

FRENCH POLYNESIA

INTRODUCTION

by Yolande Fontaine

Delegation a l'Environnement

Area: The approximately 130 islands and islets of French Polynesia have a total land area of 3,521 sq.km, distributed over more than 4,198,000 sq.km of territorial seas. Tahiti, the largest island and centre of government and commerce, has an area of 1,042 sq.km.

Population: 188,814 according to the 1988 census (with over 50% on Tahiti).

French Polynesia is an Overseas Territory of France. It lies in the South Pacific between latitudes 7°50' and 27°36' South, and longitudes 134°28' and 154°40' West, and is made up of over 120 islands and atolls grouped into five archipelagos:

- the Society Islands include nine volcanic high islands and five atolls, divided into the "Windward Islands" (Tahiti, Moorea, Maiao, Mehetia and Tetiaroa) and the "Leeward Islands" (Huahine, Raiatea, Tahaa, Bora-Bora, Maupiti, Tupai, Maupihaa, Manuae and Motu One) for the purposes of administration.
- the Marquesas, 1,300 km northeast of Tahiti, are a group of volcanic high islands comprising seven major islands (Eiao, Nuku Hiva, Ua Huka, Ua Pou, Hiva Oa, Tahuata and Fatu Hiva) and about six islets, rocks and banks. Motu One (Ilot de Sable) is the only coral island in the group. The islands of the Marquesas group are at a greater distance from a continent than any other islands in the world.
- the Australs, 600 km to the south of Tahiti, are a chain of seven islands separated from each other by distances ranging from 160 km to 230 km. Six islands (Marotiri, Rapa, Raivavae, Tubuai, Rurutu and Rimatarua) are volcanic high islands; the seventh (Maria), at the west end of the chain, is an atoll.
- the Gambiers, 1,600 km southeast of Tahiti, are a group of about 12 islands including four major volcanic high islands (Mangareva, Aukena, Akamaru and Taravai), several small volcanic islets and a low coral atoll (Temoe). These islands are often considered a part of the Tuamotu Archipelago to the northwest. the Tuamotu Archipelago comprises 76 atolls extending in a broad belt approximately 1,500 km from northwest to southeast, between latitudes 14° and 23° South and longitudes 135° and 148° West. All are low atolls, except for Makatea, near the west end of the archipelago, which is a raised atoll with a maximum elevation of 113 m (the only raised atoll in French Polynesia). Fakarava Atoll, in the central Tuamotus, is the second largest atoll in the world.
- The Governor of French Polynesia also has authority for Clipperton Island, an isolated "near atoll" in the eastern Pacific some 5,200 km northeast of Tahiti, although this is not a part of French Polynesian Territory.

There are two main types of islands. Those referred to as "high" islands are of volcanic origin; they

are mountainous with rugged and sometimes almost inaccessible interiors. These include Tahiti, Moorea, the Marquesas, the Gambiers and most of the Australs. Those referred to as "low" islands are coral formations resting on undersea plates, barely rising above the water. Most of these are in the Tuamotus.

The climate is humid tropical, greatly moderated by the trade winds. There are two seasons: a hot and humid season with torrential rains lasting for three months from December to February, and a cooler, drier season, from March to November. The driest months are July and August. Daily variation in temperature is noticeable, especially on Tahiti, where the presence of high mountains gives rise to land breezes that cool the air considerably at night. On Tahiti, the maximum temperature rarely exceeds 34°C in January, the warmest month, and rarely falls below 28°C in July, the coldest. The average maximum temperature is 30°C. Night-time temperatures seldom fall below 22° in the warm season or below 17-20°C in the cool season. On the east coast of Tahiti, the heat is moderated by the trade winds. In the mountains, there is a one degree Centigrade drop for every 200 metres of change in elevation. Given their geographical locations, the Australs are more temperate and the Marquesas more equatorial. Atmospheric humidity is very high. The average relative humidity at Papeete (Tahiti) is 78%, with a daily range of 7%. In the Tuamotus it is 75%, with a less noticeable daily variation of 2%.

Dahl (1980, 1986) has given a brief account of the natural ecosystems of the islands, and has reviewed their importance for nature conservation. UNEP/IUCN (1988) provide a general account of the coral reef systems in each island group, and also give detailed information on ten of the most important islands and reef systems (Rapa Island in the Australs; Scilly Atoll and the Temae and Tiahura Reefs on Moorea in the Society Islands; and Mataiva, Moruroa, Rangiroa, Takapoto, Tikehau and Taiaro atolls in the Tuamotus).

Summary of Wetland Situation

Very little information is available on the wetlands of French Polynesia. Although marine ecosystems, and especially the coral reefs, have received a considerable amount of attention, very few studies have been carried out on the Territory's non-marine environments, and these environments, including the aquatic habitats, remain poorly understood.

There are rather few wetlands in French Polynesia, and most of these are very small in size. They include mountain streams and torrents (on several of the larger high islands), a freshwater lake (Lac Vaihiria on Tahiti), riverine forest and lowland rivers (on Tahiti only), a number of brackish to hypersaline lagoons (on several high islands and some atolls), and many tiny freshwater marshes generally under cultivation for taro (*Colocasia esculenta* and *Cyrtosperma* sp.). There are also some interesting brackish ponds with salinities in the range 10-20 p.p.t. on some of the atolls. The Marquesas are relatively dry islands, apparently lacking any significant freshwater or brackish wetlands. Similarly, there do not appear to be any significant wetland habitats in the Gambier Islands or in most of the Austral Islands, although there are large seabird colonies in each of these three island groups.

The tidal rise and fall throughout the islands is very low (generally less than 40 cm), and there is little exposed reef flat or mudflat at low tide. In contrast to many Pacific islands, there are no indigenous mangroves in French Polynesia, although *Rhizophora sOilosa* was introduced to Tahiti, Moorea and Bora-Bora in the Society Islands in the 1970s (Taylor, 1979). The natural littoral vegetation of the high islands consists primarily of forests of "purau" (*Hibiscus tiliaceus*). This vegetation has now almost entirely disappeared because of coastal development. Similarly, most swampy areas in the coastal zone and many reef flats have been filled in to increase the area of land available for development. In Tahiti and Raiatea, for example, it is estimated that more than 50% of the coastline is now artificial. Pollution has also been a problem, at least locally. Mowbray (1988) reports on a kill of fish in rivers caused by detamethrin

and other agricultural chemicals.

This extensive coastal development on many of the high islands has resulted in the loss of much of the former wetland habitat, and with it a decline in two species associated with this habitat, the Little Heron (*Butorides striates*) and Pacific Black Duck (*Anas superciliosa*). The endemic subspecies of the Little Heron, *B. s. patruelis*, is confined to Tahiti, and with the loss much of the littoral and riverine vegetation on this island, has now become very rare. The population of Black Ducks on Tahiti has also shown a serious decline in recent decades, and may now number only 200-300 individuals. Other resident species associated with wetlands in French Polynesia include the Pacific Reef Heron (*Egretta sacra*), Spotless Crake (*Porzana tabuensis*), Great Crested Tern (*Sterna bergii*), Tahiti Kingfisher (*Halcyon venerata*) and Tuamotu Kingfisher (*H gambieri*). The Swamp Harrier (*Circus approximans*) was introduced in the Society Islands around 1885, and is now common and widespread (Thibault & Rives, 1975).

Undoubtedly the most interesting waterbirds of French Polynesia, however, are the two endemic species of shorebirds, the Tahiti Sandpiper (*Prosobonia (Aechmorhynchus) leucoptera*) and Tuamotu Sandpiper (*P. cancellatus*). The Tahiti Sandpiper is known only from three specimens collected in 1773 and 1777 on Tahiti and Moorea in the Society Islands. Apparently a bird of stream sides, this small sandpiper was already very limited in its distribution at that time, and its extinction was very swift. Predation by introduced rats seems to be the most likely explanation for its rapid disappearance.

The Tuamotu Sandpiper was first described from a specimen collected on Christmas Island (Kiribati) in 1778. The species has never been found there again, but it was collected or reported from at least 16 atolls in the Tuamotu Archipelago in the 1920s. The species has disappeared from a number of inhabited atolls in recent decades, and it seems probable that the introduction of rats and cats has eliminated it from all but the least frequently visited islands. Hay (1985) and Collar and Andrew (1988) were aware of recent records from only six localities, Marutea du Sud, Maturei-Vavao, Tenararo, Pinaki and Nukutavake in the southern Tuamotus and Rangiroa in the northern Tuamotus. However, Collar and Andrew noted that 12 of the sites where the species was found in the 1920s had not been visited since then, and a further 24 atolls in the Tuamotus, some apparently suitable, had never been surveyed for birds. In April 1989, an ornithological expedition to seven atolls in the north-central part of the archipelago discovered good populations of Tuamotu Sandpipers on four uninhabited islets (motus) in Tahanea Atoll, and was informed that the species still occurred on some other atolls in the area, notably Hiti, Taunake and Tepoto in the Raevski Group (Lovegrove *et al.*, 1989).

Only three species of migratory shorebirds occur regularly in French Polynesia, the Pacific Golden Plover (*Pluvialis fulva*), Bristle-thighed Curlew (*Numenius tahitiensis*) and Wandering Tattler (*Heteroscelus incanus*), but all three of these are widespread and fairly common. Lovegrove *et al.* (1989) estimated that at least 600 Bristle-thighed Curlews were present in the northern half of the Tuamotu Archipelago in early 1989. French Polynesia is probably the main wintering area for this threatened species. Very few other migratory waterbirds ever reach French Polynesia, although two species of ducks, the Northern Pintail (*ulnas acuta*) and Northern Shoveler (*A. clypeata*), and at least four species of shorebirds have occurred as rare vagrants (Pratt *et al.*, 1987).

Three species of *Acrocephalus* warbler, the Tahiti Reed Warbler (*Acrocephalus caffra*), Marquesas Reed Warbler (*A. mendanae*) and Tuamotu Reed Warbler (*A. atypha*) are endemic to French Polynesia, and one of these, the Tahiti Reed Warbler (confined to the islands of Tahiti and Moorea) is rare and local (Pratt *et al.*, 1987). However, these are primarily birds of bamboo thickets, secondary growth and dense scrub, and have no special affinity for wetland habitats.

Wetland Research

Very little research has been carried out on wetlands in French Polynesia, scientists on the whole being more interested in the reef systems. Nevertheless, some studies have been conducted under the auspices of ORSTOM and the Ecole Pratique des Hautes Etudes at the Museum National d'Histoire Naturelle. These have included a study of the hydrology and chemical and biological characteristics of the rivers of Tahiti, Lake Vaihiria and Maeva Lagoon. Maeva Lagoon, on the island of Huahine, has been particularly well studied from an archaeological point of view by a team of archaeologists led by Prof. Y.H. Sinoto of the Bishop Museum in Hawaii. Detailed soil surveys have been carried out, and ORSTOM has recently produced an atlas of natural resource systems in the Territory. A study of the avifauna of French Polynesia is currently being coordinated by the Delegation a l'Environnement.

Wetland Area Legislation

The provisions of the statute for self-government, Law No.84-620 of 6 September 1984, grants the Territory of French Polynesia complete authority over its environmental protection policy. Regulatory power lies with the Territorial Assembly; executive power rests with the President of the Territorial Government and his Council of Ministers. Nevertheless, enforcement of regulations and legal proceedings remain in the hands of the French Government. France is represented in the Territory by the High Commissioner of the Republic.

There are no specific regulations concerning wetlands, nor any particular regulations governing the creation and management of parks, reserves and other protected areas. A text is, however, being drafted. Currently, measures for the protection of sites derive from the Planning Code of French Polynesia, and in particular from Title V of Book I: "on the natural and cultural heritage of the Territory, on the designation and protection of sites, monuments, objects and elements pertaining thereto." It is through this mechanism that seven islets and atolls have been designated as nature reserves, and a valley on Tahiti designated a territorial park (Parc Naturel Territorial). However, this Planning Code also provides for the draining of swampy land, in Book I, Title II: "general measures against the spread of mosquitos" (Article 0.320-2). Regulations covering water and forests contain provisions concerning the protection of the soil, vegetation and waterways. The hunting and destruction of all species of birds is prohibited by a decree enacted in 1967, but this is apparently seldom enforced (Hay, 1985).

At international level, France has ratified the Convention on the Conservation of Nature in the South Pacific (the Apia Convention), after consultation with the Territorial Assembly. France is also a party to the Convention for the Protection of the Natural Resources and Environment of the South Pacific (SPREP Convention), the Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention) and the World Heritage Convention, and has signed but not yet ratified the Convention on Biological Diversity.

Wetland Area Administration

At present, the protected areas network in French Polynesia includes a small reserve covering the lagoon area of Manuae (Scilly Atoll) in the Society Islands, four reserves comprising the volcanic islands of Eiao, Hatutaa, Motu-One and Mohotani in the Marquesas, a Strict Nature Reserve and Biosphere Reserve of 2,000 ha at Taiaro Atoll in the Tuamotu Archipelago, and a Territorial Park of 750 ha in the Faaiti Valley in the Papenoo drainage on Tahiti (IUCN, 1991). None of these was established specifically to protect wetland habitat, although the Taiaro Atoll reserve includes an interesting enclosed saline lagoon, and the Faaiti Territorial Park includes some undisturbed mountain

stream habitats. A proposal to designate Miti Rapa Lagoon, located on the island of Tahiti opposite the Isthmus of Taravao, is currently being studied. This proposal was put forward by the Societe d'Ornithologie de Polynesie (MANU), and is receiving the support of the Delegation a l'Environnement.

The body currently in charge of protected areas in French Polynesia is the Delegation a l'Environnement (Environmental Commission), which was created on 30 May 1985. This is an administrative service of the Territory, with a coordinating role in the formulation and application of an environmental policy. Its principal mission is to ensure the proper management of the environment and maintenance of the quality of life, as well as to define and recommend those elements necessary to formulate a coherent environmental policy. Within this framework of general responsibilities, the Delegation is instructed to give special attention to the following:

- protection, safekeeping and restoration of the natural environment;
- prevention, reduction or elimination of pollution, degradation and other environmental hazards that may result from the spread of human activities of all kinds;
- development and coordination of studies and research in environmental matters;
- training and dissemination of information to increase awareness of environmental issues.

With its very limited staff (only 11 employees in 1991), the Delegation a l'Environnement has not as yet been able to put into place an effective policy for environmental protection or for the management of protected areas.

Organizations involved with Wetlands

(a) Governmental bodies

- Ministere de la Qualite de la Vie, de la Culture, de l'Environnement et des Transports Terrestres
- Delegation a l'Environnement

(b) Academic institutions

- ORSTOM (Office of Overseas Scientific and Technical Research) Faculty of Biology, French Pacific University
- Ecole Pratique des Hautes Etudes, Museum National d'Histoire Naturelle

(c) Non-governmental conservation bodies

- La Federation des Associations de Protection de l'Environnement
- Societe d'Ornithologie de Polynesie (MANU)
- Atuatu to Natura (on Bora-Bora)

WETLANDS

Site descriptions compiled by Yolande Fontaine, Claude Monnet and Jules Cheffort of the Delegation a l'Environnement.

Wetland Name: Lac Vaihiria

Country: French Polynesia

Coordinates: 17°41'5,149°25'W

Location: in the central highlands of Tahiti, 10 km north of Mataiea, Society Islands.

Area: 16 ha to 22 ha, depending on water level.

Altitude: 473 m.

Overview: Originally a natural lake, retained in a basin formed by crumbling of the surrounding rock faces. Since 1981, the lake has been used as a supply reservoir for hydro-electric development.

Physical features: A small natural lake at an altitude of 473 m in the interior of Tahiti. The lake has a maximum depth of 22 m. In the east and west, the shoreline is steep and rocky; to the south, the shore is gently sloping with mud and gravel. To the north, there was formerly a deltaic swamp, with gravelly and muddy areas. However, the level of the lake has been raised for the production of hydro-electricity. The lake is fed by streams rising on the south slope of Mt Urufa (1,493 m) and drains south via the Tahiria River to the coast just east of Mataiea. The region receives very heavy rainfall, with as much as 8,000 or 9,000 mm per year.

Ecological features: The aquatic formations, which are particularly extensive on the west bank of the lake, comprise *Egeria densa* with a little *Polygonum glabrum*. A riparian formation, more or less typical of waste areas, occurs on mudflats which are exposed for the greater part of the year. In 1983, J. Florence found an unusual stand of *Saccharum spontaneum* at the lake. The lake is surrounded by humid forests invaded by various introduced species.

Land tenure: Public riverine waters.

Conservation measures taken: None.

Conservation measures proposed: Dahl (1980) recommended the establishment of a reserve to protect the lake and its fauna.

Land use: The lake is utilized for the generation of hydro-electricity; it currently produces 25% of the Territory's needs.

Possible changes in land use: There are plans to double the production of hydroelectricity.

Disturbances and threats: Widespread invasion of the plant species *Miconia calvescens*, introduced from Central America at the beginning of this century. Its growth has exploded as the forested slopes around the lake have been denuded by cyclones (in 1983) and construction work for hydro-electric development.

Hydrological and biophysical values: The only high-altitude lake in Polynesia.

Social and cultural values: Vaihiria valley possesses a number of interesting archaeological structures, some of which have been restored for the public. Noteworthy fauna: The only fish native to the lake seems to be the eel *Anguilla megastoma*. The lake is a feeding area and probably also a breeding site for the Pacific Black Duck (*Anas superciliosa*).

Noteworthy flora: No information.

Recreation and tourism: The lake lies close to the only track crossing the island, and is often visited by hikers.

Management authority and jurisdiction: No information.

References: Dahl (1980); Ricard *et al.* (1983).

Reasons for inclusion: 1a, 2b. The lake is of considerable interest as the only high-altitude lake in Polynesia.

Source: Yolande Fontaine, Claude Monnet and Jules Cheffort.

Wetland Name: Miti Rapa and Port Phaeton

Country: French Polynesia

Coordinates: 17°45'S, 149°19'W

Location: on the west side of the Isthmus of Taravao, south of Taravao village, Tahiti, Society Islands.

Area: Miti Rapa, 36 ha; Port Phaeton, unknown.

Altitude: Sea level.

Overview: A brackish lagoon and sheltered sea bay with stands of *Hibiscus tiliaceus* vegetation, some brackish marshes and stands of introduced mangroves.

Physical features: Miti Rapa is a small brackish lagoon separated from the sea by a causeway carrying a main road. The lagoon receives an inflow of fresh water from the Paea River rising in the hills of the Presqu'île de Tairapu to the southeast. Port Phaeton is a sheltered sea bay on the west side of the Isthmus of Taravao with some fringing brackish marshes and mangroves. The climate is tropical oceanic, with a cool dry season from May to October and a warm rainy season from November to April. Easterly trade winds predominate from October to March.

Ecological features: Primary vegetation with *Hibiscus tiliaceus* still persists along the edge of Miti Rapa lagoon. There are some areas of brackish marsh with *Acrostichum aureum* and *Phragmites* sp. and stands of the introduced mangrove *Rhizophora stylosa* on the shores of Port Phaeton.

Land tenure: Public maritime and riverine waters. