

NEW CALEDONIA

INTRODUCTION

by the Association pour la Sauvegarde
de la Nature Neo-Caledonienne

Area: 19,100 sq.km; including the main island of Grande Terre (16,890 sq.km), the Loyalty Islands (1,970 sq.km), the Isle of Pines (152 sq.km), the Belep Archipelago and some other small islands (Huon, Surprise, Chesterfield, Matthew, Hunter etc).

Population: 164,173 (April 1989 census). These include 74,000 Melanesians, 55,000 Europeans, 19,000 Polynesians (Tahitians, Wallisians) and 16,000 Indonesians, Vietnamese and others.

The main island of New Caledonia (Grande Terre) lies in the South Pacific at the southern tip of the Melanesian arc, about 1,500 km from the east coast of Australia. Situated between latitudes 19°30' and 23°00' South, just north of the Tropic of Capricorn, it stretches from 163° to 168° East. Grande Terre is almost completely surrounded by a barrier reef which borders a lagoon of clear, rather shallow water covering 16,000 sq.km and varying in width from about one km to 25 km. This barrier reef is the second largest in the world, after the Australian Great Barrier Reef. Grande Terre itself is very elongate in shape, being about 400 km long (from northwest to southeast) but only 50 km wide. This elongate shape is due to the presence of a mountainous spine with an average altitude of 1,000 m. The two highest massifs reach peaks at 1,628 m in the north (Mt Panie) and 1,618 m in the south (Mt Humboldt). The island is noticeably asymmetrical in topography. The east coast is characterized by steep slopes and often by high shorelines. In the west, the central chain gives way to a zone of hills and small plains with wide swampy bays such as the Bay of Dumbea and Bay of St Vincent.

The Loyalty Islands, which account for most of the remaining area of New Caledonia, lie about 110 km to the northeast of Grande Terre. They comprise three raised coral limestone islands, Ouvea, Lifou and Mare, and a number of tiny islets.

The climate is tropical oceanic, typically warm and rather moist, but here again with a hygrometric asymmetry between the windward east and the leeward west of the main island. As everywhere at these latitudes, the southern trades blow mainly from the east and southeast. Although mean annual temperatures vary little from north to south, ranging between 22° and 24°C, there is a warm season from December to April (average 26°C at Noumea) and a comparatively cool season from May to October (20°C at Noumea). Precipitation varies greatly between the east and west coasts, from roughly 2,000 mm in the east to 1,000 mm in the west, and there are large variations from one year to another. Noumea may receive as much as 1,500 mm in wet years, but only 600 mm in dry years.

The south may sometimes receive more than 3,000 mm of rain. Tropical depressions and cyclones occasionally hit New Caledonia between January and the end of March.

Because of its long isolation, the variety of soil types and the diversity of climates due to its topography, New Caledonia possesses an exceptionally rich flora and varied vegetation. In this respect, New Caledonia is the most important island in the South Pacific. Some 3,250 species of vascular plants have been recorded, and about 75% of these are endemic. Of particular interest are the 44 native species of gymnosperms and 31 species of palms, all of which are endemic. Over large areas of the island, however, the native vegetation has been destroyed by burning, cultivation, livestock raising and mining. Because of these activities, native vegetation now covers only about half of New Caledonia. The native vegetation consists of moist or sclerophyllous forests, mangrove forest and scrub linked to the presence of ultrabasic or acidic rock. On some 600,000 ha, "niaouli" savannas have replaced the original

forest formations which have been destroyed by repeated fires.

New Caledonia, isolated from neighbouring continents for at least 100 million years, lacks a great number of terrestrial animal species. This is particularly true of mammals, which are represented only by bats (flying foxes), of which three species are endemic. All other land mammals have been introduced by Europeans (domestic animals, livestock, feral pigs, rats etc). On the other hand, the islands do possess a number of interesting endemic species of reptiles and birds. Of the 34 species of lizards known from New Caledonia, no less than 30 are endemic, while of the 76 bird species, 21 are endemic. The most notable of the endemic birds is the Kagu (*Rhynochetos jubatus*), the only surviving member of its family, the Rhynochetidae. Also of note are a number of endemic freshwater fishes including one species, *Galaxias neocaledonicus*, which is found only in lakes near the southeastern tip of Grande Terre. This appears to be a relict of an ancient fauna that existed when the climate was much colder than it is today. In contrast to the terrestrial fauna, the marine fauna of New Caledonia's barrier reef and lagoon is extremely rich, with a wide variety of corals, fish, crustaceans, sponges etc. A summary account of the coral reefs is given in UNEP/IUCN (1988), along with a more detailed account of five of the most important reef systems.

