb. 8-13, 1979. Columbia University Press, New York : 159-181, 11 fig. & maps.

GRANVILLE, J.-J. de (1986 a) : Le Projet de Réserve Biologique Domaniale de Kaw. In : Le Littoral Guyanais, fragilité de l'Environnement. Nature Guyanaise, Cayenne : 161-178, 4 fig., 2 maps.

GRANVILLE, J.-J. de (1986 b) : Le Projet de Réserve Naturelle de Kaw. ORSTOM, Cayenne : 18 p. 2 maps.

GRANVILLE, J.-J. de (1986 c) : Les formations végétales de la bande cotière de Guyane Française. In : Le Littoral Guyanais, fragilité de l'Environnement. Nature Guyanaise, Cayenne : 47-63, 12 fig. & photos.

GRANVILLE, J.-J. de (1988) : Phytogeographical characteristics of the Guianan forests. *Taxon* 37 (3) : 578-594.

GRANVILLE, J.-J. de & O. TOSTAIN (1986) : Compléments aux projets de Réserves Naturelles de Kaw, Ile du Grand Connétable, Battures de Malmanoury. ORSTOM, Cayenne : 22 p., 2 maps.

GRANVILLE, J.-J. de & O. TOSTAIN (1989) : Proposition d'Arrêté de Protection du Biotope de la Région de Kaw. ORSTOM, Cayenne : 21 p., 2 maps.

HOFF, M. (1990) : Diversité et répartition des groupements végétaux en Guyane Française à partir d'une Banque de Données sur l'Environnement. Atelier sur l'Aménagement et la Conservation de l'Ecosystème Forestier Tropical Humide, Cayenne 10th-19th March 1990.

HOFF, M. & G. CREMERS (1990) : Diversité, Biogéographie et Ecologie des Ptéridophytes de Guyane Française. In: Gestion de l'Ecosystème Forestier et Aménagement de l'Espace Régional. 2nd Congrès Régional de l'Environnement, Cayenne, 16th-18th Febr. 1990.

HOFF, M.; G. CREMERS; C. FEUILLET & J.-J. de GRANVILLE (1988) : "Aublet", la Banque de Données de l'Herbier du Centre ORSTOM de Cayenne : premiers résultats. *Seminfor* 1 : Premier Séminaire Informatique de l'ORSTOM. Coll. Colloques & Séminaires, ORSTOM, Paris : 145-169.

HOFF, M.; G. CREMERS; C. FEUILLET & J.-J. de GRANVILLE (1989 a) : La Banque de Données "Aublet" de l'Herbier du Centre ORSTOM de Cayenne (CAY). *Bull. Jard. Bot. Nat. Belg.* 59 : 171-178.

HOFF, M.; G. CREMERS; C. FEUILLET & J.-J. de GRANVILLE (1989 b) : Catalogue de la Flore de la Guyane Française. *Herbier du Centre ORSTOM de Cayenne*, ORSTOM, Cayenne.

MORI, S.A. & al. (1987) : The Lecythidaceae of a Lowland Neotropical Forest: La Fumée Mountain, French Guiana. *Mem. of the New York Bot. Gard.* 44 : 1-190.

Office National des Forêts (1975) : Réserves Biologiques Domaniales. O.N.F., Cayenne : 58 p., 18 maps.

Office National des Forêts (1989 a) : Bilan 1988 de l'exploitation forestière et de l'industrie du sciage en Guyane. D.A.F. - O.N.F., Direction Régionale de Guyane, Cayenne : 56 p.

Office National des Forêts (1989 b) : Orientations 1990-1994 pour les dispositifs sylvicoles de l'Office National des Forêts de Guyane. D.A.F. - O.N.F., Direction Régionale de Guyane, Cayenne : 45 p.

THIOLLAY, J.-M. (1986) : Projet de Parc National dans le Sud de la Guyane Française. Propositions préliminaires pour une valorisation du patrimoine guyanais. C.N.R.S., Ministère de l'Environnement, Paris : 52 p., 1 map.

TOSTAIN, O. (1988 a) : Projet de Réserve Naturelle de l'Ile du

Grand Connétable (Guyane). ORSTOM, Cayenne : 10 p., 2 maps.

TOSTAIN, O. (1988 b) : Projet d'Arrêté de Biotope pour les Battures de Malmanoury. ORSTOM, Cayenne : 7 p., 2 maps.

ANNEXE

Table 2 : Vascular plant species presumed to be endemic to French Guiana, or sometimes episodically found in adjacent countries.

DICOTYLEDONES

ANNONACEAE

Anaxagorea Saint-Hilaire

1. Anaxagorea brevipedicellata Timmerman (+ Suriname)

Pseudoxandra R.E. Fries

2. Pseudoxandra cuspidata Maas

APOCYNACEAE

Bonafousia A. de Candolle

3. Bonafousia morettii Allorge

ARITOLOCHIACEAE

Aristolochia Linnaeus

11. Aristolochia bukuti Poncy
 12. Aristolochia cremersii Poncy
 13. Aristolochia flava Poncy
 14. Aristolochia guianensis Poncy (+ Suriname)

ASCLEPIADACEAE

Matelea Aublet

15. Matelea sastrei Morillo

ASTERACEAE

Ichthyothere Martius

16. Ichthyothere granvillei Robinson

Stiffitia Mikan

17. Stiffitia cayennensis Robinson & Kahn

BIGNONIACEAE

Anemopaegma Martius ex Meisner

18. Anemopaegma granvillei A. Gentry
 19. Anemopaegma ionanthum A. Gentry

Distictella O. Kuntze

20. Distictella cremersii A. Gentry

Tynanthus Miers

21. Tynanthus sastrei A. Gentry

BOMBACACEAE

Pachira Aublet

22. Pachira dolichocalyx Robyns

CAESALPINIACEAE

- Crudia Schreber
34. *Crudia tomentosa* Aublet
- Dimorphandra Schott
35. *Dimorphandra* sp. nov.
- Peltogyne J. Vogel
36. *Peltogyne* sp. nov.
- Swartzia Schreber
37. *Swartzia angustifolia* (+ Suriname)
38. *Swartzia aptera* de Candolle
39. *Swartzia guianensis* (Aublet) Urban (+ Suriname and Guyana)
40. *Swartzia hostmannii* Benthham (+ Suriname)
41. *Swartzia leblondii* Cowan
 Swartzia panacoco (Aublet) Cowan
43. var. *panacoco*
42. var. *sagotii* (Sandwith) Cowan
44. *Swartzia remigifer* Amshoff (+ Suriname)

CECROPIACEAE

- Cecropia Loefling
45. *Cecropia granvilleana* C.C. Berg
- Pourouma Aublet
46. *Pourouma saülensis* C.C. Berg (+ Brazil : Amapa)

CHRYSOBALANACEAE

- Couepia Aublet
47. *Couepia guianensis* Aublet (+ Suriname and Guyana)
- Hirtella Linnaeus
48. *Hirtella tenuifolia* G.T. Prance (+ Brazil : Amapa)
- Licania Aublet
49. *Licania cyathodes* R. Benoist
50. *Licania granvillei* G.T. Prance (+ Brazil and Columbia)
51. *Licania irwinii* G.T. Prance (+ Suriname)
52. *Licania majuscula* Sagot (+ Suriname and Guyana)
53. *Licania ovalifolia* Kleinhoonte (+ Suriname)

CONNARACEAE

- Connarus Linnaeus
54. *Connarus fasciculatus* (A.P. de Candolle) Planchon

ERYTHROXYLACEAE

- Erythroxylum P. Browne
59. *Erythroxylum ligustrinum* De Candolle (+ Venezuela)

EUPHORBIACEAE

- Croton Linnaeus
58. *Croton macradenis* Goerts & Punt (+ Suriname)

FLACOURTIACEAE

- Carpotroche Endlicher
60. *Carpotroche surinamensis* Uittien (+ Suriname and Guyana)

- Casearia N.J. Jacquin
61. *Casearia acuminata* de Candolle (+ Suriname and Guyana)

GESNERIACEAE

- Besleria Linnaeus
62. *Besleria maasii* Wiehler
- Drymonia Martius
63. *Drymonia psilocalyx* Leeuwenberg

- Episcia Martius
64. *Episcia xantha* Leeuwenberg

HUMIRIACEAE

- Schistostemon (Urban) Cuatrecasas
65. *Schistostemon sylvaticum* Sabatier

- Vantanea Aublet
66. *Vantanea* prob. sp. nov.

