SOUTH PACIFIC BIODIVERSITY PROGRAMME

TERMS OF REFERENCE : NEW CALEDONIA

National Biodiversity Review prepared by

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ORSTOM New Caledonia.

"New Caledonia, because of its highly endemic, distinctive biota, is a subregion rather than merely a division in the Oriental Region" Thorne, 1963

New Caledonia is located south of the inner melanesian arc between 18-23 deg. S latitude and 158-172 deg. E longitude. It is a French Overseas Territory with a large autonomy for each province (Province Nord, Province Sud, Province des Iles). It includes the main island (Grande Terre or New Caledonia *stricto sensu* : 16890 sq. km), the Loyalty group (Mare, Lifu, Uvea, Tiga : 1970 sq. km), Pine Island (152 sq. km), the Belep, Huon and Chesterfield groups, Walpole and the small volcanic Matthew and Hunter islands. Population is ca. 170000. The main island of New Caledonia is one of the largest and oldest land masses in the tropical Pacific.

1 - GEOLOGICAL HISTORY

During the Trias (-100 MY) New Caledonia mainland was a margin of Gondwana connected with Australia. The oldest rocks are quartzo-felspathic metamorphic schists dated before Permian (-280 MY) which constitute the axial core of the island. Isolation occured between Trias and Eocene (-80 mY) with the opening of the Tasman Sea and the separation of the Norfolk Ridge. A major geological event was the extensive overthrust of ultramafic rocks on New Caledonia between the late Eocene orogenic phase (-37 MY) and the beginning of Miocene. A partial marine transgression happened in Lower Miocene. The tectonics was very active : current geomorphology results mostly from erosion triggered by a general uplifting in Miocene and Pliocene. The Loyalty islands originate from a chain of submarine volcanos on the eastern border of the australian plate. Their activity ceased 10 MY ago. Subsidence and the development of coral reefs followed until the Pleistocene, when the islands eventually emerged. The present barrier reefs date from Pleistocene and Holocene. Submarine valleys, identified by channels cut in the barrier reef, were formed during Würm regression.

2 - ROCK SUBSTATUM (Map 1)

The most striking feature of New Caledonia is the importance of ultramafic rocks (Harzburgite, Dunite). They cover all the mainland south of Thio, the east coast from Thio to Houallou and a string of massifs along the west coast : Mt Do, Téné, Me Maoya, Boulinda, Kopéto, Koniambo, Ouazangou Taom, Kaala, Tiébaghi. They induce high originality in soils and in plants but constitute a major drawback for agriculture. Nickel mining, which is the main source of income, has caused much environmental disturbance and pollution (Dupon, 1986).

Northeastern New Caledonia is covered by micashists (Mt Panié, Mt Colnett) and by an indifferentiated sedimentary prism. Large areas of pre-permian "green schist" facies are observed in the Central Range (Ouango-Netchaot/Karagreu-Boghen) but volcano-sedimentary deposits also constitute a

large part of the range. Flysch, limestone and phtanites are important along the west coast. Loyalty Islands are huge formations of reef limestone (50-500 m); outcrops of the basaltic substratum are exceptions (Mare).

3 - CLIMATE

Moderate or strong trade winds (east/north-east to south-east, 2 to 8 m/s, 218 days/Y) are dominant in New Caledonia. West winds are related to low pressure systems circulating south of the island (may to september) or to the proximity of cyclones. This scheme is modified by relief and by local breeze which may deviate the general air flow or modify its strength.

An important dissymetry in rainfall exists on the mainland : the east coast and the south (locally over 4000 mm/Y) are much more rainy than the west coast (locally under 1000 mm/Y), owing to the general orientation and dominant winds. Rainfall on the Loyalty Islands lays midway between rainfall on the east and west coasts. The rainy season runs from december-january to march and a short rainy period may be observed in june. But irregularity from year to year and from month to month may be high : heavy rains, as well as drought, may be observed during any month.

Average annual temperatures range between 21°C and 25°C. The difference between average monthly maxima (february and july/august) does not exceed 7°C and the difference between minima is 4°C. The expected range is 30°-10°Cwith observed absolute extrema of 38.8°C and 2.8°C. The mean number of sunshine hours is in the range 2400-2600.

4 - TOPOGRAPHY AND HYDROGRAPHY (Map 2)

A lengthwise Central Range (average alt. 1100 m) divides the main island. It combines structural and dissected forms. Its northeastern branch culminates at Mt Panié (1628 m). Secondary ridges run approximately east-west. A depressed western block displays hill relief and accumulation forms (quaternary deposits). There is a striking dissymmetry between the western slopes terminated by wide coastal plains and the steep eastern slopes carved by deep and narrow valleys. Southern New Caledonia is a large peridotitic plateau (250 m). The Loyalty Islands display a diversified karstic relief.

Hydrography on the mainland is directed by topography and by the general orientation of the island. Most rivers flow eastward and westward between the secondary chains. The stream pattern is dense but large rivers are few. The main river Diahot (less then 100 km) runs northwestward; its catchment area is only 292 sq. km, the largest beeing the Yaté basin with 437 sq. km. Small catchments, steep slopes, rugged stream profiles and flash floods are most common. Eastern slopes are steeper and prevailing winds cause much higher rainfall on the east coast (and the south) than on the west coast, so stream discharge is much higher in the east. Rivers on the west coast often end in large bays, are sinuous and terminate in deltas (louanga, Koumac). Rivers are numerous on the east side ; river beds are narrow but mouths may be wide and tide goes far upstream. Rivers on the southern table-land have a more steady flow; they are associated with small natural lakes and marshy areas and with the large artificial lake of Yaté dam. Seasonal and interannual distribution of rainfall induces a marked variability in the flow.

