R E P U B L I C O F V A N U A T U

INTRODUCTION

by Ernest Bani and David Esrom

Area: 12,189 sq.km. (14,763 sq.km.)
Population: 142,630 (1989 National Census).

The Republic of Vanuatu (formerly the Anglo-French Condominium of the New Hebrides) is an archipelago of about 80 islands located near the eastern limits of the Indo-West Pacific region between latitudes 13° and 21° South and longitudes 166° and 170° East. The islands are oceanic, formed by uplift and accumulation of volcanic and carbonate deposits, mainly during the Quaternary Period. Lying at the end of the Melanesian arc which includes New Guinea and the Solomon Islands to the northwest, they form a distinct geographic and biogeographic unit separated by deep ocean trenches from neighbouring land masses.

The climate varies from hot, very wet and humid with little seasonality in the north, to a warm, less humid and more seasonal climate in the south. Rainfall decreases from about 4,200 mm in the north to about 1,500 mm in the south. The mean daily temperatures at sea level fluctuate only slightly around 25°C throughout the year. Vanuatu lies in the cyclone belt, and cyclones may occur anywhere in the islands between November and April. Over the last 40 years, the islands have been struck by an average of 2.6 cyclones per year.

Some 85% of the population are dependent on traditional subsistence agriculture (slash-and-burn farming) for their livelihood, although this is often supplemented by reef fishing and occasionally also freshwater fishing. The remainder of the population live in the urban centres of Port Vila on Efate and Luganville on Espiritu Santo. Most of the population lives along the coast, and the interiors of many islands, particularly the larger, are virtually uninhabited. Thus although the overall population density is low, densities along the coast are often quite high. On some islands, this has resulted in problems of soil erosion associated with reduced fallow periods in the slash and burn cycle.

The characteristic vegetation is evergreen rainforest which covers about 75% of the country. On the larger mountainous islands, three major categories of vegetation can be readily identified: (a) evergreen tropical forests on lowland, wet, windward slopes; (b) semi-deciduous forests and fire-induced savannahs and grasslands on lowland, drier, leeward slopes; and (c) evergreen forests of upland and summit areas where the cooler, wetter and more humid climate results in a forest of smaller trees rich in epiphytes (Chambers, 1992). There are about 900 species of flowering plants in Vanuatu, a comparatively low number compared with neighbouring island groups, and only 135 (15%) are endemic. The fern flora, by contrast, is comparatively rich, with about 250 species known to occur (Chambers, 1992).

Vanuatu is rich in natural resources but generally poorly developed. About 5,000 sq.km (41%) of Vanuatu's total land area are suitable for cultivation, but only about 30% of this area is currently under cultivation. Conditions of climate and soil support the cultivation of copra, cocoa, coffee and a variety of

other agricultural crops such as tubers, spices and fruits, as well as the development of livestock husbandry. There is considerable potential for forestry development, particularly in areas where agricultural development is limited. Significant potential also exists for the development of coastal and deep-sea fisheries. Mineral resources have been located on many islands, and there is potential for the exploitation of zinc, manganese, gold and raised coral limestone, as well as geothermal energy.

The country's main export is copra, although coffee, beef and cocoa exports are gaining in importance. Tourism is the main foreign exchange earner.

Summary of Wetland Situation

Dahl (1980 & 1986) lists the following wetland habitats as occurring in Vanuatu:

- permanent lake (Ambae, Ambrym, Efate, Epi, Espiritu Santo, Gaua, Maewo, Malekula, Tanna and Thion);
- hot springs with algae (Efate);
- freshwater swamp and marsh (Anatom, Efate, Epi, Erromango, Espiritu Santo, Gaua, Maewo, Tanna and Thion);
- mountain streams (common);
- lowland rivers (common);
- riverine forest on alluvial soils;
- swamp forest (Efate, Malekula and Espiritu Santo);
- non-tidal salt marsh (Loh);
- closed lagoon (Efate);
- mangrove forest (mostly on Malekula);
- sea-grass beds (common in coastal areas).

There are about 25-30 natural freshwater lakes in Vanuatu. Several of these are crater lakes, some within active volcanoes. Much the largest is Lake Letas (1,900 ha), the largest freshwater lake in the island Pacific outside of New Guinea. This lake lies within the occasionally active Mount Garet on Gaua Island. The caldera lakes of Ambae's active volcano Waivundolue, at over 1,300 m elevation, are the highest lakes in the South Pacific. Many of the other freshwater lakes occur in lowland areas and usually support marsh vegetation. Most are very small, and some are seasonal. There are also a few brackish and saline lagoons in the coastal zone of some islands, *e.g.* on north Efate and south Espiritu Santo. The largest of the brackish lagoons is Lake Nalema on east Epi. Vanuatu's largest closed saline lagoon, Ekasuvat Lagoon near Port Vila on Efate, is now much disturbed by urban development.

Rivers and streams are abundant in the islands, the largest occurring on Espiritu Santo and Malekula. Although of no great length, these rivers may carry large amounts of water during rainy periods. Most of the rivers are characterized by their large and rapid fluctuations in flow regime coupled with generally steep gradients. Many, such as the Teouma River on Efate and the Matenoi River on south Malakula, flow through spectacular and almost inaccessible gorges for much of their length. The only extensive floodplain area in the country is formed by the rivers which drain the Tabwemasana Range of central Espiritu Santo and flow north into Big Bay. Some rivers, particularly in areas made up largely of raised reefs, *e.g.* eastern Espiritu Santo, coastal Efate and the Torres Islands, flow only at times of heavy rainfall. On some islands, there is little or no surface water for all or much of the year because of the porous nature of the uplifted coral substrates.

