DRAFT

ENVIRONMENTAL PROFILE

on

GUYANA

National Park Service Contract No. CX-0001-0-0003
with U.S. Man and the Biosphere Secretariat
Department of State
Washington, D.C.

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Prepared by the

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Guyana, with exceptionally rich natural resources, most of which remain unexploited, is in the unique position of being able to take steps to manage its resources before environmental degradation occurs. Derived from information available in the United States, this draft report profiles Guyana's environmental resources and reviews the impact of the development process upon those resources. Covered in turn are the country's geographic features; climate; population, including cultural and demographic considerations; land use; soil, mineral, water, and electrical power resources; and flora and fauna. Guyana's major environmental problems are confined to the coastal areas.

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THE UNITED STATES NATIONAL COMMITTEE FOR MAN AND THE BIOSPHERE
Department of State, IO/UCS
WASHINGTON, D. C. 20520

An Introductory Note on Draft Environmental Profiles:

The attached draft environmental report has been prepared under a contract between the U.S. Agency for International Development (AID), Bureau of Science and Technology (ST/FNR) and the U.S. Man and the Biosphere (MAB) Program. It is a preliminary review of information available in the United States on the status of the environment and the natural resources of the identified country and is one of a series of similar studies now underway on countries which receive U.S. bilateral assistance.

This report is the first step in a process to develop better information for the A.I.D. Mission, for host country officials, and others on the environmental situation in specific countries and begins to identify the most critical areas of concern. A more comprehensive study may be undertaken in each country by Regional Bureaus and/or A.I.D. Missions. These would involve local scientists in a more detailed examination of the actual situations as well as a better definition of issues, problems and priorities. Such "Phase II" studies would provide substance for the Agency's Country Development Strategy Statements as well as justifications for program initiatives in the areas of environment and natural resources.

Comments on the attached draft report would be welcomed by US MAB and ST/FNR and should be addressed to

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A COMMITTEE OF THE UNITED STATES NATIONAL COMMISSION FOR UNESCO
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Guyana

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SUMMARY

Guyana is a small country located on the northeast coast of South America. Formerly the colony of British Guyana, it became independent in 1966. Guyana has a humid tropical climate which is tempered by ocean breezes on the coast. There are two rainy and two dry seasons. Five natural topographic regions include from north to south: 1) a narrow coastal strip which is mostly reclaimed land below sea level, 2) a forested white sand and clay zone, 3) a forested hill region comprising about 60 percent of the interior, 4) the Pakaraima Mountains, a dissected sandstone plateau in the western region which exceeds 2,750 m (9,000 ft) on Mt. Roraima, and 5) the savannas of the extreme northeast and southwest. Guyana is endowed with a rich variety of biological and physical resources, although most have only begun to be exploited. The economy is based primarily on agriculture, especially sugar and rice, although mining is increasing in importance.

Despite its small size Guyana has remarkably rich mineral resources including gold, diamonds, copper, uranium, iron ore and perhaps the world's largest deposits of bauxite. Soils range from relatively fertile alluvial soils of the coastal zone to extremely fragile and nutrient poor white sand soils found inland. Undisturbed rain forest covers most of the interior of Guyana and several trees are of considerable commercial value. Many other uses for these great forests will doubtless be found also though research and exploration has barely begun. Surface and groundwater supplies are abundant and a large untapped hydropower potential exists.

Guyana's small population is confined almost wholly to a narrow coastal zone. This area has been drained and protected from the sea by an extensive system of dikes, back dams, canals and sea walls. This zone is completely cleared and intensively farmed, primarily for rice and sugar cane which comprise a significant proportion of exports. Forest exploitation is confined to a narrow zone of more well drained white sand soil behind the coastal zone. Cutting is selective, primarily for two hardwoods, wallaba, and greenheart. Guyana has no general utility softwoods and attempts to establish tree farms in the white sand soil zone met with little success because of extreme porosity and rapid-leaching of white sand soils. Commercial lumber exploitation has not gained access to sites further inland because poor subsoils, a lack of road building materials and economic factors have greatly limited road building. Waterfalls and rapids block all major rivers further confounding efforts to exploit forests further inland. Extensive sandbars at the mouths of the Demerara and Berbice rivers, sites of the two major ports, force half-loading of ships and provide an obstacle to oceangoing export.

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Guyana's major environmental problems are largely confined to a narrow coastal zone comprising only 10 to 15 percent of the country's total area but a zone where more than 90 percent of the population lives. By comparison to environmental problems facing many developing nations, those in Guyana are not of great magnitude. The major ones are:

Water Quality and Management. Because most of Guyana's water for domestic, industrial and agricultural use is derived from coastal artesian wells the protection of these supplies is of great importance. Evidence suggests that extensive use of these sources for irrigation has resulted in a drop in pressure and there is danger of seawater intrusion and widespread contamination. Alternative water sources for irrigation, as well as for industry and other major water uses, appear to be available.

Soil Protection. Guyana's most important long-term environmental problem may be the management and maintenance of its soils, most of which are highly fragile and require protective forest cover. In the white sandy soil belt there has been little or no regeneration following clear cutting, and limited regrowth in selectively cut zones. The most widespread problem with these soils as well as other soils of the forested interior is maintenance of soil fertility after the forest is removed. Few areas suffer from erosion, flooding or landslides but these problems could develop without adequate long-term management and protection.

Lack of Centralized Environmental Protection and Technical Ability. Because most of Guyana remains in a wilderness state there has been little incentive to closely monitor environmental problems. Modern technology may rapidly change this situation as the use of various toxic chemicals proliferates in the agriculture sector, new hydropower developments open up wilderness areas, and mining and smelting industries continue to grow and expand. Monitoring systems for urban and rural environmental pollution do not exist; there is little environmental legislation or enforcement, and a lack of trained personnel capable of conducting environmental surveys or monitoring environmental change.

Despite the lack of progress in establishing a strong environmental program at the legislative and judicial level, Guyana does not yet suffer from serious management problems. It has exceptionally rich natural resources, most of which remain unexploited. Guyana is in an almost unique position of being able to take steps to manage its resources before significant degradation and loss has occurred. Enlightened leadership on environmental issues, and a stronger technical base could aid significantly in permitting Guyana to cope with its future.

1.0 Introduction

This draft environmental profile summarizes information available in the United States on the natural resources and environment of the Republic of Guyana. The report reviews the major environmental problems of Guyana and the impact of development processes upon resources and the environment. This draft report represents the first step in developing an environmental profile for use by the U.S. Agency for International Development (U.S. AID) and government officials of Guyana. The next step in this process should be a field study to evaluate the information presented here, obtain additional information, and define the issues, problems, and priorities in greater detail. This entire process should help provide direction in future efforts to deal with the management, conservation, and rehabilitation of the environment and natural resources.

The information and interpretations in this report are preliminary and are not intended to attain the detail and accuracy required for development planning. The report represents a cooperative effort by the Man and the Biosphere (MAB) project staff of the Arid Lands Information Center (ALIC). The primary research, writing, and analysis were done by Steven L. Hilty through the resources of ALIC and the University of Arizona Library. The report was edited by Mercy A. Valencia. The cooperation of James Corson, AID/MAB Project Coordinator, and other AID personnel is gratefully acknowledged.

Comments on the attached draft report would be welcomed by USMAB and DS/ST and should be addressed to either:

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2.0 General Description

2.1 Geographic Features [1]

The former British crown colony of British Guyana is located on the northeastern coast of South America between 1° and 9° north latitude and 57° and 61° west longitude (Fig. 1). It is the westernmost of the three former Guainese Colonies (French Guyana is still a colony of France) and forms part of the "Guianan Region," which includes Guyana, Surinam, French Guiana, southern Venezuela, and part of northern Brazil. The Guianan region is bounded by the Orinoco on the west, by the Río Negro on the southwest and the Atlantic Ocean along the north. It gradually merges with the Amazonian region southward near the Amazon River. Guyana shares its international boundary with three countries: Surinam (formerly Dutch Guyana) on the east (726 km, 451 mi), Brazil on the south and southwest (1,208 km, 751 mi) and Venezuela on the west (650 km, 404 mi). Four hundred thirty-six kilometers (271 mi) of Atlantic Ocean coastline form the northern boundary. Guyana has unresolved border disputes with Surinam and Venezuela. The section disputed with Venezuela comprises five-eighths (53,000 sq mi) of Guyana's total area of 215,000 sq km (183,000 sq mi). Guyana divides naturally into three major geographcal zones: a narrow coastal plain, a forested zone which comprises most of the country and includes an extensive mountainous and hilly zone in the west central region, and lastly, a savanna zone in the southwest. There is also a small fragmented savanna zone about 95 km (60 mi) inland from the Berbice coast (Figs. 1 and 2).

2.1.1 The Coastal Lowlands

The flat alluvial coastal plain comprises five precent of the total land area and extends inland 20 to 40 km (12-25 mi). It is a continuation of a narrow alluvial plain that extends eastward along the coast to the mouth of the Amazon, and is composed largely of alluvial muds from the Amazon that have been carried by the south equatorial current and deposited along the northeast coast of South America. These alluvial muds are the most fertile agricultural soils in Guyana and overlay the

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[1] Sources: Kurian. 1978.
Miller-Warden-Western, Inc. 1967.
Snyder. 1966.
American University Foreign Area Studies. 1969.

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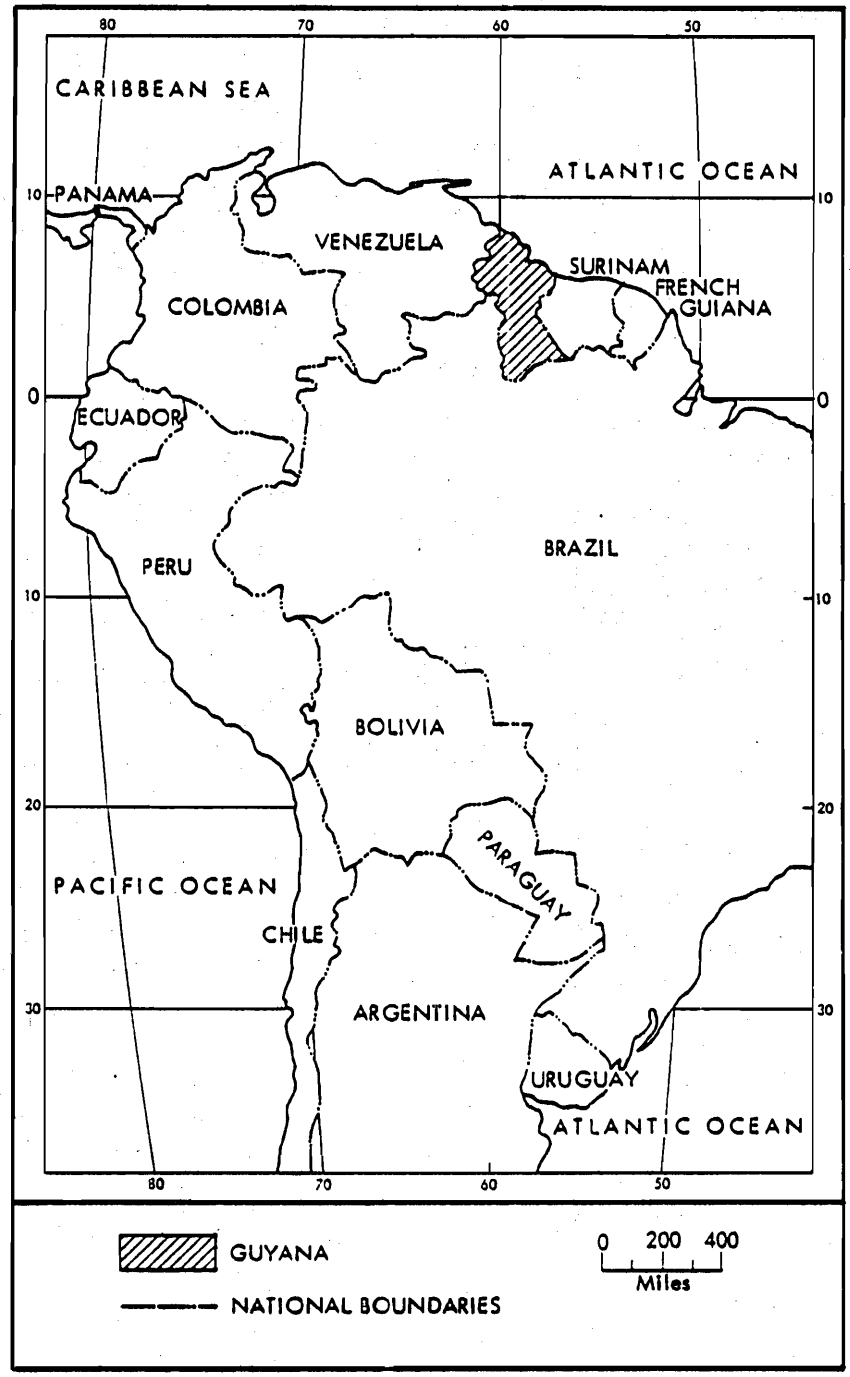

Figure 1. Geographical Location of Guyana

Source: American University Foreign Area Studies. 1969.

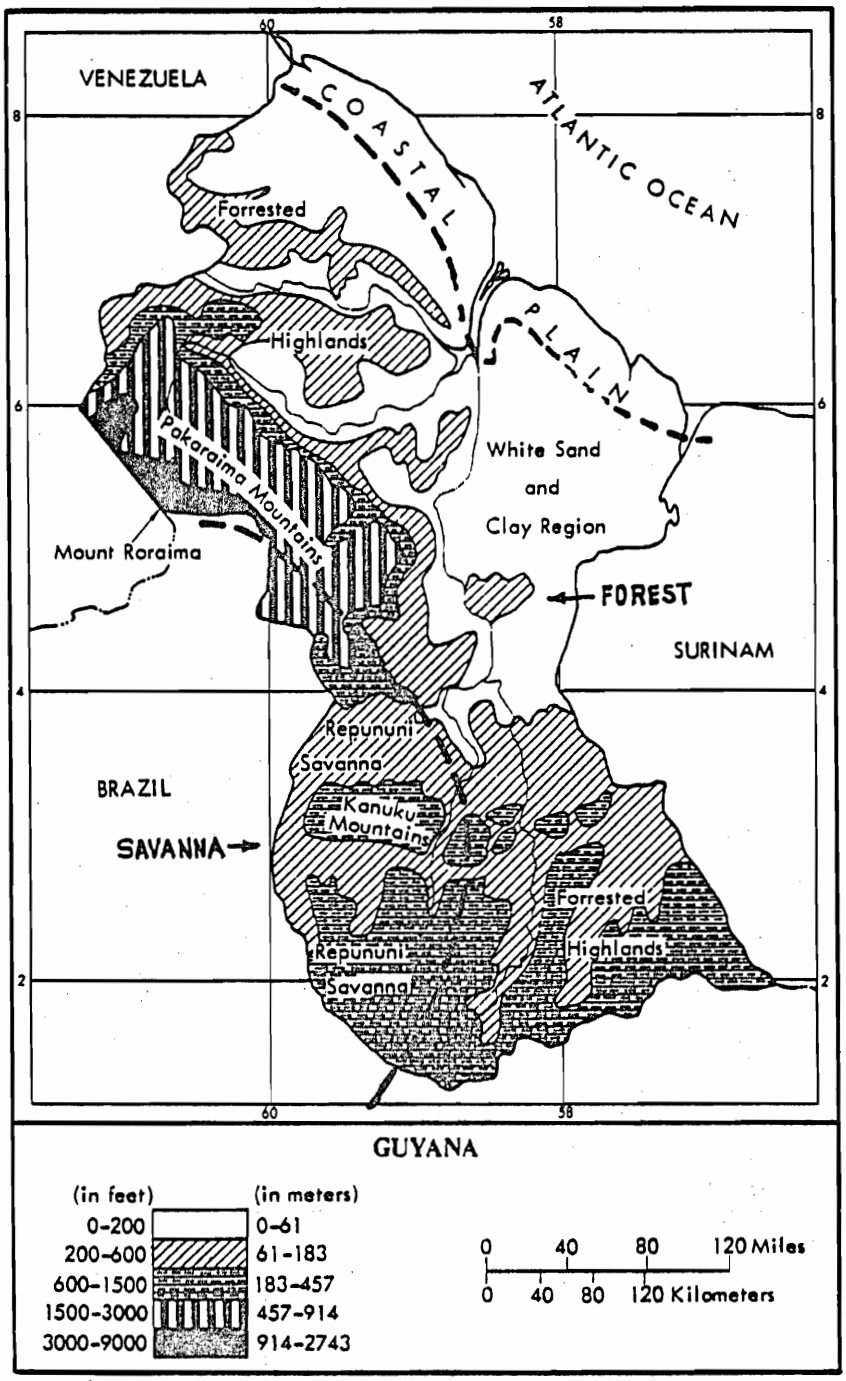

Figure 2. Three Main Geographical Regions of Guyana; Coastal Plain, Forested Interior and Savanna, and Approximate Elevations of Each

Source: American University Foreign Area Studies. 1969.

white sands and clays formed from erosion of interior bedrock and carried seaward by the rivers. Most of the plain is 1.2 to 1.7 m (4 to 5 ft) below sea level at high tide and is protected from flooding by an extensive series of dikes and seawalls. Drainage and irrigation are facilitated by a network of canals. Ninety-four percent of the Guyanese population lives on the coastal plain and almost all cultivated crops are grown here. According to U.S. Dept of State figures (1969), two million acres of the coastal plain would be suitable for cultivation, of which about one million acres have been reclaimed and over 283,000 ha (700,000 acres) are presently in production. The coastal plain is separated from the interior forests by a barrier of swamps that have formed between the white sandy hills of the interior and the dikes and canals of the coastal drainage system.

2.1.2 The Interior Forest

This is the largest of Guyana's geographical regions, comprising about 181,300 sq km (70,000 sq mi) or 84 percent of the total land area. It is also geologically the most complex, and includes virtually all of Guyana's known mineral reserves. About 25 km (40 mi) inland and immediately back of the coastal plain the terrain becomes gently undulating and is covered with tall forest. Lines of hills, varying from 15 m (50 ft) in elevation near the coastal plain, to 125 m (400 ft) inland generally trend northwest to southeast. This area, also known as the white sand (or zanderij) belt varies from 130 to 160 km (80 to 100 mi) in width and extends from the Pomeroon River eastward through Surinam. The rivers passing through this region are noted for their many rapids and falls. The white sandy soils are very infertile, being composed largely of quartz, but support a dense hardwood forest. If cut, the forest does not regenerate well and erosion is rapid and severe. Guyana's valuable bauxite reserves lie in this zone, in a strata 24 km (15 mi) wide, 9 m (30 ft) thick and beneath nearly 33 m (100 ft) of sand.

The west central portion of the forested zone is dominated by the Kaieteurian Plateau and Pakaraima Mountains. These highlands form the east slope of the Guyana Highlands, the bulk of which lie in Venezuela. The flat-topped Pakaraima escarpment averages 600 m (2,000 ft) in height and is surmounted in places by vertical-walled, flat-topped tepui mountains that rise considerably

higher. The highest tepui, Mt. Roraima, rises to 2,750 m (9,094 ft) on the Venezuela-Brazil frontier. The Pakaraima Mountains are the source of many rivers and are renown for their waterfalls that drop from the edge of the plateau. The best known is Kaieteur Falls on the Potaro River, a tributary of the Essequibo. Kaieteur drops 225 m (741 ft), nearly five times that of Niagra Falls. The Pakaraima region is virtually inacessible except by air and the population is very low. In the northwestern corner of Guyana the forested Kaieteurian Plateau extends down almost to sea level and to the coast, leaving only a very narrow coastal plain near the mouth of several rivers.

The only other highland region of importance within the central forested belt is the small Merume Mountain range, located about 100 km (62 mi) north of the Pakaraima Mountains and parallel to the main ridge. Both highland areas are mostly forest-covered except in the border area with Brazil, south of about 4° N. There the forest gives way to more open upland savanna, and merges with the next major geographical region.

2.1.3 The Savanna

Savannas comprise the third major geographical division of Guyana and cover about 11 percent, or nearly 25,900 sq km (10,000 sq mi) of the total area. The largest savanna, the Rupununi, lies along the extreme southwestern boundary, and just north of the Kamoa Mountains; it covers about 15,540 sq km (6,000 sq mi). Most of the Rupununi savanna is below 200 m (650 ft) in elevation and is very flat and subject to flooding during the wet season. The Kanuku Mountains divide the Rupununi into a northern and southern section and reach about 900 m (3,000 ft) elevation.

The intermediate savanna, slightly smaller than the Rupununi, lies about 96 km (60 mi) inland from the coast and is surrounded by forests of the sandy belt zone. This savanna covers about 5,180 sq km (2,000 sq mi). Both the Rupununi and intermediate savannas are covered by a sparce rough grass. The origin and reason for the continued existence of the savannas is not resolved but does not appear to be due to inadequate rainfall.

2.1.4 Rivers and Drainage 2/

River drainage in Guyana is generally from the south and southwest northward to the coast. There are four principal rivers. From east to west these are: the Corentyne, which forms the border with Surinam and originates within that country, the Berbice, the Demerara, and the Essequibo. The Essequibo's main artery originates in the northern Brazilian highlands and drains over half of Guyana. The estuary of the Essequibo is over 22 km (14 mi) wide. The four most important tributaries of the Essequibo are: the Mazaruni, Cuyuni, Potaro and Rupununi. All flow into the west bank of the Essequibo and with the exception of the Rupununi, all drain the Kaieteurian Plateau. West of the Essequibo several small rivers flow northward to the coast, and between the four major coastal rivers (above) there are several smaller rivers including the Canje, Mahaicony, Abary and Mahaica (see map on front cover).

Guyana, as a whole, is part of the vast Amazon-Orinoco watershed, although no Guyanese rivers of any importance flow into the Amazon or the Orinoco. The average gradient of most Guyanese rivers is about 0.2 m per km (1 ft per mi) and there are extensive flooding and swamps in many areas. All new land projects require extensive drainage before they can be used for agriculture. Because of falls and rapids, navigation is limited to 65 km (40 mi) upstream on the Essequibo, 95 km (60 mi) on the Demerara and Corentyne, and just over 160 km (100 mi) on the Berbice. Extensive, shallow alluvial deposits along the coast limit navigation to ships of shallow draft. At Georgetown a sandbar limits vessels to 3 m (9 ft) of draft at low tide and 6 m (20 ft) at high tide. Draft at the mouth of the Berbice is even less. Alluvial deposits continue up to 24 km (15 mi) offshore before navigation is considered free.

Stream flow varies widely with a maximum in June and July, and a minimum in March and April. Tides have a marked effect on coastal drainage problems and tide flow can be detected 64 to 80 km (40 to 50 mi) upriver on the four main rivers. Tidal flow does not affect small rivers because sandbars off the coast prevent the tide from entering. Also these

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2 Source: American University Foreign Area Studies. 1969.

rivers have not cut a channel to the sea because of excessive silting and small flow. The drainage and irrigation system of Guyana's coastal plain is extensive and costly, and only large well-capitalized operations have been able to sustain the heavy costs. Many areas have been abandoned due to excessive costs of maintaining drainage canals, and the need for irrigation water for flood fallowing to control salinity. Poor drainage has also hampered attempts to mechanize crop production.

2.2 Climate [3]

Guyana lies very near the equator, the southern port being less than 1° N. The climate is warm, humid and equatorial, and tempered slightly by sea breezes along the northern coastal plain. In the south, temperatures are slightly higher, with humidity and precipitation somewhat lower.

Precipitation. Rainfall is biseasonal with two rainy seasons and two dry seasons, except in the southern third of the country where there is only a single pronounced rainy season and one long dry season (Fig. 3). Along the coastal plain rain falls an average of 200 days per year. Fifty percent of the annual average falls during the primary wet season which occurs from about mid-April to mid-August, and peaks in June; the secondary wet season occurs in December and January, and accounts for an additional 23 percent of the annual total during a typical year (Fig. 3). However, the secondary wet season may fail to appear during some years. The primary dry season over the northern two-thirds of the country occurs from mid-August through November; the secondary dry season occurs from February through mid-April. As can be seen in Figure 3 the primary dry season is longer and more intense in the eastern and highland areas. In the western region the primary wet season is longer, but the driest months occur during the secondary dry season. Also, as with the secondary wet season, the secondary dry season may fail to appear during some years.

Average annual rainfall on the coastal plain at Georgetown is about 2,290 mm (90 in), varying from 1,500 to 3,400 mm

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[3] Sources: American University Foreign Area Studies. 1979.
Kurian. 1980.
Schwerdtfeger. 1976.
Snyder. 1966.
U.S. Dept. of State. 1969.

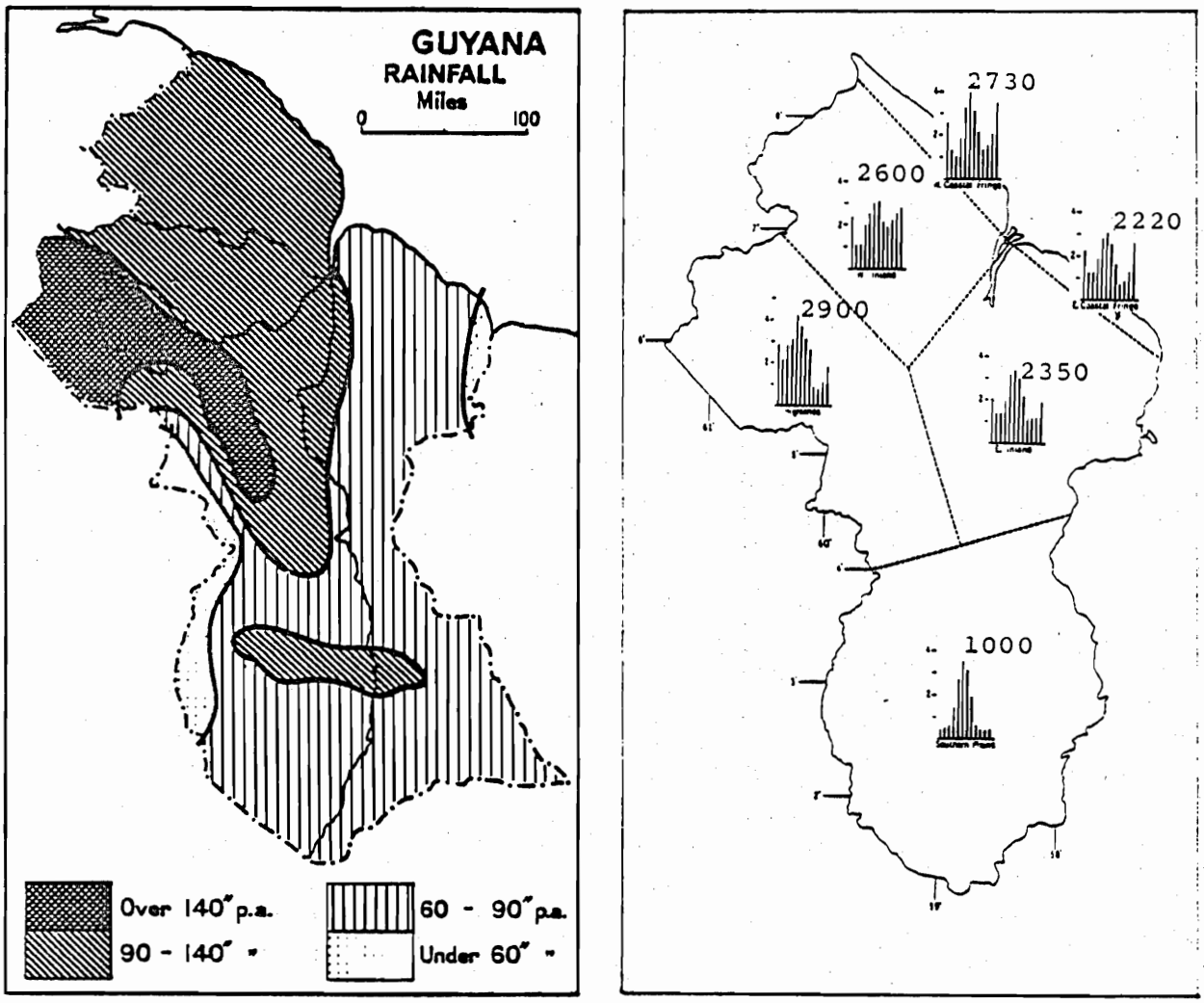

Figure 3. Annual Distribution of Rainfall. Ordinate Values (Right Figure) in mm. Annual Totals in mm. Based on Period 1931 - 60 (Certain Data Subject to Reduction)

Source: Schwerdtfeger. 1976.