The Loyalty Islands display the relief of uplifted atolls.There is no defined stream pattern. Rainwater infiltration creates a freshwater lens in equilibrium with infiltrated sea water. The quality of this lens is of prime importance for life on the islands.

5 - SOILS (Map 3)

Soils in New Caledonia and the Loyalty Islands are highly diversified and original in their morphology, mineralogy and physico-chemical characteristics. This diversity depends on the lithology of the geological substrate. It also depends on the topography and the opposition between the wet climate of the East Coast and the drier climate of the West Coast. The role of paleoclimates and vegetation may be locally important.

Ferritic ferrallitic soils (Acric and Plinthic Ferralsols) and unsaturated brown soils (Chromic Cambisols) associated with ferrallitic soils (Orthic, Rhodic Ferralsols) cover one half of the land. Other soils observed on large areas are : magnesic eutrophic brown soils (Eutric and Eutric Vertic Cambisols), calcimagnesic decarbonated soils (Humic Brown Rendzinas) and regosolic weakly developed soils of non climatic origin (Dystric Regosols). There is a marked opposition between : the eastern slopes and the range where ferrallitic and pre-ferrallitic soils are dominant; and the western slopes with more arids vertisols, eutrophic brown soils, calcimagnesic soils (Rendzinas) and leached fersiallitic soils with a podzolic tendency (Dystric Podzoluvisols). Dominant soils on the Loyalty Islands are : humic and brown rendzinas over limestone, carbonate lithic soils and humic, allitic ferrallitic soils (Humic Ferallsols). (French and F.A.O. soil classifications).

6 - LAGOON AND REEFS

Submerged reefs around the main island covers 8000 sq. km (half the size of the island). The barrier reef is 1600 km long (world longest true barrier reef) which delimits a large (23400 sq. km) lagoon which includes numerous coral reefs and islets. The difference is striking between the shallow western lagoon (25 m) in continuity with the coastal plains and the deep eastern lagoon (40 m) along a steep coast. A fringing reef is common along the coast in places exposed to the swell. The barrier reef width vary from 100 m to 1000 m. On the west coast, ocean side, the barrier reef displays a suite of ridges and furrows slowly going down to 12 m in depth. Then begins the dropoff, down to 60 m where the scree-covered slope ends at a platform over the great depth. This scheme may be deeply modified when large platforms break the dropoff (east coast near Poindimié). The reef is cut by large channels (30 m to 80 m in depth).

7 - TERRESTRIAL HABITATS OR ECOSYSTEMS

7.1. VEGETATION (Map 4)

Despite its small size, New caledonia has an exceptionally rich and original flora and a varied vegetation. But the autochtonous or primary vegetation that once covered the whole territory has now been destroyed on more than half of its surface. Autochtonous vegetation is represented by halophytic vegetation, (mangrove), marshy vegetation, dense humid evergreen forest, sclerophyllous forest and "maquis minier". Secondary vegetation includes herbaceous savanna, woody savanna and woodlands (Morat & al., in press).

Halophytic vegetation : mangroves

These habitats could be classified as marine as well. They cover approximately 200 sq. km and are primarily represented along the western coastline where the estuaries are wider and deeper than on the east. They play a major role in the retention of terrigenous sediments and in the exportation towards soft beds of the lagoon. The vegetation comprises about 20 species. *Rhizophora lamarckii* seems restricted to the east coast and to a single locality of northwestern Australia. 262 species of fishes have been inventoried in mangroves (Thollot, 1992).

Marshy vegetation

Marshy areas are poorly represented in New Caledonia. The most interesting occur in the southern ultramafic plateau where they form a suite of small lakes linked by streams ("Plaine des Lacs"). A large number of species - all endemic - exist in this locality including two rare Gymnosperms, *Decussocarpus minor* and *Dacrydium guillauminii*.

Dense humid evergreen forest

Covers approximately 4000 sq.km and occurs on all types of substratum including ultramafics, from 300 m elevation up to the highest summits. Trees in this forest are of moderate height (avg. 20 m) but taller emergents can be locally observed (*Araucaria, Agathis, Cyathea, Montrouziera*). Floristic richness is very high : 1500 sp., 90% endemics. This forest is the main source for timber.

At high elevations tree layer stature and floristic richness are lower although some groups are more abundant (e.g. Pteridophytes, Palmae, Winteraceae, Trimeniaceae, Paracryphiaceae). On ultramafics above 1000 m vegetation looks different (lichen and Hymenophyllaceae forest). On calcareous substrate (Loyalty Islands) the flora is poorer in relicts (e.g. Gymnosperms) and in endemic species; vegetation forms a woodland along the littoral, locally dominated by dense, monospecific stands of *Araucaria columnaris*.

Sclerophyllous forest

Once widespread along the west coast (up to 300 m) in dry areas (rainfall under 1000 mm, long dry season) this formation has suffered much degradation. It has often been replaced by cultivated areas or secondary vegetation.

This low forest is dominated by *Terminalia, Diospyros* and *Cupaniopsis* amongst other evergreen sclerophyllous species. While not as rich as the humid forest flora, the sclerophyllous forest flora is original and contains numerous endemic species in genera such as *Terminalia, Diospyros, Arytera, Captaincookia* and *Ancestrachne*.

"Maquis minier" (serpentine scrub)

This edaphic formation covers more than 4500 sq. km (30% of the mainland). Its distinctive vegetation results from the ultramafic nature of the substrate and occurs from sea level to the highest summits. Soils are poor in major elements (N, P, K, Ca) with the exception of Mg (high levels in poorly matured soils) and abnormally rich in some heavy metals (Ni, Mn, Cr).