Freshwater swamps and swamp forests are generally small and few in number. They occur as fringing areas around lakes on Efate and Thion Island, in depressions on plateaux *e.g.* on Efate, Epi, Maewo and Gaua, in extinct

volcanoes such as Vanua Lava, or on floodplains such as those of the rivers entering Big Bay on Espiritu Santo (Chambers, 1992). Patches of swamp forest on Efate are dominated by species of *Barringtonia* and *Pandanus,* while those on Malekula are dominated by species of *Hibiscus* and *Metroxylon.* The largest area of swamp forest in Vanuatu occurs on the floodplains south of Big Bay on Espiritu Santo. These floodplains receive most of the rivers that drain the island's high mountain massif, and support a particularly rich and diverse swamp forest community dominated by species of *Hibiscus* and *Erythrina.*

Mangroves constitute the most extensive wetland vegetation in Vanuatu. There are estimated to be between 2,500 and 3,000 ha of mangrove forest in the islands, of which almost 2,000 ha occur on Malekula. Two large areas of mangrove along the east coast of Malekula account for over 1,800 ha of this total; elsewhere mangroves occur as small stands or narrow belts along lagoon perimeters, sea shores and estuaries. Sizeable stands of mangrove occur on only nine of the 80 islands in the archipelago: Malekula (1,915 ha), Hiu (210 ha), Efate (100 ha), Emae (70 ha), Epi (60 ha), Vanua Lava (35 ha), Ureparapara (30 ha), Mota Lava (25 ha) and Aniwa (15 ha) (Lal & Esrom, 1990). Thirteen species of mangrove tree have been recorded (Macrae, 1968). Typically, there are four recognizable zones: a landward fringe now generally cleared by human activity, thickets of *Ceriops tagal* with the mangrove fern *Acrostichum aureum, a Rhizophora* forest zone, and a seaward zone of *Avicennia marina,* occasionally with scattered *Sonneratia caeseolaris* and *Bruguiera.* In some localities, the stands of *Sonneratia* and *Bruguiera* comprise a further recognizable zone (Chambers, 1988).

The human impact on mangroves in Vanuatu still appears to be slight, and is mainly limited to subsistence activities. Mangrove wood is harvested to meet the energy needs of rural populations, and mangroves are occasionally cleared for easier access to the sea. However, conversion of mangroves to other uses has not as yet occurred to any significant extent. In some localities, the landward fringe has been converted to agricultural use such as coconut plantations, while in other areas, notably the Maskelyne Islands, some mangroves have been cleared to allow for village construction. In the Port Vila area, tourist developments have involved the removal of 10 ha of mangroves (Chambers, 1988; Lal & Esrom, 1990).

Although the exploitation of mangroves on a traditional subsistence basis is allowed, there is a total ban on commercial logging in mangroves. Occasionally requests for logging permits have been received by the Forestry Department, but to date these have always been rejected (Chambers, 1988). There is some community based management of aquatic resources of the mangroves and adjacent coral reefs. This is based on the traditional land and sea tenure system. On special occasions, a partial or complete ban may be imposed on the harvesting of certain resources, *e.g.* in the Port Stanley area, local community chiefs often collectively ban the harvest of *Cardiosoma* crabs for commercial sales during the crab's breeding season, while continuing to allow subsistence use (Lal & Esrom, 1990).

The seagrass communities of Vanuatu have recently been described by Chambers *et al.* (1990). These authors surveyed sixty sites from Aneityum in the south to Ureparapara in the north, and found seagrass beds in 39 of these. Nine species of seagrass were recorded, six of which were new records for Vanuatu. The most widespread species were *Thalassia hemprichii, Cymodocea rotundata, Halodule inermis, Enhalus acoroides* and *Halophylla ovalis.* Dense stands of seagrasses were located at sixteen sites in shallow lagoons, bays and intertidal areas, in all instances where sand was the major or only substrate component. Most of the sites were rather small, but extensive seagrass beds were located on the comparatively wide intertidal areas around the Maskelyne Islands and along the southeast coast of Malakula.

Coral reefs occur throughout the archipelago, encircling some islands, but discontinuous around recently active land masses such as Espiritu Santo, Malekula and Ambrym. These have recently been described in some detail in an inventory of the coral reefs of the world (UNEP/IUCN, 1988).

Threatened taxa associated with the wetlands of Vanuatu include the Black Flying-Fox *Pteropus tonganus* and endemic White Flying-Fox *P. anetianus,* which often roost in mangroves, the Estuarine Crocodile *Crocodylus porosus,* now confined to a single site on Vanua Lava island in the Banks Islands,

and the Dugong *Dugong dugon,* which occurs throughout the islands and remains relatively common. For both the Estuarine Crocodile and the Dugong, Vanuatu is the easternmost limit of their extensive distributions in southern Asia and the Pacific. Little is known about marine turtles in Vanuatu, although the Green Turtle (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Loggerhead (*Caretta caretta*) and Leatherback (*Dermochelys coriacea*) occur and nest in the islands. However, as there are few large sandy beaches, breeding populations may be small (Chambers, 1992). Other species of conservation interest include three species of freshwater mollusc.

Dahl (1980) recommended that reserves be established to protect examples of all major natural ecosystems in Vanuatu including lakes, freshwater swamps, swamp forests and mangroves. At present, however, there are only five small reserves and recreation parks in Vanuatu (IUCN, 1991). The largest of these, President Coolidge and Million Dollar Point, is a marine reserve covering 100 ha off the coast of Espiritu Santo. Lake Emaotul (commonly known as Duck Lake) on Efate has been proposed as a freshwater reserve (Dahl, 1980; TCSP, 1990), but no further action has been taken. Undoubtedly there are many lakes and rivers in Vanuatu which, on account of their interesting features and often spectacular locations, merit consideration for protected area status.

Although the freshwater wetlands are currently little disturbed by human activity, they are likely to come under increasing pressure as populations increase and the development of mining, forestry and agriculture proceeds. Because of their limited extent, swamp forests in particular are likely to come under threat. Agricultural pressures are already high on some islands, and with a population growth rate of about 3.3% per annum, these pressures are likely to increase considerably in the coming decades. There are, as yet, no records of environmental damage from pesticide use, but the inadequate disposal of various pollutants, including sewage and solid waste, is resulting in some contamination of coastal wetlands.

Wetland Research

The freshwater wetlands of Vanuatu have never been adequately studied, and there are only some scattered references to these wetlands in the literature (Baker, 1929; Balfour-Browne, 1939; Bregulla, 1992; Jenkin, 1929; Kimmins, 1936; Lowndes, 1928 & 1931; Mosely, 1932; Salem, 1959). The freshwater fauna has been little studied and is virtually unknown. Data are lacking on the composition and type of freshwater communities, their distribution and variation within the country, and their chemical, physical and morphometric characteristics. Some limited chemical analyses have been carried out by government agencies in the past, but these have never been published. As a consequence, there is insufficient information available to plan development in such a way that the freshwater resources and human dependence upon these resources can be adequately safeguarded.

The mangrove resources of Vanuatu have received rather more attention. Marshall and Medway (1976) have described the mangrove community in Vanuatu, and scientists from the ORSTOM Mission on Efate have carried out a variety of studies, including some inventory work using SPOT satellite imagery. Lal and Esrom (1990) conducted a study on the economics of mangrove utilization and management in Vanuatu, while Chambers (1988) reported on the mangroves of Vanuatu for the UNDP/UNESCO Working Group Meeting on Mangroves in Apia in 1988. The Action Strategy for Nature Conservation in the South Pacific Region (SPREP/IUCN, 1989) recommends that a thorough survey and inventory of the mangrove areas of Malekula be undertaken as a national priority.