(59 to 135 in). Rainfall also increases as one goes westward up the coast. For example, the average annual rainfall is 2,000 mm (80 in) at New Amsterdam, 2,290 mm (90 in) at Georgetown, 2,540 mm (100 in) at the Essequibo River, and over 2,800 mm (110 in) in the northwest. Annual rainfall averages 1,525 mm (60 in) in the Rupununi, most of which falls during the single longer "summer" rainy season. Rainfall increases to over 3,560 mm (140 in) in the forested mountain regions.

Rainfall over most of Guyana is related to annual shifts of the equatorial trough and its accompanying zone of intense convection. The primary dry season is thought to be influenced by the trade winds of the south Atlantic, the secondary dry season with those of the north Atlantic, although the variation in winds during the year in Guyana is slight (Schwerdtfeger 1976). Higher rainfall values in the interior are due to the additional lift given to the atmosphere by the mountains.

The single wet and single dry season, is representative of a continental monsoon climate. An explanation of this pattern, which prevails over the plains of the southern third of the country, is not fully understood.

Temperature. Average mean temperatures are higher along the coast and in the southern plains than in the interior. Annual means are about 26.5°C (79°F) near the coast, 27.0°C (81°F) on the plains and 25.5°C (78°F) for the inland section. The higher temperatures of the southern plains are due to a greater number of cloud-free days, or days with only light cloud cover. Month-to-month mean temperature shows a double-peaked curve which is the mirror-image of the rainfall pattern that prevails over the northern two-thirds of the country. The primary temperature maxima occurs in October, a secondary one in April. Minima occur in June and January. Additional temperature data is shown in Table 1.

Relative humidity is high and varies little with the seasons except in the southern plains. Estimates of the annual mean relative humidity for the coastal and inland sections are 80 to 85 percent, and for the southern plains 70 to 75 percent, with the annual range of monthly variation at four to six percent on the coast, six to nine percent inland, and 15 to 20 percent in the south. Guyana lies south of the hurricane belt and escapes most Caribbean storms.

Table 1. Climatological Data

	Georgetown		Rupununi Savannas	
	Averages for 1846-1938		Averages for 1961, 1963	
	Temp.	Rainfall	Temp.	Rainfall
January	79°	8.0"	82°-82.0	T- 4.70
February	79°	4.5"	82°-82.0	T- 12.50
March	80°	6.9"	83°-82.5	.07"- 1.80
April	80°	5.5"	84°-82.0	T- 12.97
May	80°	11.4"	84°-81.0	1.46"- 38.05
June	80°	11.9"	80°-80.0	14.42"- 47.40
July	80°	10.0"	79°-80.5	17.92"- 29.45
August	81°	6.9"	81°-81.5	13.29"- 20.80
September	81°	3.2"	83°-84.5	2.72"- 5.83
October	81°	3.0"	84°-84.5	1.83"- 1.58
November	81°	6.1"	82°-83.5	4.22"- 5.85
December	80°	11.3"	82°-82.5	.51"- 0.78
Mean Temp.	80°		82°-82.2°	
Total rainfall		88.7"		56.48"-181.71

Notes: Temperatures to nearest whole degree. T = trace of moisture. No data was available for montane forest areas, with much more abundant rainfall, which averages well above 100" a year. Lowland forest rainfall (Bartica) varies from 75" to 119", the average for 20 years being 100.3".

Source: Snyder. 1966.

2.3 Population

2.3.1 Cultural and Political Background 4/

The first European settlers in Guyana were the Dutch, who founded the settlement of Kijkorveral in 1616. In 1621 the colony was placed under the direction of the West Indian Company of the Netherlands, which administered the region for the next 170 years. During this period many British migrated to the colony, and by 1760 were a majority in Demerara. Britain gained formal control in 1814 and instituted two important changes: the abolition of slavery in 1837, and the introduction of thousands of East Indian coolies under an indenture system between 1844 and 1917. The colony received full self-government in 1961 and final independence in 1966. The British legacy is still clearly evident today in the business, legal, administrative and educational framework of the country. Political values have made a rapid and strong shift to the left.

From the point of view of human settlement, there are only two regions in Guyana - the densely peopled coastal strip, and the sparsely populated interior. Most of the inhabitants of the interior are Amerindians. They are still largely unaffected by modern civilization; some still live a tribal life, speaking their own dialect and preserving their own customs. They produce cassava, some vegetables, and hunt using bows and arrows to kill fish; and blow pipes and poison darts to kill birds and mammals. The Amerindians recently have been given several large reservations, although many have left the tribal life of the reservation to work on mines, cattle ranches or lumber companies.

The remainder of the population, over 90 percent of the total, resides on the narrow coastal plain. Seven ethnic groups comprise the Guyanian population; six of these are largely confined to the coast (Table 2). Of these, the East Indians are the most important numerically, comprising about 50 percent of the total population. Almost all are descendents of some 239,000 East Indians that were imported to work on sugar plantations between 1844

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4 Sources: Kurian. 1980.
U.S. AID. 1979.
U.S. AID. 1981a.

Table 2. Principal Ethnic Groups of Guyana

Ethnic Group	Percent
East Indians	50.16
Afro Guyanese	30.00
Mixed (or Colored)	13.20
Amerindian	4.60
Portuguese	1.00
Chinese	0.60
British and Other Europeans	0.40

Source: Kurian. 1980.

and 1917. Most still live in rural villages as farmers and have avoided participation in politics, government or social activities. They have resisted assimilation into mainstream culture.

The Afro-Guyanese form the largest minority (Table 2). They are all descendents of slaves imported from the Guinea coast of West Africa. Politically they are the most active ethnic group, and occupy most important governmental positions.

Ethnic polarization in Guyanese society is strong, and is reflected not only in politics but also in the economy and in occupational distribution of the labor force. Certain occupations are monopolized by each ethnic group, and ownership and employment in these sectors follow ethnic lines (Kurian 1980). The lack of ethnic integration (in contrast to neighboring Surinam) is viewed as a grave threat to national unity.

English is the official language. Several vernaculars, Hindustani, Hindi, Urdu, Portuguese and Chinese, are used by older immigrants but are now being replaced by English. The Amerindians speak languages belonging to three classes: Warrau, Arawak and Carib. There are six Carib-speaking groups - Carib, Akawaio, Patamona, Arekuna, Makusi and Waiwai, almost all of which live in the interior. Creole, influenced by languages of the country's diverse ethnic groups, is also widely understood and spoken.

2.3.2 Population Growth and Distribution

Guyana's population was estimated at 804,000 in 1978, based on the last official census held in 1970 when the population was 701,855. The annual growth rate is 2.4 percent, based on an annual birthrate of 32.4 per 1,000 inhabitants (Kurian 1980). Additional population statistics are shown in Table 3.

Table 3. Growth Rates and Vital Statistics

Births/1,000 population, 1976	26.0
Deaths/1,000 population, 1976	7.0
Infant mortality/1,000 live births, 1972	50.0
Annual deaths/1,000 persons age 1-4, 1977	4.0
Life Expectancy at Birth, 1970	64.0
Life Expectancy at Birth, 1978	67.0

Source: U.S. AID. 1981a.

Over 90 percent of the population is concentrated on four percent of the available land. Consequently, average population density in 1970 was four per sq km (10.36 per sq mi) but on the narrow coastal strip the density averages 777 per sq km (300 per sq mi) and up to 2,590 per sq km (1,000 per sq mi) along the east coast where villages are concentrated (Fig. 4). By contrast, vast areas of the interior are virtually uninhabited (Table 4, Fig. 4).

The age profile shows 44 percent of the population under 14, 53 percent between 15 and 64, and three percent over 65. Females slightly outnumber males, presumably because of immigration by younger males. There are no official birth control policies or programs.

Note: Some variance in the values quoted in this section were noted among the sources consulted. The values cited are believed to be representative.

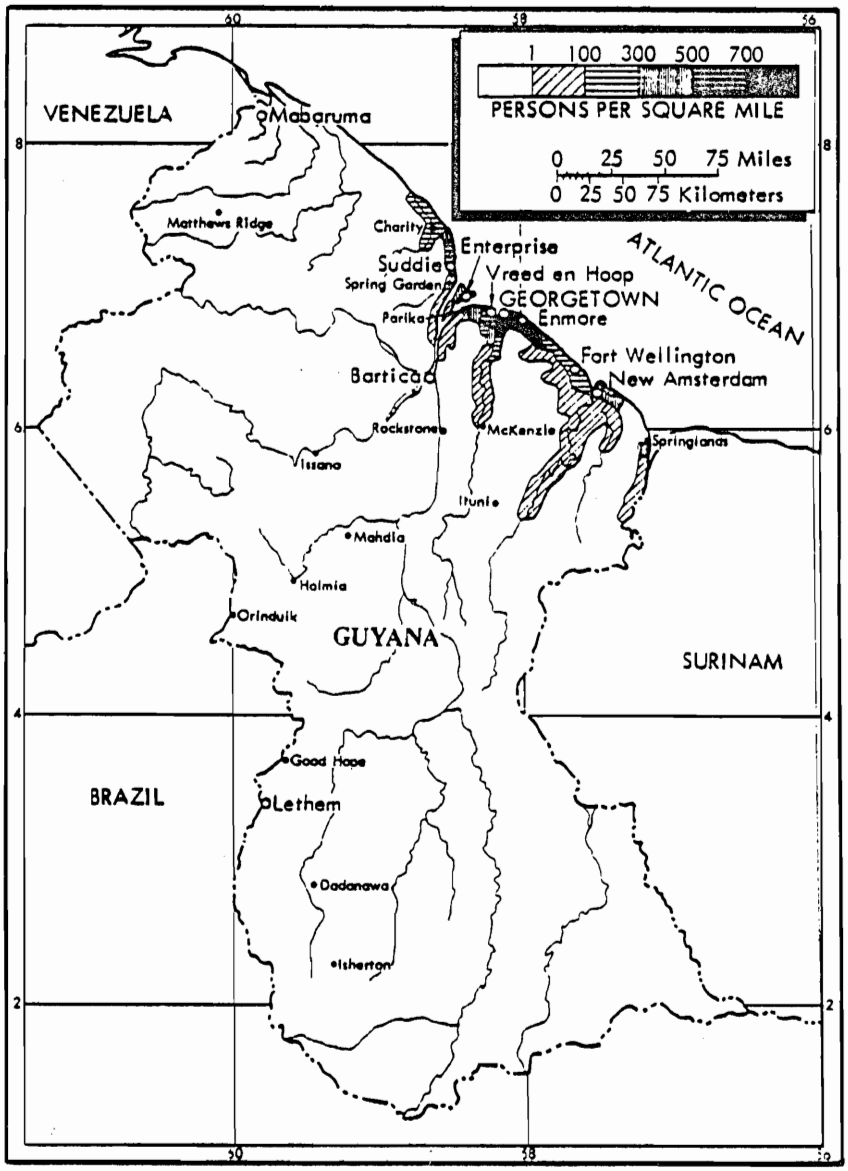

Figure 4. Population Density

Source: American University Foreign Area Studies. 1969.

Table 4. Population by District

District	Census 1960	Census 1970
COASTAL		
1. West Berbice	-----	-----
2. East Demerara	276,0900	343,000
3. Essequibo	46,000	57,000
4. West Demerara	62,000	87,000
COASTAL AND INLAND		
5. East Berbice	116,000	147,000
6. North West	13,000	16,000
INLAND		
7. Mazaruni - Potaro	12,000	13,000
8. Rupununi	1,000	1,000

Source: U.S. AID. 1981a.

2.3.3 Health and Nutrition [5]

Health problems in Guyana are derived from a complex of factors. Poor drainage in low-lying coastal areas contributes to mosquito breeding and waterborne diseases, and extensive forests of the interior provide a natural reservoir, making complete eradication of some diseases such as malaria and yellow fever very difficult.

Malaria has been virtually eliminated along the coast but remains a constant threat because it is reported regularly in the interior. Along the coast there is increased insecticide resistance in some strains of mosquitos and increased drug resistance in some blood parasites. In 1972 malaria was reduced to a minor problem along Guyana's borders as a result of DDT house spraying and the use of chloroquinized salt. There was a resurgence in 1975-76 with outbreaks in the Rupununi region, the North West District and the New River Triangle area. In 1976, of a sample of 56,937 blood smears, 7.3 percent were positive for malaria, of which 3.8 percent were *Plasmodium falciparum* and 3.5 percent *Plasmodium vivax*. The *P. falciparum* strain is chloroquine resistant in the Rupununi region, and DDT and some other insecticides are no longer effective against the major malaria vectors. Primary prophylaxis against *falciparum* malaria is the drug Fansidar.

Yellow Fever remains a threat although an eradication program has been waged against the mosquito vector, *Aedes aegypti* since 1939. The interior forests and native monkey populations provide sanctuary and natural hosts for survival of the parasites. Control appears best effected through vaccination. There is an active mosquito vector control program, using Abate, Baytex, Malathion and Dursband, but delays and other problems occur frequently.

The lack of adequate water supplies or waste and sewage disposal systems contribute to a high incidence of enteroparasitic diseases. Helminthiasis is common, especially in rural areas, and gastro-enteritis (including amoebiasis and other gastro-intestinal disease) and malnutrition

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[5] Source: U.S. AID. 1979, 1981a.

are particularly severe among children. Since 1975 immunization for polio, diphtheria, and tetanus has been required for school entry.

Filariasis (elephantiasis), typhoid and leprosy are endemic, the latter with an estimated prevalence of two per 1,000 population. Filariasis, caused by the nematode Wuchereria bancrofli, occurs along the Guyana coast and up the Demerara River to McKenzie and the Essequibo River to Bartica. It is transmitted by two species of mosquito, Culex pipens fatigans and Mansonia tittllans.

Other diseases of importance, though with low incidence of human infection, include: 1) leishmaniasis (Bush Yaws), a protozoan disease transmitted by phlebotomine sandflies, 2) Ilheus virus, and 3) dengue fever, which has not been reported in recent years.

Schistosomiasis, transmitted by snails of a few species, and river blindness or onchoceriasis, a nematode parasite transmitted by blackflies, are reported in adjacent Venezuela and Surinam but not yet in Guyana.

Vital health statistics have been given in Section 2.4. Health status of the population is typical of a developing nation with a per capita income of about $544.00. Life expectancy is increasing and crude mortality rate is decreasing. Diarrheal health problems and malaria are important and a threat, but malnutrition is lower than in other Latin American countries. Some health problems associated with modern societies, such as cardio-vascular disease, hypertension and automobile accidents are increasing.

Primary health care is minimal in most rural areas and only adequate in Georgetown. Further, there is a chronic shortage of well-trained health personnel, especially in rural areas. As elsewhere in the world, as Guyana modernizes, the patterns and types of illness and death are changing to reflect those of other developed nations. The control of some health problems may also conflict with environmental planning.

2.4 Land Use

2.4.1 Land Use Potential 6/

Guyana's total land surface is about 2.15 million hectares (53.1 million acres). According to Kurian (1980) about 15 percent is potentially suitable for agriculture. At present only 1.5 percent of the total land area is cultivated. Thus, while the population density, based on the total land area, is less than seven per square mile, the population density based on cultivated land rises to about 1,000 per sq mi, more than agriculture alone can support.

Guyana is divided into three agriculture regions: the coastal strip, the forest and the savanna. Agriculture is presently limited to land between the Essequibo and Corentyne Rivers (Fig. 5), but even here most land lies largely below high tide level. Under these conditions, agricultural expansion requires a heavy financial commitment for construction of dikes and dams, and labor and equipment to maintain them. Consequently, even after two centuries of effort, less than a tenth of the potentially suitable agriculture land on the coastal plain has been properly drained and placed in cultivation. Even in the most developed region between the Esesquibo and Corentyne Rivers, large areas once under cultivation now have been abandoned.

Aside from the savanna region of the northeastern coast, and the Rupununi savanna of the extreme southwest, both of which are suitable only for raising livestock, there are almost no other areas in Guyana that are suitable for agriculture. The vast interior forests overlie very sandy, nutrient-poor soils that have so far defied attempts to use them successfully for traditional agriculture. Limited agriculture along the banks of major rivers has been hampered because all major rivers have waterfalls that prevent easy access and transport by water.

Even the productive coastland soils have been converted to agriculture only at enormous effort and expense. Because almost everywhere the coastlands

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6 Sources: FAO. 1978.
Kurian. 1980.
MacPherson. 1967.

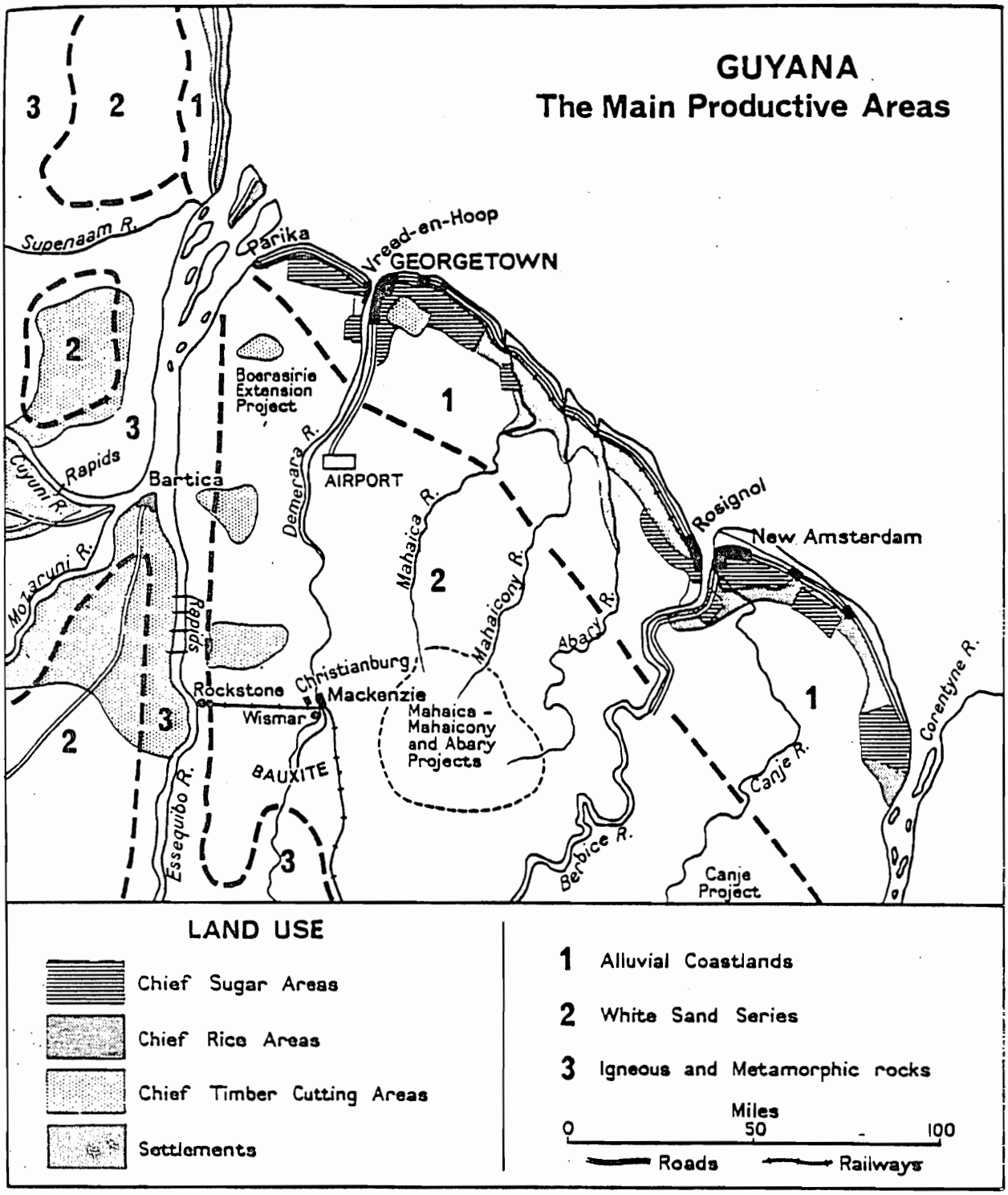

Figure 5. Main Productive Agriculture Areas in Guyana

Source: MacPherson. 1967.

lie a few feet below high tide and are subject to flooding, a sea wall had to be built to keep out the sea. In addition, residential and commercial areas had to be protected from flooding by fresh water during frequent heavy rains. To accomplish this an elaborate system of dams was built to collect flooded fresh water into shallow inland reservoirs (called "conservancies"). These are drained by thousands of canals, either into the lower portions of rivers where drainage can occur at all times, or to the sea, where water can be drained only at low tide (Fig. 6). At all other times the water from this reservoir and canal system must be pumped out at great expense.

In view of these difficulties it is not surprising that so little land has been brought under cultivation. Thus, despite the large amount of undeveloped land in Guyana, much of it appears to have little or no potential for traditional agricultural uses, and is not easy to open up. The coastal lowlands have great potential but require enormous financial commitments for development.

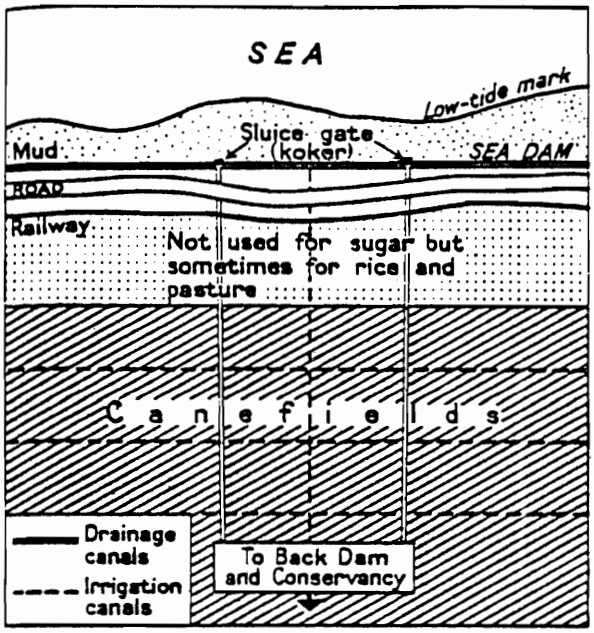

Figure 6. Schematic Drawing of Land Reclamation Along Coastal Plain. See text for details.

Source: MacPherson. 1967.

Table 5 contains FAO (1978) data on Guyana land use in several important categories from 1961-65 through 1977. The table confirms that in almost every category there has been very little change in the total land area in any category during the past 20 years. This is in sharp contrast to most Latin American countries which have experienced sharp increases in cropland and pasture and alarming decreases in forest and woodland. Table 5 also confirms the remarkably small amount of land devoted to agriculture. Arable land and permanent crops as a proportion of the total land area is about 1.7 percent. The figure climbs to just over six percent if permanent pastures (most of which are natural savanna) are included. Also, it is particularly significant that forest and woodland, according to FAO statistics (1978), still cover about 85 percent of the total area. The significance of this immense, and still largely untapped native forest resource is discussed in section 2.4.3.

Table 5. Land Use Potential

	1961-65	1967	1972	1976	1977
Total Area	21,497	21,497	21,497	21,497	21,497
Arable and Permanent Crop	360	365	375	379	379
Arable Crop	350	355	360	364	364
Permanent Crop	10	10	15	15	15
Permanent Pastures	999	999	999	999	999
Forest and Woodland	18,190	18,190	18,190	18,190	18,190
Other Land	122	117	107	110	117

Source: FAO. 1978.

2.4.2 Agricultural Land Use: Background and Trends 7/

Today agriculture in Guyana is based primarily on two crops, sugar and rice. Sugar is a legacy of Guyana's colonial past, and with the exception of some commerical rice production, dominated agriculture in Guyana until independence in 1966. Since that time an attempt has been made to maintain the strength of sugar production and to expand other food crops, especially rice, to a commercial level.

The direction of agriculture in Guyana has been shaped by unique geographical features. The narrow coastal plain, although requiring enormous effort and expense to protect and drain, has been proven rich agriculturally. By contrast, the hilly and mountainous interior has proven very difficult to exploit because of lack of transportation, and extreme soil infertility. Beyond this, agriculture development has been influenced considerably by culture. Many Guyanese are descendents of Africans and East Indians, imported by the British to work on sugar estates. The non-estate agriculture of Guyana was primarily developed by these groups and reflects their culture. The development of rice, for example, was largely due to the fact that this grain was of major importance to the East Indian diet.

At the time of independence in 1966 sugar production was in the hands of two firms, Bookers Sugar Estates Ltd., and Demerara Sugar Estates. Both were nationalized in the late 1970s, and a state company (Guysuco) was formed. Sugar remains the chief source of export earnings, and the chief source of employment for a large segment of the population. About 15 percent of the total sugar production is from private farms.

Rice, by contrast, has always been the domain of small producers, although government sponsored rice-growing programs have been encouraged. The average farmer produces ten or fewer acres of rice, and supplements his income with livestock and other crops.

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7 Sources: Evans. 1973.
Kurian. 1980.
MacPherson. 1967.
SECID. 1981.

In 1978 U.S. AID/Georgetown sponsored a survey of rural farm households in the coastal area. Farms of the interior were excluded (except in the North West District) because of their inaccessibility and low density.

Table 6 shows the number of farms by type. The most significant finding is that agricultural commodities on most farms are mixed and include livestock, rice and other crops. Table 7 provides data on the number of farms of various size categories. The median size farm is 7.4 acres, with 40 percent being less than five acres and only two percent having 100 acres or more. Despite the rather small farm size, the level of technology is relatively high, with much work done by machines. Table 8 shows the number of acres devoted to various crops on farms. More acreage is devoted to rice than to any other crop and rice is grown by over half of all farmers (Table 8).

Land tenure in Guyana is currently by freehold or private ownership (47 percent), government lease (34 percent) and private lease (19 percent). In recent years, almost all new land that has opened up has been available by government lease, formerly for periods up to 99 years but more recently for much shorter periods. The shorter lease terms have resulted in a reluctance by farmers to undertake any needed capital improvements. There is a tendency to once again grant longer leases and assure lease continuity.

Table 9 gives some data on livestock production. About 30 percent of the producers owned cattle and more than 75 percent owned poultry. Typically each farmer owns only a few animals of each type, suggesting that much of the animal production on farms of the coastal plain is for home use. The reverse is true in the Rupununi savanna of the southwest where almost 100 percent of agricultural production is cattle, and virtually no sugarcane or rice is produced.

Table 6. Number of Various Types of Farms

Type of Farm	No.	%
Rice	6,635	27
Food Crops	6,989	29
Livestock	4,146	17
Mixed	6,700	27
TOTAL	24,470	100

Source: SECID. 1981.

Table 7. Size of Farms

Size of farms in acres	No. of farms	%
less than 2.5 acres	6,252	25
2.5 - 4.9 acres	3,732	15
5 - 9.9 acres	4,906	20
10 - 14.9 acres	3,415	14
15 - 24.9 acres	3,605	15
25 - 49.9 acres	1,609	7
50 - 99.9 acres	704	3
100 - 199.9 acres	278	1
over 200 acres	182	1
TOTAL	24,683	100

Median size of farm: 7.4 acres

Source: SECID. 1981.