It includes sclerophyllous evergreen associations. Constitutive species are adapted to high levels of light. Maquis vegetation can be dominated by trees or shrubs, or it can comprise a mixture of woody and herbaceous species with a dense layer of Cyperaceae. It is locally dominated by an open woody stratum of *Araucaria spp.* or *Agathis ovata*. The maquis contains about 1000 species of flowering plants (92% endemics). Some families are particularly rich : Myrtaceae (*Xanthostemon, Tristaniopsis, Austromyrtus*), Cunnoniaceae (*Codia, Pancheria*), Dilleniaceae (*Hibbertia*), Proteaceae (*Grevillea, Stenocarpus*). Maquis at higher altitude has a similar physiognomy but a rather different flora.

Secondary vegetation

Is the result of anthropogenic factors : fire, over-exploitation of some tree species, mining, agriculture, extensive livestock. **Herbaceous savanna** covers approximately 1000 sq. km and is composed by a large number of introduced grasses. **Woody savanna** covers about 4000 sq. km; "niaouli" trees *Melaleuca quinquenervia* (Myrtaceae) are most frequent. **Woodland** is dominated by

gregarious species : *Acacia spirorbis, Lantana camara, Leucaena leucocephala, Psidium guajava.*

7.2. FAUNAL ASSOCIATIONS

Our knowledge of animal life cannot be compared by far with what is known on plants. Few groups have been thoroughly investigated (4500 species known). Even birds have not been investigated to a point which allows sound ecological conclusions : the situation of rare species (Kagu, Uvea Parakeet) an even of game bird (Notu) remains questionable (Hannecart & Letocart, 1980, 1983). Bats and reptiles also need further research (Sandborn & Nicholson, 1950; Sadlier, 1986; Bauer, pers. com., 1992). In Invertebrates, attempts have been done only for Lepidoptera (Holloway, 1979), Orthoptera and Mantodea (Kaltenbach, 1976).

8 - MARINE HABITATS OR ECOSYSTEMS

Most of the available data has been acquired in the south west lagoon (Chardy & Clavier, 1988; Chardy & al., 1988; Chevillon (in press)).

Mud beds

They include (*pro parte*) Dahl's (1980) animals in sediments and cover 700 sq. km in the south west lagoon (35%). They are found in coastal bays and submarine valleys. Macrophytes are scarce (1.5% org. mat.). Dominant groups are molluscs (*Trachycardium elongatum, Lioconcha* sp., *Crassostrea sp.*), sponges (*Ircinia sp.*) and echinoderms (*Maretia planulata, Brissopsis sp.*) (respectively 55%, 18% and 14% org. mat.). In the trophic structure, suspension feeders and bivalvia are prominent. Some madrepora well adapted to these conditions may constitute original habitats for a varied fauna (Gail Bank, rich in scleractinian corals).

Grey sand beds

They include Dahl's (1980) algal bed, sea grass bed, animals in sediments (*pro parte*) and open lagoon. They cover 1000 sq. km in the south west lagoon (50%) and correspond to the lagoon flat bottoms. They are the richest biota for macrobenthic organic matter and excellent supports for sea grass. The important biomass of macrophytes (58%) is dominated by fleshy algae (50%); other components are phanerogames (34%) and calcareous algae (16% mostly *Halimeda*). Cnidarians (31%), molluscs and sponges constitute 73% of the zoomacrobenthic biomass. In the zoobenthic structure, freeliving corals *Heteropsammia michelini* and commensal sipunculids *Aspidosiphon corralicola* are most prominent, followed by the bivalvia *Anadara scapha* and *Brachtechlamys vexillum* and by the gastropod *Strombus erythrinus*. The trophic structure is dominated by suspension feeding cnidarians.

White sand beds

They include Dahl's (1980) animals in sediments (*pro parte*). They cover 300 sq. km in the south west lagoon (15%) and form part of the rear reef. They contain the lowest biomass dominated by molluscs (64%) and sponges (22%). Most common species are 2 gastropods *Strombus gibberulus* and *S. luhuanus*, a bivalvia *Glycymeris reevi* and a sponge *Spirastrella sp.*; the later is related to the subjacent slab. Surface deposit feeders dominate. Macrophytes are few but microphytobenhos is abundant.

Coral reefs

They correspond to Dahl's (1980) algal reef, windward and leeward atoll reefs, fringing reef and lagoon reef. Reefs in the south lagoon are generally in good conditions despite localized damage of

cyclones, man activity and action of *Acanthaster* : they include more than half the number of coral species known from New Caledonia.

Other habitats are locally important for the life of various species : **seabird rookeries** in Matthew, Walpole, Chesterfield, Hunter, Surprise; **sea turtle nesting areas** in Belep, Chesterfield, Surprise, Fabre, Le Leizour and Huon islands, as well as islets in the south lagoon (Laboute, 1989; Hamel, 1992); **sand beaches** where littoral bivalvia are fished for recreative or commercial purpose (*Actatodea striata, Gafrarium tumidum, Anadara scapha*).