Wetland Area Legislation

There is no legislation relating specifically to wetland conservation in Vanuatu, although a draft Water Resources Act was submitted to the Government in 1986. This draft act, which seeks to promote the coordinated management of water resources and watershed areas at a national level, is still under consideration by the Government. Two major provisions of the draft act call for an inventory of water resources and the production of a National Water Development Plan, respectively. No progress has as yet been made on either of these two basic requirements for the management of water resources.

The 'Public Health Bill', also still in draft form, includes a separate provision for the protection of water supplies. This would penalize persons who 'drop, deposit or throw any refuse or other matter or thing into any channel, drain, lake, reservoir, river, stream or watercourse or upon the bank of any of the same or in any part of the sea abutting on the foreshore'. Provision is also made for a specific offence which consists of defiling or polluting, or permitting drainage or refuse from land to flow into or be deposited in, any watercourse, stream, lake, pond or reservoir forming part of the water supply.

The Forestry Act 1982 provides for the restriction of clearing operations using heavy machines (bulldozers, graders) or similar machines on any land within 15-20 metres of any stream without first obtaining approval from the Director concerned. It provides for the protection of land from erosion and disruption of stream flow, the conservation of land as an area or part of an area of particular scenic, cultural, historical or national interest, and the preservation of land for use by the public for recreation.

The principal statute governing the management of fisheries is the Fisheries Act 1982. This Act requires the Director of Fisheries to prepare and keep under review plans for the management and development of fisheries in Vanuatu waters. The Act prohibits all fishing for marine mammals in Vanuatu waters, and also prohibits the use of explosives and poisons for fishing. It also provides that the Minister may declare 'any area of Vanuatu waters and the seabed underlying such waters to be a marine reserve'.

The principal piece of legislation dealing with wildlife protection is the Wild Bird Protection Regulation 1962. This regulation makes it unlawful to kill, wound, capture or take the eggs of a number of named species of wild birds unless a permit to do so has been granted by the Department of Agriculture. These regulations also impose a close season for Pacific Black Duck (*Anas superciliosa pelewensis*) and for some ten other species including other ducks, doves and the Incubator Bird *Megapodius freycinet.*

Vanuatu is not yet a party to any of the international conventions or programmes that directly promote the conservation of natural areas, namely the World Heritage Convention, the UNESCO Man and the Biosphere Programme and the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention). However, Vanuatu has recently become a party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). An International Trade (Fauna and Flora) Act 1989 was drafted, and has now been approved by the national parliament and gazetted. This provides the responsible government institution with powers to restrict the capture or killing of wetland species listed under CITES. Vanuatu has also signed but not yet ratified the Convention on Biological Diversity.

Wetland Area Administration

Vanuatu has no wetland reserves, and the total area covered by wetlands is unknown. There is a need for research to be carried out on the wetlands of Vanuatu to assess their wildlife values and requirements for conservation. It has recently been proposed that a Freshwater Resources Survey be implemented on a collaborative basis between the relevant government agencies and competent regional authorities.

Organizations involved with Wetlands

a) Government of the Republic of Vanuatu

- Department of Agriculture, Livestock and Horticulture
  Responsible for the management and administration of the Wild Bird Protection Regulation.
- Department of Fisheries
  Responsible for the management and development of marine resources as spelt out under the Fisheries Act 1982.
- Department of Forestry
  Responsible for the management and development of the country's forest resources.
- Department of Geology, Mines, Minerals and Water Supply
  Responsible for water protection, management and development to meet the needs of the people.
- Department of Physical Planning and Environment
  Responsible for planning in urban areas, assessment of potential protected areas, and management and administration of the country's natural environment. The Department is the country's focal point for local, regional and international environmental organizations, and is the agency responsible for CITES.

b) Non-governmental Organizations

- Institut Francais de Recherche Scientifique pour le Developpement en Cooperation (ORSTOM)
  Conducts research on mangroves and fisheries, the latter in collaboration with the Department of Fisheries.
- Vanuatu Natural Science Society (VNSS)
  Organizes meetings relevant to wildlife protection, and conducts surveys on the wild fauna and flora of Vanuatu. The Chairman of VNSS is the International Council for Bird Preservation (ICBP) Representative for Vanuatu. The Society publishes the newsletter 'Naika'.

WETLANDS

Site descriptions compiled by Ernest Bani and David K. Esrom of the Environment Section, Department of Physical Planning and Environment.

Wetland Name: Alligator River
Country: Republic of Vanuatu
Coordinates: 13°49'S, 167°32'E
Location: on the east coast of Vanua Lava Island in the Banks Islands, northern Vanuatu.
Area: 200 ha.
Altitude: Sea level.
Overview: A tidal inlet in mangrove forest.
Physical features: The Alligator River is a tidal inlet which meanders for some 500-700 metres through a patch of mangrove forest before coming to an abrupt halt at a steep bank. Some fresh water trickles down this bank, but there is no river or stream as such entering the inlet. The main channel is generally about 10 metres wide, but widens to about 50 metres near its mouth. There are a few short side channels.

The climate is humid tropical with an average annual rainfall of 4,000 mm and a mean temperature of 30°C. The wet season (also the cyclone season) extends from November to April.
Ecological features: Mangrove forest with a canopy at about 15-20 m.
Land tenure: Customary ownership.
Conservation measures taken: None.
Conservation measures proposed: The Environment Section in the Department of Physical Planning and Environment has recommended that the site be protected *as* a Crocodile Reserve.
Land use: Some subsistence fishing; subsistence agriculture in adjacent areas.
Disturbances and threats: Severe cyclones are known to have caused a decline in the crocodile population in the past, and may do so again.
Hydrological and biophysical values: No information.
Social and cultural values: None known.
Noteworthy fauna: The Alligator River still supports a tiny population of the Estuarine Crocodile *Crocodylus porosus*. Recent studies have shown that very few crocodiles remain, and breeding has apparently ceased (Chambers and Esrom, 1989). This decline appears to have been caused by mortality from cyclones and hunting. The Estuarine Crocodile occurs in Vanuatu at the easternmost extremity of its enormous range.
Noteworthy flora: The site includes an interesting stand of mangrove forest.
Scientific research and facilities: The Environment Section in the Department of Physical Planning and Environment carried out a preliminary survey of the area in 1989 (Chambers and Esrom, 1989).
Management authority and jurisdiction: The sites is under the jurisdiction of the Department of Lands.
References: Armstrong (1900); Chambers & Esrom (1989); Dickson (1981); Fox (1958); Groombridge (1982); Luders (1983).
Reasons for inclusion: lb, 2a. This is the only site in Vanuatu in which crocodiles have been sighted in recent years.
Source: E. Bani and D.K. Esrom.