Table 8. Number of Farms and Crop Acreage

Crop	No. of farms	% Farms	Acreage
Rice	12,638	51	148,017
Sugar	2,368	10	17,681
Corn	1,676	7	5,749
Coconuts	2,861	12	21,691
Cassava	6,176	25	3,590
Eddos	3,820	16	1,419
Yams	868	4	126
Other Ground Provisions	1,664	7	484
Plantain	5,012	20	2,454
Banana	6,780	28	1,339
Citrus	2,764	11	1,938
Pineapple	825	3	1,812
Other Fruit	3,829	16	-
Dry Peas and Beans	1,989	8	133
Peanuts	99	-	55
Tomatoes	3,185	13	306
Cabbage	189	1	31
Vegetables and Greens	6,759	27	1,183
Coffee	1,027	4	1,493

Source: SECID. 1981.

Table 9. Number of Farms and Number of Livestock

Livestock stock	No. of farms	% Farms	# Animals
Cattle	7,035	29	67,599
Sheep and Goats	4,451	18	39,942
Swine	2,798	11	28,748
Poultry	18,897	77	515,150

Source: SECID. 1981.

2.4.3 Forest Exploitation and Deforestation 8/

Forests cover some 17.4 million ha (43 million acres or 70,000 sq mi) of Guyana, or nearly 85 percent of the total area of the country. Partially valuable species cover at least 133,600 ha (33 million acres) and contain an estimated 1.98 billion cu m (70 billion cu ft) of wood. Total annual exploitation to date is about 170,000 cu m (6 million cu ft). At present most logging and saw-milling takes place in an area known as the Bartica Triangle, between the Essequibo and Mazaruni Rivers. This restricts logging operations to some 36,260 sq km (14,000 sq mi). Although forest potential elsewhere in the interior is considerable, the lack of roads into remote areas has made access and transportation extremely difficult. Waterfalls block all major rivers a short distance inland, preventing use of rivers as conduits for transportation.

The forests contain many valuable timber-yielding species which are excellent for durable construction work. However, forest exploitation has been very selective with greenheart (*Ocotia rodiaei*), a hardwood species, accounting for over 60 percent of the wood removal. Greenheart wood is valued because its wood is extremely dense and hard and resists marine boring animals. Consequently, it is sought in marine construction such as the building of wharves. Extraction of greenheart from the interior is expensive because the wood is too heavy to float, requiring it to be loaded onto pontoons in rivers. Numerous waterfalls and a lack of inland roads has prevented harvest in the interior beyond the falls. The most accessible areas of greenheart--those nearest major rivers--have been heavily exploited. The remaining trees are so difficult to reach and bring out that logging costs are not competitive with treated woods of other species.

Other commercially important tree species include purpleheart, which has an attractive color and is used for ornamental work, crabwood (or Mora) which

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8 Sources: American University Foreign Area Studies. 1969.
Evans. 1973.
Kurian. 1980.
Libr. of Congress. n.d.
MacPherson. 1967.

is used locally to make furniture, and wallaba, which is cut for fuel, charcoal and telegraph poles. Wallaba has also become the basis of a plyboard industry in which wood chips are mixed with resin and pressed into strong boards. These "pressed boards" are then used for a variety of purposes including prefabricated houses. The Guyanan forests contain many other species of trees (up to 1,000 species by some estimates) but few are in demand. Many are known to be excellent varieties of wood but are not harvested because local demand is small and are not exported because they are unfamiliar abroad.

According to Evans (1973) only about one-fifth of the forests in Guyana are likely to be exploited commercially for timber in the near future, largely because of transportation and accessibility problems. Consequently, accessible areas have been heavily exploited, but there has been very little effort to promote regeneration. Where present extraction occurs, primarily in the Bartica Triangle, forest soils are rather coarse-grained white sands that are almost useless for conventional agriculture, and do not readily regenerate to forest cover once the canopy "shade" is lost. Future prospects for the timber industry will require some type of reforestation program, as well as the success of government or private industry in solving problems of forest surveys, inspection and grading, transportation and storage facilities. In 1968 these difficulties limited extraction to about ten percent of the total marketable volume available. Accurate forest inventories will be required to provide information on feasibility, as well as training of Guyanese technicians in needed forestry skills.

The population of the forested interior is presently very low and until recently, economic activity was limited to mining and forestry. The presence of these activities when they open up areas, often leads to colonization attempts, especially as a means to relieve the poulation pressure of the coastal zone. The presence of dense forests, however, does not necessarily mean that the soils are suitable for agriculture. Careful soil surveys should be made before new settlements are permitted although this is often difficult to control. Some farming of formerly forested lands has occurred at Matthews Ridge and ill-fated Jonestown in the North West District, and at Mahdia south of the Potaro River, and in some valleys of the Kanuku Mountains.

The long-term suitability of some of these areas to traditional agriculture is in doubt.

2.4.4 Land Use in the Savanna Regions 9/

The interior forests give way to extensive expanses of grassland in two places. The largest, the Rupununi savanna, is in the southwest. The intermediate savanna is considerably smaller and located on the northeastern sector of the country (Fig. 7). In addition, there are a few patches of savanna on plateau summits in the Pakaraima Mountains.

The Rupununi savanna covers about 12,350 sq km (5,000 sq mi) of land close to the Brazilian border. It is mostly flat or gently rolling terrain from which rise scattered, small, rounded hills. The much larger Kanuku Mountains, rising to 900 m (3,000 ft), separate the Rupununi grasslands into a northern and southern section. Drainage is poor throughout the Rupununi and the vegetation is primarily coarse grass. In some places the savanna is dotted with widely-spaced, low trees, mostly Curatella sp., Brysonium or Moriche Palm (Mauritia flexuosa). The Rupununi savannas have attracted few settlers and at present cattle ranching, mostly on very large ranches, is the only important economic activity. The Dadanawa Ranch, one of the largest in the world, is situated on the Rupununi. It covers about 6,475 sq km (2,500 sq mi) or about 1.6 million acres) and grazes about 33,000 cattle.

Three factors have hindered development of cattle ranching and other economic enterprises on the Rupununi. First, during the rainy season large areas of savanna are flooded. Second, partly because of the very long dry season and poor sandy soil, grass is of very low quality and in even the best areas more than 12 ha (30 acres) of grazing land per animal is required (compared to one animal per two to three acres in many areas of the United States). Third, the remoteness of the area, and lack of roads linking other parts of the country, has made marketing difficult.

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9 Sources: Evans. 1973.
MacPherson. 1967.

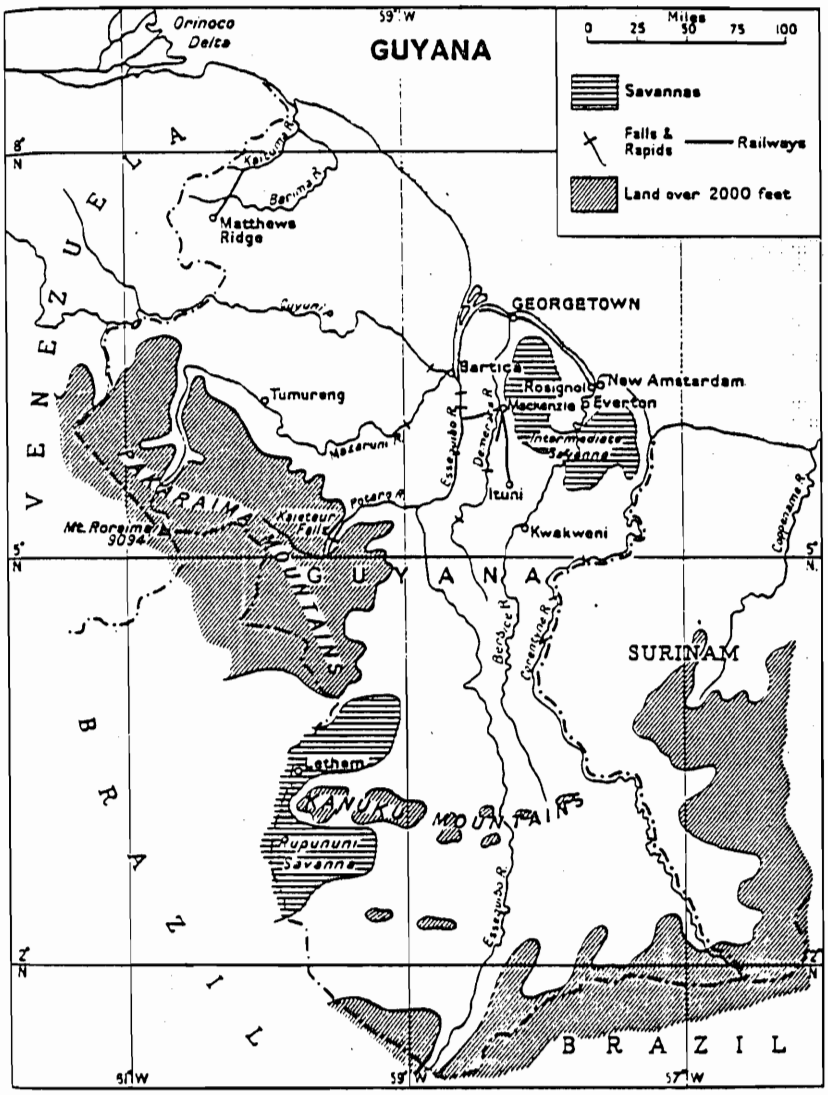

Figure 7. Map Showing Location of Rupununi and Intermediate Savanna.

Source: MacPherson. 1967.

Several thousand Amerindians live in the Rupununi, many of which earn a living as cattlemen. Others grow small amounts of tobacco, cassava (yucca), maize and vegetables. There are at present no land use practices on the Rupununi that appear to have long-term detrimental environmental problems. If the number of cattle are greatly increased the grass cover could be seriously weakened or damaged.

Grasses of the intermediate savanna in the northeast (Fig. 7) are even of poorer quality than the Rupununi. Formerly the intermediate savanna was used to fatten cattle brought from the interior by a cattle trail. Now, very few cattle are even reared here because of infertile soils, and very poor grasses. According to Dalfelt (1978) portions of the intermediate savanna in West Berbice and East Demerara Districts are threatened by extensive agriculture and irrigation projects. Most important is the possible environmental damage a dam connecting the Abary, Mahaicony and Mahaica Rivers might do. The project was well underway in 1978. Dalfelt (1978) mentions possible impacts on the flora and fauna of the lower parts of these river systems, and the possibility of increased salinization due to tidal inflow.

2.4.5 National Land Use Planning

Guyana does not have a national land use policy, or a fish and game service. There is no specific legislation to deal with environmental problems, nor specific legislation to regulate the exploitation of forests or the management of natural resources such as water and agriculture.

There are a number of separate government ministries that deal with certain aspects of environmental problems such as health, agriculture production, water management, minerals and mining, etc. But there is no means within the government to fully coordinate the activities of these ministries and insure unified national planning.

There are specific laws to protect some species of animals such as the manatee, which could be beneficial in acquatic weed control. There is an urgent need to establish legislation to monitor the use of chemicals in agriculture and pollution in industry.

The main organizations responsible for environmental and/or natural resource activities are

listed and discussed below (From Libr. of Congress n.d.). A flow diagram of the organization of these groups and their subunits is shown in Figure 8.

The Ministry of Agriculture and National Development. This ministry is responsible for the administration of several resource areas in Guyana. The Hydraulics Department of this ministry serves as the executing agency of the Sea Defense Board, and the Drainage and Irrigation Board in implementing schemes for coastal and land conservation, and activities for the drainage and irrigation of land.

Land Development Division administers the land development plans and the Fisheries Division is responsible for management of the nation's fisheries resources. The ministry is also responsible for wildlife protection. Other divisions of the ministry are listed in the flow chart (Figure 8).

The Guyana Water Authority (GUYWA), created by the Guyana Water Authority Act of 1972, is a public corporation administered by the Prime Minister through the Guyana State Corporation (GUYSTAC). Formed from the former Pure Water Division of the Ministry of Works and Housing, GUYWA is responsible for water supply, sewage disposal, and water treatment over the entire country.

The Ministry of Works and Housing (Works). The Hydropower Division of this Ministry was created in 1972 to investigate the hydroelectric potential of Guyana. The Division Budget up to the end of 1973 was G$2.4 million. Its staff includes specialists in all areas of hydroelectric development.

The Ministry of Energy and Natural Resources is responsible for the administration of minerals, mining and forests. The Forest Department of the Ministry is responsible for the general management of the nation's forest and for implementing the government's forest policy of developing forest resources as part of an integrated land use policy for conservation and development of all natural resources. The Geological Surveys and Mines Department conducts geological surveys, enforces the mining and mineral laws, and advises the government on related matters. The 1976 expenditure for the Ministry was estimated at G$12,057,000, three percent of the total central government's expenditure.

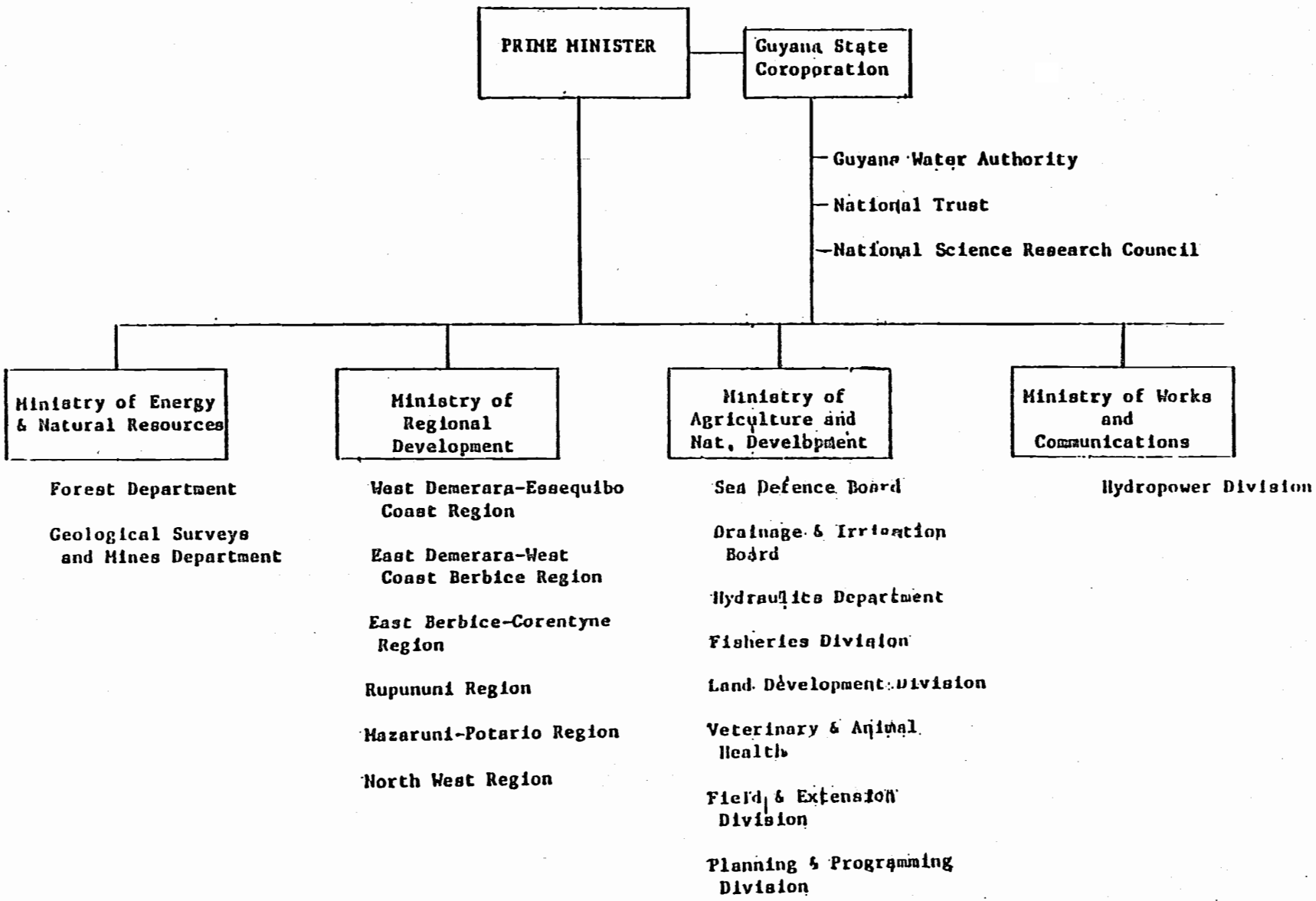

Figure 8. Organizational Diagram of Ministries with Responsibilities for Land Use and Environmental Planning

Source: Library of Congress. n.d.

Local governments are empowered by certain statutes to pass bylaws concerning the protection and conservation of local resources.

Non-government bodies:

The Guyana Museum and Zoo is interested in wildlife conservation.
The Guyana Association of Professional Engineers (GAPE) is involved in studying the environmental impact of developmental activities such as the proposed hydroelectric power scheme on the Mazaruni river.

3.0 Environmental Resources

3.1 Geology, Minerals and Soil Resources

3.1.1 Geologic History 10/

There is a great deal of information on the geology of the Guyana region. The following discussion summarizes geological and geomorphic features. Some of the more important studies on the geology of the Guyana area, including southern Venezuela east to French Guiana, include: Bateson (1961), Bracewell (1948), Brown and Sawkins (1875), Choubert (1974), Geological Survey of British Guyana (1961), Jenks (1956), Lopez et al. (1942), McConnell and Dixon (1962), McConnell et al. (1964), and Snelling and McConnell (1969).

Guyana can be divided into three geological and geomorphic units (Fig. 9): 1) a narrow coastal strip of marine sediments of Cretaceous to Recent age, 2) the Pakaraima Mountains in the west, which are the easternmost extension of the Roraima Formation covering a large area of adjacent Venezuela and Brazil, and 3) a large, low-elevation pediplane interrupted by occasional plateaus and mountains rising to 350 m, and rarely 700 to 1,000 m. This low region is mostly covered by humid lowland forest except for a broad savanna zone along the southeastern border. This latter area is underlain by Precambrian metasedimentary and metavolcanic rocks, gneisses and granites with a scattered cover of Tertiary to Recent sediments.

A history of the geology of Guyana begins in the Precambrian with Guyana Shield Rocks. Little is known about these rocks except that they are highly crystalline gneiss, schists and granites. These rocks form the basement or lowest series (Fig. 10) and are most evident in areas away from the Roraima Formation (Fig. 11). In general, the gneissose areas are poor in gold and other economic minerals, but near the coast they have been converted by weathering into commercial deposits of bauxite and kaolin.

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[10]Sources: Jenks. 1954.
Lopez et al. 1942.
Mayr and Phelps. 1967.
McConnell et al. 1964.

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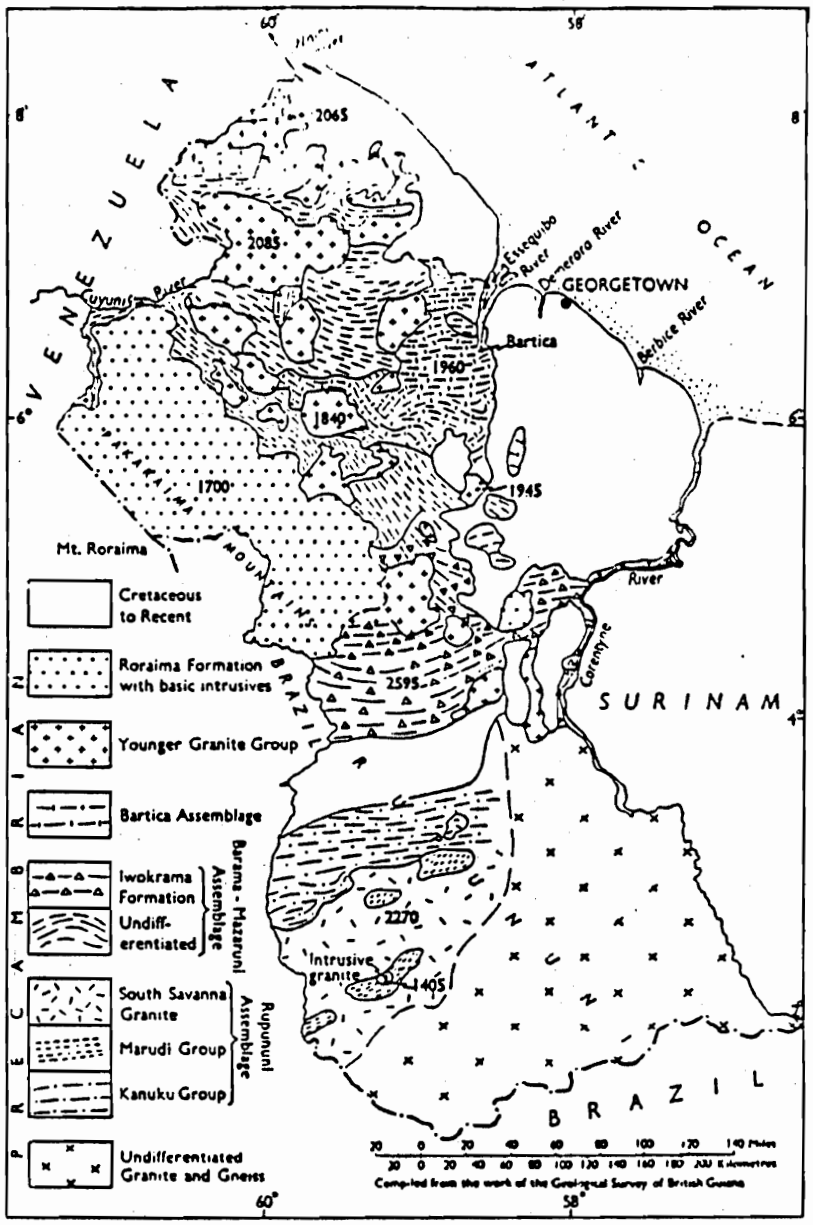

Figure 9. Generalized Geologic Map Showing Trendlines and Minimum Radiometric Ages (million years)

Source: McConnell. 1964.

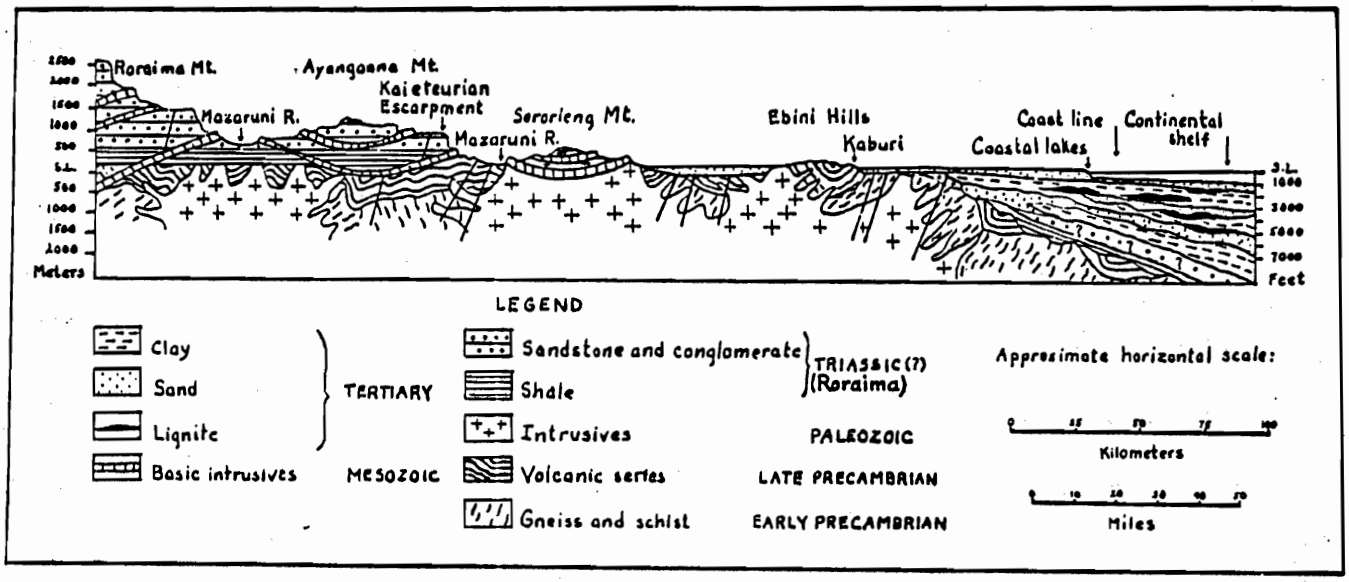

Figure 10. Schematic Geologic Cross-Section

Source: Jenks. 1956.

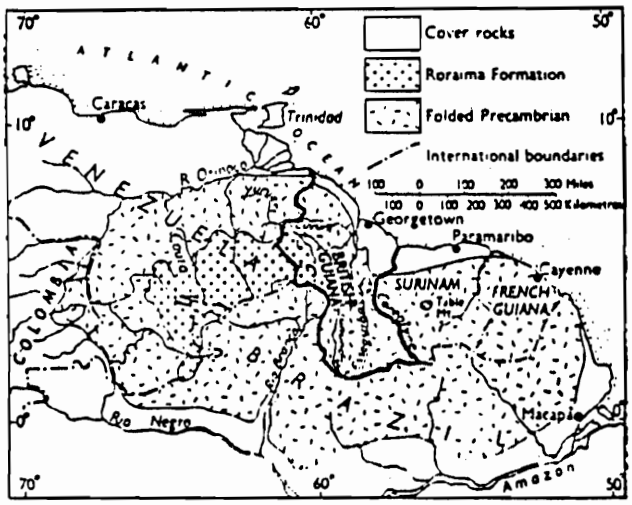

Figure 11. Outline Geologic Map of the Guiana Shield Showing Outcrop of Folded Precambrian Rocks, and Roraima Formation

Source: McConnell. 1964.

Between the overlying Roraima Formation and the gneissose rocks of the crystalline basement, there is a thick series of metamorphosed, fine-grained sedimentary and volcanic rocks, usually called the Volcanic series (Fig. 10). They are believed to be late Precambrian age. The most important gold fields in Guyana are located on or near the Volcanic series, especially along their contacts with granite intrusions. Massive or slightly foliated hornblende- and biotite-granites are common in the crystalline basement. These younger granites, shown as intrusions in Figure 10, are covered by thick alluvial and residual deposits and their extent is uncertain. Many goldfields occur where these intrusive granites meet members of the Volcanic series. The intrusive granites are believed to be of Paleozoic age.

The Roraima Formation, named after the highest mountain in Guyana, forms part of the series of plateaus and mesas known as the Pakaraima Mountains. The Roraima Formation (Fig. 11) extends from central Guyana westward across southern Venezuela and adjacent northern Brazil. The Roraima Formation is a very thick series of sandstone layers, mostly in horizontal beds. It rests directly atop the older Precambrian "Guyana Shield" of older granite. The sandstone layers of the old Roraima peneplain have been greatly eroded, leaving vertical-walled pillars known as tepuis, of which Mt. Roraima is the highest (Fig. 12), though not the largest in surface area. The highest known point on Mt. Roraima is 2,606 m (8,600 ft), arising from a base at 424 m (1,400 ft). No fossils have been found anywhere in the Roraima Formation and its age is unknown. A Cretaceous age is believed most probable.

The coastal plain of Guyana consists of Quaternary age deposits of marine alluvium. Approximatley 60 m (200 ft) thick, this alluvial layer extends inland from the present coast line for varying distances, eventually ending in grassy lakes or swamps that separate it from the white sand region. These alluvial deposits appear to be brought down from continental rivers, including material from the Amazon which is transported northwestward by the Guiana current. Most of this area is slightly below sea level and drained artifically by canals and lakes.