9 - THE INTEREST OF NEW CALEDONIAN NATURE

New Caledonian native flora comprises 3250 species with nearly 80% endemics. The richness of native flora is very high in groups like Myrtaceae, Cunoniaceae, Cyperaceae, Pandanaceae, Gymnosperms (43 species on 44 are endemic) and Palmae (32 species in 17 genera, 16 of which endemic). **This flora has considerable potential as a source of genetic material : thus far only a little part as been utilized.**

New Caledonian terrestrial fauna is quite unique in many groups. This may be attributed to the extinction of faunas in neighbouring areas and to a long evolution of surviving groups after partial subsidence (Gressitt, 1967, 1971). The ante-Eocene stock has radiated through long isolation, then has been modified by mobile pionneer taxa dispersing from various origins. The percentage of endemic birds is relatively high (31%). Species and generic diversity are high in gekkos and skinks which are primarily endemic (76%). Many invertebrate groups display high endemism (60% to 100%) and diversity : richest area for Philotarsid Psocoptera (Thornton & Smithers, 1974), richest Pacific island group for Phasmatodea (Nakata, 1961), richest area for Micropterigid Lepidoptera (Gibbs, 1983). Evidence of high originality and archaism is found in molluscs, in Collembola and in most groups of insects lacking vagility (Blattodea, Phasmatodea, Dermaptera, some Coleoptera), but also in mobile groups like Micropterigids (Zeugloptera).This old original basis has often been underestimated (Chazeau, in press) (Table II). Recent work demonstrates that much can be expected from research on New Caledonian biota (Tillier, 1988; Chazeau & Tillier, 1991).

An idea of New Caledonian marine specific richness is given by Table IV. Marine fauna is not as original as terrestrial fauna. However, many endemics have been discovered in the lagoon in the past years. **The coastal zone of New Caledonia is of high biological, ecological and conservation importance.**

10 - RARE OR THREATENED SPECIES

FLORA

New Caledonia is considered a "hotspot" for tropical forest conservation (Myers, 1988). Existing lists (cf.. Dahl for IUCN-UNEP, 1991) don't give a complete account of the situation, as numerous species in the New Caledonian flora are known only from a single locality, sometimes from a very reduced area or even a single population (as for *Dacrydium guillauminii*). Table I is an attempt to update such lists, but is far from exhaustive.

LAND AND FRESHWATER FAUNAS

Studies on fossile birds indicate recent major extinctions correlated with the arrival of man and rats. Eleven species of non-passerines birds have become extinguished since the arrival of man (Balouet, 1987; Balouet & Olson, 1989). The extinction of the Great Kagu *Rhynochetos orarius* which lived in the sclerophyllous forest of the west coast and could not adapt to the rain forest - as did *R. jubatus* - is a striking evidence of drastic environment alteration. Progressive anthropisation continues to increase predatory pressure in shrinking biota. The Giant Skink, the New Caledonian Wood Rail, and the New Caledonian Lorikeet are known only by the type and by rare and questionable reports of visual contact. The endemic Painted Button-quail has not been captured for the last 50 years and is, at best, relictual in dry forest patches near Nepoui. The Uvea Crested Parakeet is still an endangered species. The Kagu has been selected as world's most important priority in bird protection by IUCN (1982) : populations don't exceed a few hundred individuals, with evidence of recent extinctions (Mt Panié). One can easily imagine that many other more discrete species went down the same way (Chazeau, in press).

Species mentionned in IUCN Red List and some other vertebrates, either rare or restricted to unique biota, are listed in Table III. Information lacks for Invertebrates.

MARINE FAUNA

Rare or vulnerable species visiting or inhabiting New Caledonian waters and shores are listed in Table V (Origin : CITES (Convention on International Trade in Endangered Species of Wild fauna and Flora, appendix I, II & III; and IUCN Red List book). Information lacks for most Invertebrates. Turtles, dugongs and tridacnes are of socio-cultural importance (traditional food, cultural value).

11 - PROTECTED AREAS

11.1. GENERAL ORGANIZATION (Map 5)

Protected areas exist only on and around the mainland. They are under the authority of provincial administration (Law N° 88.1028, 9 November 1988). So far only Province Sud has established a Service in charge of environment and protected areas. Major protected areas are classified in Strict Nature Reserves, Provincial Parks (formerly Territorial Parks) and Special Reserves (Territorial Assembly Delliberation N° 108, 9 May 1980; Decree N° 1504, 21 May 1980). Measures to control or to prohibit polluting or destructive activities have also been adopted for water reserve areas, afforestation zones and archaeological, historical or touristic sites. Despite limited resources, a local NGO is actively promoting nature conservation (Association pour la Sauvegarde de la Nature Néo-calédonienne, 37 Rue G. Clémenceau, Nouméa, Nouvelle-Calédonie).It must be pointed that a number of "protected" areas are in fact not protected against future mining activity (IUCN, 1991; Veillon, in press).

11.2. PROTECTED TERRESTRIAL AREAS

Surface of main protected areas : approximately 550 sq. km (total surface : 1500 sq. km).

Province Nord

Administrative authority : Direction du Développement Rural et de la Pêche de la Province Nord, B.P. 41 Koné, Nouvelle-Calédonie. Fax : 35 55 27.

Strict Nature Reserve : none

Special Botanical Reserve :
Mt Panié : middle and high altitude thick forest, rich in palms; mountain shrubberies. Notable species : *Araucaria schmidii*, *Agathis montana*, *Lavoixia macrocarpa*, various Cunoniaceae and Winteraceae.

Special Faunal Reserves (birds) : Mt Aoupinié; Pam Island.

Water supplies.

Province Sud

Administrative authority : Service de l'Environnement et de la Gestion des Parcs et Réserves. Direction du Développement Rural de la Province Sud. B.P. 2386 Nouméa, Nouvelle-Calédonie.
Fax : 28 51 27.

Strict Nature Reserve :
Montagne des Sources : thick rainforest, rich shrub-herb maquis with *Neocallitropsis pancheri*, mountain thickets dominated by *Araucaria humboldtensis*.
Notable species : *Platyspermation crassifolium*, *Basselinia porphyrea*, *Canacomyrica monticola*.