Wetland Name: Nagpen (Selva) River
Country: Republic of Vanuatu
Coordinates: 13°49'-13°51'S, 167°32'E
Location: near the southern end of Vanua Lava Island in the Banks Islands, northern Vanuatu.
Area: 10 km of river.
Altitude: Sea level to 200 m.
Overview: An unusually sterile river draining a large area of sulphur springs.
Physical features: A small river, 10 km in length, draining some 500 ha of hot sulphur springs in the interior of Vanua Lava. The river water has a very bitter taste, is highly acidic and appears to be almost sterile. It is a dark, peaty brown in colour and quite clear, except along the lower reaches of the river where there is a yellowish/brownish substance in suspension. This may be produced as a result of a chemical reaction occurring when fresh and saline waters mix near the river mouth.

The climate is humid tropical with an average annual rainfall of 4,000 mm and a mean temperature of 30°C. The island lies in the cyclone belt, and has been severely affected by cyclones on several occasions during the 1970s and 1980s.
Ecological features: There are no aquatic plants in the river. The vegetation along the banks of the lower reaches is dominated by the screw palm (*Pandanus* sp.) and tamanu (*Calophyllum* sp.). *Hibiscus tiliaceus* also occurs here and becomes progressively commoner nearer the river mouth where it is the dominant species. Along the tidal reaches of the river, *Pandanus* stems are stained an orange colour, presumably from sulphur precipitated out of the water.
Land tenure: Customary ownership.
Conservation measures taken: None.
Land use: None; subsistence agriculture in adjacent areas.
Disturbances and threats: None known.

Hydrological and biophysical values: No information.
Social and cultural values: None.
Noteworthy fauna: There are no fish in the river and very few invertebrates. Only a few insect larvae were observed during a brief survey of the river in 1989.
Noteworthy flora: None known.
Management authority and jurisdiction: No information.
References: Chambers & Esrom (1989); TCSP (1990).
Reasons for inclusion: 1d. This is the largest area of hot springs in Vanuatu.
Source: E. Bani and D.K. Esrom.

Wetland Name: Lake Letas
Country: Republic of Vanuatu
Coordinates: 14°13'-14°16'S, 167°29' -167°33'E
Location: in the centre of Gaua (Santa Maria) Island in the Banks Islands, northern Vanuatu.
Area: 1,900 ha.
Altitude: 418 m.
Overview: A deep freshwater lake and associated marsh in a volcanic crater.
Physical features: A freshwater lake, 360 m deep, and associated marshy area in a crater in the caldera of Mount Garet. The caldera is about seven to ten km in diameter. The lake has an active volcanic cone emerging at one side and hot springs on the inner crater wall. The climate is humid tropical with an average annual rainfall of over 4,000 mm and a dry season from may to October.
Ecological features: No information is available on the aquatic vegetation. The lake is surrounded by dense equatorial cloud forest rich in epiphytes and *Hibiscus tiliaceus.*
Land tenure: Customary ownership.
Conservation measures taken: None.
Conservation measures proposed: The Tourism Council of the South Pacific has identified Lake Letas as a suitable site for inclusion in Vanuatu's protected area system (TCSP, 1990), and the Department of Physical Planning and Environment is currently considering the site as a potential protected area.
Land use: None.
Disturbances and threats: in the 1980s, it was suggested that the lake could be used as a source of water for power generation to supply industrial developments proposed for the island.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: No information.
Noteworthy flora: No information.
Management authority and jurisdiction: The Department of Lands has jurisdiction over the area.
References: Mallick (1973); Quantin (1982); TCSP (1990).
Reasons for inclusion: lb. Lake Letas is the largest lake in Vanuatu, and the largest freshwater lake in the island Pacific outside of New Guinea.
Source: E. Bani and D.K. Esrom.

Wetland Name: Jordan River Floodplains
Country: Republic of Vanuatu
Coordinates: 15°12 ' S, 166°49 ' -166°55'E
Location: south of Big Bay, in north-central Espiritu Santo.
Area: Over 1,000 ha.
Altitude: Near sea level to 300 m.
Overview: A large area of freshwater marshes and swamp forest on the floodplain of several rivers entering Big Bay.
Physical features: A low-lying area of freshwater marshes and swamp forest on the floodplain of the Jordan River and several other rivers and streams debouching into Big Bay on the north coast of Espiritu Santo Island. The rivers rise in the densely forested Tabwemasana Range to the south, which includes Vanuatu's highest mountain, Mount Tabwemasana (1,869 m).

The climate is humid tropical with an average annual rainfall of 2,000 mm and a mean temperature of 29°C.
Ecological features: Swamp forest dominated by species of *Hibiscus* and *Erythrina.* Undisturbed humid tropical forest and cloud forest in the catchment area to the south.
Land tenure: Customary ownership.

Conservation measures taken: None.
Conservation measures proposed: The floodplains of the Jordan River and forested slopes of the Tabwemasana Range to the south have been identified as a priority area for the establishment of some form of protected area.

Land use: Fishing. Livestock grazing and subsistence agriculture in some areas.

Disturbances and threats: None known.

Hydrological and biophysical values: The rivers and their floodplains support a rich fishery. The region is an important water catchment area for settlements around Big Bay.

Social and cultural values: The fishery resources have traditionally provided an important source of food for the local people.

Noteworthy fauna: Little information is available on the wetland fauna, although the rivers are known to support a variety of freshwater fish species and the swamp forests are reported to be rich in bird life. The montane forests in the catchment area support the rare endemic Santo Mountain Starling (*Aplonis santovestris*), thought to be on the verge of extinction but rediscovered in this area in September 1991.

Noteworthy flora: No information.

Management authority and jurisdiction: No information.
References: Chambers *et al.* (1989); Dahl (1980, 1986); Quantin (1982).

Reasons for inclusion: ld, 2b, 2d. The only extensive floodplain in Vanuatu, with the largest area of swamp forest. The region remains in a relatively pristine condition.

Source: E. Bani.

Wetland Name: Lake Wai Memea
Country: Republic of Vanuatu
Coordinates: 15°15'S, 167°59'E
Location: at the extreme northeast tip of Ambae (Aoba) Island.
Area: 6 ha.
Altitude: 100 m.
Overview: A small freshwater crater lake with some swamp vegetation.
Physical features: A permanent freshwater lake formed in one of the eight interlocking craters near the northeastern tip of Ambae Island, and surrounded by human settlements and subsistence gardens. The crater is considered by Bullard (1962) to be a typical example of a phreatic cone where explosions resulting from the contact of hot lava with cold water have resulted in the accumulation of a rampart of cinders and ash in a wide ring round a large explosion crater.

The climate is generally humid tropical with mean temperatures of around 30°C and a mean annual rainfall in the range 1,500-2,000 mm.
Ecological features: Areas of open water are bordered by swamp vegetation with *Hibiscus tiliaceus* and sago palm *Metroxylon* sp. There are stands of *Nypa fruticans* to the north of the lake.

Land tenure: Customary ownership.
Conservation measures taken: None.
Land use: Water supply, hunting and fishing; subsistence farming in surrounding areas.
Possible changes in land use: There are plans to extend the water supply from the lake to communities some 10-15 km away.

Disturbances and threats: There is a considerable amount of hunting in the area, which may threaten local wildlife populations. A proposal to increase utilization of the lake for water supply may lead to problems of over-use.

Hydrological and biophysical values: A source of good quality water, unaffected by any siltation problems.

Social and cultural values: The lake constitutes a water supply for the surrounding communities, schools, a hospital and the local government centre. It is also popular for recreational fishing.

Noteworthy fauna: An important wetland for the Australasian Dabchick *Tachybaptus novaehollandiae,* the Incubator Bird *Megapodius freycinet* and mud crabs. The lake supports a large population of fish introduced in the 1960s.

Noteworthy flora: No information.
Recreation and tourism: The site has considerable potential for outdoor recreation.
Management authority and jurisdiction: The lake is under the control of the Local Government Council.

References: Bullard (1962); Ward (1970).
Reasons for inclusion: 1b. A good example of a freshwater crater lake in a phreatic cone.
Source: E. Bani and D.K. Esrom.

Wetland Name: Lake Wai Lembutaga
Country: Republic of Vanuatu
Coordinates: 15°15'S, 167°58'E
Location: near the northeast tip of Ambae (Aoba) Island.
Area: 10 ha.
Altitude: 2 m.
Overview: A freshwater crater lake with extensive beds of papyrus.
Physical features: A permanent freshwater lake formed in a phreatic explosion crater at the eastern end of Ambae Island. The cone or tuff ring contains a crater about 914 metres in diameter with steep walls up to 91 metres in height. This type of structure is considered by Bullard (1962) to be typical of phreatic cones where explosions resulting from a contact of hot lava with cold water have resulted in the accumulation of a rampart of cinders and ash in a wide ring round a large explosion crater. The lake is situated in one of the eight interlocking craters of this type at the eastern end of the island (Bullard, 1962; Ward, 1970).

The climate is humid tropical, with an average annual rainfall of 1,500 mm and a dry season from may to October.

Ecological features: Large portions of the lake are covered with papyrus (*Cyperus papyrus*). The vegetation around the lake is secondary with various species of trees and shrubs.

Land tenure: Customary ownership. Adjacent areas are leased to Vureas High School (a Government school).

Conservation measures taken: None.
Land use: Some hunting and fishing; subsistence agriculture, forestry plantation and cattle ranching in surrounding areas. The lake is a source of water supply for a nearby Junior Secondary School.

Disturbances and threats: Excessive use of water for domestic supply and road construction along the escarpment towards the coast. Native forests nearby have been cleared for forestry plantations.

Hydrological and biophysical values: Public water supply.
Social and cultural values: The lake has some cultural significance to the local people.
Noteworthy fauna: The lake supports a large fish population and is important for the Australasian Dabchick *Tachybaptus novaehollandiae.* Other resident birds include *Circus approximans, Falco peregrinus, Megapodius freycinet, Rallus philippensis* and *Halcyon chloris.* Black Flying-Fox *Pteropus tonganus* and White Flying-Fox *P. anetianus* also occur in the area.

Noteworthy flora: No information.
Management authority and jurisdiction: Local Government Council.
References: Bullard (1962); Ward (1970).
Reasons for inclusion: la, 2b. A good example of a freshwater crater lake in a phreatic cone, with an interesting papyrus swamp.

Source: E. Bani and D.K. Esrom.

Wetland Name: Ambae Caldera Lakes
Country: Republic of Vanuatu
Coordinates: Lake Manaro Ngoru 15°24'S, 167°48'E; Lake Vui 15°24'S, 167°49'E
Location: Lake Manaro Lakua 15°24'S, 167°51'E; in the centre of Ambae (Aoba) Island in northern Vanuatu.
Area: Lake Manaro Ngoru, 15 ha; Lake Vui, 150 ha; Lake Manaro Lakua, 170 ha. Total area of volcanic craters 500-600 ha.

Altitude: Lake Manaro Ngoru, 1,391 m; Lake Vui, 1,340 m; Lake Manaro Lakua, 1,397 m. Summit of crater rim at 1,496 m.
Overview: A caldera lake and two crater lakes surrounded by dense virgin forests at high altitude within the active volcano of Ambae Island.
Physical features: Lake Vui and Lake Manaro Ngoru are situated in young craters formed within the inner caldera. It is not certain if Lake Vui, the larger of the two, was formed within the summit crater of a broad cone filling the centre of the inner caldera or in a third and smaller caldera (Ward, 1979). The Manaro Ngoru crater has a floor one kilometre in diameter, which at times is covered by a temporary lake surrounded by a low rampart of pyroclastics abutting against the caldera wall along its western margin. It probably represents an explosion crater.

Lake Manaro Lakua lies in a third crater, to the east of Lake Vui. The presence of well-sorted, bedded, commonly cross-bedded tuffs deposited in or reworked by Lake Manaro Lakua indicates that the water once stood 100-150 metres above its present level. The tuffs occur in islands and along the crater walls. Conversely, a fringe of partly submerged trees along the western edge of the lake shows that it recently stood at a lower level (Ward, 1970).

Thermal areas exist on the southeast side of Lake Manaro Lakua and on the bed of Lake Vui. These include hot springs, geysers and fumaroles. The water of Lake Vui has a bitter taste and a distinctive green colour. Similar discolouration is often seen in the sea around Vanuatu where fumaroles occur on the summits of submarine volcanoes.

The area generally has a humid tropical climate with little seasonal variation. Mean temperatures are around 30°C along the coast and drop slightly in the caldera to a low of 23°C. The mean annual rainfall is in the range 2,500-3,500 mm. The wet season (also the cyclone season) extends from November to April.
Ecological features: The lakes are surrounded by dense, pristine montane rain forest with endemic orchids and a very rich flora. This gives way to moss forest above 1,350 m. No information is available on the aquatic vegetation.
Land tenure: The lakes and surrounding areas are under customary ownership.
Conservation measures taken: None.
Conservation measures proposed: Government, local government centres and customary land owners are discussing the possibility of declaring the area Public Land and establishing a protected area. The lakes were identified as a site suitable for protection by the Tourism Council of the South Pacific (TCSP, 1990).
Land use: None; the area is remote and uninhabited.
Disturbances and threats: None known.
Hydrological and biophysical values: The lakes are the source of a number of rivers and streams.
Social and cultural values: The lakes are of considerable cultural importance to the people of Ambae who believe that the spirits of the dead reside there.
Noteworthy fauna: Lake Manaro Lakua is an important site for the Australasian Dabchick *Tachybaptus novaehollandiae* and green frogs. There are no fish in the lakes. Noteworthy flora: The forests around the caldera are rich in orchids. A recent investigation discovered three new species of orchids for Vanuatu, *Agrostophyllum* cf. *torricellense, Dendrobium kietaense* and *Bulbophyllum microrhombos,* and a species of *Peristylus* unknown to science (Wheatley, 1989).
Scientific research and facilities: The lakes were surveyed by the Department of Mines, Minerals and Rural Water Supply in 1969, and by the Department of Physical Planning and Environment in 1988.
Recreation and tourism: The area has some potential for tourism.
Management authority and jurisdiction: The lakes are currently under the jurisdiction of the Ambae/Maewo Local Government Council. The proposed protected area would be managed by the Island Regional Council, with advice from the Department of Physical Planning and Environment.
References: TCSP (1990); Ward (1970); Wheatley (in press).
Reasons for inclusion: ld. Three interesting crater lakes in a region of thermal activity; the highest lakes in the island Pacific outside of New Guinea.
Source: E. Bani and D.K. Esrom.

Wetland Name: Port Stanley, Bushman Bay and Crab Bay
Country: Republic of Vanuatu
Coordinates: 16°04'-16°11'S, 167°24'-167°32'E
Location: on the northeast coast of Malekula Island, 1-15 km southeast of Lakatoro.
Area: 1,000 ha, including 963 ha of mangrove forest.
Altitude: Sea level.
Overview: A complex of mangrove forests, tidal lagoons and associated salt marshes and mudflats along the northeast coast of Malekula Island.
Physical features: One of the two largest areas of mangrove in Vanuatu, comprising several large patches of mangrove forest and associated tidal lagoons, salt marshes, mudflats, rivers, streams and sandy beaches. The Port Stanley-Crab Bay area is a coraline reef platform. The largest contiguous stand of mangroves (560 ha) occurs in the Port Stanley embayment and along the shores of the adjoining Botun Bay. There are a further 32 ha of mangroves on the coast near Lakatoro to the northwest, 72 ha on the island of Uri and 24 ha on the island of Taikata, at the entrance to Port Stanley bay. Further southeast along the coast, there is a large patch of mangroves totalling 275 ha along the northeast coast of Bushman Bay (25 ha) and along the entire coast of the adjoining Crab Bay (250 ha).

The climate is humid tropical with an average annual rainfall of 1,638 mm at Port Stanley.
Ecological features: Three zones have been identified in the mangrove vegetation: an inner zone of *Ceriops tagal* thickets, a *Rhizophora* forest zone dominated by *R. mucronata* and *R. stylosa,* and a seaward zone of *Avicennia marina* with a few scattered *Sonneratia caeseolaris.* Sago palms (*Metroxylon* sp.) occur in the coconut plantations behind the mangroves.

Land tenure: Customary ownership. Some areas are leased, especially in Crab Bay.

Conservation measures taken: No special protection measures have been taken. Mangrove forests are protected from commercial exploitation by the Government. Local community chiefs can apply closures on hunting and fishing in the mangroves if considered appropriate.
Conservation measures proposed: The Environment Section of the Department of Physical Planning and Environment has proposed that a marine reserve be established in the area and that this incorporate the mangrove forests. Responsibility for management would be given to the local landowners.
Land use: Subsistence fishing and harvesting of mangroves for building materials and fuelwood; coconut plantations and subsistence agriculture in adjacent areas.
Possible changes in land use: A proposal, currently with the government, for logging in the upper catchment area could have an impact on the wetlands.
Disturbances and threats: There is some disturbance from the small human settlements scattered throughout the area. A commercial wharf was built in the area in 1987 for inter-island trading vessels. This involved the building of a causeway through the mangroves in Port Stanley bay and clearing of two or three hectares.

Hydrological and biophysical values: The mangrove fringe provides protection against coastal erosion and reduces storm damage during the frequent cyclones which affect this area. The mangroves provide a source of nutrients for a diversity of food chains, and serve as vital nursery and feeding grounds for a variety of inshore and marine invertebrates and fishes important in the commercial and subsistence fisheries.

Social and cultural values: The mangroves and their fisheries resources have traditionally provided an important source of fuelwood and food for the local people, and continue to do so.
Noteworthy fauna: The mangroves support a diverse invertebrate and fish fauna including numerous species of molluscs, crustaceans, polychaetes and finfish. Of the 20 or so crustaceans recorded from the area, only the crabs *Cardiosoma hirtipes* and *Scylla serrata* are regularly harvested for local consumption and export to Port Vila. A species of flying fox (*Pteropus* sp.) occurs in the mangroves, and there is still an apparently healthy population of Dugong (*Dugong dugon*) in the area. No information is available on the birds and reptiles.

Noteworthy flora: The site contains one of the two largest stands of mangroves in Vanuatu.

Scientific research and facilities: Several surveys and studies have been carried out in the area, particularly with respect to the species composition of the mangroves and utilization of mangrove resources.
Management authority and jurisdiction: The mangroves fall under the jurisdiction of the Department of

Fisheries in collaboration with the Department of Lands and the Department of Physical Planning and the Environment.

References: Chambers (1988); Chambers *et al.* (1989); David (1985, 1987 & 1988); David & Cillaurren (1988); Lal & Esrom (1990); Macnae (1968); Marshall & Medway (1976); Quantin (1982); Woodroffe (1987).

Reasons for inclusion: la, 2b, 2c. One of the two largest areas of mangroves in Vanuatu.

Source: E. Bani and D.K. Esrom.

Wetland Name: Port Sandwich and the Maskelyne Islands

Country: Republic of Vanuatu

Coordinates: 16°25' -16°35'S, 167°47' -167°51'E

Location: at the southeastern tip of Malekula Island.