The New Caledonian archipelago has been inhabited for over 3,000 years. The first colonists were a branch of the Austronesians originating in Southeast Asia. Polynesians arrived at a much later date, and European settlement began in the 19th century, followed by Asians (Indochinese, Javanese, and Japanese) and further Polynesians (Wallisians and Tahitians). New Caledonia was annexed by France in 1853, and became a French Overseas Territory in 1946. The principal economic activities are mining (nickel, with a ferro-nickel plant at Noumea), livestock raising (primarily cattle) and tourism (86,000 tourists in 1990). New Caledonia is the world's third largest nickel producer, behind Canada and the former U.S.S.R., and possesses 30% of the world's reserves of nickel ore. There are also some chromium, iron, cobalt and manganese mines on the west coast. Mining provides around 90% of exports.

Livestock raising is concentrated on the west coast while coffee and copra are cultivated mainly on the east coast. Shrimp aquaculture has recently expanded and is enjoying considerable success. A large portion of the island's meat, vegetables and fruit are imported from Europe, Australia, New Zealand and the U.S.A.

Summary of Wetland Situation

The most extensive wetlands in New Caledonia are mangrove forests, which occur widely on saline and muddy soils in the intertidal zone. The total area of mangroves has been estimated at 20,250 ha (Thollot, 1987), with most of this being found on the west coast of Grande Terre where conditions are most favourable for mangrove development. Thollot (1987) estimated the linear extent of mangroves as 79% of the west coast shoreline but only 14% of the east coast. The rivers of the gently sloping northern half of the west coast are characterised by intricate mangrove-fringed deltas and tidal mudflats. Mangroves are also found in sheltered inlets and embayments, in the lee of headlands and lagoon islands, and fringing estuaries and shallow lagoon areas. Further south along the west coast, hills and promontories are common, with intervening wide bays occupied by extensive mangrove and salt marsh communities. The large rivers of the southern half of the west coast empty into intricate embayments where active delta formation allows abundant mangrove development (Holthus & Galinie, 1990). Along most of the rugged east coast, mangroves are restricted to estuarine river mouths, and have a lower species diversity than those on the west coast, because of the exposed shoreline and strong wave action. There are also a few small patches of mangroves on the Isle of Pines, the Loyalty Islands and the Beleps.

Most stands of mangrove are not very tall, and none exceeds 20 metres in height. Estimates of the

number of mangrove species range from 11 to about 20, depending on definition. They include: five species of *Rhizophora*, *Bruguiera eriopetala* (syn. *sexangula*), *Ceriops tagal*, *Xylocarpus granatum*, *Lumnitzera littorea*, *L. racemosa*, *Sonneratia alba*, *Heritiera littoralis* and *Avicennia officinalis*. *Rhizophora* generally dominates along the outer edge of the mangrove forest. Behind this, a narrower band dominated by *Avicennia* is commonly found in estuaries and sheltered embayments. *Bruguiera* tends to dominate along river channels. On the landward edge of the mangrove forest, *Acanthus ilicifolius*, *Excoecaria agallocha* and the creeper *Derris trifoliata* are often present, along with the halophytic fern *Acrostichum aureum*. The highly saline soils of the upper mangrove flats support halophytic vegetation with *Suaeda* sp., *Salicornia australis* and filamentous algae (Cyanophyceae), beyond which there is often a littoral forest of common Indo-Pacific species.

A considerable amount of work has been carried out on the mangroves of New Caledonia, particularly by Baltzer (1965, 1969), who has described the mangroves of the Mara embayment and Dumbea River delta in some detail. Thollot (1987) has investigated the importance of mangrove forests for the fish fauna of New Caledonia's lagoon, and lists 64 species of fish belonging to 35 families which occur in the mangrove areas.

The total area of freshwater lakes, ponds and marshes has been estimated at 4,000 ha (SPREP, 1985). Much the most important freshwater wetlands are the lakes and marshes of the Plaine des Lacs near the southeastern tip of Grande Terre. This region of impermeable sub-soils is always at least partially flooded, and contains two large lakes (Lac en Huit and Grand Lac), numerous smaller lakes and ponds, and a large zone of swamps. It is a unique and very fragile ecosystem with a natural heritage of exceptional value.

Other wetlands include limited areas of freshwater swamp forest dominated by *Melaleuca quinquenervia* and numerous rivers and mountain streams. The rivers and streams possess a distinctive fauna including 11 endemic freshwater snails, but this fauna remains poorly known (Dahl, 1980).

The waterfowl of New Caledonia appear to have received very little attention. Only about 12 species are resident, and none of these is endemic (Mayr, 1945). Seven species are fairly common and widespread: the Little Pied Cormorant (*Phalacrocorax melanoleucos*), White-faced Heron (*Ardea novaehollandiae*) Pacific Reef Heron (*Egretta sacra*), Rufous Night-Heron (*Nycticorax caledonicus*), Pacific Black Duck (*Anas superciliosa*), Banded Rail (*Rallus philippensis*) and Purple Swampphen (*Porphyrio porphyrio*). The other five species which are known or thought to be resident, Australian Dabchick (*Tachybaptus novaehollandiae*), Australian Bittern (*Botaurus poiciloptilus*), White-browed Crake (*Porzana cinerea*), Spotless Crake (*P. tabuensis*) and Beach Thick-knee (*Esacus magnirostris*), are all rare or local. Small numbers of migratory shorebirds occur on passage and during the austral summer, the commonest species being Pacific Golden Plover (*Pluvialis fulva*), Whimbrel (*Numenius phaeopus*), Bar-tailed Godwit (*Limosa lapponica*), the two tattlers (*Heteroscelus incanus* and *H. brevipes*), Ruddy Turnstone (*Arenaria interpres*) and Sharp-tailed Sandpiper (*Calidris acuminata*). The Silver Gull (*Larus novaehollandiae*) is a common winter visitor from Australia. Other birds associated with the wetlands include the Swamp Harrier (*Circus approximans*) and Osprey (*Pandion haliaetus*), both widespread residents in the Territory.

Although neither the economy nor the population density of New Caledonia is having an overwhelming effect on wetlands as yet, some degradation and loss of wetlands has occurred. Nickel mining activities in the interior highlands have had a pronounced effects on many rivers and streams. The massive dumping of waste material down the slopes below the nickel mines has resulted in huge amounts of loose material being washed into the valleys, clogging the minor stream beds and thus causing flooding in the major rivers beds and covering fertile agricultural land in the valleys. Further downstream, deltas have undergone rapid changes as a result of increase in the sediment loads carried by the affected rivers (Dupon, 1986). The effects of these changes on the aquatic flora and fauna are poorly known. Bird *et al.* (1984) report on no fewer than forty streams whose valleys, in their middle and/or lower reaches, have been modified to

various extents by deposits of mining waste. In more than half of these cases, the estuaries and bays into which the streams flow have also been affected. Here, the increased deposition of red clay and sterile lateritic sub-soil has caused some degradation of the mangrove forest and associated organisms (Holthus & Galinie, 1990).

The greatest threats to mangrove forest are in the area of the capital, Noumea. These include reclamation of mangrove swamps for the expansion of urban areas, in-filling for road construction, and industrial pollution, especially in the neighbourhood of the Doniambo nickel plant. Overall, however, the mangrove forests of New Caledonia remain in a relatively healthy condition, although in the longer term, reclamation for the development of aquaculture and associated eutrophication could pose serious threats to these systems.

Wetland Area Legislation

While the first legislative measures directed toward nature protection in New Caledonia are a half-century old, the first text generally defining areas of environmental protection and listing zones already protected is Resolution No.108 of 9 May 1980. In accordance with this text, New Caledonia has established over 30 Strict Nature Reserves (Reserves Naturelles Integrales), Territorial Parks (Pares Territoriaux) and Special Reserves (Reserves Speciales). Special Reserves include botanical reserves, faunal reserves and marine reserves (IUCN, 1991). This protected areas system covers many of the Territory's natural ecosystems, but does not include examples of dry (sclerophyllous) forest and maquis (shrub vegetation) in the mining areas on the west coast. Provisions in Article 10 of Resolution No.108 created four protected areas which include significant tracts of wetland:

- L'Ile Pam and L'Ilot Lepredour, including their mangroves, have been designated as Special Faunal Reserves.
- Part of the periphery of the Plaine des Lacs lies within the Southern Botanical Reserve (a Strict Nature Reserve).
- A large portion of Yate Lake lies within the Haute Yate Special Faunal Reserve.

In March 1990, the Assembly of the South Province created a Special Botanical Reserve of 400 ha at Madeleine Falls (La Chute de la Madeleine). This reserve also includes a part of the Plaine des Lacs.

Protection zones can also be established under the Water Resources and Pollution Law (Deliberation No.105 of 26 August 1968), whereby activities likely to endanger water quality can be prohibited or controlled.

At international level, France has ratified the Convention on the Conservation of Nature in the South Pacific (Apia Convention), the Convention for the Protection of the Natural Resources and Environment of the South Pacific (SPREP Convention) and the World Heritage Convention, and has signed but not yet ratified the Convention on Biological Diversity. France became a party to the Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention) in October 1986, but its ratification does not extend to New Caledonia.

Wetland Area Administration

Article 5 of Resolution No.108 provided that all protected areas be placed under the control of the Service des Eaux et Forêts du Territoire. Since decentralization of administration and jurisdiction in 1990, environmental matters and the management of parks and reserves have been placed under the jurisdiction of the provinces. Thus in South Province, the agency responsible for the environment, parks

and reserves (Service de l'Environnement, de la Gestion des Pares et Reserves) comes under the Provincial Directorate of Rural Development.