Special Botanical Reserves :
Chutes de la Madeleine : swamp and riverside associations (Cyperaceae). Species : *Neocallitropsis pancheri*, *Dacrydium guillauminli*, *Nageia minor*.
Plaine des Lacs : 7 areas (Yaté Barrage, Fausse Yaté, Mts Oungoué, Forêt Nord, Cap Ndua, Pic du Pin, Forêt Cachée); serpentine scrub and valley forests with *Agathis lanceolata*, *Arillastrum gummiferum*. Notable species : *Nothofagus spp.*, *Kermadecia pronyensis*, *Xanthostemon aurantiacum*, *Gymnostoma deplancheanum*.
Mt Mou : mountain forest and shrubberies rich in bryophytes and filmy ferns. Notable species : *Nothofagus baumanniae*, *Metrosideros porphyrea*, *Strasburgeria robusta*.
Mt Humboldt : thick rainforest, mountain maquis. Notable species : *Araucaria humboldtensis*, *Paracryphia alticola*, *Logania imbricata*, *Libocedrus chevalieri*, *Metrosideros tetrasticha*, *Greslania montana*.
Saille Forest, Mt Ninga, Mt Do : valley forest, thick *Araucaria* and *Nothofagus* forest, *Greslannia circinnata* association, shrub-herb maquis. Notable species : *Pseudosciadium balansae*, *Oxera sp.*, *Austrobuxus montis-do*, *Casearia coriifolia*.

Special Faunal Reserve :
Upper Yaté, Le Prédour Island : forest birds.
Notable species (Upper Yaté) : *Rhynochetos jubatus* (Kagu).

Provincial Parks (open to public recreation.) :
Rivière Bleue : thick rainforest.
Corbasson Park, Ouen-Toro : sclerophyllous forest.

Tourist site :
Mt Koghi : middle altitude forest and mountain shrubberies with *Araucaria* and *Nothofagus*.
Notable species : *Neisosperma thiollieri*, *Sloanea koghiensis*, *Acropogon megaphyllus*.

Water supply sites.

Province des Iles

Administrative authority : Service de l'Agriculture, des Forêts et des Pêches de la Province des Iles, B.P. 1014 Nouméa and B.P. 1 We Lifou. Fax : 27 64 20.

There is no protected area on Loyalty Islands.

11.3. PROTECTED MARINE AREAS

Surface : approximately 450 sq. km.

All protected areas are in Province Sud : no official protected area exist elsewhere but customary areas where some level of protection is enforced may be recognized (for exemple, Fayawa Bay on Uvéa or the closed bay between Wabao and Cengeite on Mare). Limited use of other areas may result from traditional or recent local custom.

Strict Marine Reserve (entrance and all activity stricly forbidden) :
Réserve Yves Merlet (16700 ha).

Special Marine Reserve (forbidden to remove or disturb minerals, flora or fauna) :
- 6 islets near Noumea with surrounding reefs over 10 m depth (Signal 181 ha, Larégnère 362 ha, Maître 350 ha, Amédée, Canard 50 ha, Bailly 314 ha);
- 3 areas of the barrier reef near Noumea constitute successively a reserve for a period of 3 years;
- 1 submarine reserve "La Dieppoise" (300 m around a sunken ship).

11.4 PREVIOUS AND CURRENT PROPOSALS

Only two types of plant formations are currently protected : evergreen forest and maquis on ultramafic substrates (9% of the total area). Mining is a threat on natural biota, though the Commission de Prévention des Dégâts Miniers is supposed to be consulted prior to any disturbance. As mining is a vital part of New Caledonia economic activity, so-called "protected areas" may not be protected against total destruction unless they are established in a mining reserve (IUCN, 1991). Annual bush-fires also are destructive for the relicts of the western sclerophyllous forest, as well as for low or middle altitude eastern forests. **Immediate protection of identified vulnerable habitats should prove more efficient than inventories of rare plants or animals for specific protection.**

It is recommended :

1 - **To extend protective measures to other plant associations**, particularly : mangroves (east and west coast); rainforest on varied substrates (northern and central New Caledonia); sclerophyllous forest is by far the most vulnerable association needing urgent protection (western New Caledonia); high forest on Loyalty Islands, rich in endemics; maquis in various substrate in northern and northwestern New Caledonia.

2 - **To protect sites containing discontinuously distributed floristic elements**, especially on ultramafics (more than 30 identified sites) **in order to save this endangered genetic heritage**.

REFERENCES

ANONYME - 1981. Atlas de la Nouvelle-Calédonie et Dépendances. ORSTOM, Paris, France.

BALOUET J.-C. - 1987. Extinctions des vertébrés terrestres de Nouvelle-Calédonie. *Mém. Soc. géol. France, (N.S.)*, 150 : 177-183.

BALOUET J.-C. ; OLSON S.L. - 1989. Fossil birds from Late Quaternary deposits in New Caledonia. *Smithson. Contrib. Zool.*, 469, 38 p.

CHARDY P.; CHEVILLON C.; CLAVIER J. - 1988. Major benthic communities of the south-west lagoon of New Caledonia. *Coral Reefs*, 7 : 69-75.

CHARDY P.; CLAVIER J. - 1988. Biomass and trophic structure of the macrobenthos in the south-west lagoon of New Caledonia. *Marine Biology*, 99 : 195-202.

CHAZEAU J. - (in press). Research on New Caledonian terrestrial fauna : achievements and prospects. *J. Biogeography.*

CHAZEAU J.; TILLIER S. (eds.) - 1991. Zoologia Neocaledonica, Vol. 2. *Mém. Mus. natn. Hist. nat.*, A (149), 358 p.

CHEVILLON C. - (in press). Biosédimentologie du Grand Lagon Nord de la Nouvelle-Calédonie. *Etudes et Thèses*, ORSTOM, Paris, France.

DAHL A.L. - 1980. Regional ecosystems survey of the South Pacific Area. South Pacific Commission, Noumea, New Caledonia, *Technical Paper n 179*, 99 p.