Area: 1,000 ha.

Altitude: Sea level.

Overview: A complex of mangrove forests, tidal lagoons and associated salt marshes and mudflats at the southeast end of Malekula Island and in the nearby Maskelyne Islands.

Physical features: A complex of mangrove forests and associated mudflats, tidal lagoons, salt marshes, rivers, streams and sandy beaches along the southeastern shores of Malekula Island and around the Maskelyne Islands a few kilometres offshore. There are three main areas of mangrove: Port Sandwich (175 ha), the coast south of Lamap (262 ha) and the Maskelyne Islands (420 ha). in the Port Sandwich area, there are 25 ha of mangroves at the mouth of the Lasopenamor River on the west side of the bay, 35 ha in the southwest corner of the bay, and 120 ha in the estuary of the Sandwich River. The area south of Lamap includes 130 ha of mangroves along the coast from Lamap to Doucere Point, 32 ha in the innermost portion of Cook Bay, and 100 ha along the coast opposite Lembong and Awi in the Maskelyne Islands. The Maskelynes are a group of small coral islands and reef platforms with extensive mangrove forests on most of the islands.

The climate is humid tropical, with an average annual rainfall of 1,987 mm and a mean temperature of 26.1°C.

Ecological features: Mangrove forest with three recognizable zones: an inner *Ceriops tagal* zone, a *Rhizophora* forest zone dominated by R *mucronata* and *R. stylosa,* and a seaward zone of *Avicennia marina* with some *Sonneratia caeseolaris.* The sago palm (*Metroxylon* sp.) occurs amongst the coconut plantations along the landward edge of the mangroves.

Land tenure: Customary ownership.

Conservation measures taken: No special protection measures have been taken. As elsewhere in Vanuatu, mangrove forests are protected from commercial exploitation by the Government. Local community chiefs can apply closures to the exploitation of the mangrove resources if considered appropriate.

Conservation measures proposed: The Environment Unit in the Department of Physical Planning and Environment has recommended that a marine reserve be established in the area, incorporating the principal mangrove forests.

Land use: Subsistence fishing and harvesting of mangroves for building materials and fuelwood.

Disturbances and threats: in the Maskelyne Islands, villages are located within the mangrove forests. The population of the largest island, Koulivou, is about 1,000 (1989 National Census estimates), giving a population density of 313 people per sq.km. This is one of the largest population densities in Vanuatu and some 20 times the national average. As the population continues to grow, more and more mangrove is being cleared for residential areas.

Hydrological and biophysical values: The mangrove fringe provides protection against coastal erosion and reduces storm damage during the frequent cyclones which affect this area. The mangroves provide a source of nutrients for a diversity of food chains, and serve as vital nursery and feeding grounds for a variety of inshore and marine invertebrates and fishes important in the commercial and subsistence fisheries.

Social and cultural values: The mangroves and their fisheries resources constitute an important source of fuelwood and food for the local people, and are vitally important in maintaining the livelihood of the inhabitants of the Maskelyne Islands.

Noteworthy fauna: The mangroves support a rich invertebrate fauna dominated by molluscs,

crustaceans and polychaetes. Of the 20 or so crustaceans, only the crabs *Cardiosoma hirtipes* and *Scylla serrata* are regularly harvested. in the Maskelyne Islands, 66 species of finfish belonging to 32 families are regularly caught in the mangrove areas, and 29 of these are found exclusively within the mangroves. Common species include mullets (Mugilidae), rabbit fish (Siganidae) and goat fish (Mullidae). Two species of flying fox, *Pteropus tonganus* and *P. anetianus,* occur in the mangroves, and there is still an apparently healthy population of Dugong (*Dugong dugon*) in the area. The region is known to be rich in birds and reptiles, but no details are available.

Noteworthy flora: The site contains one of the two largest stands of mangroves in Vanuatu.

Scientific research and facilities: Several surveys and studies have been carried out in the area, particularly with respect to the species composition of the mangroves and utilization of mangrove resources.

Management authority and jurisdiction: The mangroves fall under the jurisdiction of the Department of Fisheries in collaboration with the Department of Lands and the Department of Physical Planning and the Environment.

References: Chambers (1988); Chambers *et al.* (1989); David (1985, 1987 & 1988); David & Cillaurren (1988); Lal & Esrom (1990); Macnae (1968); Marshall & Medway (1976); Quantin (1982).

Reasons for inclusion: la, 2b, 2c. One of the two largest areas of mangroves in Vanuatu.

Source: E. Bani and D.K. Esrom.

Wetland Name: Southwest Bay Lagoon
Country: Republic of Vanuatu
Coordinates: 16°29'-16°32'S, 167°25'-167°27'E
Location: on the southwest coast of Malekula Island.
Area: 72 ha.

Altitude: Sea level.
Overview: A small patch of mangrove forest.
Physical features: A stand of mangrove forest around Southwest Bay Lagoon, the only significant stand of mangroves on the west coast of Malekula Island.

The climate is humid tropical with an average annual rainfall of 1,900 mm and a mean temperature of 28°C.
Ecological features: Mangrove vegetation dominated by *Rhizophora mucronata, R. stylosa, Sonneratia caeseolaris* and *Avicennia marina.*

Land tenure: Customary ownership.
Conservation measures taken: None.
Land use: Subsistence fishing and the harvesting of mangroves for building materials and fuelwood.

Disturbances and threats: None known.

Hydrological and biophysical values: The mangrove fringe acts as a barrier to coastal erosion and reduces storm damage during the frequent cyclones which affect this area. The mangroves provide a source of nutrients for a diversity of food chains, and constitute vital breeding and nursery grounds for a variety of inshore and marine invertebrates and fishes.

Social and cultural values: The mangroves and their fisheries resources constitute an important source of timber, fuelwood and food for the local people.

Noteworthy fauna: The mangroves support a rich invertebrate fauna dominated by molluscs, crustaceans and polychaetes, as well as numerous fishes such as mullet (Mugilidae). Dugong (*Dugong dugon*) occur in the bay (Chambers *et al.,* 1989). No information is available on the birds and reptiles.

Noteworthy flora: No information.

Management authority and jurisdiction: No information.
References: Chambers *et al.* (1989); David (1988); Lal & Esrom (1990); Quantin (1982).
Reasons for inclusion: ld, 2c. An important mangrove area.
Source: E. Bani and D.K. Esrom.