LAMIACEAE

- Hyptis N.J. Jacquin
67. *Hyptis pachycephala* Epling

LECYTHIDACEAE

- Corythophora R. Knuth
68. *Corythophora rimosa* W.A. Rodrigues

- Eschweilera Martius ex De Candolle
69. *Eschweilera squamata* Mori

- Lecythis Loefling
70. *Lecythis persistens* Aublet

LOGANIACEAE

- Strychnos Linnaeus
72. *Strychnos cayennensis* Krukoff

MELASTOMATAACEAE

- Clidemia D. Don
78. *Clidemia granvillei* Wurdack
79. *Clidemia saülensis* Wurdack

- Ernestia A.P. De Candolle
80. *Ernestia confertiflora* Wurdack
81. *Ernestia granvillei* Wurdack (+ Suriname)
82. *Ernestia subglabra* Wurdack

Henriettella Naudin

83. Henriettella ininiensis Wurdack

Leandra Raddi

84. Leandra cremersii Wurdack
85. Leandra paleacea Wurdack (+ Brazil : Amapa)

Loreya A. P. de Candolle

86. Loreya subrotundifolia (Wurdack) Renner

Macrocentrum J.D. Hooker

87. Macrocentrum latifolium Wurdack

Miconia Ruiz & Pavon

88. Miconia oldemanii Wurdack
89. Miconia sastrei Wurdack
90. Miconia trimera Wurdack (+ Suriname and Brazil : Amapa)

Mouriri Aublet

91. Mouriri viridicostata Morley

Ossaea A.P. de Candolle

92. Ossaea coarctifolia Wurdack

MELIACEAE

Guarea Allamand ex Linnaeus

93. Guarea costata Adr. Jussieu (+ Suriname)

MENISPERMACEAE

Disciphania Eichler

94. Disciphania unilateralis Barneby

Elephantomene Barneby & Krukoff

95. Elephantomene eburnea Barneby & Krukoff

MIMOSACEAE

Inga P. Miller

96. Inga fanchoniana O. Ponce

Parkia R. Brown

97. Parkia reticulata Ducke

Stryphnodendron Martius

98. Stryphnodendron moricolor Barneby & Grimes

MORACEAE

Ficus Linnaeus

99. Ficus cremersii C.C. Berg

Poulsenia Eggers

100. Poulsenia sp.

Trymatococcus Poeppig & Endlicher

101. Trymatococcus oligandrus (R. Benoist) Lanjouw (+ Suriname)

OCHNACEAE

Ouratea Aublet

104. *Ouratea cerebroides* Sastre (+ Guyana)
 105. *Ouratea francinae* Sastre
 106. *Ouratea manacuja* Sastre

Sauvagesia Linnaeus

- Sauvagesia aliciae* Sastre
 107. subsp. *aratayensis* Sastre
 108. *Sauvagesia tafelbergensis* Sastre (+ Suriname)

OLACACEAE

Heisteria N.J. Jacquin

109. *Heisteria cauliflora* J.E. Smith (+ Suriname and Guyana)

PASSIFLORACEAE

Passiflora Linnaeus

118. *Passiflora crenata* Feuillet & Cremers
 119. *Passiflora plumosa* Feuillet & Cremers

PAPILIONACEAE

Ormosia Jackson

117. *Ormosia wayana* Stirton

RUBIACEAE

Chomelia Linnaeus

122. *Chomelia glabriuscula* Steyermark

Coussarea Aublet

123. *Coussarea hallei* Steyermark

Geophila D. Don

124. *Geophila granvillei* Steyermark

Psychotria Linnaeus

125. *Psychotria alloantha* Steyermark
 126. *Psychotria antennaeformis* Steyermark
 127. *Psychotria granvillei* Steyermark
 128. *Psychotria lateralis* Steyermark
 129. *Psychotria microbracteata* Steyermark
 130. *Psychotria perferruginea* Steyermark
 131. *Psychotria saulensis* Steyermark
 132. *Psychotria urceolata* Steyermark

Rudgea Salisbury

133. *Rudgea oldemanii* Steyermark

Sipanea Aublet

- Sipanea ovalifolia* Bremekamp
 134. var. *villosissima* Steyermark

RUTACEAE

Esenbeckia Humboldt, Bonpland & Kunth

135. *Esenbeckia cowanii* Kaastra

TRIGONIACEAE

Trigonia Aublet

136. *Trigonia hypoleuca* Grisebach (+ Suriname, Guyana & Northern Brazil)

Trigonia laevis Aublet

137. var. *laevis* (+ Guyana)

TURNERACEAE

Turnera Linnaeus

149. *Turnera rupestris* Aublet

150. *Turnera guianensis* Aublet (+ Suriname)

URTICACEAE

Pilea Lindley

138. *Pilea tabularis* C.C. Berg

VERBENACEAE

Lantana Linnaeus

Lantana armata Schauer

139. var. *guianensis* Moldenke

Petrea Linnaeus

140. *Petrea sulphurea* Jansen-Jacobs

VIOLACEAE

Rinorea Aublet

141. *Rinorea pectino-squamata* Hekking

VITACEAE

Cissus Linnaeus

142. *Cissus guianensis* Descoings

VOCHYSIACEAE

Vochysia Aublet

143. *Vochysia neyratii* Normand

MONOCOTYLEDONES

ARECACEAE

Asterogyne Wendland

4. *Asterogyne guianensis* De Granville & Henderson

Geonoma Willdenow

5. *Geonoma oldemanii* J.-J. de Granville

Scheelea Karsten

6. *Scheelea camopiensis* S.F. Glassman
 7. *Scheelea degranvillei* S.F. Glassman
 8. *Scheelea guianensis* S.F. Glassman
 9. *Scheelea maripensis* S.F. Glassman

Syagrus Martius

10. *Syagrus stratinicola* Wessels Boer (+ Suriname)

BROMELIACEAE

Bromelia Linnaeus

23. *Bromelia agavifolia* Brongniart
24. *Bromelia granvillei* L.B. Smith

Disteganthus Lemaire

25. *Disteganthus basilateralis* Lemaire
26. *Disteganthus bromeliifolius* L.B. Smith ined.
27. *Disteganthus calatheoides* (L.B. Smith) L.B. Smith & Read

Pitcairnia L'Heritier

28. *Pitcairnia geyskesii* L.B. Smith
29. *Pitcairnia incarnata* Baker
30. *Pitcairnia leprieurii* Baker
31. *Pitcairnia sastrei* L.B. Smith

Vriesea Lindley

32. *Vriesea gladioliflora* (Wendland) Antoine

BURMANIACEAE

Thismia Griffith

33. *Thismia saülensis* Maas & Maas

CYPERACEAE

Mapania Aublet

55. *Mapania assimilis* T. Koyama

Rhynchospora Vahl

56. *Rhynchospora subdicephala* Koyama

ERIOCAULACEAE

Syngonanthus Ruhland

57. *Syngonanthus caulescens* (Poiret) Ruhland
forma *longifolius* Moldenke

LILIACEAE

Alstroemeria Linnaeus

71. *Alstroemeria* sp.

MARANTACEAE

Calathea G.F.W. Meyer

73. *Calathea dilabens* L. Andersson & Kennedy
74. *Calathea erecta* L. Andersson & Kennedy
75. *Calathea granvillei* L. Andersson & Kennedy

Ischnosiphon Koernicke

76. *Ischnosiphon ursinus* L. Andersson

Maranta Linnaeus

77. *Maranta rupicola* L. Andersson

MUSACEAE

Heliconia Linnaeus

102. *Heliconia dasyantha* Koch & Bouché
 103. *Heliconia lourteigia* Mello & E. Santos (+ Brazil, Amaz.)

ORCHIDACEAE

Degranvillea Determann

110. *Degranvillea dermaptera* Determann

Epidendrum Linnaeus

- Epidendrum nocturnum* N.J. Jacquin
 111. var. *tumuc-humaciense* Veyret

Habenaria Willdenow

112. *Habenaria alterosula* Snuverink & Westra (+ Suriname)
 113. *Habenaria longicauda* Hooker (+ Suriname & Guyana)

Palmorchis Barbosa Rodrigues

114. *Palmorchis pabstii* Veyret
 115. *Palmorchis prospectorum* Veyret

Scelochilus

116. *Scelochilus ecalcaratus* Determann

POACEAE

Axonopus Palisot de Beauvois

- Axonopus flabelliformis* Swallen
 120. var. *camporum* G.A. Black
 121. *Axonopus passourae* G.A. Black

ZINGIBERACEAE

Costus Linnaeus

144. *Costus claviger* R. Benoist (+ Suriname & Guyana)
 145. *Costus curcumoides* Maas
Costus lanceolatus O.G. Petersen
 146. subsp. *pulchriflorus* (Ducke) Maas (+ Suriname & Para)

PTERIDOPHYTA

CYATHEACEAE

Cyathea J.E. Smith

147. *Cyathea marginalis* (Klotzsch) Domin (+ Suriname & Guyana)

DRYOPTERIDACEAE

Cyclodium C. Presl

148. *Cyclodium rheophilum* A.R. Smith