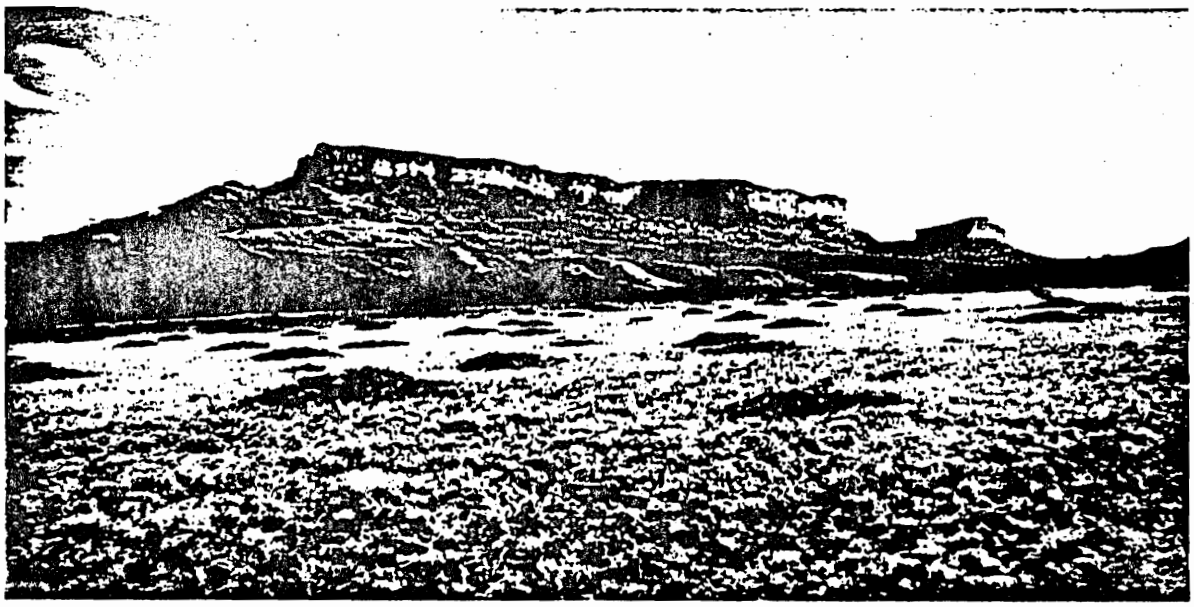

Figure 12. Western Side of Mt. Roraima.
View from the Gran Sabana, Venezuela

Source: Mayr and Phelps. 1967.

Beneath the Quaternary coastal alluvium there is a succession of stratified white sands, gravels and clays. Reaching at least 1,910 m (6,300 ft) thickness near the mouth of the Berbice River, this white sand series slowly thins out inland against the sloping surface of basement rocks (Fig. 10) which gradually approach the surface and are exposed about 32 to 96 km (20 to 60 mi) up the main rivers. At the surface these deposits are almost pure, fine-grained white quartz sand. Inland these white sand deposits become more and more restricted to narrower channels between ridges. The white sand belts generally occupy the valleys or estuaries of old river systems and cover an ancient land surface of crystallines (the Guyana Shield). The age of these deposits is based on Arenaceous Foraminifera of probably Miocene to Pliocene age. Most of the small alluvial diamond deposits are derived from white sands between the protruding ridges at the base of the Pakaraima Mountains. The bauxite deposits of Guyana occur in a rather narrow belt that runs approximately north-northwest from Kwakwani on the Berbice River to the mouth of the Essequibo River (see map, side cover). They occur as caps sloped like turtle-backed domes, over the old land surface and beneath the sediments of the white sand series. They are exposed only where erosion has removed the white sand sediments, and in most areas lie buried beneath 30 m (100 ft) or more of white sand sediment.

3.1.2 Minerals [11]

Guyana is remarkably rich in minerals. The most important mineral resources presently exploited are bauxite (aluminum ore) and manganese. Bauxite is taken from several mines located between the mouth of the Essequibo River and Kwakwani on the Berbice River (Fig. 13 and 14). Guyana's enormous bauxite resources place it among the top three countries in the world in terms of known reserves. Estimates of 70 million tons (Amer. Univ. 1969) will have to be substantially increased due to inclusion of lateritic ore deposits occurring in over 388,500 sq km (15,000 sq mi) of the western Pakaraima Plateau. Preliminary reports have indicated the existence

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[11] Sources: American University. 1969.
Bureau of Mines. 1981.
World Mines Register. 1980.

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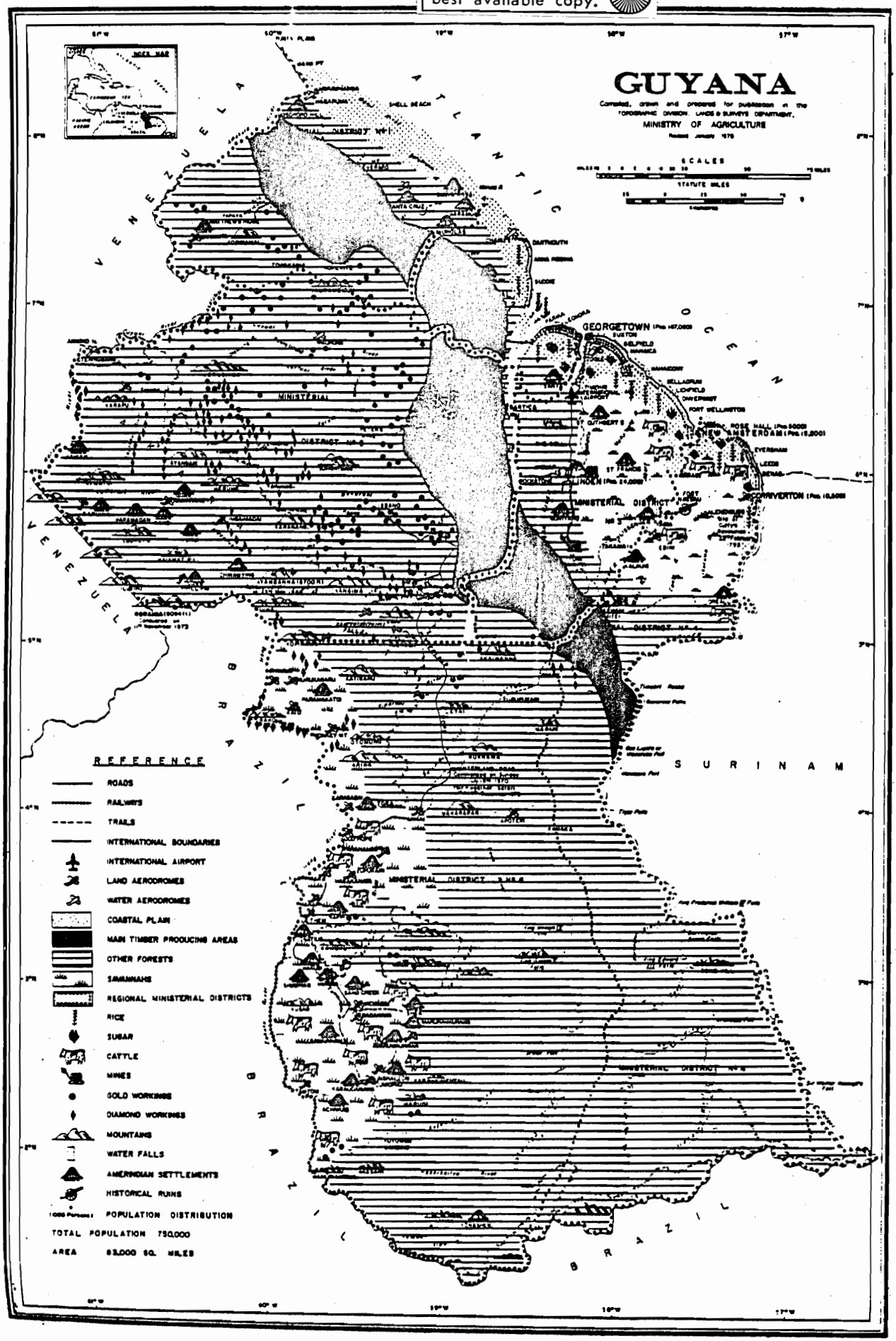

Figure 13. Location of Bauxite, Gold and Diamond Mines

Source: Guyana Ministry of Agriculture. 1976.

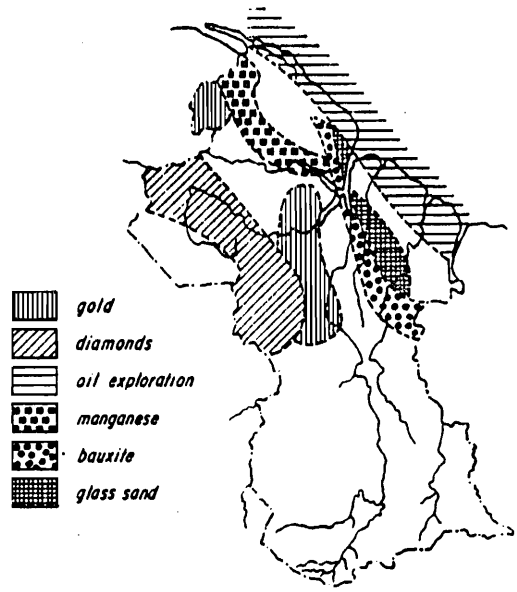

Figure 14. Guyana Mineral Map

Source: Miller-Warden-Western. 1967.

of billions of tons of ore that would require little, if any, overburden removal.

Despite these reserves, there has been an apparent trend toward declining productivity in the bauxite industry in recent years. The East Montgomery Mine, opened in mid-1979 by Guyana Mining Enterprises, Ltd. (GUYMINE), marked the first expansion of the industry since 1971, but it suffered a severe production setback, caused by a landslide, shortly after it opened.

Manganese is mined at Arakaka and Matthews Ridge on the Barima River in the northwest. Diamonds and gold are mined by free-lance prospectors in the Pakaraima region (Fig. 13). There have been no commercial gold mines in operation since 1959. Production in 1964 reached 107,000 carats of diamonds, and 2,000 troy ounces of gold. By 1978 production fell to 530 carats and 39 troy ounces, respectively, but the government urged gold mines to step up production in response to the dramatic surge in gold prices in 1979 and 1980.

In April 1979 Guyana granted a joint offshore exploration concession to Seagull International Exploration Inc., of Houston, Texas and Denison Mines, Ltd., of Toronto, Canada. The 10,360 sq km (4,000 sq mi) concession is located 32 km (20 mi) offshore between the mouths of the Demerara and Berbice Rivers. Deminex Oil Co. abandoned offshore exploration in 1976 after drilling two dry wells off the Essequibo coast. In October 1979 another petroleum exploration agreement was signed with a consortium of four Canadian companies, Home Oil and Gas Co., Ranger Oil Ltd., Voyager Petroleum Ltd., and Norcen International, Ltd. Then in November 1979, Major Crude Oil Inc., a U.S. firm, signed a lease to explore in a concession adjacent to that of Seagull International.

Traces of uranium have been found in Guyana and in 1979 non-exclusive uranium exploration rights were granted to Compagnie Générale des Maiéres Nucléaires (Cogéma) of France and Grundstoff-technik Gmbll of Essen, Federal Republic of Germany. The presumed uranium deposits are based on aerial surveys, but geological exploration on the ground has been hampered by difficult and remote terrain.

Columite, used in the manufacture of corrosion-resistant steel, is found near the Mazaruni Plateau.

Several other ores and minerals are believed to occur, but it is not known if they are commercially exploitable.

3.1.3 Soil Resources

Most of the soils of Guyana have not been eroded or damaged as a result of man's activities. This is in sharp contrast to many neighboring Latin American countries, and is the result of land reclamation projects along the flat coastal plain, and an absence of agricultural activity inland in hill or mountainous zones. Except for the alluvial soils of the coast, most Guyanese soils are notably poor and unsuitable for traditional agriculture. The following discussion is taken primarily from FAO (1971).

Various erosion cycles have molded the Guiana Shield into a complex of extensive rolling to hilly crystalline uplands, level pediplanes and mountainous highlands. After elevation of the Guiana Shield, the older, higher surfaces were highly dissected by erosion. In some areas the strongly weathered mantle of soil material has been only partly removed. In southern Guyana, for instance, where surfaces have been progressively dissected, shallow ferralsols are common, especially on steep slopes. The ferralsols sometimes contain a high content of iron concretions that may aid soil conservation. Some hilltops are still covered by concretionary soils. Northward the dissection of Plio-Plistocene Rupununi surfaces has created an array of ferralsols and orthic acrisols, the former where soils are better preserved, the latter where erosion has exposed the underlying acidic rocks. In both cases the soils are sandy, leach rapidly, and are deficient in nutrients.

The mountainous highlands cover a large area of the interior of Guyana. The Pakaraima Mountains, with a sequence of plateaus separated by escarpments, represent the most important part of these highlands. The relief has resulted from uplifted block-faulting of the Guiana Shield and erosion of the overlying sandstone. Acid sandy, sometimes gravelly, ferralic arenosols are common (not shown on map, Fig. 15) and where basic rocks have intruded, dystric nitosols and eutric nitosols occur. In the Rupununi region the Kanuku Mountain soils are mainly lithosols. Along the extreme southern border a low mountain range, representing a

Figure 15. Major Soils of Guyana

COASTAL SOILS

FLUVISOLS. Good agricultural soils.

DYSTRIC HISTOSOL. Thick, sticky, poorly osygenated, poor drainage; little value for modern agriculture, fair grassland.

PLINTHIC ACRISOL. Low fertility, mostly savanna.

SOILS OF INTERIOR

DYSTRIC NITOSOL. Moderate suitability for agriculture and grassland; can be improved with careful management.

EUTRIC GLEYSOL. Highly variable. Along coast when drained are good for agriculture; inland usually forest cover.

ALBIC ARENOSOL. Extremely low fertility, very sandy. Natural vegetation may be forest but when cleared, scrub or grass returns. Poorest soils in Guyana for agriculture.

ORTHIC ACRISOL. Not used for agriculture in Guyana. Usually on hilly terrain and low fertility; subsoil dense. Restricted agric. use.

ACRIC FERRALSOL. Low nutrient content; usually support savanna.

SOILS OF SOUTHERN THIRD OF COUNTRY

ORTHIC FERRALSOL. Low nutrient content; usually support forest; suitable mainly for shifting agriculture.

ORTHIC FERRALSOL. As above. Distinction between these two Orthic Ferralsols, as shown on FAO map unclear.

MIXED: ORTHIC FERRALSOL, DYSTRIC NITOSOL, LITHOSOL. Lithosol. Rocky and on steep slopes. Not suitable for modern agriculture and rarely used.

Source: FAO. 1971.

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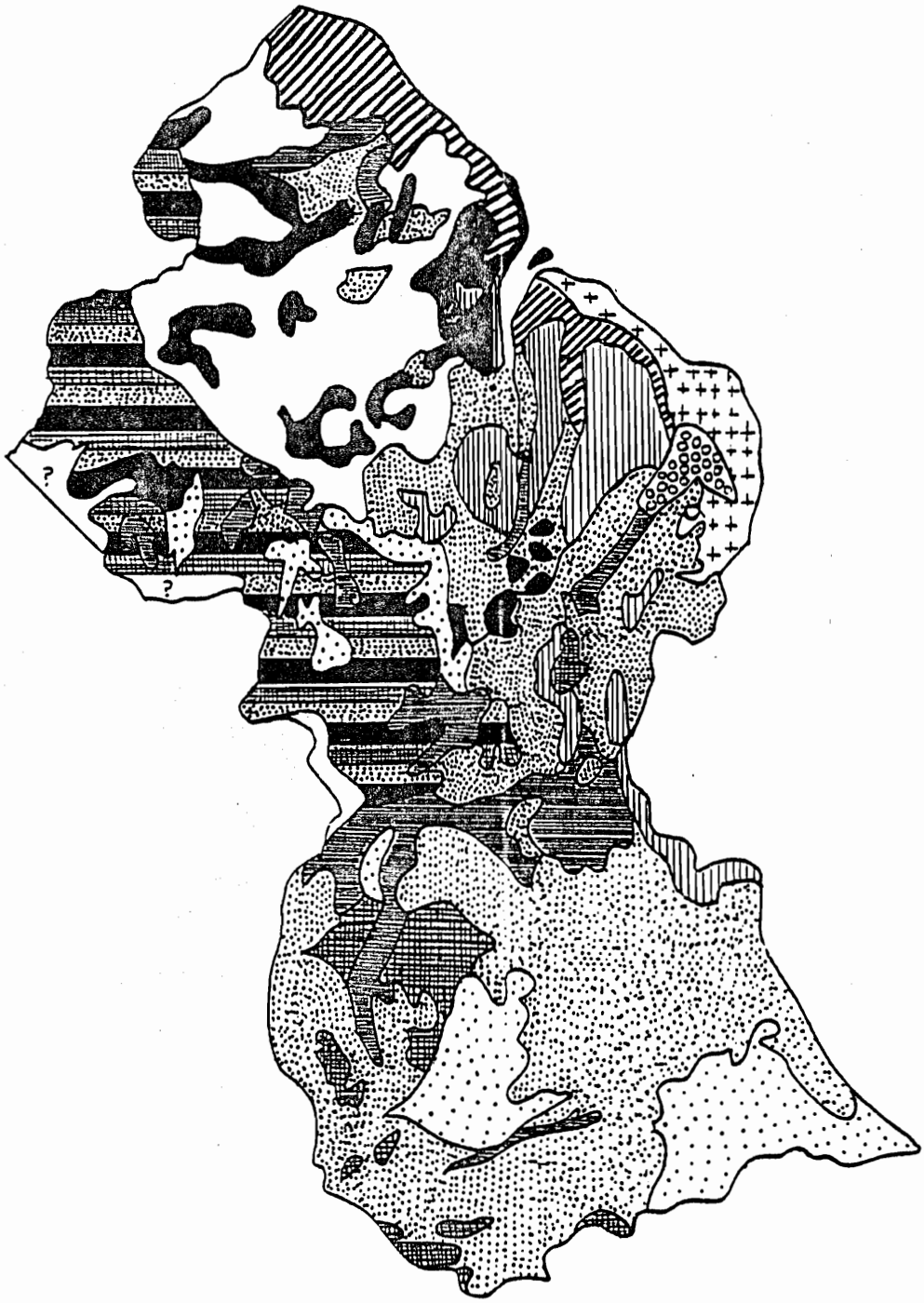
Figure 15, continued



relic relief of an old pediplanation process, has formed the Kwitaro surface. Here, as in the Kanuku Mountains, lithosols are predominant and on steep slopes ferralsols are common.

The potential agricultural value of the major soils in Guyana is mentioned in the text of Figure 15. In general, coastal alluvial soils have a good nutrient content and are suitable for a variety of agricultural purposes. Most of the soils of the interior and the southern plateau are of low fertility and are of restricted usefulness for modern agriculture.

3.2 Water Resources 12/

3.2.1 Surface and Groundwater Resources

The major surface drainage systems are shown in Figure 16 and flow characteristics of seven of these rivers (no.'s 1-7 on Figure 16) are given in Table 10. The total surface of national drainage basins is 45,584 sq km (17,600 sq mi) but increases to 172,235 sq km (66,500 sq mi) when international drainage is included. There are abundant water resources, as might be expected in a country where the average annual rainfall is about 2,500 mm (100 in). But seasonal differences, as illustrated by the Essequibo River (Table 11), are marked. Average discharge during July is over 7.5 times the November rate for the Essequibo at its mouth on Plantain Island.

Guyana's water resources, which far exceed demand, are further augmented by coastal artesian aquifers that supply most of the country's drinking water (Table 12). In fact, one principal aquifer, the "A" sand layer, lying between 90 to 300 m (300 to 1,000 ft) below the surface, supplies 90 percent of the drinking water. Only about ten percent of domestic water use is from surface sources (Table 13). The major use of water in Guyana is for agriculture. Most of this is derived from shallow reservoirs (conservancies), streams or drainage canals. Although the bauxite industry uses large amounts of water, its total water use accounts for only a fraction of the country's total usage (Table 13).

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[12]Sources: van der Leeden. 1975.
Library of Congress. n.d.

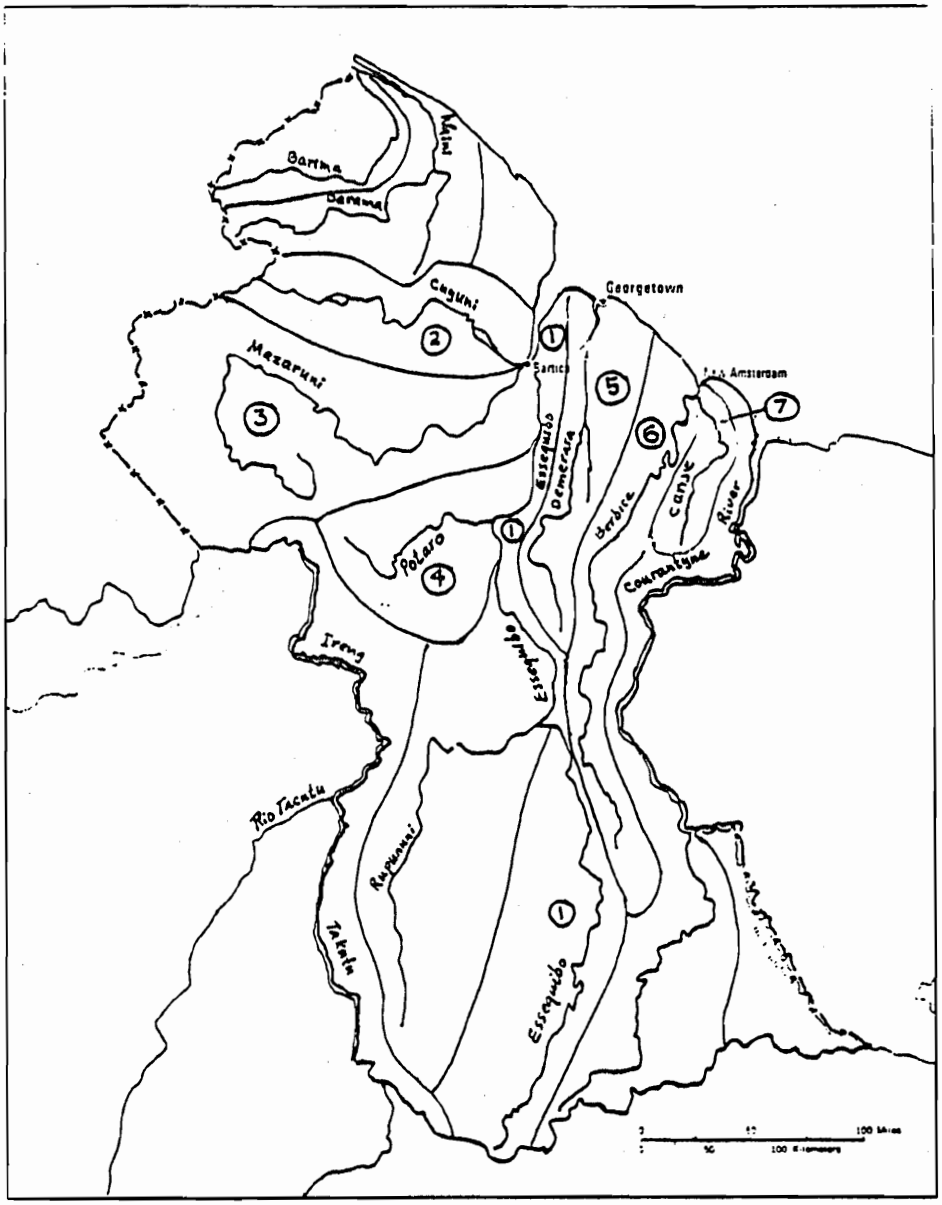

Figure 16. Surface Drainage Basins. Flow Characteristics of Basins 1 through 6 are Given in Table 10.

Table 10. Flow Characteristics of Selected Rivers

River	Station	Drainage area mi2	Max. daily flow			Min. daily flow			Mean flow		Period of record
			cfs	cfs/mi2	Date	cfs	cfs/mi2	Date	cfs	cfs/mi2	
Essequibo	Plantain Is.	25,700	283,000	11	Jul. 1'51	5,130	.2	May 5-8'61	78,570	3.1	1950-69
Cuyuni	Kamaria Falls	20,600	190,500	9.3	Sep. 2'54	350	.02	Apr. 18-19 '47	37,560	1.8	1946-68
Mazaruni	Apaikwa	5,420	92,150	17	Jun. 22'54	1,500	.28	Apr. 25'61	25,990	4.8	1950-68
Mazaruni	Hillfoot	8,000	146,350	18	May 20'63	2,000	.25	May 1'51	40,460	5.1	1961-68
Potaro	Kaietour Fall	1,020	39,600	39	Jun. 18'68	400	.39	Apr. 16-18 '61	7,224	7.1	1950-68
Potaro –	Tumatumari	2,395	78,550	33	Jul. 1'47	1,550	.65	Apr. 6,14 '47	18,427	7.7	1946-54
Demerara	Great Falls	950	18,100	19	Jul. 27'55	150	.16	May 11-16 '64	2,585	2.7	1949-67
Demerara	Saka	1,560	15,790	11	Jul. 2'51	410	.27	May 13'64	3,938	2.5	1950-67
Berbice	Itabru Falls	1,970	14,740	7.5	Jun. 16'63	60	.03	Apr. 23-27 '62	1,412	.7	1960-68
Canje	Reynold's Bridge	107	304	2.3	Jul. 16'69	51	.48	Apr. 7-9'67	94	.9	1969

Source: van der Leeden. 1975.

Table 11. Monthly Discharge of the Essequibo River

River and station	Basin area km2	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year	Period of record
Essequibo, Plantain Island	68,600	1,040	1,120	998	1,180	2,790	4,770	5,320	4,450	2,270	979	698	889	2,190	1950-66

Source: van der Leeden. 1975.

Table 12. Principal Aquifers in Coastal Artesian Basin

Aquifer	Depth below land surface ft	Thickness ft	Transmissivity gpd/ft2	Remarks
Upper Sand	100-200	50-400	–	Little used due to high Fe content (more than 5 mg/l) and salinity (to 1,200 mg/l).
"A" Sand	300-1,000	50-200	200,000	Yields 90% of country's drinking water; treated for Fe.
"B" Sand	1,200-2,600	50-200	–	Excellent quality but high temperature (105° F); trace H_2S.

Source: van der Leeden. 1975.

Table 13. Water Use, 1971

Catagory	Quantity, mgd[1]	Source of water
Agriculture (mainly for flood irrigation of sugar and rice)	3,240	Surface water; shallow reservoirs (conservancies) and streams.
Domestic	50	90% obtained from wells; 10% from surface sources.
Industrial (mainly bauxite industry)	1	

1) Imperial gallons.

Source: van der Leeden. 1975.

The major water problem on the coastal plain is excess water removal, rather than insufficient water. Because most of the coastal plain is several feet below sea level, an intricate system of canals must be maintained in agricultural areas.

3.2.2 Water Management

Management and maintenance of the coastal canal system is of vital importance to Guyana's economy. The fertile coastal plain, upon which the economy is based, requires drainage, flood control, protection from sea water intrusion, and even irrigation during sporadic periods of drought. An extensive system of drainage and irrigation canals, sea walls and dams has developed in a rather uncoordinated fashion along the coast. Today the Hydraulics Department of the Ministry of Agriculture administers this system under 34 declared drainage and irrigation districts. Administration, maintenance and extension of this system is costly, and complicated by the fact that the waterway systems serve a large number of private holdings as well as the large state sugar companies. In 1976 water control expenditure was about nine percent of total government expenditures. The government also is implementing two ambitious programs to increase efficiency of the waterway system and to open more land within the system to agriculture. These are the Coastal Pumped Drainage Program, to speed up traditional gravity drainage, and the Mahaica-Mahaicony-Abary River Control project, which will create two reservoirs for flood control, drainage and irrigation. The project should add 57,490 ha (142,000 acres) to the 283,400 ha (700,000 acres) of coastal land already under cultivation. Other water managment projects are in planning and survey stages. Within the administration, there is a proposal to unite all water management activities under a single agency, the Water Resources Board.

3.2.3 Water Quality and Supply

Guyana has fewer water quality problems than most neighboring Latin American countries. The most serious problem is toxic chemical pollution of water in drainage canals on the coastal plain. In the past, chemical control such as pentachorophenol, has been used to control aquatic weeds in the canal but this has killed fish and contributed to chemical pollution of the water.

A remarkably high proportion of the population has access to safe drinking water. According to U.S. AID (1981b), the percentage of rural people with reasonable access to a safe water supply has risen from 63 percent in 1970 to 75 percent in 1975. One hundred percent of the urban population has access to safe water; values for the urban and rural population combined were 75 percent in 1970, and increased to 84 percent by 1975.

Administration of Guyana's water supply, sewage disposal and water treatment is charged to the Guyana Water Authority (GUYWA) which is discussed in Section 2.4.5. By 1980 they were to spend 60 million dollars in the first of a three part program to provide and maintain a supply of potable water for domestic and industrial use. Fifteen million dollars have already been spent on the construction of six treatment plants and other facilities in the coastal area. Another 10.3 million is being spent in cooperation with a United Nations Development Program to improve water supply and sewage and storm drainage in Georgetown, New Amsterdam, and Linden.

3.3 Energy Resources

3.3.1 Electrical Power [13]

Guyana has a huge hydroelectric potential but development of even a fraction of this potential is inhibited by inaccessibility of the interior. There is almost a complete lack of roads, and navigability of the rivers is seriously limited by waterfalls and rapids. Most of the interior has been inadequately surveyed.

The Ministry of Works and Communications is responsible for developing the hydroelectric potential of the interior and for building access roads to the interior. Currently there are plans to build a large hydroelectric project on the upper Mazaruni River, as well as an access road to the Mazaruni region. The proposal calls for a first stage installation of between 750 and 1,200 megawatts (MW) on the upper Mazaruni River. This

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[13] Sources: Library of Congress. n.d.
National Report, Guyana. 1981.
U.S. AID. 1979.

would provide power for a primary aluminum smelter of 140,000 to 280,000 tons capacity per year, as well as supply other internal electrical demands. Ultimate installed capacity of the Mazaruni project is projected to be 3,000 MW. There is also a feasibility study underway for first stage development of the Potaro River Basin, based on installation of a 20 to 50 MW of hydropower capacity at Tumatumari.

Presently thermal generation from imported fuels is the sole source of power. Consequently, electricity is available only on the coastal plain and in a few river towns such as Linden which are accessible by river. The dramatic rise in crude petroleum prices during the past decade has driven the cost of energy production higher and underscored urgent need for cheaper alternative energy sources such as hydropower.

The Guyana Electricity Company, with several generating stations, is the main supplier of power. A few other municipal and industrial establishments also provide small amounts. In 1981 the total generating potential of hydropower plants greater than 6 MW was about 7,600 MW, of which about 7,000 MW are considered economically feasible. Limited generating capacity, resulting in power shortages, has reduced economic growth.

Plans for the Upper Mazaruni Hydroelectric Project (UMHP) are underway. When completed, the reservoir is estimated to cover about 518 sq km (200 sq mi) of the Upper Mazaruni region and should make Guyana energy self-sufficient. It should provide an abundant and relatively cheap source of energy that will make possible the development of various industries that depend heavily on abundant low cost power.

The environmental costs of the Upper Mazaruni Hydroelectric Project will be considerable. In addition to inundation of a large area of forest and possibly valuable mineral resources, several Amerindian settlements, prospectors, and others will have to be relocated. The operation of the hydropower plant will require a permanent staff, and the access road will provide an avenue for settlement. The reservoir itself will doubtless result in an increase in diseases dependent upon mosquito and snail vectors.

Guyana has several indigenous energy sources other than hydropower, of which wood products may be the most important. Selective cutting of only six species accounts for about 75 percent of annual wood production; greenheart represents 50 percent of this total. According to estimates submitted in Report on Guyana (1981), only about 15 to 20 percent of the estimated total timber resources are exploited. Some options for energy production, based on use of wood-derived resources include: wood waste (logging and sawmill wastes), cutting of forests, energy farming (assuming fast regenerating, non-native species can be used successfully), bagasse, rice chaff, solar energy (for crop drying and some commercial and industrial application), wind energy (now used mostly for irrigation and domestic water supply purposes), and peat deposits.

3.4 Vegetation

3.4.1 Flora and Vegetation Communities

Interest in the vegetation of Guyana has centered on the highland region and as has been pointed out by Maguire et al. (1953), "Seldom do richness of natural history and delightful fantasy of fabulous legend and classic literature so combine to lure attention as they do in the ancient region of Guyana." Barely ten years after Columbus discovered the New World, incredible tales reached Europe of a land, soon to be called Guyana, that was filled with headless savages, warrior women, poisoned arrows, and the Myth of Mar del Dorado, where Indians covered themselves with gold dust. Despite the travels of von Humboldt and Schomburgk, which argued to the contrary, legend and mythology continued to flourish. Stories eventually gave rise to famous writings such as William H. Hudson's "Green Mansions," and Conan Doyle's "Lost World," both imaginative classics.

Actual history, scenic grandeur and extraordinary endemism among the biota of the isolated sandstone plateaus is in fact hardly less remarkable than the legends that followed. These attractions have lured a steady stream of botanists and naturalists from throughout the world. Since 1925 the majority of the botanical work in the Guyana Highlands (usually defined as the highlands from the Essequibo River, westward through southern Venezuela to eastern Colombia) has been carried out by expeditions from

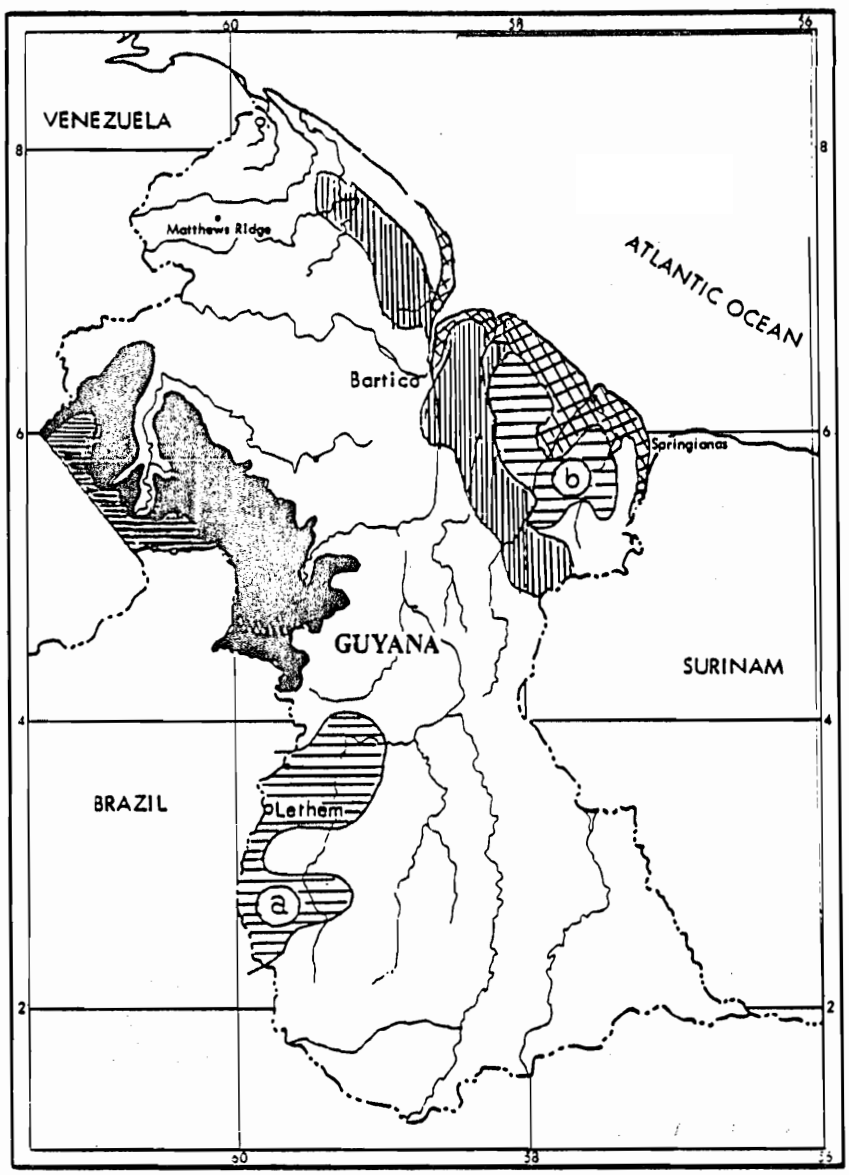
Venezuela and the United States. Roraima, in particular, has attracted numerous explorations. A history of botanical exploration in the Guyana highland region may be found in Maguire et al. (1953) and Maguire (1970). A selected list of botanical publications on the region is included in Appendix I.

By contrast, the lowland flora is typical of the broad Guyanan biogeographical region (Udvardy 1969) and has received less interest although it is doubtless much more valuable economically. A list of the main vegetation communities is given in Table 14 and discussed briefly below. Approximate geographic distribution of the vegetation communities is shown in Figure 17.

Table 14. Vegetation Communities

Tropical Moist Forest
1. White Sand Forest or Wallaba Forest
2. Brown Sand Forest
3. Swamp Forest
4. Mangroves
Lower Montane Forest
Montane Moist Forest
Savanna
1. Wet Savanna
2. Dry Savanna

Sources: Delfelt. 1978.
Hilty. Pers. Data.
Holdridge. 1967.



Tropical Moist Forest

Swamp Forest (Tropical Moist)

Savanna (a = Tropical Dry; b = Tropical Moist)

Montane Moist Forest

White Sand Forest (Tropical Moist)

Premontane Moist Forest

Figure 17. Major Vegetation Communities

Source: Composite of sources cited in text.

According to the Holdridge classification (1967) most lowland forested zones of Guyana are Tropical Moist Forest, receiving between about 2,000 to 3,000 mm (75 to 120 in) of rainfall annually. Some coastal areas receive less than this and fall within Tropical Dry Forest classification. The Rupununi savanna also lies within the Tropical Dry Forest designation but vegetation cover is apparently determined by edaphic rather than climatic factors. The Guyana Highlands are classified as Lower Montane Moist Forest (= Subtropical Forest); the upper zones of Mt. Roraima and a few other high peaks are Montane Moist Forest (= Temperate Forest). There are no elevations above treeline in Guyana.

Tropical Moist Forest. This is the widespread lowland forest type, occupying more than half of the country, it grows at elevations below about 1,500 m (4,950 ft). It is strongly modified by edaphic conditions along the coastal plain where a swamp forest develops, and over white sand regions where wallaba or sandy-belt forest develops. Typically the canopy is 30 to 50 m (100 to 160 ft) high, lianas form a conspicuous part of the upper level vegetation, and palms and epiphytes are common. Many trees are prominently buttressed. Vast areas of this forest have not been disturbed by man to any significant degree.

White Sand Forest or Wallaba Forest. The white sand belt is characterized by wallaba (*Eperua falcata*). The undergrowth consists partly of young canopy trees and species peculiar to the wallaba forest. Palms are occasional to frequent in occurrence. These forests have been logged extensively for many years (Dalfelt 1978). Forest regeneration following exploitation or clearing is very slow and difficult.

Brown Sand Forest. These are well-drained areas bordering white sand. They are characterized by greenheart forest (*Ocotea rodioi*), mixed lowland tropical species, and zones of morabukea forest. Shrub, lianas and epiphytes are common.

Swamp Forest. In poorly-drained coastal plain areas with clay loam and alluvial silt, mora (*Dimorphandra mora*) predominates. A shrub layer is dominated by palms and ferns. This vegetation type is most extensive in the northwest.

Mangroves. Mangrove forests are widespread onthe Guyanan coast, and occur to the uppermost tide zone. Guyanan mangrove forests are characterized by three species, *Rhizophora mangle*, *Avicennia marina* and *Laguncularia recemosa*.

Lower Montane Moist Forest. This vegetation zone lies above the upper limits of the tropical zone, marked approximately by the 24°C isotherm (about 1,500 m) and extends upward to about the lower limits of frost, or in wet zones to a line of critical temperatures that have the same effect. The forest is found mainly on the Pakaraima Plateau in the central and western region (Fig. 17). The region is very scenic with sharp rising mountains, some very steep-sided or vertical-walled. Soils of this zone are notably fertile but fewer commercially important trees are found in this zone than at lower elevations.

Montane Rain Forest. These forests are scattered and of limited distribution. They occur in cold damp zones above Lower Montane Forest, and principally in the highest mountains of southwestern Mazaruni District such as Mt. Roraima and Mt. Ayanganna. Because of inaccessibility to humans, the vegetation of this zone has not been disturbed.

Wet Savanna. This grassland vegetation community occurs in the extreme northeast, and is perpetuated largely by extreme edaphic (soil) conditions rather than climate. Characteristic plants include grasses, scattered, scrubby sandpaper trees (*Curatella*), and the long john tree (*Tripilaris surinamensis*). The grassland is interrupted by slow, winding, brandy-colored rivers supporting narrow gallery forests. Tremendously large silk cotton trees (*Ceiba pentandra*) and smaller sandbox trees (*Hura crepitans*) dominate the gallery forest landscape.

Dry Savanna. This vegetation community is similar to Wet Savanna but receives less rainfall--about 1,200 mm (50 in) versus 2,000 mm (80 in). The dry season is notably long (up to 6 to 7 months) but during the wet season extensive areas are inundated leaving shallow pools that may last for long periods. Plants are mainly grasses, moriche palms (*Mauritia flexuosa*), and *Curatella*. Soils of both savannas are comprised mostly of white sand.

3.5 Fauna and Conservation

3.5.1 Native Terrestrial Fauna

Guyana's small size belies its remarkably rich fauna. Several factors contribute to this richness, including its geographical position on the edge of the great Amazon basin, and a wide variety of habitats ranging from sea coasts and coastal swamps to vast grassy savannas, humid forests and the ancient highlands of the Guiana Shield. Many species of the tepui highlands, in fact, occur only in Guyana and the adjacent tepui zone of southern Venezuela. Guyana has not made great strides in conservation but because its human population is very small and highly localized, environmental damage has not been great. Most of Guyana is still largely an undisturbed wilderness, consequently few native terrestrial vertebrates are seriously threatened.

In large part because much of the flora and fauna of Guyana has not been disturbed it has been the site of a number of important and much publicized scientific studies. Examples include Beebe's natural history studies (1917), Gillard's work (1962a, 1962b) on the Cock-of-the Rock (Rupicola rupicola), Rettig's magnificent studies (1977, 1978) of the Harpy Eagle (Harpia harpyja), David Snow's fascinating book, The Web of Adaptation (1976), and several reports on the endangered manatee (see Appendix III). Numerous popular and scientific works on the flora and legends of the Guyana highlands are given in Section 3.4.1.

Mammals. There is no published list of mammals of Guyana, and relatively little work on mammals has been completed there. Tate's (1939) Mammals of the Guiana Region is a comprehensive list covering the region approximately bounded by the Orinoco and Casiquiare Rivers on the west, and the Negro and Amazon on the south. It is somewhat out of date but serves as a basis for the mammal list in Appendix I. Additional information peripheral to Guyana may be found in Eisenberg (1979), and the new, important, Mammals of Surinam (author unknown 1980) and in IUCN data in Appendix II.

The U.S. Department of Interior (1979) lists seven threatened and endangered mammals in Guyana (Table 15). None are endemic to Guyana, and most, if not all, probably survive in much greater numbers in

Table 15. Vertebrates Listed by the IUCN Red Data Books and the U.S. Department of Interior

Scientific Name	Common Name	Status	
		IUCN	U.S. Dept. Interior
MAMMALS			
Trichechus manatus	Caribbean Manatee	V	X
Panthera onca	Jaguar	V	X
Felis pardalis	Ocelot	V	X
Pteronura brasiliensis	Giant River Otter	E	X
Speothos venaticus	Bush Dog	Rare	X
Priodontes giganteus	Giant Armadillo	V	X
Myrmecophaga tridactyla	Giant Anteater	V	X
BIRDS			
Harpia harpyja	Harpy Eagle	V	X
REPTILES			
Podocnemis unifilis	South American River Turtle (or Yellow-spotted Amazonian Sideneck Turtle)	V	X
Crocodylus intermedius	Orinoco Crocodile	Not Listed	X
Caiman crocodilus	Spectacled Caiman	E	Not Listed
Paleosuchus palpebrosus	Dwarf (Cuvier's Smooth-fronted) Caiman	V	Not Listed
Paleosuchus trigonatus	Smooth-fronted Caiman	V	Not Listed
Melanosuchus niger	Black Caiman	E	Not Listed

X = listed (status not given); V = vulnerable; T = threatened; E = endangered.

Table 15. Vertebrates Listed by the IUCN Red Data Books and the U.S. Department of Interior (Continued)

Scientific Name	Common Name	Status	
		IUCN	U.S. Dept. Interior
Chelonia mydas	Green Sea Turtle	X	E
Eretmochelys imbricata	Hawksbill Sea Turtle	E	X
Lepidochelys kempii	Atlantic Ridley Sea Turtle	E	X
Dermochelys coriacea	Leatherback Sea Turtle	E	X
FISH			
None			

Sources: IUCN. 1966, 1969, 1975, 1978.
U.S. Department Interior. 1979.

Guyana than in other parts of their range. According to Dalfelt (1978), most mammals in Guyana are not seriously threatened because vast wildlands exist with minimal disturbances. Two species mentioned by Dalfelt (1978) need urgent attention in the form of protected reserves. These are the Caribbean Manatee (Trichechus manatus) and Giant River Otter (Pteronura brasiliensis).

The manatee is believed fairly common in a number of river systems, especially in the northeast. These rivers are being increasingly subjected to water management and alterations for agriculture. Damming, channeling, irrigation, dredging and other operations may threaten manatees in several watersheds and Dalfelt (1978) considers the establishment of a preserve, where protection can be enforced, to be important to the survival of this species in Guyana.

A preliminary review (Dalfelt 1978) indicated that the Ikuruwa River basin, and the upper Canje River were suitable for large preserves. The upper reaches of the Abary and Mahaicony River above the present dam may also be suitable for a sanctuary. Abstracts of several reports on the manatee are presented in Appendix III.

Giant River Otter. This magnificent mammal is now believed extinct over considerable portions of its range, and has been the subject of recent study, mostly in remote areas of Surinam (Duplaix 1980). It is found in several areas of Guyana. Because of hunting pressures it is no longer found near urban areas or villages and is rare or occurs only in small numbers even where it is not persecuted. The species reportedly still thrives in numbers in the upper Berbice River, Mazaruni River, and in the Kanuku region (Dalfelt 1978) and was recently reported in numbers opposite the Guyana border on Kapoeri Creek (Fig. 18), a tributary of the Corantyne in Surinam (Duplaix 1980). River reserves and effective hunting control should be a high priority to insure the survival of this species.

Although not mentioned by Dalfelt (1978), the Giant Armadillo (Priodontes giganteus) is greatly reduced in numbers over parts of its broad Amazonian range. It probably suffers from similar persecution in Guyana. Wherever there is human activity it is eagerly sought for food.

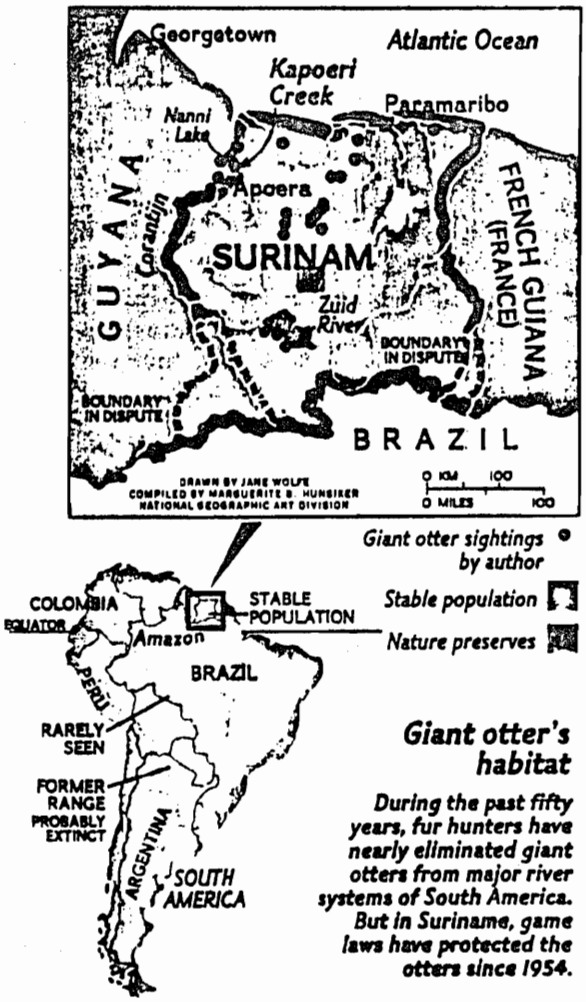


Figure 18. Distribution of the Giant Otter in Surinam and South America

Source: Duplaix. 1980.

Large cats are widely hunted for pelts and other products, and in the case of Jaguars (Panthera onca) because they also occasionally prey on cattle. Large cats are not threatened in Guyana because vast regions exist with little disturbance but more effective hunting controls and export prohibitions should be undertaken (Dalfelt 1978).

Birds. The Guyanan avifauna is treated by Snyder (1966) who lists 720 species. A few additional species have been reported since that date, and a number of species collected from the Venezuelan side of Mt. Roraima probably will eventually be found because the northern slopes of Roraima in Guyanan territory have not been visited by ornithologists. The total number of species occuring in Guyana is probably in excess of 775 species. The greatest diversity of birds occur in the humid tropical lowlands which occupy most of the country. A small and highly circumscribed group of species occur on the slopes of Mt. Roraima and in the adjacent highland tepui zone of southeastern Venezuela and extreme northern Brazil. Members of this group include Fiery-shouldered Parakeet (Pyrrhura egregia), Roraima Parrottet (Nannopsitta panchlora), Peacock Coquette (Lophornis pavoninus), Velvet-browed Brilliant (Heliodoxa xanthogonys), Tepui Spinetail (Crainoleuca demissa), Roraiman Barbtail (Roraimia adusta), Roraima Antwren (Herpsilochmus roraimae). Scarlet-horned Manakin (Pipra cornuta), Red-banded Fruiteater (Pipreola whitelyi), Rose-collared Piha (Lipaugus streptophorus), Flutist Wren (Microcerculus ustulatus), Tepui Greenlet (Hylophilus sclateris), Olive-backed Tanager (Mitrospingus oleagineus) and Golden-tufted Grackle (Macroagelaius imthurni).

Migrants comprise a small proportion of the total avifauna, but include species from both north temperate and south temperate regions. A very small number of pelagic migrants have been reported in Guyanan waters.

There are no species endemic to Guyana although several species occur whose distribution is limited to the Guianan region (eastern Venezuela to the mouth of the Amazon). Examples of these include Caica Parrot (Pionopsitta caica), Blue-cheeked Parrot (Amazona brasiliensis), Guianan Toucanet (Selenidera culik), Guianan (Arrowhead) Piculet (Picumnus minutissimus), Waved Woodpecker (Celeus

undatus), Rufous-bellied Antwren (Myrmotherula guttata), Tiny Tyrant-Manakin (Tyranneutes virescens), Guianan Red-Cotinga (Phoenicircus carnifex), Capuchinbird (Perissocephalus tricolor), White Bellbird (Procnias alba) and Red-billed Pied-Tanager (Lamprospiza melanoleuca). The Lesser Antillean Bullfinch (Loxigilla noctis), a Caribbean species, is recorded on the South American continent only in northern Guyana (Snyder 1966). It is believed to have been introduced into Guyana by man.

The Harpy Eagle (Harpia harpyja) was placed on the endangered list by the U.S. Department of Interior (1979) and probably also by the IUCN Red Data Book (1979 edition not available to this study). According to the U.S. Department of Interior the Harpy Eagle is considered endangered throughout its broad range from southeastern Mexico to northern Argentina. However, because of its immense size and specialized feeding habits it always occurs in very low density. Recent work in Guyana (Fowler and Cope 1964; Rettig 1977, 1978) suggests the species has suffered no decline in the interior forests. In fact, most of the information on this remarkable bird in the wild has been obtained from observations at nest sites in southern Guyana.

Table 16 provides a list of possibly threatened species in Guyana. The list is derived from Poonai (reported in Dalfelt 1978).

Most of the listed species are inhabitants of swampy or marshy zones, and occurred primarily in the north coastal lowlands of Guyana. Consequently, because of extensive drainage and land reclamation, this group of species has suffered more than others. The Orinoco Goose (Neochen jubata) is the only one considered rare or threatened. It favors open wet grassland, and was probably never numerous in Guyana. The status of most others is believed declining, although surprisingly, they believed the Comb Duck (Sarkidiornis melanotos) and Muscovy Duck (Cairina moschata) were recovering from a previous decline. The Comb Duck favors marshland, the Muscovy swampy terrain, and both are likely to have suffered habitat loss as well as persecution from hunting. Dalfelt (1978) indicates the Hoatzin (Opisthocomus hoazin) is still common in some coastal areas but increasingly threatened in other areas because of river water utilization projects, uncontrolled hunting, and riverine habitat destruction. It is primarily a swamp and backwater species.

Table 16. Birds Possibly Threatened[1] or Endangered[1]

Common Name	Scientific Name	Status
Orinoco Goose	Neochen jubata	Rare or threatened
Maguari Stork	Euxenura galeata	Uncertain; declining
Jabiru	Jabiru mycteria	"
Buff-necked Ibis	Theresticus caudatus	"
Yellow-crowned Night-Heron	Nyctanassa violacea	Local; greatly reduced
Whispering Ibis	Phimosus infuscatus	"
Limpkin	Aramus guarauna	"
Hoatzin	Opisthocomus hoazin	"
Scarlet Ibis	Eudocimus ruber	Uncertain; believed not threatened
Comb Duck	Sarkidiornis melanotos	"
Muscovy Duck	Cairina moschata	"

[1] Not listed by IUCN (1966) or U.S. Department of Interior (1979).

Source: Poonai in Dalfelt (1978).

Two species, the Black Curassow (Crax alector) and Gray-winged Trumpeter (Psophia crepitans), are notably sensitive to human pressures from hunting and settlement. Both are certainly no longer found in the most intensively logged zones near the coastal plain but are common in remote interior areas.

Lists of game bird species and those of potential economic importance are given in Tables 17 and 18, respectively. Because in remote areas almost any bird captured is a potential source of food, the game list could be expanded. It is intended to show species most commonly sought. Potentially economically important species include those sought primarily for cage bird trade. The extent of persecution of members of this group for such purpose is not known, although in adjacent coastal Surinam, the lesser Seed-Finch (Oryzoborus angolensis) is now quite rare because it has been widely sought for its pleasing song.

Table 17. Game Birds

Common Name	Scientific Name	Status
Great Tinamou	*Tinamus major*	Not threatened
Variegated Tinamou	*Crypturellus variegatus*	"
Cinereous Tinamou	*Crypturellus cinereus*	"
Horned Screamer	*Anhima cornuta*	Rare or extirpated
Black-bellied Whistling-Duck	*Dendrocygna autumnalis*	Not threatened
White-faced Whistling-Duck	*Dendrocygna viduata*	"
Orinoco Goose	*Neochen jubatus*	Rare or threatened
Comb Duck	*Sarkidiornis melanotos*	"
Muscovy Duck	*Cairina moschata*	"
Crestless (Lesser Razor-billed) Curassow	*Crax tomentosa*	"
Black Curassow	*Crax alector*	"
Spix's Guan	*Penelope granti*	"
Marail Guan	*Penelope marail*	"
White-headed Piping-Guan	*Pipile cumanensis*	"
Little Chachalaca	*Ortalis motmot*	"
Crested Wood-Quail	*Colinus cristatus*	"
Marbled Wood-Quail	*Odontophorus gujanensis*	"
Gray-winged Trumpeter	*Psophia crepitans*	"
Gray-fronted Dove	*Leptotila rufaxilla*	"
Ruddy Quail-Dove	*Geotrygon montana*	"
Toucans[1]	(*Ramphastos* spp.)	"

[1] Not usually considered a game species but sometimes used for food by Amerindians.

Source: Personal information.

Table 18. Birds of Potential Economic Importance

Common Name	Scientific Name	Status
Blue-and-yellow Macaw	Ara arauna	Not believed to be threatened
Scarlet Macaw	Ara macao	"
Red-and-green Macaw	Ara chloroptera	"
Sun Parakeet	Aratinga solstitialis	Few records
Green-rumped Parrotlet	Forpus passerinus	Not threatened
Black-headed Parrot	Pionites melanocephala	"
Yellow-headed Parrot	Amazona ochrocephala	Uncertain
Orange-winged Parrot	Amazona amazonica	Not threatened
Mealy Parrot	Amazona farinosa	"
Guianan Cock-of-the-Rock	Rupicola rupicola	"
Purple Honeycreeper	Cyanerpes caeruleus	"
Red-legged Honeycreeper	Cyanerpes cyaneus	"
Silver-beaked Tanager	Ramphastos carbo	"
Lesser Seed Finch	Oryzoborus angolensis	"

Source: Personal information.

Reptiles and Amphibians. There is apparently no comprehensive survey of the herptofauna, and few surveys of specific groups or areas. References on various species of Crocodyla may be found in the IUCN data in Appendix IV, and on the breeding of marine turtles in Carr and Sancyk (1975). More species of reptiles and amphibians are listed by the U.S. Department of Interior (1979) and the IUCN Red Data Book (1975) than for any other vertebrate taxa. Nine species are listed by IUCN, and one additional species by the U.S. Department of Interior. This doubtless reflects the greater commercial value of many reptiles, as well as their greater vulnerability at breeding and feeding sites which are often accessible to humans.

The beaches of the northwestern coast are an important sea turtle breeding site and have been systematically exploited for food since man came to the region. Among all the herps, Dalfelt (1978) singles out the four species of sea turtles, Green, Hawksbill, Atlantic Ridley and Leatherback, as those in need of urgent attention. All four breed on extensive beaches from the mouth of the Moruca River to Waini Point. According to Dalfelt (1978) thousands of sea turtles are killed and nests exploited for eggs each year in this region. Combined with similar exploitation all through the Caribbean this has resulted in marked declines in turtle populations.

The northwestern beaches are particularly favored turtle breeding sites because they consist of almost pure, finely ground marine shell deposits. These shell beaches provide excellent drainage for turtle nests. According to Dalfelt (1978) there are government plans to exploit the shell resources of the beach. The shells will be used for cement because Guyana lacks limestone or other suitable material for cement production. A large scale, unrestricted shell operation could have serious detrimental effects on the turtle population of these beaches, and could contribute to a significant risk of beach erosion (Dalfelt 1978).

Dalfelt (1978) recommends establishment of a protected turtle reserve as well as regulation of turtle harvest along the entire country's coast. Further, guidelines to reduce the detrimental impact of eventual shell exploitation should be established and enforced, including measures for beach stabilization after the exploitation.

Information on the status of Crocodyla listed by IUCN and the U.S. Department of Interior was not obtained, nor was information obtained on the extent of commercial harvest of hides of this group.

Fisheries. Because Guyana has no large lakes, freshwater fishing is not an established industry. There is a small marine fisheries industry and some evidence suggests it has suffered recently from coastal water pollution. Fishing and the fisheries industry are largely unregulated. Further, there is little knowledge of or current research into fisheries population and reproductive biology, consequently no national fisheries allocation has been developed. Electric eels have reportedly increased sharply in numbers in coastal water conservancies. These eels are considered an important fisheries problem because of competition with other fish, and because they pose a potential hazard to fishermen.

Dalfelt (1978) reports that South America's largest freshwater fish, the Arapaima (*Arapaima gigas*), is heavily exploited, and is now common only in the Rupununi River. Some believe that despite the exploitation, Arapaima populations receive yearly input from Amazonian drainage basins during floods. Dalfelt (1978) recommends an adequate reserve be established for this species, perhaps combined with a savanna and lowland forest preserve, and that research should be undertaken on the biology of this species.

3.5.2 Parks, Protected Areas and Conservation

Guyiana has only one designated national park, Kaieteur National Park. It was set aside by a special ordinance. Otherwise, conservation, in an administrative, organizational and official context is treated in a very unscientific and unplanned way (Dalfelt 1978). There is a bird protection ordinance, as well as a fisheries ordinance. The fisheries ordinance includes protective measures for the manatee. Otherwise, there are no other national park laws or ordinances or any general wildlife laws.

The absence of a nature conservation program or a park service in Guyana points up the uniqueness of the Guyanese territory. Almost 90 percent of Guyana is in a state of natural wilderness, all of it government owned. A limited part of this wilderness has been graded for valuable timber species, mostly

in the wallaba and greenheart forest zones of the north. Most potential national park sites (proposed only) are completely inaccessible and are not threatened by potential commercial uses. Because of these conditions, priority for a network of parks and protected areas is low. In fact, any proposal for a park system at this point will be primarily an effort to identify potential areas of national significance. Further, the government of Guyana has restricted access to most interior territory in recent years. Dalfelt (1978) indicates that despite the high level of protection that this inaccessibility provides to most wildlife in Guyana, some coastal areas with a high value for conservation are threatened. These areas should receive highest priority.

A network of parks and preserves that would incorporate the most important floral and faunal resources in the country was outlined by Dalfelt (1978) and is reproduced in Table 19. This scheme details the major vegetation communities and threatened or endangered species, and suggests suitable locations for designation.

3.5.3 Tourism and the Environment

Guyana has not been affected by the tourist industry and since receiving full independence in 1966, has done little to encourage tourism. Guyana lacks the extensive sandy beaches and blue seas of Caribbean Islands, although Georgetown's quaint colonial architecture, beautiful parks and tree-lined avenues are of interest. In addition it has several large modern hotels. Kaietur Fall, 224.5 m (741 ft) is Guyana's best known tourist feature. Formerly it was easily reached by air from Georgetown but since 1975 all passenger flights to Kaietur as well as to the ranchlands at Lethem and elsewhere in the interior have been cancelled. Travel to the interior by any means is discouraged. Prior to the government's policy of restricting interior travel, there was limited interest by specialized tourists in bird-watching, botanical trips, and hunting at a number of remote interior localities. Tourism in Guyana is nil at present.

3.5.4 Government Agencies in Conservation

Government participation in land use policy and planning has been discussed in Section 2.4.5. Several of the same Ministries are involved in organization and administration of conservation

Table 19. Proposed Park and Reserve System for Guyana

Resource	Suitable region or area for conservation unit	Possible location of conservation unit	Proposed management category	Urgency of implementation
1. Mangroves	Waini Point to mouth of Moruka river	Shell beach	Biological Reserve	Medium
2. Coastal beaches	Waini Point to mouth of Moruka river	Shell beach	Wildlife Sanctuary Biological Reserve	High
3. Wet savannah	Area between the Ituni and Wiruni rivers. Central and upper Ikuruwa and Canje river area	Ikuruwa river area	Biological Reserve	High
4. Dry savannah	a. Orinduik area b. Middle and Upper Rupununi River area	1) Orinduik 2) To be identified (Possibly including the Karanambo swamp area)	National Park Biological Reserve	High Medium
5. White sand forest	Essequibo - Demerara Rivers area	1) Kwapau-Mazaruni triangle 2) Upper Demerara Forest Project (including Great Falls and Iron Mountains)	Biosphere Reserves (MAB-UNESCO) Biosphere Reserve	High High
6. Swamp forest	Northwest District	To be identified (Possibility: Biara Barra Barra)	Biological reserve	Low to medium
7. Lowland rainforest	a)Northwest District b)Southeast Rupununi District	1) Upper Barama river area 2) Kassikaituy & Sipu 3) To be identified	Biological reserve Resource reserve	Low to medium
8. Highland rainforest	Upper Mazaruni and Upper Potaro rivers areas	1) Kumarow Falls to Macreba 2) Kaieteur N.P. extention	National Park National Park	High Medium
9. Mountain ecosystems	a)Upper Mazaruni b)Kanuku Mts. c)Ayanganna Mts.	1) Roraima Mts. 2) Ayangaik 3) Kanuku Mts. 4) Ayanganna Mts.	National Park National Monument Multiple Use F. Res. National Park or Multiple Use F. Res.	Low to Medium Low Medium Low to Medium
a. Sea turtles	Waini Point to mouth of Pomeroon river (North west coast)	Shell beach	Wildlife Sanctuary	High
b. Manatees	Berbice District	Ikuruwa River basin and Canje river	Wildlife Sanctuary	High
c. Giant otter	Berbice District Upper-Mazaruni	Berbice River, Ikuruwa basin, Canje river	Wildlife Sancturary	High
d. Ibatzin	Berbice District	Mahaicony,Abary,Canje,Ikuruwa rivers	Wildlife Sancturary	High
e. Arapaima	Rupununi District	Rupununi River	Wildlife Sanctuary	Medium
f. Giant Armadillo		Ikuruwa and Canje river areas	Wildlife Sanctuary	High
Scenic Mountains	Rupununi District Upper Mazaruni	Mount Ataraipu on Rewa River Ayangaik Mts.	National Monuments National Monuments	Low Low
Caves	Upper Mazaruni	Phillipai Caves	National Monument	Low
Scenic Waterfalls	Essequibo R. Rupununi Dist. Demerara River Upper Mazaruni, Karowiong Kamarang River Kuribrong River East Berbice District	Great Falls, Essequibo Great Falls, Demerara Maipuri Falls and rapids Utshi Falls and surroundings Amaila Falls Christmas rapids	National Monument National Monument National Monument National Monument National Monument National Monument	Low Low Low Low Low Low

Source: Dalfelt. 1978.

programs although the various roles are somewhat confused.

The Ministry of Agriculture is in charge of wildlife. A recently created Wildlife Committee, with seven members from the Ministry of Agriculture and five from the Wildlife Exporters Association, is charged with controlling the exports of wildlife products, and the establishment and control of hunting regulations. The Ministry of Agriculture also places one individual in charge of conservation of wildlife. He is also a member of the Wildlife Committee.

The Ministry of Public Works has a parks commission which oversees recreational parks, city parks and other areas of urban recreational activity.

Forestry is under the Ministry of Energy and Natural Resources but none of the personnel in this section are charged with responsibility for conservation or wildlife.

The National History and Arts Council, a division of the Ministry of Education, has a National Trust committee which is interested in conserving samples of the natural heritage of the country. According to Dalfelt (1978) their activities so far have been confined to written reports.

The National Science Research Council, under the Ministry of Economic Development and Cooperatives, also houses the MAB Committee. This organization is taking the most active part in natural area conservation (Dalfelt 1978).

4.0 Environmental Problems

This section reviews environmental problems in Guyana. Unlike many developing countries of the world which have already ravaged and denuded most of the natural landscape, Guyana has, for the most part, an environment little disturbed by humans. Agriculture, lumbering, mining and human settlements are heavily concentrated on a narrow coastal strip or a short distance inland, while vast reaches of the country remain essentially undisturbed. Consequently, Guyana is in a good position to undertake an enlightened course in management, exploitation, and preservation of its environment. Because Guyana has economically significant natural resources, eventual exploitation is almost certain. The major problem is, then, not so much correcting abusive and uninformed land use and environmental practices of the past, but planning for rational, long-term utilization and protection of resources that will be exploited in the future.

Some major problems and areas of concern are outlined below. These include soil conservation, water conservation, and timber and natural resource conservation, as well as problems caused by toxic chemical contamination and urban settlement.

4.1 Land Use Problems and Management

4.1.1 Water, Soils and Mining

Water. Land use problems caused by current agriculture are confined to the coastal plain. This former swampland, most of which was below sea level, has been drained by a network of canals, and is protected from seawater intrusion by a sea wall, and from periodic flooding by lagoons or conservancies. Maintenance and operation of the canal and conservancy system is expensive, and especially complicated when the land is owned by many small farmers, rather than when controlled by large privately held estates. According to Field (1978) there is a problem in coordination of water usage and drainage, caused in part by the lack of an independent agricultural water users association. As water demands from agriculture increase, and more coastal land is brought into production there will be greater need for an overall national policy to protect large conservancies, their canal networks, and the large artesian aquifer.

Water quality management also remains a problem because it is linked to health, pollution, and

potential protein production. These problems, as well as the problem of salinization and groundwater contamination near the coast are treated in more detail in Section 4.2.2.

Soils. Guyana's most important long-term environmental problem could be the management of forest soil (Field 1978). Soil loss and depletion of soil nutrients has not been a problem on the coastal plains where most soils are derived by alluvial deposition. But the white sand, brown sand, and red lateritic soils of the forested interior are fragile and subject to rapid soil nutrient depletion and physical erosion when the forest is removed. There is presently no known method for successfully utilizing white sand soils once the forest cover is removed. On brown sand and lateritic areas, most successful agriculture involves shifting sites frequently and permitting the forest cover to regenerate. Management and preservation of these soils and their forests will require a strengthened forestry agency, and one that places professional judgement ahead of political pressure when faced with the need to generate increased foreign exchange revenue through forest products. The highly porous white sand soils doubtless represent the greatest challenge, because some of the most valuable trees for forest products grow in these soils, and if these forests are to remain productive they will require extraordinarily close supervision. Significant areas of wallaba forest of the white sand zones have already been degraded, with little hope for regeneration in the foreseeable future.

In the humid white sand soils it is essential that forest cover be maintained permanently. Selective cutting must be carefully controlled so that the nutrient cycle, soil and forest structure is maintained. The most important consideration for these delicate soils must be nutrient conservation through forest biomass maintenance. In areas of clay, such as near forest-savanna boundaries, emphasis should be placed on maintaining soil cover to maintain soil structure as well as nutrient content. Even the best soils of the coastal strip are subject to damage as a result of heavy equipment, inefficient water use, and erosion of the costly canal system.

Soils of the savanna regions are also subject to rapid structural damage as a result of overstocking

cattle and frequent fires. Desertification of the dry edges of savanna areas can already be detected and will lead to serious problems if not managed with care.

Erosion, although reported by Field (1978) to be severe on steep slopes of forest to savanna boundaries in humid zones, is not yet a widespread problem because of extensive forest cover. The potential for extensive erosion is present, however, and should be recognized as hydraulic works and other water management projects are undertaken. Because of great fragility of most of Guyana's soils, a policy of forest cover protection may be necessary for most interior regions, with economic development confined by these constraints.

Mining. The environmental impact of mining is at present not well known. Bauxite is mined by strip mining, a process that sometimes requires removal of up to 30 m (100 ft) of overburden. Land reclamation of strip pits is not undertaken at present. Bauxite processing produces several potential health and environmental problems. The most obvious is massive amounts of dust. Costs of this air pollution, as well as its impact on surface water or groundwater, vegetation and human health is unknown. No control is undertaken at present. Although Guyana does not engage in aluminum smelting, proposed hydropower projects will ultimately give Guyana the energy supplies required to operate smelting plants. The problem of fluoride poisoning associated with present smelting technology will pose a serious and direct health threat.

Because most of Guyana is virtually inaccessible, there has been little need to develop a fish and game service. As more areas become accessible there will be a need to effectively monitor and control populations of the more vulnerable and economically important species. An important part of Guyana's environmental plan should include active participation by a fish and game service in aquaculture and agriculture pest control as well as traditional hunting control, fishery regulation, and research into wildlife interactions. An immediate problem is the rapidly growing population of electric eels in conservancies on the coastal plain, and the necessity of investigating their basic biology (Field 1978).

4.2 Environmental Pollution

Very little information was available on the extent of air, water or noise pollution . Dalfelt (1978) and Field (1978) deal primarily with non-urban environmental problems and planning. Van der Leeden (1975) and U.S. AID (1981) tabulate a variety of data on water supply, sewage system services and health related statistics. This data is discussed in Sections 2.3.2 and 3.2.2.

4.2.1 Air Pollution, Water Pollution and Biocides

Air. Guyana has exceptionally clean air. The two most important sources of air pollution at present are dust from bauxite milling and urban concentration of vehicle exhausts. Pollution from these sources is seldom, if ever, measured. Likewise, health consequences resulting from air pollution in various industrial occupations do not seem to be of major concern to the government.

Water. In addition to the agricultural problems mentioned previously (Section 4.1.1), there are some serious urban and rural waste disposal problems. Open ditch, sewer and canal discharges of oils and chemicals are common. Septic tanks flood during rainy seasons. In settlements on sandy soils, it is believed that some shallow wells are heavily contaminated. Deep wells ($>$300 m or $>$1,000 ft) are sometimes artesian and usually clean, but pressure is reportedly declining. Salt water invasion may, in some places, be the result of excessive pumping and irrigation from sources on the coastal plain. There also is uncertainty as to which inland environmental changes will affect recharge of coastal aquifers that supply human water supplies. According to U.S. AID (1981) the majority of persons in urban areas have access to safe water. This differs from Field (1978) who states that, "with the possible exception of forest-dwelling, remote, Amerindian populations, and some privileged urban sectors, domestic water supplies are inadequate in quality. Access to clean water is especially difficult in the densely settled rural areas and especially for the poor."

Biocides. Unsupervised use of toxic chemicals in agriculture and industry represents an important threat to human health and existing wildlife ecosystems in heavily urbanized and agricultural coastal zones. For example, sprayers are regularly loaded and washed in canals and applications of

pesticides to garden vegetables on canal embankments are heavy. Hard pesticides such as heptachlor are easily available in retail outlets. Packing, labeling, merchandising, instruction and application of toxic chemicals is chaotic and uncontrolled. The government has no monitoring or regulatory process. Evidence is presently inconclusive to indicate serious health problems, or deterioration of wildlife food chains, but if controls are not implemented the danger will increase. Chemical pollution of canals, in addition to becoming a human health problem, could adversely affect fish and manatee populations which provide protein and aid in control of grass and vegetation in canals. If pesticides are systematically contaminating water and other parts of the food chain, the consequences will be manifested from food supply through extraction, production, health, productivity and economy (Field 1978). Awareness of the problem exists (Gulmahamad in Field 1978; page 12), and because aerial spraying is not practiced, biocide pollution is probably not yet a serious problem.

At present a system to regulate use of pesticides and herbicides to appropriate quantities, and timing does not exist in Guyana. An effective system of biocide procurement, distributional information, control, and monitoring, as well as programs to disseminate information to users, is needed (Field 1978).

4.2.2 Artesian Water Pressure

Aside from pesticide contamination, the most serious environmental hazard to water supplies may be the slow drop reported in artesian pressure from deep wells. If this indicates groundwater depletion, it may result in seawater invasion and complete contamination of coastal fresh water sources. Field (1978) recommends careful study of potential recharge areas and recharge rates.

4.3 Environmental Policy

Guyana lacks laws or regulations that require environmental impact analysis and statements to be made before development projects are approved. As noted in previous sections (e.g., Section 4.1.1), several projects are underway that may have serious environmental, social and economic consequences. One of the most important of these is the Mazaruni hydropower project. Others include the

Abary, Mahaica and Mahaicony water regulation project. Guyana has important natural resources which are largely uninvestigated. In an effort to avoid serious or irreversible loss or mismanagement of these resources, impact analysis should preceed approval of government or private projects.

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Appendix I

Mammals of the Guyana Region[1]

Didelphidae	
Didelphis marsupialis	Opossum
Chironectes minimus	Water Opossum
Metachirops opossum	Four-eyed Opossum (with pouches)
Metachirus nudicandatus	Four-eyed Opossum (no pouches)
Lutreolina crassicaudata	
Caluromys philander	Wooly Opossum
Caluromys laniger	Wooly Opossum
Marmosa demararae	Mouse Opossum
Marmosa murina	Mouse Opossum
Marmosa tyleriana	Mouse Opossum
Marmosa fuscata	Mouse Opossum
Marmosa parvidens	Mouse Opossum
Monodelphis brevicaudata	
Dasypodidae	
Cabassous unicinctus	
Priodontes giganteus	Giant Armadillo
Dasypus kappleri	
Dasypus novemcinctus	Nine-banded Armadillo
Myrmecophagidae	
Cyclopes didactylus	Two-toed Anteater
Tamandua tetradactyla	Tamandua
Mermecophaga tridactyla	Giant Anteater
Bradypodidae	
Bradypus tridactylus	Three-toed Sloth
Choloepus didactylus	
Leporidae	
Sylvilagus orinoci	(Not in Guyana)
Sciuridae	
Sciurus pusillus	Squirrels
Guerlinguetus aestuans	
Guerlinguetus gilvigularis	
Hadrosciurus igniventris	
Hadrosciurus flammifer	

[1] Includes the entire region from Orinoco and Casiquiari Rivers east and south approximately to the Amazon River. Bats (*Chiroptera*) not included.

Echimyidae	
Proechimys cayennensis	Spiny Rats
Mesomys lispidus	
Echimys chrysurus	
Echimys armatus	
Echimys semivillosus	
Isothrix bistriatus	
Caviidae	
Myoprocta exilis	
Myoprocta acouchy	
Dasyprocta cayanus	Agouti
Dasyprocta fuliginosa	Agouti
Cuniculus paca	Paca
Cavia guianae	
Hydrochoerus hydrochaeris	Capybara
Erethizontidae	
Coendou sp.	Prehensile-tailed Porcupine
Cricetidae	
Akodon (Chalcomys) *aerosus*	
Podoxymys roraimae	
Zygodontomys microtinus	
Oryzomys macconelli	Rice Rat
Oryzomys laticeps	
Oryzomys trinitatis	
Oryzomys klagesi	
Oligoryzomys delicatulus	
Holochilus sciureus	
Neacomys guianea	
Oecomys auyantepui	
Oecomys guianae	
Oecomys phelpsi	
Oecomys marmosurus	
Oecomys rex	
Oecomys nitedulus	
Thomasomys macconnelli	
Rhipidomys nitela	
Rhipidomys venezuelae	
Rhipidomys sclateri	
Rhipidomys borallii	
Sigmomys alstoni	
Sigmomys savannarum	
Mectomys squamipes	Neotropical Water Rat

Appendix I (continued)

Procyonidae	
Bassaricyon sp. (?)	Cacomistle (?)
Potos flavus	Kinkajou
Nasua phaeocephala	Coatimundi
Nasua candace	Coatimundi
Procyon cancrivorus	Racoon sp.
Canidae	
Dusicyon thous	
Speothos venaticus	Bush Dog
Mustelidae	
Mustela frenata	Long-tailed Weasel
Lutra enudris	River Otter
Pteronura brasiliensis	Giant River Otter
Conepatus sp. (?)	(Perhaps not in Guyanan region)
Erica barbara	Tayra
Grison vittata	Grison
Felidae	
Felis concolor	Mountain Lion
Felis (Panthera) *onca*	Jaguar
Felis pardalis	Ocelot
Felis tigrina	Margay
Felis jaguarondi	Jaguarundi
Callitrichidae	
Tamarin midas	
Tamarin bicolor	
Tamarin martinsi	
Leontocebus (sp)?	
Cebidae	
Cebus fatuellus	Capuchin Monkey
Cebus apella	
Cebus albifrons	
Lagothrix lagothrix	Wooly Monkey (Not in Guyana?)
Ateles paniscus	Spider Monkey
Ateles ater	
Ateles belzebuth	
Alouatta senicula	Howler Monkey
Saimiri sciureus	Squirrel Monkey
Callicebus torquatus	Widow-Monkey
Pithecia pithecia	Saki Monkey
Pithecia monacha	
Pithecia chiropotes	
Aotus trivirgatus	

Appendix I (continued)

Tapiridae	
Tapirus terrestris	South American Tapir
Tagassuidae	
Tagassu tajacu	Collared Peccary
Tagassu pecari	White-lipped Peccary
Cervidae	
Mazama americana	Red Brocket
Mazama nemorivaga	Gray Brocket
Odocoileus gymnotis	Deer

Source: Tate. 1939.

Appendix II. Mammals Listed by IUCN (1978)

CARIBBEAN MANATEE

Trichechus manatus (Linnaeus, 1758)

Order SIRENIA Family TRICHECHIDAE

STATUS Vulnerable. Occurs in freshwater and coastal areas of the tropical Caribbean region from Florida to the Guianas. Depleted principally by overhunting. Viable and reasonably secure populations are known to occur in Florida, Belize, Guyana and Surinam; elsewhere the species is believed to be declining. Surveys and further conservation efforts are required.

DISTRIBUTION Coastal waters and rivers of the Florida peninsula (stragglers reported from the Carolinas, Georgia, and Texas); Gulf and Caribbean shores of Middle and South America from central Mexico to the Guianas; waters surrounding the islands and the greater Antilles; Atlantic coast of northern Brazil. Present distribution appears to be little changed from the past. (D.S. Hartman 1976, pers. comm.)

POPULATION Estimated to be 600-1000 in the United States; several thousand believed present in Guyana and probably under 1000 in Surinam, also known to occur in Belize, Dominican Republic, Costa Rica, Guatemala and Venezuela but status of the species in these countries is uncertain. Probably declining over most of its range; US population considered to be stable but, in the long-term, further decline is predicted. (2; 3; 4; 5) The principal cause of decline is overhunting, for meat and hides, which began in the Caribbean in the 17th century. The extent of losses through accidental deaths in commercial fisheries is unknown, but in the United States losses from injuries caused by vandals and the propellers of boats are significant. (2; 4)

HABITAT Shallow coastal waters, bays, estuaries, lagoons and rivers. Feeds on submerged and emergent aquatic vegetation. Believed to migrate. Habitat destruction along heavily populated coasts and herbical spraying over weed-choked waterways may pose a threat to the manatees in some regions. (2; 3; 4; 5)

CONSERVATION MEASURES TAKEN Legally protected throughout much of its range but, with some notable exceptions, protection is rarely enforced. Known to occur in the Everglades (USA), Rio Dulce (Guatemala), and Tortugero (Costa Rica) National Parks. Included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973: trade in these animals between acceding nations is subject to severe restriction; trade for primarily commercial purposes is banned. In 1973, the species was the subject of a detailed distribution and status survey in the United States (4); it is also included in the world-wide conservation programme for Sirenia, which in 1975 confirmed its existence in the Dominican Republic. (5) Active research is presently being undertaken on these animals at the US Fish and Wildlife Laboratory in Gainesville. The proposed International Centre for Research on Manatees that is to be established in Georgetown, Guyana, includes among its objectives the conservation of the manatee and the development of husbandry techniques to promote its use as a semi-domestic animal for aquatic weed control. The Caribbean species, which occurs in Guyana, has already demonstrated its ability to control aquatic vegetation and is likely to receive early attention in the Centre's research and conservation programme. (1)

CONSERVATION MEASURES PROPOSED Establishment of the International Centre for Research on Manatees and promotion of its conservation objectives and of the world-wide conservation programme for Sirenia. Encourage further status and distribution surveys with the aim of identifying discrete manatee populations whose protection would be locally enforceable. (3) Control of power-boats and restriction of pollution in areas known to be occupied by manatee populations. (4)

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4. Hartman, D.S. (1974): Distribution, status, and conservation of the manatee in the United States. Office of Endangered Species, US Dept. of the Interior.
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JAGUAR

Panthera onca (Linnaeus, 1758)

Order CARNIVORA Family FELIDAE

STATUS AND SUMMARY Vulnerable. Once fairly common from Mexico to northern Argentina, but exterminated in much of its former range and in most of the remainder greatly reduced in number. Hunting and habitat loss are the prime causes. The Jaguar is now protected in most countries in which it occurs though enforcement is difficult. Whilst illegal hunting must be halted, its future largely depends on habitat preservation.

DISTRIBUTION Formerly southern United States (California, Arizona, New Mexico, Texas and possibly lower Louisiana) through Central America to Venezuela, the Guianas and Brazil, and through Colombia, eastern Peru and Bolivia (east of the Andean foothills), to Paraguay, Uruguay, northern Argentina but not Chile (2; 3; 4; 5; 6). It is now virtually extinct in the United States, most of Mexico and Argentina, and developed areas of Central and South America (6). Eight subspecies are recognized: P. o. palustris - southern Brazil from São Paulo to Mato Grosso, southern Bolivia east of the Andes, Paraguay and Argentina as far south as Chaco and northern Corrientes, but no longer, as early in the century, the provinces of San Luis and La Pampa; P. o. onca - Venezuela, the Guianas and central Brazil east to the state of Espirito Santo; P. o. peruvianus - basins of the upper Solimões (Amazon), Maranon and Ucayali rivers in northeastern Peru; P. o. centralis - north-western South America, through the mountainous region of Colombia and Central America to El Salvador (2); P. o. goldmani - Yucatan peninsula; P. o. hernandesii - western coastlands of Mexico; P. o. veraecrucis - from Chiapas up the east coast to Texas and Louisiana; and P. o. arizonensis - Sonora to the south-western United States (5).

POPULATION No precise estimates but species known to be severely reduced in numbers or absent from large areas of former range. The largest remaining population is in the Amazon rainforest. Highest densities formerly occurred in the Orinoco llanos of Venezuela and the pantanal or swampy savannas of the Mato Grosso in Brazil, but both were heavily hunted from the 1930s to 1960s and jaguars now only survive on large cattle ranches. Hunting also eliminated them from Brazilian coastal forests (6) but fair numbers survive in the Paraguayan Chaco and adjacent areas of Bolivia and Brazil (1; 6). In Argentina jaguars have steadily retreated and are now confined to a few forest or scrubland areas near the northern border, with an estimated density of adults of 1 per 100 sq. km in favourable areas (6). At the northern end of its range, the jaguar was widespread in the lowlands but is now largely restricted to rainforests, palm thickets and coastal mangroves in southern Mexico and the savannas of north-western Guatemala: generally, where it was common 10 to 30 years ago, it is now rare (6).

HABITAT AND ECOLOGY Tropical and sub-tropical forests, sometimes more open woodland, also mangroves, swamps and scrub thickets (6; 10), particularly along watercourses (4). The jaguar rarely occurs at altitudes over 1000 m or in waterless zones (6). It is an excellent swimmer and climbs trees easily, hunting mainly at dawn or dusk or during moonlit nights (4). Its food consists largely of aquatic animals such as capybaras, turtles, iguanas and fish, often scavenged as carrion. Peccaries both collared and white-lipped are also taken (6). Gestation varies from 93 to 105 days and litters range from one to four (4).

THREATS TO SURVIVAL Hunting and habitat loss. The jaguar is the largest Neotropical cat and the richest prize for fur hunters (9), who pursue it with guns or traps, the latter baited with monkeys (often of threatened species) (10). Demand for Latin American spotted cat skins increased substantially in the mid-1960s, but known exports dropped after 1969, thanks to new conservation restrictions and probably because accessible populations had been depleted (6; 9). In the mid-1960s an estimated 15,000 jaguars were killed annually in the Brazilian Amazon, but the number is thought to have been halved after the enactment of conservation legislation in 1967 (9). The price of a crude pelt now varies between US $80 and 130 (9; 10). Near cattle ranches it is still treated as vermin, owners paying bounties equivalent to the price of two cattle (roughly US $250 in Paraguay) and the hide going to the successful hunter as a bonus (1). The U.S.A. officially imported 13,516 jaguar skins in 1968; 9831 in 1969 (9). Hunting and export is still allowed in some Central American countries and restrictions in other countries are poorly enforced; even if hunting is prohibited, the import, manufacture or transit of skins originating from elsewhere is sometimes allowed. The situation generally favours bribery, smuggling and other illicit trade (6) and the new roads criss-crossing the Amazon basin, such as the Trans-Amazonian Highway, constitute a continuing threat to fur-bearing cats. Although up till now the highway itself has had little impact on the rainforest ecosystem and of the 20 km-wide strip set aside by the government for farming, only one km has yet been taken up, the biggest danger is now conversion of forest into cattle pasture (9). Clearing, whether for timber, firewood, cropland, grazing or pine and eucalyptus plantations (notoriously poor habitats for wildlife) together with construction of airstrips for mining and oil exploration, have made once remote areas accessible to hunters and developers. Huge areas of savanna are also burned annually during the dry season (as in Venezuela and Colombia), thus further reducing the woody cover and prey needed by the jaguar (6).

CONSERVATION MEASURES TAKEN The Jaguar is listed in Appendix I of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora, trade in it or its products therefore being subject to strict regulation by ratifying nations, and trade for primarily commercial purposes banned. Legal protection in most countries of its range is difficult to enforce but a gradual improvement has been noted in this respect (6). A few large national parks in Colombia, Peru, Bolivia and Brazil protect limited populations of jaguars (2). It has been stated that no reserve in Brazil contains a viable population (8), but a few apparently persist in Araguaia and Iguacu National Parks (6). Several small reserves protect isolated pairs or families and a number of vast private ranches in Brazilian and Venezuelan savannas are de facto reserves (6).

CONSERVATION MEASURES PROPOSED Stamping out of illegal hunting and illegal trade in skins. Studies of population densities and dynamics and the ecology of the species (6). Its survival depends largely on preservation of habitat and a few suitable savanna reserves have been proposed but have met with opposition because of their high value as potential pasture. Koford argues that conservation based on safeguarding isolated remnants within the boundaries of a park or reserve is insufficient and that the cat must be recognized as an essential part of the lowland tropical ecosystem as well as of a wildlife heritage which is being squandered (6).

REMARKS For description of animal see (3; 4; 7). Some authorities have included the jaguar in the genus Leo. This data sheet was compiled with the assistance of Dr. C. Koford, a member of the IUCN/SSC Cat Specialist Group.

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OCELOT

Felis pardalis Linnaeus, 1758

Order CARNIVORA Family FELIDAE

STATUS AND SUMMARY Vulnerable. Wide distribution from southern Texas to northern Argentina. Numbers declining because of hunting for its pelt and habitat loss. The Texas race albescens is endangered. Existing hunting laws need adequate enforcement. Studies needed as a basis for establishing reserves which will give the ocelot effective protection.

DISTRIBUTION Southern Texas through Central and South America to northern Argentina (6; 9; 10) but not Chile (6). Many subspecies have been described but data on their distribution and status are scanty. The endangered F. p. albescens is now restricted to the Texas/Mexico border region south of a line between Eagle Pass and Corpus Christi, Texas (12) as far as the coastal lowlands of south-eastern Tamaulipas, about 32 km north of Tampico (1; 2). F. p. mearnsi from Panama, Costa Rica and Nicaragua and F. p. mitis from central and eastern Brazil (south of the lower Amazon), Paraguay and northern Agentina (5), are also listed in the Washington Convention.

POPULATION No figures available. Rare and threatened in parts of its range but not in others such as the Chaco region of Paraguay and adjacent areas of eastern Bolivia (3; 11). Its populations near settlements, roads and waterways are known to have been everywhere seriously reduced (11). Koford suggests that less than 1000 adults of the subspecies albescens may now survive.

HABITAT AND ECOLOGY Humid tropical and subtropical forests, coastal mangroves, swampy savannas and even semi-arid thorn scrub. The Texas race inhabits scrub vegetation along waterways and in mountainous areas (12) and brushy coastal lowlands of Tamaulipas (11). More adaptable than the jaguar, Panthera onca, ocelots may persist in partly-cleared forests, second growth woodland, and abandoned cultivation which has gone back to bush (11). It is an expert climber and hunts for food both in trees and on the ground (10; 16). The varied diet includes fish and reptiles as well as small mammals and birds (11; 16). Its cubs, usually two in number, are born between September and January (10).

THREATS TO SURVIVAL The Ocelot is in great demand by the fur industry, widespread, easily trapped or shot, and therefore the most frequently hunted cat in Latin America. The demand for Latin American spotted cat skins increased substantially in the mid-1960s but known exports dropped after 1969, with new conservation restrictions and probably because accessible populations had been depleted (11; 15). In the late 1960s it was estimated that 80,000 ocelots were killed annually in Brazilian Amazonas, but implementation of conservation legislation in 1967 is thought to have halved the number. None the less, in 1968, 128,966 ocelot skins and in 1969, 133,069 were imported into the USA (14). In 1975, Britain imported 76,838 (4). Panama, Honduras, Guyana and a few other countries still allow hunting and commerce in ocelot pelts. The recent price paid to a hunter for a crude pelt was about US$ 40 (15). Such conditions invite smuggling from countries now trying to protect their cats (11). Ocelots are also reported to be much in demand as pets, selling for $ 800 (7) and the trade still flourishing in Nicaragua, where the method is to kill the mother in order to capture the cubs (S. Ryan 1977, pers. comm.). The new roads being built in the Amazonian region are not considered by Smith as likely to threaten the status of wild cats for decades; as yet the Trans-Amazonian highway has had little impact on the rainforest ecosystem, only 1 km of the 20 km-wide strip along the road allocated by the government for agricultural development having been effectively taken up, poor soils, ill-chosen crops and other factors having slowed down the human colonisation; but clearing of forest for cattle raising is posing a bigger threat (15). Elsewhere, clearing of land for plantation crops has eliminated vast belts of the ocelot's lowland habitat. If protected from hunting the ocelot would survive but adequate woody cover is essential.

CONSERVATION MEASURES TAKEN The species as a whole is listed in Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora, trade in it or its products therefore being subject to regulation and monitoring by ratifying nations. Three subspecies F. p. albescens, F. p. mearnsi and F. p. mitis are listed in Appendix 1, trade in them therefore being subject to much stricter regulations and trade for primarily commercial purposes banned. The species is also listed as endangered in the USA which makes hunting illegal and importation of it illegal, and is protected by law in Mexico. In fact, ocelot hunting and trading are prohibited in most countries of its range (in Colombia and Peru, for example, from 1973). Unfortunately, enforcement is difficult because hunters are so numerous and the ocelot skins easy to conceal. Several national parks, reserves and private ranches give the ocelot protection (11), the Texas race, for example, in the National Wildlife Refuges of the lower Rio Grande Valley, where river-bottom brush is not cleared for agriculture.

CONSERVATION MEASURES PROPOSED More effective suppression of illegal hunting and international commerce in illicit skins, including strict enforcement of existing laws. The Brazilian practice of leaving 'islands' of unutilized forest behind when land is cleared, thus providing refuges for ocelots and other wildlife, should be copied elsewhere in the ocelot's range (11). Studies are needed to determine the extent to which wild populations could supply a sustainable yield for the fur industry (11) and to provide a sound basis for the creation of effective reserves for the species.

REMARKS For description of animal see (6; 8; 10). In 1976, 91 males, 86 females and 3 of unknown sex were held in 76 collections (13). This data sheet was compiled with the assistance of Dr. C. Koford and Dr. R.H. Baker.

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GIANT OTTER

Pteronura brasiliensis (Gmelin, 1788)

Order CARNIVORA Family MUSTELIDAE

STATUS Endangered; almost certainly the most endangered species of Amazonian mammal, occurs in rivers of eastern Brazil to Paraguay, northeast Argentina and Uruguay, parts of the Guianas, Venezuela, Colombia and Peru. Its range and population size has been seriously reduced by over-hunting for the fur trade as it is relatively easy to hunt and its pelt commands a high price. It is totally protected in Brazil, Ecuador and Peru, but enforcement is difficult in isolated areas. It occurs in parks in Brazil, Colombia, and Peru. It was recorded from Bolivia in 1933.(2)

DISTRIBUTION Former distribution not known precisely, but has contracted considerably in Peru (4), and there has undoubtedly been a similar reduction in other parts of its range. At present it inhabits the eastern rivers of Brazil, from the Guianas south to Paraguay, extreme northeast of Argentina (very rare on the rivers of Parana and Uruguay) and the Rio Negro, Uruguay. In French Guiana it occurs on the upper Maroni and a few other rivers. (J. Leclerc 1976, pers. comm.) It is also found in Surinam, Guyana, and the Territorio Amazonas; in Venezuela, in the Orinoco, Caura, Ventuari Apure, Arauca, Cunaviche, Capanaparo, Claro, Aguaro and Cinaruco rivers and probably in other rivers in the Llanos and Amazon region, but very scarce. Small relict populations probably survive in a number of rivers in Peru but the only undisturbed population is in the basin of the River Manu, in the Rio Madre de Dios drainage system. In Colombia it still exists in some numbers in the lower part of the Macarena Reserve, and in the National Reserve of Rio Tomo, an effluent of the Orinoco.(4; 6; I.R. Grimwood 1967/68, pers. comm.; C.P. Trebbau 1964, pers. comm.) In eastern Brazil, the typical race, P.b. brasiliensis has all but disappeared, although some individuals probably still occur in more isolated, smaller rivers of the Rio Sao Francisco system. In 1973, during a four month survey of the Rios Negro Tapajos, Solimoes, Japura and lower Amazon, Mittermeier was unable to locate anyone who had recently seen it, although many people were familiar with it from times when it was still abundant. The southern sub-species, P.b. paranaensis, has also just about disappeared in the states of Sao Paulo, Parana, Santa Catarina and Rio Grande do Sul. Occasionally specimens still crop up in the effluents of the Rio Parana. In the Rio Ivinheima (Mato Grosso), Coimbra-Filho was unable to locate any specimens of the southern race, even though local inhabitants reported that 20 years ago it was quite abundant. It was seen in 1967-68 in the Xingu Indian National Park (Mato Grosso) and is also said still to occur on Rio Sumissu (upper Xingo), Rio Fresco, Rio Biozinho and Rio Mucajai off the Boraima. It has been seen once in the last five years on the Rio Formoso in the Emas National Park (Goias).(6)

POPULATION There are no reliable estimates of population sizes. In Brazil it has been hunted out of the better part of its range and continues to be persecuted in spite of the fact that it is protected by law. H.W. Schwarz, a fish exporter in Manaus with more than 30 years of experience in Amazonia, says it has diminished tremendously in recent years and will be extinct, or nearly so, within ten years - unless the Government imposes a severe penalty upon anyone found with any part of this animal. Unlike the manatee, the giant otter is very curious and trusting, allowing people to approach very closely in areas where it has not been persecuted. In addition, it is very loud and easy to locate and diurnal. It is also social, going in groups of up to 20 in undisturbed areas. In Venezuela, extinction is not imminent, but the otter has declined considerably in those rivers, especially the Apure, which are easily accessible to hunters. In Peru, it has now virtually disappeared; animal export figures in the mid-1960's are a tenth of the figures in the mid-1940's (4; C.P. Trebbau 1964, pers. comm.) The decline has been caused solely by commercial hunting for the skin, which is equal in value to that of a jaguar. Because their carcases sink at death, probably two or three animals are killed for every skin that reaches the market.(I.R. Grimwood 1967/68, pers. comm.)

HABITAT Confined to the low selva zone of the Amazon region and principally found in "black water", i.e. the slow flowing, peat-stained reaches of these Amazon rivers and the intricate system of lagoons and backwaters associated with them. At times of low water they are found in the rivers, but during the flood season, they follow the spawning fish into the smallest of creeks and drains. In Peru, they are never found in the clear, fast flowing upper reaches of the rivers (i.e. "white water") but in Venezuela and Guiana heavy persecution has driven the species into the upper reaches of the rivers.(4; D. Branch 1969, pers. comm.)

CONSERVATION MEASURES TAKEN Protected by law in Brazil, Colombia, Ecuador, Guyane, Peru, Surinam and Venezuela. In Brazil it is on the endangered species list, but enforcement of conservation laws is very difficult or impossible in the remote areas where it still occurs. P. b. brasiliensis is protected in the National Parks of Araguaia (Goias), Tocantins (Goias), Brasilia (Distrito Federo), Emas (Goias and Mato Grosso) and in the Biological Reserve of Cará-cará (Mato Grosso). In Peru the bulk of its remaining undisturbed range lies within the Manu National Park. Occurs in at least two reserves in Colombia. Included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973; trade in these animals between acceding nations is subject to severe restriction, trade for primarily commercial purposes is banned. In 1971/74, the International Fur Trade Federation operated a voluntary ban on the use of its furs.

CONSERVATION MEASURES PROPOSED Urge the Governments of Paraguay, Uruguay, Guiana and Argentina to give full legal protection to the species, and the Governments which already protect it to enforce their existing restrictions and legislation. Urge all the above Governments to sponsor surveys and to create more reserves. Obtain information on countries importing and selling Giant otter pelts and put pressure on the Governments of those countries to adhere to the Washington Convention and stop this trade. It has been suggested that it could be reintroduced into Monte Pascoal National Park in Bahia and the Sooretama Biological Reserve in Espirito Santo, Brazil. A captive breeding programme for this species should be initiated while it is still possible to obtain specimens.

REMARKS In 1974, 7 males and 11 females were held in 8 collections.(3) Carvalho (1967) reported that in nine years, 61,028 pelts were imported from the Brazilian State of Amazonas alone.

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BUSH DOG

Speothos venaticus (Lund, 1842)

Order CARNIVORA Family CANIDAE

STATUS Rare, throughout its range; absent in areas of human settlement. Possibly at risk as more and more of the Amazon region is opened up for human occupation.

DISTRIBUTION Widely but sparsely distributed in Panama, eastern Peru and northern Bolivia.(1) Recently discovered in northern Argentina (Misiones).(2) Occurs in Surinam. (R.A. Mittermeier 1976, pers. comm.)

POPULATION Apparently never abundant in Peru or Colombia (the native people do not know it and have no name for it); it is reported to be now extremely absent in areas of human habitation. (D.S. Grimwood 1969, pers. comm.) Like most other Amazonian species, it is affected by habitat destruction but it is not especially hunted or sought as a pet. (A.F. Coimbra-Filho and R.A. Mittermeier 1974, pers. comm.)

HABITAT Tropical forest and savanna areas of the Amazon region. Reported to spend the day in abandoned burrows of armadillos.(3) In French Guiana only found in the primary forests of the interior. (J. Leclerc 1976, pers. comm.)

CONSERVATION MEASURES TAKEN Protected by law in Brazil and Peru. Not protected (but not hunted) in French Guiana. (J. Leclerc 1976, pers. comm.) In Brazil, may be present in Araguia and Tocantins (Goias), Brasilia (Distrito Federal), Emas (Goias and Mato Grosso), and Iguacu National Parks and in the Cara-Cara Biological Reserve (Mato Grosso). Probably also occurs in the Manu National Park, Peru, and Iguazu National Park, Argentina, and three of four rain forest reserves in the interior of Surinam.

CONSERVATION MEASURES PROPOSED Legal protection in all countries within its known range; ecological studies to determine what conditions must be provided in parks and reserves to ensure its survival would be difficult in view of its scarcity. A detailed study of its distribution would be most useful. (A.F. Coimbra-Filho, and R.A. Mittermeier 1974, pers. comm.)

REMARKS The bush dog is apparently nocturnal and hunts in packs. It is reported to be able to dive and swim under water in pursuit of pacas (Cuniculus paca).

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GIANT ANTEATER

Myrmecophaga tridactyla (Linnaeus, 1758)

Order EDENTATA Family MYRMECOPHAGIDAE

STATUS Vulnerable. Has a wide distribution in Central and South America but is disappearing rapidly as a result of over-hunting and the spread of human settlement. Occurs in several national parks and reserves.

DISTRIBUTION Central and South America, from Guatemala to northern Argentina. The nominate race occurs from Venezuela and Guayana as far as Peru, northern Argentina (Salta, Formosa, Chaco and Misiones), Paraguay and southern Brazil. The subspecies M.t. artata occurs in Colombia and the western part of Venezuela as far as the Cordillera de Merida. (1) Farther north it is replaced by the Central American subspecies M.t. centralis, which ranges from Belize near Punta Gorda southward along the Caribbean coast to Colombia and up the Pacific coast to Guatemala. (5) The species ranges over the French Guiana savanna region at low altitudes. (J. Leclerc 1972, pers. comm.) In Peru, it occurs mainly in the low selva zone of the Amazon region, within the basins of the Ríos Ucayali, Marañon [illegible] in the departments of Loreto from the north and the south of the Department of San Martín, [illegible] from the Provinces [illegible] Pachitea [illegible], Jauja (Junín), Paucartambo (Cuzco), Sandia (Puno) and Manu (Madre de Dios). [illegible]

ABUNDANCE Nowhere common; reported to be uncommon and localized in most regions, its range and populations are undoubtedly contracting as a result of [illegible] and [illegible] human disturbance. Argentina: it has disappeared wherever human settlement has occurred, and is now a rare animal in the northern areas of Argentina. (2) Brazil: in the Amazon region of Brazil, the animal [illegible] usually [illegible] on [illegible]. Paraguay: still appears to be fairly common in some areas, frequently acquired by live animal dealers in Asunción. (A.F. Coimbra-Filho and R.A. Mittermeier 1974, pers. comm.) Peru: the species appears also to have been uncommon and has now disappeared from many areas where it was formerly known. (4) Guatemala: has already been exterminated from much of Guatemala, although it is reported in the Pacific coast region between San José and the border of El Salvador. (7) French Guiana: it is not common in French Guiana and is threatened by trophy hunters and live animal dealers. (J. Leclerc 1972, pers. comm.) Costa Rica: rare. (G. Vaughan 1972, pers. comm.)

HABITAT Grasslands and more open forests of the humid tropical lowlands but may venture into thicker vegetation. In French Guiana, it ranges over the savanna region up to 150 m altitude; it is now largely confined to isolated, wilderness areas. In Peru, it occurs mainly within the low selva zone (below 500 m altitude) but may extend to the lower part of the high selva zone, up to 900 m altitude. Its available habitat is being reduced by increasing human pressures on land. (4; 6; J. Leclerc 1972, pers. comm.)

CONSERVATION MEASURES TAKEN Is totally protected by law in Brazil and French Guiana. Colombia and Peru have placed an indefinite ban on hunting, killing and capturing the species. Included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973; trade in these animals between acceding nations is subject to strict regulation and monitoring of its effects. In Brazil, it occurs in the National Parks of Araguaia (Goiás), Brasília (Distrito Federal), Emas (Goiás and Mato Grosso), Monte Pascoal (Bahia), Iguaçu (Paraná), Sete Cidades (Piauí) and Tocantins (Goiás), and in the Biological Reserves of Caracará (Mato Grosso), Córrego de Veado and Sooretama (Espírito Santo). (A.F. Coimbra-Filho, and R.A. Mittermeier 1974, pers. comm.) It also occurs in the National Parks of Iguazu (Argentina), Tortuguero (Costa Rica), Tikal (Guatemala) and Manu (Peru). An ecological study of this animal is in progress.

CONSERVATION MEASURES PROPOSED Stricter enforcement of protection. A campaign is needed to convince rural human populations of the importance of this species as a predator on termites and ants, and of its harmlessness to humans. (A.F. Coimbra-Filho, and R.A. Mittermeier 1974, pers. comm.)

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GIANT ARMADILLO

Priodontes giganteus (Geoffroy, 1803)

Order EDENTATA **Family** DASYPODIDEA

STATUS Vulnerable. Its range, in northern and eastern South America, is wide but populations have been reduced or exterminated in many areas by overhunting, settlement and agricultural development.

DISTRIBUTION From southeast Venezuela, southern Colombia, Peruvian Amazonia, and the Guianas, through Brazil, Bolivia and Paraguay as far as Misiones, Formosa and Chaco in the far northeastern sector of Argentina. The boundaries of this range have probably altered little in recent decades, but the species' actual distribution within this range has contracted.(1; 3)

POPULATION [illegible] unknown; apparently widespread but always sparsely distributed, of solitary habit and never common. Carvalho (1957) stated that the species was observed most commonly in southeast Brazil and the Guianas. Ruschi (1954) counted only three individuals in a census of 10.7 sq.km of unexploited forest in Espírito Santo State, Brazil. J.C. Mello Carvalho (1974, pers. comm.) has reported some 30 individuals in Brasília National Park (28,000 ha). The flesh of the armadillo is relished and it is hunted by man whenever it is encountered; the species has disappeared from the vicinity of all settlements in Peru. (2; 3; 4; A.F. Coimbra-Filho and R.A. Mittermeier 1974, pers. comm.)

HABITAT Unbroken, relatively undisturbed forest; in Peru, it appears to be largely restricted to tropical forest in the low selva zone (below 500 m altitude) that are not subjected to flooding. The species is a highly specialized animal that is intolerant of disturbance; its range is receding under the impact of deforestation, [illegible] and agriculture, [illegible] for irrigation [illegible]. The Transamazonian Highway and other roads throughout Amazonia, is continuing to open large areas of previously undisturbed forest to human colonization. (2; R.A. Mittermeier 1976, pers. comm.)

CONSERVATION MEASURES TAKEN Protected against hunting or capture by law in Argentina, Brazil, Colombia, Peru [illegible]; included in Brazil's endangered species list. Protected against hunting from September until February, inclusive, in Paraguay. Included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; trade in these animals between acceding nations is subject to severe restriction, trade for primarily commercial purposes is not permitted. In Brazil, it is believed to occur in the national parks of Araguaia (Goiás), Iocatim (Goiás), Emas (Goiás, Mato Grosso), Monte Pascoal (Bahia) and the biological reserves of Cariceara (Mato Grosso) and Sooretama (Espírito Santo). (A.F. Coimbra-Filho and R.A. Mittermeier 1974, pers. comm.) In Colombia, it occurs in the Sierra de la Macarena National Park and the El Tuparro Reserve and, in Peru, it occurs in the Manu National Park and Pacaya National Reserve. It is protected in at least four nature reserves in Surinam. (R.A. Mittermeier 1976, pers. comm.)

CONSERVATION MEASURES PROPOSED Stricter enforcement of protection or regulation of hunting; where habitat destruction is unavoidable, consideration could be given to the translocation of some animals to protected areas. The species is difficult to maintain in captivity and a captive breeding programme might have little hope of success. (A.F. Coimbra-Filho and R.A. Mittermeier 1974, pers. comm.)

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Appendix III

Abstracts of Articles on

1. The Manatee

2. The Mazaruni Hydropower Project

ACCESSION NO. 76J0052647
TITLE OPERATION MERMAID
AUTHOR(S) CARR, A.
AFFILIATION UNIV OF FLORIDA
DATE MAR-APR 1976
PUB DESC INTL WILDLIFE, MAR-APR 76, V6, N2, P12 (6)
SUBJ CODE 21
ABSTRACT FEATURE ARTICLE:THERE HAS BEEN A WORLDWIDE SURGE OF INTEREST IN THE WORSENING SURVIVAL OUTLOOK OF SEA COWS. ONE OF THE FACTORS RESPONSIBLE FOR GROWING PUBLIC CONCERN FOR MANATEES IN THE U.S. HAS BEEN THE NEW VISIBILITY THEY ACQUIRED WHEN THEY RETURNED TO SOME OF THE BIG FLORIDA SPRINGS, WHICH WERE ONCE PART OF THEIR NORMAL WINTER HABITAT UNTIL HUNTING AND POACHING DROVE THEM OUT. CURRENT ATTEMPTS TO SAVE THE SEA COW ARE DESCRIBED. (4 PHOTOS)
LIT. INDICATOR JOURNAL ARTICLE OR REPORT
SOURCE VOLUME 6
SOURCE ISSUE 2
SOURCE PAGE(S) 12-17
LIT. TYPE J
EST YEAR 76
EST VOLUME 6
EST NUMBER 07606945
KEYWORDS WILDLIFE;MARINE MAMMALS;DUGONGS;MARINE MAMMAL PROT ACT 71; ENDANGERED SPECIES-ANIMAL;FLORIDA;GUYANA;U S FISH WILDLIFE SERVICE;LEGISLATION, ENV-INTL;HUNTING;EXTINCT SPECIES-ANIMAL INTL WILDLIFE

ACCESSION NO. 76R0005433
HEADER W76-05433
TITLE AN INTERNATIONAL CENTRE FOR MANATEE RESEARCH.
CORP AUTH NATIONAL ACADEMY OF SCIENCES, WASHINGTON, D.C.
AVAIL AVAILABLE FROM THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VA 22161 AS PB-240 244, $3.75 IN PAPER COPY, $2.25 IN MICROFICHE. REPORT OF A WORKSHOP HELD FEBRUARY 7-13, 1974 AT GEORGETOWN, GUYANA, 1974. 38 P, 13 FIG., 1 TAB., 17 REF. AD/A-025-2584.
IDENTIFIERS #MANATEES, GUYANA.
COMM CATEG. 04A,05B;05G
ABSTRACT MANATEES SHOW GREAT POTENTIAL FOR CONTROLLING AQUATIC WEED INFESTATIONS IN TROPICAL WATERS. THEY ARE NATIVE TO MORE THAN 40 TROPICAL COUNTRIES IN THE AMERICAS AND AFRICA AND ARE THE WORLD'S ONLY HERBIVOROUS, TOTALLY AQUATIC MAMMAL. THEY HAVE BEEN USED SUCCESSFULLY IN GUYANA TO CLEAR WEEDS FROM CANALS. THEIR USE COULD ENHANCE DRAINAGE, IRRIGATION, HYDROELECTRIC SCHEMES, TRANSPORTATION, FISHING, AND WITH PROPER HUSBANDRY, CAN BE A PALATABLE PROTEIN SOURCE FOR HUMAN CONSUMPTION; 65% OF THE CARCASS CAN BE USED IN ADDITION TO THE MEAT. HOWEVER, MANATEES ARE ALMOST EXTINCT. MAN IS THEIR ONLY PREDATOR. ONCE A COLONY IS ESTABLISHED IN WEED INFESTED AREAS THERE ARE NO MAINTENANCE COSTS. AN INTERNATIONAL CENTER FOR MANATEE RESEARCH AT GUYANA IS PROPOSED TO SPONSOR, PROMOTE, AND COORDINATE ACTIVITIES ON BASIC RESEARCH, MANATEE EFFECTIVENESS AS AQUATIC WEED CONTROL AGENTS IN TROPICAL REGIONS, TO DEVELOP PROGRAMS FOR REPOPULATING DEPLETED HABITATS, TO PROMOTE CONSERVATION, TO FOSTER THEIR DOMESTICATION, AND TO PROVIDE GUIDANCE IN PLANNING AND TECHNIQUES OF ADVANCED MAMMALIAN RESEARCH. AN INTERIM STEERING COMMITTEE WAS APPOINTED TO ORGANIZE THE RESEARCH CENTER'S ESTABLISHMENT. (BUCHANAN-DAVIDSON--WISCONSIN)
ISSUE NO W9 111
KEYWORDS #BIOCONTROL, #MAMMALS, #AQUATIC WEED CONTROL, TROPICAL REGIONS, AQUATIC ANIMALS, HERBIVORES, ECOLOGICAL DISTRIBUTION, LIFE CYCLES, DIETS, CONSERVATION, RESEARCH AND DEVELOPMENT.

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ACCESSION NO. 75J0042899
TITLE THE ENDANGERED BUT USEFUL MANATEE
AUTHOR(S) VIETMEYER, N.
AFFILIATION NAS
DATE DEC 1974
PUB DESC SMITHSONIAN, DEC 74, V5, N9, P60 (6)
SUBJ CODE 21
JOURNAL CODEN SMSNA
ABSTRACT FEATURE ARTICLE:MANATEES, AIR-BREATHING, WARM-BLOODED ANIMALS RELATED TO THE ELEPHANT, MAY BE THE WORLD'S MOST ENDANGERED AQUATIC MAMMAL. FOUND IN MORE THAN 40 COUNTRIES, MANATEES CLING TO SURVIVAL BY A THREAD. IN 1973 GUYANA ASKED NAS TO DEVISE SOLUTIONS TO A SERIOUS PROBLEM CAUSED BY AQUATIC WEEDS. SINCE MANATEES MAY EAT UP TO 150 LB OF AQUATIC PLANTS A DAY, THEY MIGHT BE THE ANSWER TO UNCLOGGING WATERWAYS AND CANALS. GUYANA WILL ESTABLISH A SMALL RESEARCH INSTITUTE TO STUDY MANATEE BREEDING. (6 PHOTOS)
LIT. INDICATOR JOURNAL ARTICLE OR REPORT
SOURCE VOLUME 5
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SOURCE PAGE(S) 60-65
LIT. TYPE J
ESI YEAR 75
ESI VOLUME 5
ESI NUMBER 07505796
KEYWORDS WILDLIFE;GUYANA;MARINE MAMMALS;AQUATIC WEED CONTROL;ENDANGERED SPECIES-ANIMAL;RESEARCH, ENV;ENV PROGRAMS, NON U S;BIOLOGICAL CONTROL-WEEDS
SMITHSONIAN

ACCESSION NO. 75J0037494
TITLE SEA COWS EAT THEIR WAY TO DOMESTICATION
AUTHOR(S) SPURGEON, D.
AFFILIATION DEVELOPMENT RESEARCH CENTRE, CANADA
DATE 1 AUG 1974
PUB DESC NEW SCIENTIST, AUG 1, 74, V63, N908, P236 (2)
SUBJ CODE 06
JOURNAL CODEN NWSCA
ABSTRACT FEATURE ARTICLE:THE MANATEE, SOMETIMES CALLED THE SEA COW, HAS TWO POTENTIAL USES FOR PEOPLE: ITS VORACIOUS APPETITE FOR AQUATIC PLANTS COULD BE USED FOR WEED CONTROL IN TROPICAL COUNTRIES, AND ITS AMPLE AND SUCCULENT FLESH COULD LEAD TO ITS DOMESTICATION AND BREEDING AS A PROTEIN SOURCE IN DEVELOPING NATIONS. A MAJOR OBSTACLE TO ANY PLAN TO USE THE MANATEE IS THE CURRENT LACK OF KNOWLEDGE OF ITS REPRODUCTIVE LIFE, NUTRITION, AND PATHOLOGY. THE GOALS OF THE INT'L MANATEE RESEARCH CENTER IN GUYANA ARE DESCRIBED. (1 PHOTO)
LIT. INDICATOR JOURNAL ARTICLE OR REPORT
SOURCE VOLUME 63
SOURCE ISSUE 908
SOURCE PAGE(S) 236-239
LIT. TYPE J
ESI YEAR 75
ESI VOLUME 5
ESI NUMBER 07500463
KEYWORDS FOOD & DRUGS;MAMMALS;AQUATIC WEED CONTROL;DOMESTIC ANIMALS; GUYANA;BIOLOGICAL CONTROL-WEEDS;DEVELOPING NATIONS;WILDLIFE
NEW SCIENTIST

ACCESSION NO.	77U00C4329
TITLE	GUYANA. "LAND OF WATERS." MOVES TO HARNESS HYDRO POTENTIAL
AUTHOR	CASEY, D.J.
PUB DESC	ACTION UNDP, NOV-DEC 76 (1)
SUBJ CODE	13
ABSTRACT	NEWS FEATURE:IN ITS MOST AMBITIOUS DEVELOPMENT EFFORT TO DATE, GUYANA IS PLANNING TO HARNESS ITS ENORMOUS HYDROELECTRIC POTENTIAL ESTIMATED AT 7,200 MW TO PROVIDE CHEAPER ENERGY FOR ITS EXPANDING BAUXITE INDUSTRY, AND TO DEVELOP ITS FORESTRY, AGRICULTURAL, AND TOURISM INDUSTRIES. THE DAM'S CONSTRUCTION WILL REQUIRE THE CREATION OF A 200 SQ MI LAKE TO TRAP ABOUT 40,000 MILLION CU FT OF WATER. SOME OF THAT LAND IS NOW OCCUPIED BY 4500 AMERICAN INDIANS AND GUYANESE WHO WILL HAVE TO BE RESETTLED BEFORE THEIR LANDS ARE FLOODED IN 1980. A SPECIAL UNIT, DEVELOPMENT SUPPORT COMMUNICATION, HAS BEEN ESTABLISHED TO STUDY THE HUMAN PROBLEMS OF THOSE IN THE COMMUNITIES INVOLVED, AS MANY DEVELOPMENT PROJECTS IN THE THIRD WORLD HAVE FAILED BECAUSE THE RECIPIENT POPULATION WAS NOT MADE AWARE THAT THE PROJECT WAS FOR THEM. THE GUYANESE GOVERNMENT'S ROLE IN THE BAUXITE INDUSTRY AND DAM CONSTRUCTION IS DISCUSSED. (2 PHOTOS)
ICC	105
LIT INDICATOR	JOURNAL ARTICLE OR REPORT
LIT TYPE	U
EIA YEAR	77
EIA VOLUME	7
EIA SEQ NO	07720427
KEYWORDS	ELECTRIC POWER GENERATION;GUYANA;HYDROELECTRIC POWER;DAM CONSTRUCTION;WATER RESOURCES MANAGEMENT;BAUXITE; NATIONALIZATION, NON U S;U N DEVEL PROGRAM;FORESTRY;RESERVOIRS; AGRICULTURAL DEVELOPMENT;TOURISM;ALUMINUM ORES

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Appendix IV. Reptiles Listed by IUCN (1975)

GREEN TURTLE

Chelonia mydas (Linnaeus, 1758)

Order TESTUDINES Family CHELONIIDAE

STATUS Endangered. Drastically reduced and in some areas (e.g. Bahamas, Florida) totally eliminated by over-exploitation (1). In other areas, including Australia, its status is still sound (15).

DISTRIBUTION Seas where temperature does not fall below 20°C (68°F) in the coldest month; occasionally found in colder waters (1).

POPULATION Total unknown. Extinction or decline of some populations attributed particularly to exploitation for meat, hides, eggs and other products (including souvenirs), massive killing of turtles in the trawl nets of fishing fleets, and increasing habitat destruction and disturbance. The situation has become even more critical with the expansion of international trade in sea turtles and their products (15).

HABITAT Makes long, little-understood migrations between nesting beaches and the habitat in areas of submarine vegetation where most of its life is spent (15).

BREEDING RATE IN WILD Usually nests every second or third year; clutches average of 106 eggs; infant mortality very heavy (14).

CONSERVATION MEASURES TAKEN Transplantation of eggs to special hatcheries on islands off south-west coast of Borneo (2, 15), in Pacific Trust Territories, in Costa Rica and elsewhere (15). The effectiveness of this practice has not been proved. Laws protecting nesting sites, egg-laying females and all adults are being increasingly promulgated in many parts of the world, but not always strictly enforced (4, 5, 7, 8, 11-13, 15, 19, 20). Research programmes have often neglected active conservation measures on the spot (15). Species is listed in Appendix II of the Convention on International Trade in Endangered Species or Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED All mass nesting sites to be completely protected as soon as possible: the species is nowhere in a condition to support continued exploitation at its breeding grounds or by international commerce; the sole justification for harvesting diminishing stocks might be as subsistence for local people and when the turtles are taken in their normal marine habitat, so that the drain is shared by both sexes and by immatures as well as adults; enforced prohibition of exploitation at all rookeries and of international traffic in turtles and turtle products and strict control of local markets are therefore considered essential (1, 2, 3). The distinction between turtle farming and turtle ranching has been emphasized in this connection: a turtle farm is completely independent of wild stocks, while a ranch is dependent on removing eggs or turtles from wild populations into varying degrees of captivity (15). However, farming which leads to expansion of existing markets and hence possibly an increased exploitation of wild turtles is of no conservation value, although it can be endorsed if its products replace wild turtle products in existing traditional markets; hence the acceptability of any farming project should be demonstrated by suitably designed and independently evaluated tests and data; to some extent, the same considerations might apply to ranching projects, if and when it can be positively shown that no harm is being done to the wild turtle populations concerned (15).

NUMBER IN CAPTIVITY Considerable.

BREEDING POTENTIAL IN CAPTIVITY Can be reared in captivity, but the long term effects of doing so are still uncertain.

REMARKS Two forms of Chelonia mydas are recognized: the typical subspecies mydas of the Atlantic and, apparently, Indo-Pacific region; and the subspecies agassizi of the eastern Pacific (from Baja California to the Galapagos Islands and Peru, and westward to Hawaii and the Marshalls), which is discussed in the next entry (15).

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LEATHERY TURTLE, LEATHERBACK or LUTH

Dermochelys coriacea (Linnaeus 1766)

Order TESTUDINES Family DERMOCHELYIDAE

STATUS Endangered, particularly in certain areas.

DISTRIBUTION Nests widely in the tropics, but in the non-breeding season may range far to the north and south in temperate zones (1 and A.F. Carr in litt.).

POPULATION World population small, vulnerable and probably declining in some areas. At Matina Beach, Costa Rica, it is estimated that 20%-30% of the breeding population is killed annually, while the eggs, considered a delicacy wherever found, are systematically collected, often as a local business enterprise, on many nesting beaches. The only practicable estimate that can be made of populations must be based on numbers of breeding females, since males are rarely seen and impossible to count. On this basis it is calculated that about 4000 leatherbacks nest in Trengganu, Malaya, about 15,000 in French Guiana, at least 1000, possibly more, at Matina Beach, Costa Rica, and perhaps 200-400 each in Trinidad, Surinam, South Africa, Sri Lanka and south India. Taking account of populations that nest on eastern Pacific shores from Mexico to Peru, the size of which can only be guessed, and of uninvestigated beaches elsewhere, the total number of breeding female leatherbacks in the world can be put at between 30 and 40 thousand (1).

HABITAT Oceanic. Makes long, little understood migrations (1).

BREEDING RATE IN WILD Leatherbacks may nest at least four, probably six, or up to ten times in a season, successive layings being at intervals of about 10 days. Fewer eggs are laid than by any other marine turtle, except Chelonia depressa: average clutch size in a series of Surinam nests was 87. The incubation period on the same beaches was 60 to 73 days and the percentage of eggs hatched 76% (1).

CONSERVATION MEASURES TAKEN About 15 years ago the Malayan Nature Society under the guidance of Professor J.R. Hendrickson started to transplant eggs into special protected enclosures; a hatch as high as 70% under these artificial conditions was achieved. The turtle hatcheries are now under the jurisdiction of the Fisheries Department. In the period 1961-71, 247,531 eggs were transplanted and 133,884 hatchlings produced for release. The project is continuing with the aid of a WWF grant. The number of eggs incubated in 1971 represented about 5% of the total eggs laid on the 20 km long beach; the project aims to increase this number to 15% over 1973-76. The number of eggs planted in June/July 1973 was 72,208. Laws have been enacted to protect leatherbacks in Surinam, French Guiana, Costa Rica, Trinidad, Tobago, Mexico, South Africa, Sri Lanka and Australia (Queensland). Classified in Category A by the African Conservation Convention of 1968. Included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (1, 2).

CONSERVATION MEASURES PROPOSED Better enforcement of protective laws both on and away from the nesting grounds. Establishment of National Parks to safeguard most important rookeries (2).

NUMBER IN CAPTIVITY Very few specimens in public aquaria.

BREEDING POTENTIAL IN CAPTIVITY Virtually nil.

ATLANTIC RIDLEY TURTLE

Lepidochelys kempi (Garman, 1880)

Order TESTUDINES Family CHELONIIDAE

STATUS Endangered.

DISTRIBUTION Mature specimens have been found only within the Gulf of Mexico, but immatures leave the Gulf and are found from central Florida to Massachusetts and Europe. The only nesting place is near Rancho Nuevo, Municipio de Aldama, Tamaulipas, Mexico, except for individuals nesting sporadically in Veracruz and on Padre Island, Texas (2). Its absence from the Caribbean is apparently completely natural (A. Carr in litt.).

POPULATION The world population of mature females is perhaps between 2500 and 5000 (2). During the years following the discovery of the mass daytime nesting emergences 25 years ago, the numbers coming ashore in a single day were estimated to be as high as 40,000. By 1963, these arribadas (arrivals) had dwindled to a few thousand and today may sometimes number only several hundred.

HABITAT Breeds on shore; forages on shallow bottom; occasionally carried by currents into open ocean.

BREEDING RATE IN WILD Known to breed every year (2 and Carr loc. cit.). Among the most impressive assemblages of any aquatic animal are the nesting arribadas, which in this species occur at wholly unpredictable times from April through June (1). There may be several arribadas of different sizes in a given season. Decline attributed originally to over-exploitation of eggs and adults for leather. Increasing numbers are being drowned in shrimp trawls in Florida and along Gulf coast (2 and Carr loc. cit.). The great increase in shrimping within the range and habitat of the ridley is affecting it even more seriously than it has the loggerhead, since it feeds on crabs on the same kind of bottom favored by shrimp and is undoubtedly being killed in large numbers; with the total population already at a dangerously low level, this unless rapidly corrected seems likely to bring the species to extinction within a few years (2).

CONSERVATION MEASURES TAKEN Since 1967, the Mexican Government has each season detailed military units to patrol the shores on which the arribadas occur; eggs are also hatched in enclosures in an effort to circumvent human and animal predation (Carr loc. cit.). Similar efforts to establish a breeding colony on Padre Island, Texas are being made (2). Listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED Immediate effective action to prevent further lethal netting. Better enforcement of protective laws both on and outside the nesting grounds. Legal protection of all marine turtles in Florida waters would also cover this species in an important part of its non-breeding range.

NUMBER IN CAPTIVITY A few specimens in public aquaria.

BREEDING POTENTIAL IN CAPTIVITY Unknown.

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HAWKSBILL TURTLE

Eretmochelys imbricata (Linnaeus, 1766)

Order TESTUDINES Family CHELONIIDAE

STATUS Endangered (A. Carr in litt.).

DISTRIBUTION Thinly scattered throughout the Atlantic, Pacific and Indian Oceans; also Gulf of Mexico and Caribbean. Formerly far more numerous throughout its range, which also included the Mediterranean (3, H.R. Bustard, P.R. Bacon, G. Hughes, P.C.H. Pritchard in litt. and Carr loc. cit.).

POPULATION Numbers vary widely between one part and another of enormous range (Carr loc. cit.). Declining because of over-exploitation of adults, except possibly in Australia; Japanese and European concerns are now promoting new industrial uses for tortoiseshell, the market for which previously decreased; the plastron has begun to be used as a substitute in the manufacture of Green turtle soup; preserving and lacquering yearlings as souvenirs is widespread in Mexico, the Antilles and the Far East, especially Indonesia, Malaysia and Singapore; and there is a growing world demand for skins (4, Bustard, Hughes, Pritchard and Carr loc. cit. and T. Harrisson in litt.).

HABITAT Reefs and hard bottom inshore waters. Nests on mainland and island beaches, often emerging on short stretches not acceptable to other sea turtles.

BREEDING RATE IN WILD Lays about 200 eggs, probably two or three times a season, with a migration cycle of usually about two years.

CONSERVATION MEASURES TAKEN The United States has banned import of the species or any part of it except on federal permit (Pritchard loc. cit.). Protected at all stages in Surinam and French Guiana; egg-collecting prohibited in some countries including Costa Rica and Sabah (Carr loc. cit.). In Australia, protected by law along the whole Barrier Reef and in the important, recently discovered nesting grounds on Torres Strait Islands (Bustard loc. cit.). Protected in Malaysia (6) and in Sri Lanka (T.W. Hoffmann in litt.). Classified under Category "A" of the New African Conservation Convention 1968 (5). Placed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED A strong campaign to depopularize tortoiseshell, to persuade individual countries to declare the sale and use of hawksbill products illegal, and to urge the public to refrain from buying polished shells and stuffed young hawksbills (Pritchard loc. cit.). Promotion of strictly enforced reserves and encouragement of governments to join in international agreements to suppress commerce in shell, calipee and skins (Carr and Harrisson loc. cit.).

NUMBER IN CAPTIVITY Commonly kept in public aquaria, especially and easily in S.E. Asia (Harrisson loc. cit.).

BREEDING POTENTIAL IN CAPTIVITY Dependent on a very expensive operation (Pritchard loc. cit.).

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TERECAY TURTLE or YELLOW-SPOTTED AMAZONIAN SIDENECK TURTLE

Podocnemis unifilis Troschel, 1848

Order TESTUDINES Family PELOMEDUSIDAE

STATUS Vulnerable.

DISTRIBUTION Northern South America (Venezuela, Colombia, Guyanas and northern Brazil (1, 2). Becoming rare in many parts of its range (R.A. Mittermeier in litt.).

POPULATION Persecuted for its meat which is excellent, surpassing that of all other Podocnemis, and for its eggs; has become increasingly rare; this applies particularly to the mainstream of the Amazon, although it is still quite common in tributaries like the Jurua and Purus; however, market demand is so great that boats from medium-sized Upper Amazon towns (such as Teffe, Coari, Codajas and Fonte Boa) where enforcement of protective legislation is minimal or non-existent, visit these tributaries during the nesting season and bring back boatloads for the market (Mittermeier loc. cit.).

HABITAT Freshwater rivers.

BREEDING RATE IN WILD The females usually nest singly on sandy beaches, laying from 18-40 eggs (2).

CONSERVATION MEASURES TAKEN Nominally protected in Brazil and Colombia, although this is difficult to enforce. The species is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, and is registered under the United States Endangered Species Act of 1973.

CONSERVATION MEASURES PROPOSED The exact locality of the Jurua and Purus nesting beaches should be discovered and accorded full protection. The possibility of nesting beaches elsewhere should also be investigated. A detailed study of this species with a view to careful management and sustained yield harvesting needs to be undertaken as soon as possible: P. unifilis is an extremely important animal which, like P. expansa, has the ability to convert aquatic plant matter into high quality animal protein and can produce 20-40 offspring per year (Mittermeier loc. cit.).

NUMBER IN CAPTIVITY Although the mass export of Podocnemis unifilis has ceased, large numbers are still being sold in European pet-shops (Honegger pers. obs.).

BREEDING POTENTIAL IN CAPTIVITY This fresh-water turtle certainly could be propagated under suitable artificial conditions and proper management (Honegger pers. obs.).

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SPECTACLED CAIMAN

Caiman crocodilus crocodilus (Linnaeus, 1758)

Order CROCODYLIA Family ALLIGATORIDAE

STATUS Endangered. This applies equally to Caribbean and Pacific coastal regions, the Llanos Orientales and the upper Putumayo and Caqueta rivers in Colombia and the Amazon proper. Caiman populations elsewhere are likely to become similarly threatened in the near future (6).

DISTRIBUTION Venezuela, the Guianas, lower Amazon (1) and Colombia, where local populations still occur from the Llanos Orientales (Orinoco) and Rio Guayabero-Guaviare to the westernmost tributary of the Orinoco (Medem loc. cit.) and also Peru. Former distribution was similar but the animals were more common (4).

POPULATION Most wild populations are declining and some have all but disappeared due to slaughter by hunters for their hides (F. Medem in litt.) and by animal collectors; large numbers are collected for the pet trade or are stuffed for the curio/souvenir market (3).

HABITAT Still-waters in open situations: ponds, lakes, swamps, streams and salt-marshes.

BREEDING RATE IN WILD Up to 120 eggs in one nest, suggesting that several females may use the same site (Medem loc. cit.).

CONSERVATION MEASURES TAKEN Peru: Hunting and capture prohibited by Presidential decree no. 934 of 1973. Colombia: By law, Spectacled Caimans under 1.5 m in length may not be killed, but the law is not enforced. However, even if enforced this law would do little good as the species does not become sexually mature until it is much larger (I.R. Grimwood in litt.). This sub-species is in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED Establishment of protected areas so that semi-captive breeding possibilities can be studied (Medem loc. cit.). Total protection over a long period, say 15-20 years, is highly recommended (4).

NUMBER IN CAPTIVITY Numerous.

BREEDING POTENTIAL IN CAPTIVITY Fair.

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DWARF CAIMAN or CUVIER'S SMOOTH-FRONTED CAIMAN

Paleosuchus palpebrosus (Cuvier, 1807)

Order CROCODYLIA Family ALLIGATORIDAE

STATUS Vulnerable (2)

DISTRIBUTION Northern and central South America. Formerly a little more common in the same region (1 and F. Medem in litt.).

POPULATION Decline has not been drastic, since Paleosuchus is possibly the least persecuted of the crocodilians. Its small size and the heavy ossification of the osteoderms makes the skins less desirable than those from the larger caimans and crocodiles of South America.

HABITAT Still, deeply shaded waters of floodplain ponds.

BREEDING RATE IN WILD One nest found in Colombia contained 13 eggs (Medem loc. cit.).

CONSERVATION MEASURES TAKEN In Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. The hunting and capture of crocodiles in the forest areas of Peru has been prohibited for an indefinite period by Presidential Decree No. 934 of 1973.

CONSERVATION MEASURES PROPOSED None as yet.

NUMBER IN CAPTIVITY None recorded.

BREEDING POTENTIAL IN CAPTIVITY Unknown.

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1. Wermuth, H. and Mertens, R. 1961. Schildkröten, Krokodile, Brückenechsen. Jena.
2. King, F.W. and Brazaitis, P. 1971. Species identification of Commercial Crocodilian Skins. Zoologica 56(2): 15-70. New York.
3. Medem, F. 1971. The reproduction of the Dwarf Caiman Paleosuchus palpeprosus; in Crocodiles: Proc. 1st Meeting Croc. Spec. IUCN Publ. N.S. Suppl. Paper 32: 159-165.

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BLACK CAIMAN

Melanosuchus niger (Spix, 1825)

Order CROCODYLIA Family ALLIGATORIDAE

STATUS Endangered (I.R. Grimwood in litt. 1967).

DISTRIBUTION Peru, Ecuador and Brazil where almost extinct (Grimwood loc. cit.); Colombia where practically exterminated in the Amazon, scarce in 1958 in the Putumayo between Laguna Apaya and Rio Caucaya, not to be found in the Cano La Concepcion and very scarce in the Caqueta (F. Medem in litt.). Formerly found throughout Amazonas drainage of South America (1 and Grimwood loc. cit.).

POPULATION Over-exploitation for hide industry: recently, much suitable caiman habitat has been cleared for cattle ranching, and a large number of eggs has been destroyed (Grimwood and Medem loc. cit.).

BREEDING RATE IN WILD Sexually not mature until a length of considerably longer than 2 m is attained (Grimwood l.c.); between 35 and 50 eggs per clutch (Medem l.c.).

HABITAT Shallows and margins of large lakes, and areas with many small ponds. Low-lying grassy savannas which are periodically inundated are probably the optimum habitat.

CONSERVATION MEASURES TAKEN Peru: Hunting and capture prohibited by Presidential decree no. 934 of 1973; in Bolivia protected by law when less than 2.5 m in length; generally protected in French Guiana but laws not enforced; in Colombia totally protected by law, but no enforcement (Medem loc. cit.). Now in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Brazil has prohibited commercial hunting and the export of hides of this species. Possibly the last undisturbed population is protected in the Manu National Park, Peru.

CONSERVATION MEASURES PROPOSED In Colombia a National Park should be established within the natural habitat at Laguna Apaya. Total protection for an indefinite number of years is essential also in Colombia, Ecuador and Brazil (Grimwood loc. cit.). A breeding station in some reasonably accessible area is also recommended (Medem loc. cit.).

NUMBER IN CAPTIVITY A number of specimens can be found scattered around in different zoos.

BREEDING POTENTIAL IN CAPTIVITY Unknown.

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SMOOTH-FRONTED CAIMAN or SCHNEIDER'S SMOOTH-FRONTED CAIMAN

Paleosuchus trigonatus (Schneider, 1801)

Order CROCODYLIA Family ALLIGATORIDAE

STATUS Vulnerable (4).

DISTRIBUTION Guyana, Surinam, French Guiana, Brazil and Peru (2). Northern and central South America, the Amazon and Orinoco river drainages of Colombia, Venezuela, Guyana, Brazil, Ecuador, Peru and Bolivia (4). In Colombia, from the upper Putumayo to the upper Caqueta, Apaporis, Vaupes, Guayabero and the northern part of La Macarena to Rio Ocoa (F.Medem in litt.). Formerly throughout northern South America southwards to 10°S (1).

POPULATION Declining very little at present. Genus is least persecuted of South American crocodilians (4).

HABITAT Freshwater, in floodplain ponds.

BREEDING RATE IN WILD Nothing known (5).

CONSERVATION MEASURES TAKEN In Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. The hunting and capture of crocodilians in the forest areas of Peru has been prohibited for an indefinite period by Presidential Decree No. 934 of 1973.

CONSERVATION MEASURES PROPOSED None as yet.

NUMBER IN CAPTIVITY None on record.

BREEDING POTENTIAL IN CAPTIVITY Unknown.

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Appendix V

Select Bibliography

1. General Resources
2. Conservation and Environment
3. Biological Resources
4. Physical Resources

1. General Resources

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