Wetland Name: Duck Lake (Emaotul)
Country: Republic of Vanuatu
Coordinates: 17°44'S, 168°25'E
Location: 8 km east of Port Vila on the island of Efate.
Area: 30 ha.
Altitude: 119 m.
Overview: A small freshwater lake with associated swamp vegetation and some swamp forest, surrounded by degraded lowland tropical rain forest.
Physical features: A small, permanent, freshwater lake with freshwater swamp and some swamp forest, in a region of lowland tropical rain forest on a raised limestone plateau above the Teouma Valley. The lake is situated between the Teouma and Rentapao rivers, but there is no surface inflow or outflow.
The climate is humid tropical with an average annual rainfall of 2,270 mm. There is little seasonal variation in rainfall, although November to April are slightly wetter than the other months.
Ecological features: Most of the lake is open water. There are grassy swamps at the east and west ends, and some swamp forest with *Barringtonia* sp. The wetland is surrounded by degraded lowland tropical forest and shrubbery, and there is an area of sago palms (*Metroxylon* spp.) and *Phragmites* reeds nearby.
Land tenure: The lake is under customary ownership, although there is considerable dispute amongst local families as to who the rightful owners are. Surrounding areas are leased for logging, subsistence farming and cattle grazing.
Conservation measures taken: None.
Conservation measures proposed: Dahl (1980) proposed the establishment of a reserve at Duck Lake and Rentapao Valley to protect the lake, freshwater swamp, swamp forest and surrounding lowland rain forest. The Tourism Council of the South Pacific has also identified the lake as a suitable site for protection (TCSP, 1990). Duck Lake is now one of the priority areas proposed for protection by the Environment Section of the Department of Physical Planning and Environment.
Land use: None at the wetland. Subsistence farming, cattle grazing and small-scale selective logging in surrounding areas.
Possible changes in land use: There have been several proposals to expand cattle grazing in the area. Proposals to establish a pig farm and a poultry farm near the lake have been rejected by the Government.
Disturbances and threats: The surrounding forest has recently been much affected by logging. The logging operations cause some disturbance to wildlife, and provide easy access, encouraging increased land clearance for agriculture.
Hydrological and biophysical values: The lake plays an important role in maintaining water supplies in the Teouma and Rentapao rivers during the dry season. Social and cultural values: An important water supply for the local people. Noteworthy fauna: The avifauna includes Pacific Black Duck *Anas superciliosa,* Swamp Harrier *Circus approximans* and Barn Owl *Ito alba.* Surrounding forests are rich in bird life.
Noteworthy flora: *Barringtonia* swamp forest is a threatened ecosystem in Vanuatu.
Recreation and tourism: The lake has considerable potential for outdoor recreation and tourism because of its easy access and close proximity to Port Vila.
Management authority and jurisdiction: No information.
References: Dahl (1980); Quantin (1982); TCSP (1990).
Reasons for inclusion: ld, 2b. Probably the best example of a non-volcanic freshwater lake in Vanuatu, with one of the country's few patches of swamp forest.
Source: E. Bani and D.K. Esrom.

Wetland Name: Emaotfer Swamp
Country: Republic of Vanuatu
Coordinates: 17°48'S, 168°25'E
Location: southeast of Port Vila on the island of Efate.
Area: 60 ha.
Altitude: 20 m.
Overview: A small freshwater swamp in the southern lowlands of Efate.
Physical features: An area of freshwater swamp consisting of tall emergent sedges and rushes, with

scattered trees and pandanus around its edge. The water level fluctuates according to the wet and dry seasons.

The climate is humid tropical with an average annual rainfall of over 1,000 mm. The wet season extends from November to April.

Ecological features: The swamp vegetation includes *Cyperus difonnis* and *Lepironia articulata*. Scattered *Pandanus* and lowland forest occur in surrounding areas.

Land tenure: Customary ownership.

Conservation measures taken: None.

Land use: None.

Disturbances and threats: None known.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: No information.

Noteworthy flora: No information.

Management authority and jurisdiction: No information.

References: Quantin (1982).

Reasons for inclusion: ld, 2b. A good example of a permanent freshwater swamp, a scarce habitat type in Vanuatu.

Source: E. Bani.

Wetland Name: Lake Isiwi

Country: Republic of Vanuatu

Coordinates: 19°31'5, 169°26'E

Location: at the foot of Yasur Volcano on the island of Tanna in southern Vanuatu.

Area: 225 ha.

Altitude: 60 m.

Overview: A freshwater volcanic lake with some marsh vegetation, at the base of Yasur Volcano.

Physical features: A shallow, freshwater lake located in a picturesque setting at the foot of Yasur Volcano, an active volcano with a summit at 1,084 m. To the north of the lake, there is an area of volcanic sand; to the northeast, an area of grassland and shrubs; and to the east, an area of sandy beaches and volcanic ash. The lake became shallower after a severe cyclone in 1987 (Cyclone Uma). The cyclone caused landslides on the slopes of Yasur, and as a result, the lake was partially filled with debris and silt.

The climate is tropical. Temperatures and rainfall are lower than in central and northern Vanuatu, and seasonality is much more pronounced.

Ecological features: Stands of *Phragmites karka* occur along the northern and western margins of the lake, and there are scattered pandanus (*Pandanus* spp.), ferns and shrubs along the northwest and southwest shores. Elsewhere the shoreline consists of sandy beaches and volcanic ash.

Land tenure: Customary ownership.

Conservation measures taken: No legal measures have been taken. However, no-one is allowed to visit the area, especially the volcano, without first obtaining permission from the customary landowners. The Tourism Council of the South Pacific has recommended that the area be brought under Government control and given protected status (TCSP, 1990).

Land use: The lake is regularly visited by foreign tourists. There are small settlements and subsistence farms in surrounding areas.

Disturbances and threats: None, other than natural disasters such as Cyclone Uma.

Social and cultural values: The customary landowners obtain some revenue from the collection of fees from tourists visiting the area to see the active volcano. The site is a sacred place for the local people of Tanna.

Noteworthy fauna: The lake supports a variety of waterfowl including Little Green Heron *Butorides striatus* and Pacific Black Duck *Anas superciliosa.*

Noteworthy flora: None known.

Recreation and tourism: The lake is a popular spot for foreign tourists coming to see Yasur Volcano, one of the most famous tourist attractions in Vanuatu at the present time. However, tourists frequently complain of the rather exorbitant costs charged by the local custodians, and little or none of the money collected from the tourists

goes into providing facilities for them (TCSP, 1990).

Management authority and jurisdiction: The site is under the control of the customary landowners.
References: Mallick (1973); TCSP (1990).
Reasons for inclusion: la. An interesting freshwater lake of volcanic origin, noted for its scenic attraction.
Source: E. Bani and D.K. Esrom.

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