Organizations involved with Wetlands

At governmental level, the Service de l'Environnement, de la Gestion des Pares et Reserves, the Service de la Protection Vegetale et des Forets and the Department of Maritime Affairs have jurisdiction in matters relating to the terrestrial and marine environments. The National Gendarmerie verifies infractions and seizes equipment used by offenders (Articles 6 and 7 of Resolution No.108).

ORSTOM (French Institute of Scientific Research for Development in Cooperation), a governmental agency with an office in Noumea, employs teams of research botanists and zoologists, some of whom have studied wetlands, particularly mangroves, in the Territory.

Two non-governmental organizations, the Association pour la Sauvegarde de la Nature Neo-Caledonienne (ASNNC) and the Caledonian Ornithological Society, direct their activities toward a better understanding of the natural world and better protection of the environment.

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WETLANDS

Site descriptions compiled by the Association pour la Sauvegarde de la Nature N6oCal donienne.

Wetland Name: Embouchure du Diahot

Country: New Caledonia

Coordinates: 20 20'S, 164 20'E

Location: downstream from the town of Ouega, near the northwest tip of Grande Terre.

Area: Approximately 2,000 ha.

Altitude: Sea level to about 10 m.

Overview: A large area of mangrove forest, *Melaleuca* swamp forest and marshy savannah in the estuary and delta of the Diahot River, with a small mangrove-fringed island offshore.

Physical features: The Diahot River is New Caledonia's longest river. It empties into a gulf where a large delta of silt and sand is covered by extensive mangrove forests. Inland, a complex of fresh to brackish water lakes and marshes borders the lower reaches of the river, the entire area being about 15 km long and up to 2 km wide. Pam Island (460 ha) at the mouth of the river is surrounded by mangroves and reefs; it is steep-sided and rises to a peak at 166 m. The tides are semi-diurnal with a range of 0.1-1.8 m. The climate is tropical oceanic, with a mean annual precipitation of 1,200-1,300 mm, and a mean annual temperature of 24 C.

Ecological features: Mangrove forest in brackish and saline areas, closed stands of *Melaleuca* forest

in areas permanently flooded with fresh water, and swampy *Melaleuca* savannah (niaouli). The closed stands of *Melaleuca* include trees 30 metres tall and lack an understorey. Pam Island is covered in secondary vegetation.

Land tenure: Partly public maritime waters of the French Government and partly Territorial. Pam Island is under public ownership. There are a few private properties in surrounding areas.

Conservation measures taken: None at the wetland. Pam Island was declared a Special Faunal Reserve (Reserve Speciale de Faune de l'Ile de Pam) by Resolution No.108 of the Territorial Assembly in May 1980. Entry into the reserve and hunting are prohibited.

Conservation measures proposed: It has been recommended that a Special Faunal and Floral Reserve be established at the mouth of the Diahot.

Land use: There is probably some harvesting of mangrove crabs (*Scylla serrata*) and mangrove oysters (*Crassostrea cucullata turberculata*) and limited extraction of firewood. Pam Island is uninhabited.

Disturbances and threats: No information.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Dugongs (*Dugong dugon*) are present in the Diahot estuary.

Noteworthy flora: It is believed that the mangroves of the Diahot estuary include all of the mangrove species occurring on both the east and west coasts of Grande Terre. Such a convergence of species is known to occur in the Bêlep Islands. The closed stands of *Melaleuca* forest in the perennial freshwater marshes are unusual in New Caledonia and merit protection.

Management authority and jurisdiction: Service des Domaines, Direction Territoriale des Services Fiscaux.

References: Holthus & Galinie (1990); IUCN (1991).

Reasons for inclusion: 1a, 1d, 2b, 2c. The site possesses closed stands of *Melaleuca* swamp forest, a rare habitat type in New Caledonia, and probably also an unusually diverse mangrove forest.

Source: Association pour la Sauvegarde de la Nature N60-Calédonienne.

Wetland Name: Lepridour Islet

Country: New Caledonia

Coordinates: 21°59'S, 165°59'E

Location: in West Lagoon, just off the west coast of Grande Terre about 15 km south of the Commune of Bouloupari.

Area: About 200 ha of mangroves.

Altitude: Sea level.

Overview: An unusual stand of mangrove forest on the southwestern shore of Lepredour Islet in West Lagoon.

Physical features: Lepredour Islet is a small limestone and sandstone island, 760 ha in area, with steep slopes rising to a peak at 225 m. The islet is composed of volcanic and sedimentary formations of Tertiary origin. The extensive intertidal zone in the southwestern part of the island is entirely covered by mangrove forest. The tides are semi-diurnal with a range of 0.1-1.8 m. The climate is tropical oceanic, with an annual rainfall of between 800 and 1,000 mm and a mean annual temperature of 22.5°C.

Ecological features: Mangrove forest and some *Melaleuca* savannah (niaouli).

Land tenure: Property of the French Government, placed at the disposal of the High Commissioner.

Conservation measures taken: Lepredour Islet, including its mangroves, was created as the governor's hunting reserve in September 1941, and was designated as a Special Faunal Reserve by Territorial Resolution No.108 of May 1980 (Reserve Speciale de Faune de l'Illet Lepredour). Article A 1322-2 of the Code de la Protection de la Nature et de l'Environnement prohibits disembarkation or approach on the seaward side within 100 m. All hunting is prohibited throughout the year, except with permission of the Service de l'Environnement et Gestion des Parcs et Reserves and the High Commissioner.

Land use: A little hunting. There was a settlement on the island in former times, but it is now uninhabited.

Disturbances and threats: Deer have been introduced onto the island, and the mangrove forest and *Melaleuca* savannah are reported to be very disturbed (IUCN, 1991).

Hydrological and biophysical values: The commercial and artisanal harvest of fishes in West Lagoon is to a large extent dependent on the mangrove ecosystem.

Social and cultural values: No information.

Noteworthy fauna: No information.

Noteworthy flora: The mangrove is thought to be a fossil mangrove swamp, a relic of pre-transgression times, before the post-glacial rise of the general ocean level.

Management authority and jurisdiction: The Service de l'Environnement et Gestion des Parcs et Reserves is responsible for the management of the reserve; the Service des Domaines, Direction Territoriale des Services Fiscaux, has territorial jurisdiction.

References: IUCN (1991).

Reasons for inclusion: 1a, 2b, 2c. The mangrove swamp is of particular interest as it is the most extensive mangrove swamp on any islet in the lagoon, and is the only example of a mangrove swamp facing the prevailing wind and thus with no protection from wave action and ocean swell.

Source: Association pour la Sauvegarde de la Nature N60-Caledonienne.

Wetland Name: Dumbea and Karikouie Mangroves

Country: New Caledonia

Coordinates: 22°12'S, 166°24'E

Location: west from the outskirts of Noumea for about 20 km, Grande Terre.

Area: About 1,000 ha.

Altitude: Sea level.

Overview: A large area of coastal and estuarine mangroves in the deltas of the Dumbea and Karikouie Rivers in the Baie de Dumbea. There is evidence that the mangroves were formerly much more extensive.

Physical features: Extensive mangrove forests occur in the intertidal zone in the deltaic and estuarine systems of the Dumbea and Karikouie Rivers which enter the Baie de Dumbea to the west of the city of Noumea. In the Dumbea delta, mangroves occur widely on river levees, on mud and sand banks, along tidal channels and in marginal depressions. Inland, the mangrove swamps give way to salt marshes and then brackish and freshwater swamps. The maximum tidal range in the bay is 1.7 m.

The climate is tropical oceanic, with an average annual rainfall of about 1,000 mm and a mean annual temperature of about 22°C. The temperature of the sea varies from a minimum of 19°C to a maximum of 28°C.

Ecological features: Several vegetation zones have been identified in the Dumbea River delta, and these have been related to the frequency of tidal inundation (Baltzer, 1969; Chapman, 1976). The lowest zone, on the seaward fringe of the mangroves, is dominated by *Rhizophora mucronata* which occurs down to 1.1 m below the high equinoctial spring tide level. *R. mucronata* and *Bruguiera eriopetala* occur together in an intermediate zone around the level of the high neap tides. Where conditions become brackish, *Rhizophora* decreases and *Acrostichum aureum* and Cyperaceae are associated with *Bruguiera*. At higher and drier levels, *Avicennia officinalis* becomes mixed with *Bruguiera*, or else forms a pure community of its own. Eventually it borders onto a *Salicornia australis* sward. Beyond the *Salicornia* belt, with further rise in land level up to extreme high water mark, there is a belt of *Lumnitzera racemosa*.

Land tenure: Public maritime waters of the French government. Surrounding areas are partly owned by the Communes of Noumea and Mount Dore, and partly private properties.

Conservation measures taken: The remaining mangrove areas around Noumea have been given protected status in the Urban Development Plan (Plan d'Urbanisme) in zones where no clearing, filling or construction is allowed. The entire coastal zone of Noumea and its environs is part of a protected area within which all

mining activity is regulated.

Conservation measures proposed: Holthus and Galinie (1990) suggested that mangrove areas could be developed as natural parks, with walkways to provide access, to offset the decrease in open wooded areas around Noumea.

Land use: Some mangrove crabs (*Scylla serrata*) and mangrove oysters (*Crassostrea cucullata turberculata*) are harvested, and there is a little extraction of firewood. The only products harvested in substantial amounts from the mangroves here, as elsewhere in New Caledonia, are fish.

Possible changes in land use: A proposal to develop commercial shrimping at the mouth of the Dumbea River is under consideration.

Disturbances and threats: The principal threat to the mangroves in the Noumea area has been, and still is, clearing and filling for waterfront, industrial and residential development. In the early 1900s, the waterfront area of Noumea (Baie de la Moselle) was cleared of mangrove and filled with material removed during the levelling of adjacent hills. All four of the principal stands of mangroves in the Noumea area are either in the process of being cleared for urban development, or are under threat of being cleared (Holthus & Galinie, 1990). The construction of solid-fill causeways for a highway through riverine mangrove along the Dumbea River has resulted in mangrove die-off due to waterlogging on the inland side of the causeway (Bird *et al.*, 1984). In spite of the protected status of the mangroves, clearing and filling continue to be authorized by the Territorial Government and building permits are granted by the Municipal Government (Holthus & Galinie, 1990). There is also a considerable amount of pollution in the mangroves in the vicinity of the Doniambo nickel plant.

Hydrological and biophysical values: The mangrove forests play a valuable role in dampening the effects of flood waters and trapping much of the river-borne sediment, preventing it from being discharged into adjacent coral reefs and recreational waters. The mangroves may also play a valuable role as a natural tertiary treatment system for secondarily treated waste water (Holthus & Galinie, 1990). The commercial and artisanal harvest of fishes in West Lagoon is to a large extent dependent on the mangroves.

Social and cultural values: No information.

Noteworthy fauna: No information.

Noteworthy flora: No information.

Scientific research and facilities: Baltzer (1969) carried out a detailed survey of the plant communities, sediments and tidal phenomena in the Dumbea River delta, and various studies have been undertaken by ORSTOM researchers, *e.g.* a study of the importance of the mangroves for the fish fauna of the lagoon by P. Thollot (1987).

Management authority and jurisdiction: Service des Domaines, Direction Territoriale des Services Fiscaux.

References: Baltzer (1969); Bird *et al.* (1984); Chapman (1976); Holthus & Galinie (1990); Thollot (1987).

Reasons for inclusion: 1a, 2b, 2c. One of the largest areas of mangrove vegetation in New Caledonia, close to a large urban centre.

Source: Association pour la Sauvegarde de la Nature N6o-Calédonienne.

Wetland Name: Yate Lake and Riviere Bleue

Country: New Caledonia

Coordinates: 22°08'S, 166°49'E

Location: west of Yate, near the southeastern tip of Grande Terre.

Area: Unknown.

Altitude: Lake Yate at 156 m; catchment area to 1,250 m at the summit of Mt Dzumac.

Overview: A large water storage reservoir, built for hydro-electric purposes, and two of the principal tributary rivers, the Riviere Bleue and Riviere Blanche, in protected catchment areas to the west.

Physical features: Lake Yate is much the largest artificial lake in New Caledonia and probably the largest in the insular Pacific. It was created by a hydro-electric scheme in 1959, and flooded large areas of forested valleys bottoms. Two of the largest rivers entering the lake, the Riviere Bleue and the Riviere Blanche, rise in the Massif du Dzumac to the west, and are wholly within a protected catchment area. Although there has been some logging in the past, much of the forest in the catchment areas of these two rivers remains relatively intact, and as a consequence, the rivers have remained in an almost pristine condition. Freshwater marshes occur along the lower reaches of the Riviere Blanche and near the southwest corner of the lake (Ouenarou). The lake itself is subject to wide fluctuations in water level and supports little emergent aquatic vegetation. Geologically, the area forms part of the ultrabasic southern massif, with significant alluvial deposits in the valley bottoms. The climate is tropical oceanic with an average annual rainfall exceeding 3,000 mm.

Ecological features: Clear fast-flowing rivers and streams, and freshwater marshes with some *Melaleuca*. The Territorial Park protects the most important remnant of the once extensive southern forest, and includes 6,000 ha of dense rainforest. The area was logged in the 1930s and includes secondary growth. The main plant communities are described by IUCN (1991).

Land tenure: Public. The area is under relatively little pressure from Melanesian land claims.

Conservation measures taken: The western end of the lake and its watershed are included within the Haute Yate Special Faunal Reserve (Reserve Speciale de Faune de la Haute Yate), a reserve of 15,900 ha created in 1960 and confirmed by Resolution No.108 of May 1980. An area of 9,054 ha within the faunal reserve, including the whole of the Riviere Bleue, its mouth in Lake Yate and a small section of the lake shore, was designated as a Territorial Park (Parc Territorial de la Riviere Bleue) in May 1980. Under Article A 1321-4 of the Code de la Protection de la Nature et de l'Environnement, entry into the Faunal Reserve is regulated, and only holders of titles for forestry or mining and staff of La Societe d'Energie Electrique are permitted to visit the area regularly (IUCN, 1991). Hunting and fishing are prohibited in the reserve, but the legal protection does not prohibit prospecting for minerals, exploitation of minerals or forestry. The Territorial Park enjoys total legal protection, including prohibition of prospecting and mining.

Land use: Research, outdoor recreation and tourism in the Territorial Park and Faunal Reserve. There is no permanent habitation in the reserve, and there are no villages in the immediate vicinity.

Disturbances and threats: Mineral prospecting and fires have degraded parts of the Faunal Reserve. There has been some forestry exploitation in the past, but this ceased in what is now the Territorial Park in 1975, and the forest is regenerating. The Kagu and other native wildlife is threatened by introduced dogs, cats, pigs and rats. Black Bass have been introduced into the lake.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Little Pied Cormorants (*Phalacrocorax melanoleucos*), White-faced Herons (*Ardea novaehollandiae*) and Pacific Black Ducks (*Arras superciliosa*) occur around the lake. No other information is available on the aquatic fauna of the lake or rivers. The forests of Riviere Bleue Territorial Park contain all of the endemic bird species of New Caledonia which are still known to survive. The park is particularly important for its large population of the endemic flightless Kagu (*Rhynochetos jubatus*), estimated at 200 individuals in 1989. The park also supports the largest remaining population of the Crow Honeyeater (*Gymnomyza aubryana*) and a large population of the Notou or Giant Pigeon (*Ducula goliath*).

Noteworthy flora: No information is available on the aquatic vegetation. Over 400 species of plants have been recorded in the Territorial Park, about 80% of which are endemic to New Caledonia. Rare species such as *Libocedrus yateensis* and the parasitic gymnosperm *Parasitaxis ustus* are of particular interest (IUCN, 1991).

Scientific research and facilities: The fauna and flora of the Territorial Park has been well documented, and research on the Kagu has been on-going since 1980. However, little if any work seems to have been carried out on the fauna and flora of the rivers or the lake.

Recreation and tourism: About 20,000 people visited the Territorial Park in 1991. Various camping and picnicking facilities are available in the park, and a network of trails, including 60 km suitable for

motor vehicles, provides easy access.

Management authority and jurisdiction: Management of the Faunal Reserve and Territorial Park is the responsibility of the Service de l'Environnement et Gestion des Pares et Reserves.

References: IUCN (1991).

Reasons for inclusion: 1a, 2b. Lake Yate is the largest freshwater body in New Caledonia, and Riviere Bleue and Riviere Blanche are two of the least disturbed rivers.

Source: Association pour la Sauvegarde de la Nature Neo-Calédonienne.

Wetland Name: Plaine des Lacs

Country: New Caledonia

Coordinates:

Location: 22°15'S, 166°55'E; about 50 km east of Noumea and 10 km south of the Noumea-Yate road, Yate Commune, near the southeastern tip of Grande Terre.

Area: About 5,000 ha.

Altitude: 200-260 m.

Overview: A group of permanent freshwater lakes and marshes in depressions on a large plain surrounded by hills near the southeastern tip of Grande Terre. The area is of exceptional botanical and zoological interest, and supports many endemic species.

Physical features: The Plaine des Lacs is a slightly undulating plain about 10 km long by 5 km wide, with altitudes varying between 260 and 240 m. The numerous depressions are occupied by permanent freshwater lakes, ponds and marshes, the largest lakes being Lac en Huit and Grand Lac. The plain is drained by the Riviere des Lacs, a tributary of the Yate, from its source in Lac en Huit across the northern edge of the plain. After the 10 m drop of Madeleine Falls (La Chute de la Madeleine), the river enters Yate Lake beyond its confluence with Pernod Creek which drains the exterior of the northwest slopes of the Plaine des Lacs. A narrow alluvial zone 1-5 m wide along the banks of the Riviere des Lacs is subject to flooding during high water. The geological substrate comprises peridotitic rocks which make up much of southern Grande Terre; the soils are ultrabasic ferric latosols and very poor in chemical elements except magnesium, iron and chromium. The deep horizons have concentrations of nickel and manganese that are higher than normal. In the lowest, central portions of the plain, the soils are more or less peaty. The soils show a clear tendency toward induration in the form of fine ferruginous gravel, boulders of laterite or even solid laterite crusts several metres thick and completely impermeable.

The climate is tropical oceanic with an average annual rainfall of 2,500-3,000 mm and a mean annual temperature of between 22° and 23°C.

Ecological features: Freshwater marshes throughout the Plaine des Lacs are dominated by *Xyris pancheri* (Xyridaceae) and *Schoenus brevifolius* (Cyperaceae) (Dahl, 1980). In the Madeleine Falls area, the aquatic vegetation is poor in species, but includes a carnivorous species of *Utricularia*, a relatively rare aquatic fern *Bkchnum francii*, and a species of *Eriocaulon* endemic to the south of Grande Terre (Jaffre, 1988). The narrow alluvial zone along the Riviere des Lacs supports a distinctive community dominated by the two gymnosperms *Nageia (Decussocarpus) minor* and *Dacrydium guillauminii* in a shrub layer 3-5 m high. *D. guillauminii* is known only from the banks of the Riviere des Lacs. A low discontinuous shrub layer in this alluvial zone comprises *Melaleuca brongnartii*, *Xanthostermon aurantiacum*, *Homalium kanaliense*, *Pancheria communis* and *Cloezia aquarium*. The herbaceous layer, which is absent on gravelly soil but continuous on alluvial soil, comprises the Cyperaceae *Costularia xyridiodes*, *Schoenus brevifolius*, *Chorizandra cymbaria* and *Tricostularia guillauminii*, and the Xyridaceae *Xyris pancheri* and *X. neocaledonica* (Jaffre, 1988). The dominant vegetation of drier ground is a semi-wet woody/herbaceous scrub with two endemic species of gymnosperms, an endemic fern and numerous lichens. Plant communities in the Madeleine Falls area have been described by Jaffre

(1988) and are summarized in IUCN (1991).

Land tenure: Owned by the French Government and the Territory. Concessions for mineral exploration have been granted, but no mining was in progress in 1991.

Conservation measures taken: A Special Botanical Reserve of about 400 ha (Reserve Speciale Botanique de la Chute de la Madeleine) was created along the Riviere des Lacs in 1990 (Resolution No.39-90/APS of 28 March 1990). This is located on the north-northwest edge of the Plaine des Lacs and is bordered in part by the Riviere des Lacs. Legislation prohibits the collection, removal, displacement or harvesting of any mineral or vegetation. Seven small protected areas, totalling 4,466 ha, have been established in the vicinity of the Plaine des Lacs. Together these constitute the Southern Special Botanical Reserve (Reserve Speciale Botanique du Sud), established by Resolution No.108 in May 1980. All mining activity is prohibited in these reserves (Order No.72-395/CG of 17 August 1972).

Conservation measures proposed: Dahl (1980) recommended the establishment of a reserve on the Plaine des Lacs to protect the lake fauna and marsh flora. More recently, it has been recommended that a Special Faunal and Floral Reserve be created to protect the entire plain.

Land use: No information.

Disturbances and threats: The growing numbers of visitors to the region have caused considerable damage; trees have been burned and broken, and rubbish has been dumped in the area. In the medium or long term, the principal threat comes from mining development (nickel, iron, chromium etc.) because of the potential mineral value of the region. Some mining activities began in the area in 1992.

Hydrological and biophysical values: No information.

Social and cultural values: The wetlands have some potential for tourism and conservation education. The region is of great interest to scientists and is becoming the object of intensive scientific study.

Noteworthy fauna: An endemic species of fish, *Galaxias neocaledonicus*, is known only from the Plaine des Lacs. It has been found in Lac en Huit and may also occur in the Madeleine Falls Special Botanical Reserve. This nocturnal species is believed to be a "living fossil" with Gondwanian affinities with New Zealand. Other aquatic species of scientific interest include two genera and three endemic species of freshwater snails, two species of shrimps, which are possibly endemic to the lakes, and a sponge. No information is available on the waterfowl.

Noteworthy flora: The Madeleine Falls area is exceptional for the diversity of its flora, the high concentration of gymnosperms and the presence of many rare species such as the aquatic fern *Blechnum francii* and an endemic carnivorous bladderwort (*Utricularia* sp.). Jaffre (1988) lists 168 species of phanerogam and ferns belonging to 53 families. About 95% of these are endemic to New Caledonia, and about 20% are endemic to the south of Grande Terre. The area is rich in lichens, many of which are apparently undescribed.

Scientific research and facilities: Botanists from the Botanical Laboratory at ORSTOM carried out a survey of the vegetation and detailed inventory of the flora of the Madeleine Falls area in 1988 (Jaffre, 1988).

Conservation education: The wetland is situated close to the small town of Yate, and could have some potential for conservation education.

Management authority and jurisdiction: Service des Forêts et du Patrimoine Nature! (SFPN), Direction du Développement Rurale Province Sud. Responsibility for management of the Madeleine Falls Special Botanical Reserve rests with the Service de l'Environnement et Gestion des Pares et Reserves.

References: Dahl (1980); IUCN (1991); Jaffre (1988).

Reasons for inclusion: 1a, 2a, 2b, 2d. A unique wetland; much the largest area of freshwater lakes and marshes in New Caledonia, with many endemic species.

Source: Association pour la Sauvegarde de la Nature N60-Calédonienne.

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