DAHL A.L. - 1991. Island Directory. UNEP Regional Seas Directories and Bibliographies, 35, 573 p.

DUPON J.-F. - 1986. Les effets de l'exploitation minière sur l'environnement des îles hautes : le cas de l'extraction du minerai de nickel en Nouvelle-Calédonie. Environnement : études de cas. Fiche 1. PROE, CPS, PNUD, Nouméa, Nouvelle-Calédonie, 6 p.

GARRIGUE C.; TSUDA, R.T. - 1988. Catalog of marine benthic algae from New Caledonia. *Micronesica*, 21 : 53-70.

GIBBS G.W. - 1983. Evolution of Micropterigidae (Lepidoptera) in the S.W. Pacific.. *Geojournal*, 7 (6) : 505-510.

GRESSITT J.L. - 1967. The role of the Papuan Area in insect evolution and dissemination. *Mushi*, 40 (8) : 89-95.

GRESSITT J.L. - 1971. Relative faunal disharmony of Insects on Pacific islands. *In* : Entomological Essays to commemorate the retirement of Professor Yasumatsu. Hokuryukan Publ., Tokyo, Japan : 15-24.

HANNECART F.; LETOCART Y. - 1980. Oiseaux de Nlle Calédonie et des Loyautés. Vol. 1. Ed. Cardinalis, Nouméa, Nouvelle-Calédonie, 150 p.

HANNECART F.; LETOCART Y. - 1983. Oiseaux de Nlle Calédonie et des Loyautés. Vol. 2. Ed. Cardinalis, Nouméa, Nouvelle-Calédonie, 136 p.

HOLLOWAY J.D. - 1979. A survey of the Lepidoptera, biogeography and ecology of New Caledonia. W. Junk, The Hague, Boston, London, ser. Entomol, 15, 588 p.

IUCN - 1990. 1990 IUCN Red List of threatened animals. IUCN, Gland, Switzerland & Cambridge, UK, 228 p.

IUCN - 1991. IUCN Directory of protected areas in Oceania. IUCN, Gland, Switzerland & Cambridge, UK, xii + 447 p.

KALTENBACH A. - 1976. Beiträge zur Kenntnis der ökologischen Verteilung der Orthopteroidea and Dictyoptera Neukaledoniens. *Ann. Naturhistor. Mus. Wien*, 80 : 657-667.

MORAT P.; JAFFRE T.; VEILLON J.-M. - (in press). Data sheet of New Caledonia (France). *In* : Centres of plant diversity : a guide and strategy for their conservation. IUCN-WWF Publication.

MYERS N. - 1988. Threatened biotas : "Hotspots" in tropical forest. *Environmentalist*, 8(3) : 1-20.

NAKATA S. - 1961. Some notes on the occurrence of Phasmatodea in Oceania. *Pac Insects Monogr.*, 2 : 107-121.

SADLIER R. - 1986. A review of the Scincid lizards of New Caledonia. *Rec. Aust. Mus.*, 39 : 1-66.

SANDBORN C.C.; NICHOLSON A.J. - 1950. Bats from New Caledonia, the Solomon Islands, and New Hebrides. *Fieldiana Zool.*, 31 (36) : 313-338.

THOLLOT P. - 1992. Les poissons de mangrove du lagon sud-ouest de Nouvelle-Calédonie. *Thèse de Doctorat*, Aix-Marseille II, 406 p.

THORNE - 1963. Biotic distribution patterns in the tropical Pacific. *In* : GRESSITT J.L. (ed.), Pacific Basin Biogeography, Bishop Museum, Honolulu, Hawaii : 311-354.

THORNTON I.W.B.; SMITHERS C.N. - 1974. The Philotarsidae (Psocoptera) of New Caledonia. *Pac. Insects*, 16 (2-3) : 177-243.

TILLIER S. - 1988. Zoologia neocaledonica, Vol. 1. *Mém. Mus. natn. Hist. nat.*, A (142), 158 p.

VEILLON J.-M. - (in press). State of the protection of floristic diversity in New Caledonia. *J. Biogeography*.

APPENDIX

Table I . Rare or threatened plants in New Caledonia

Blechnaceae	Blechnum	francii	Endemic	Rare (1 site)
	Doodia	gracilis	Endemic	Rare
Cyatheaceae	Cyathea	cicatricosa	Endemic	Rare
	Cyathea	stelligera	Endemic	Rare
Araucariaceae	Araucaria	nemorosa	Endemic	Vulnerable
		schmidii	Endemic	Vulnerable
Cupressaceae	Callitris	sulcata	Endemic	Vulnerable
	Libocedrus	chevalieri	Endemic	Vulnerable
		yateensis	Endemic	Vulnerable
	Neocallitropsis	pancheri	Endemic	Vulnerable
Podocarpaceae	Dacrydium	guillauminii	Endemic	Endangered (1site)
	Decussocarpus	minor	Endemic	Vulnerable
	Podocarpus	decumbens	Endemic	Vulnerable
		longefoliolatus	Endemic	Rare
		polyspermus	Endemic	Rare
Taxaceae	Parasitaxus	ustus	Endemic	Vunerable
Acanthaceae	Graptophyllum	balansae	Endemic	Rare
		ophiolithicum	Endemic	Rare
	Hemigraphis	neocaledonica	Endemic	Rare
Anacardiaceae	Semecarpus	riparius	Endemic	Rare
Annonaceae	Unona	tiebaghiensis	Endemic	Rare
Apocynaceae	Cerberiopsis	neriifolia	Endemic	Vulnerable
	Melodinus	insulae-pinorum	Endemic	Rare
	Neisosperma	seventii	Endemic	Vulnerable
		thiolliereI	Endemic	Vulnerable
	Ochrosia	inventorum	Endemic	Rare
	Rauvolfia	spathulata	Endemic	Rare
Asclepiadaceae	Marsdenia	balansae	Endemic	Rare
Balanopaceae	Balanops	balansae	Endemic	Rare
Burseraceae	Canarium	whitei	Endemic	Rare
Capparaceae	Oceanopapaver	neo-caledonicum	Endemic	Rare
Combretaceae	Terminalia	gatopensis	Endemic	Rare
Convolvulaceae	Turbina	inopinata	Endemic	Rare
Cunoniaceae	Weinmannia	ouaiemensis	Endemic	Rare
Cyperaceae	Chortzandra	gigantea	Endemic	Endangered
Dilleniaceae	Hibbertia	bouletii	Endemic	Rare
		favieri	Endemic	Rare
		margaretae	Endemic	Rare
Elaeocarpaceae	Elaeocarpus	biflorus	Endemic	Rare
		castanaefolius	Endemic	Rare
		colnettianus	endemic	Rare
		kaalensis	Endemic	Rare
		moratii	Endemic	Rare
	Sloanea	koghiensis	Endemic	Rare
		lepida	Endemic	Rare
		suaveolens	Endemic	Rare
Epacridaceae	Dracophyllum	alticola	Endemic	Rare
		cosmelioides	Endemic	Rare
		ouaiemense	Endemic	Rare
	Styphelia	enervia	Endemic	Rare
Ericaceae	Agapetes	neo-caledonica	Endemic	Rare
Eriocaulaceae	Eriocaulon	longipedunculatum	Endemic	Rare
Euphorbiaceae	Phyllanthus	cherrieri	Endemic	Rare
		conjugatus	Endemic	Rare
		galonensis	Endemic	Rare
		margaretae	Endemic	Rare
		pindaiensis	Endemic	Rare

		rozennae	Endemic	Rare
		umbricola	Endemic	Rare
		unifoliatus	Endemic	Rare
	Triganostemon	cherrieri	Endemic	Rare
Fagaceae	Nothofagus	baumanniae	Endemic	Rare
Flacourtiaceae	Casearia	kaalaensis	Endemic	Rare
	Xylosoma	gigantifolium	Endemic	Rare
		peltatum	Endemic	Vulnerable
Gesneriaceae	Cyrtandra	mareensis	Endemic	Rare
Goodeniaceae	Scaevola	coccinea	Endemic	Endangered
		macropyrena	Endemic	Rare
Gramineae	Ancistrachne	noumaeensis	Endemic	Rare
	Lepturopetium	kuniense	Endemic	Rare
	Setaria	jaffrei	Endemic	Rare
Lauraceae	Adenodaphne	spathulata	Endemic	Rare
	Cryptocarya	bitriplinerva	Endemic	Endangered
		longifolia	Endemic	Rare
	Endiandra	lecardii	Endemic	Rare
	Litsea	imbricata	Endemic	Rare
		miana	Endemic	Rare
Leguminosae	Serianthes	germainii	Endemic	Endangered
Meliaceae	Dysoxylum	pachypodium	Endemic	Rare
Moraceae	Streblus	sclerophyllus	Endemic	Rare
Myrtaceae	Metrosideros	humboldtiana	Endemic	Rare
	Tristaniopsis	jaffrei	Endemic	Rare
		polyandra	Endemic	Rare
		vieillardii	Endemic	Rare
		yateensis	Endemic	Rare
	Xanthostemon	francii	Endemic	Endangered
		grisei	Endemic	Rare
		longipes	Endemic	Vulnerable
		sebertii	Endemic	Rare
		sulfureum	Endemic	Rare
Orchidaceae	Dendrobium	munificum	Endemic	Vulnerable
	Megastylis	latissima	Endemic	Vulnerable
Palmae	Actinokentia	huerlimannii	Endemic	Rare
	Alloschmidia	glabrata	Endemic	Rare
	Basselinia	humboldtiana	Endemic	Rare
		iterata	Endemic	Rare
		porphyrea	Endemic	Rare
		sordida	Endemic	Rare
		tomentosa	Endemic	Rare
	Brongniartikentia	lanuginosa	Endemic	Rare
	Burretokentia	hapala	Endemic	Rare
	Chambeyronia	lepidota	Endemic	Rare
	Clinosperma	bractealis	Endemic	Rare
	Cyphophoenix	elegans	Endemic	Rare
		nucele	Endemic	Rare
	Cyphosperma	balansae	Endemic	Rare
	Kentiopsis	oliviformis	Endemic	Endangered
	Lavoixia	macrocarpa	Endemic	Endangered
	Mackeea	magnifica	Endemic	Rare
	Moratia	cerifera	Endemic	Rare
	Pritchardiopsis	jeanneneyi	Endemic	Endangered (Isite)
	Veillonia	alba	Endemic	Rare
Pandanaceae	Pandanus	clandestinus	Endemic	Rare
		lacuum	Endemic	Vulnerable
Pittosporaceae	Pittosporum	gomonenense	Endemic	Rare
		heckelii	Endemic	Rare
		lifuense	Endemic	Rare
		paniense	Endemic	Rare
Proteaceae	Bauprea	congesta	Endemic	Rare
		crassifolia	Endemic	Rare
		penariensis	Endemic	Rare

	Kermadecia	pronyensis	Endemic	Vulnerable
	Stenocarpus	dumbeensis	Endemic	Rare
		villosus	Endemic	Rare
Rhamnaceae	Alphitonia	erubescens	Endemic	Rare
Rubiaceae	Bikkia	kaalaensis	Endemic	Vulnerable
		lenormandii	Endemic	Vulnerable
		pachyphylla	Endemic	Endangered
	Captaincookia	margaretae	Endemic	Endangered
	Cyclophyllum	tenuipes	Endemic	Vulnerable
Rutaceae	Aurantium	neo-caledonica	Endemic	Vulnerable
		oxanthera	Endemic	Endangered
	Geijera	salicifolia	Endemic	Rare
	Medicosma	articulata	Endemic	Rare
		congesta	Endemic	Rare
		diversifolia	Endemic	Rare
		emarginata	Endemic	Rare
		exigua	Endemic	Rare
		gracilis	Endemic	Rare
		latifolia	Endemic	Rare
		obliqua	Endemic	Rare
		petiolaris	Endemic	Rare
	Oxanthera	brevipes	Endemic	Rare
		undulata	Endemic	Rare
	Zieria	chevalieri	Endemic	Endangered
Santalaceae	Elaphantera	baumannii	Endemic	Rare
	Exocarpos	spathulatus	Endemic	Rare
Sapindaceae	Cossinia	trifoliolata	Endemic	Vulnerable
Sapotaceae	Itellluma	leptostylidifolium	Endemic	Rare
		rheophytopsis	Endemic	Rare
	Planchonella	contermina	Endemic	Rare
		kaalaensis	Endemic	Rare
		koumacensis	Endemic	Rare
		vieillardii	Endemic	Rare
Solanaceae	Solanum	hugonis	Endemic	Vulnerable
		insulae-pinorum	Endemic	Vulnerable
		pseuderanthemoides	Endemic	Rare
		vaccinioides	Endemic	Rare
Sphenostemonaceae	Sphenostemon	oppositifolium	Endemic	Rare
Thymelaeaceae	Deltaria	brachyblastophora	Endemic	Rare
Ulmaceae	Celtis	balansae	Endemic	Rare
Verbenaceae	Gmelina	lignum-vitreum	Endemic	Rare
	Oxera	crassifolia	Endemic	Rare

Table II : State of knowledge on New Caledonia biodiversity : specific richness in terrestrial and freshwater faunas

Sponges		5
Platyhelminthes		39
Nemathelminthes		18
Annelids		44
Molluscs	Gastropods	210
	Bivalves	3
Arthropods	Arachnids	318
	Crustacea	100
	Myriapods	88
	Entognathes	51
	Insects	3460
Vertebrates	Fishes	33
	Amphibians	1
	Reptiles	44
	Birds	68
	Mammals	11

Table III : Rare or threatened terrestrial and freshwater vertebrates in New Caledonia

Fishes				
Galaxiidae	Nesogalaxias	neocaledonicus		Restricted habitat
Birds				
Aegothelidae	Aegotheles	cristatus savesi	New Caledonian Aegotheles	Recently extinct ?
Caprimulgidae	Eurostopodus	mysticalis exul	White-throated Nightjar	Very rare
Columbidae	Drepanoptila	holosericea	Cloven-feathered Dove	Rare
	Ducula	goliath	Notu, Imperial Pigeon	Vulnerable
Psittacidae	Charmosyna	diadema	New Caledonian Lorikeet	Recently extinct ?
	Eunymphicus	cornutus uveaensis	Uvea Crested Parakeet	Vulnerable
Rallidae	Gallirallus	lafresnayanus	New Caledonian Wood Rail	Recently extinct ?
Rhynochetidae	Rhynochetos	jubatus	Kagu	Endangered
Turdidae	Turdus	poliocephalus mareensis	Mare Island Thrush	Recently extinct ?
		poliocephalus pritzbueri	Lifu Island Thrush	Recently extinct ?
Turnicidae	Turnix	varia novaecaledoniae	Painted Button-quail	Recently extinct ?
Reptiles				
Scincidae	Phoboscincus	bocourti	Giant Skink	Recently extinct ?
Gekkonidae	Rhacodactylus	sarasinorum		Rare
Mammals				
Pteropidae	Pteropus	ornatus	New Caledonian Fruit Bat	Vulnerable

Table IV : State of knowledge on marine biodiversity in New Caledonia
(specific richness in lagoon and reefs)

Macrophytes	336
Madrepora	600
Sponges	600
Molluscs	5500
Ascidies	300
Echinoderms	600
Crustacea	5000
Fishes	1950 (1300 living in the lagoon)

Table V : Rare or threatened marine species in New Caledonia

Balaenopteridae	Megaptera	novaeangliae	Humpback Whale	Vulnerable (RDB & CITES I)
	Physeter	catodon		(CITES I)
	Balaenoptera	acutorostrata	Minke Whale	(CITES I)
Delphinidae	Tursiops	truncatus		(CITES II)
Dugongidae	Dugong	dugon	Dugong	Vulnerable (RDB & CITES I)
Cheloniidae	Caretta	caretta	Loggerhead Turtle	Vulnerable (RDB)
	Chelonia	mydas	Green Turtle	Endangered (RDB)
	Eretmochelys	imbricata	Hawksbill Turtle	Endangered (RDB)
Rhincodontidae	Rhincodon	typus	Whale Shark	Indeterminate (RDB)
Coenobitidae	Birgus	latro	Coconut Crab	Rare (RDB)
Palinuridae	Panulirus	penicillatus	Spiny Lobster	Commercial Threat (RDB)
Cymatidae	Charonia	tritonis	Triton's Trumpet	Rare (RDB)
Tridacnidae	Tridacna	maxima		Information lacking I(RDB)
		squamosa		Information lacking (RDB)
	Hippopus	hippopus		Indeterminate (RDB)

Chazeau Jean, Chevillon Christophe, Garrigue Claire, Jaffré Tanguy, Veillon Jean-Marie. (1992).

South Pacific biodiversity programme, terms of reference : New Caledonia : national diversity review.

Nouméa : ORSTOM, 17 p. multigr.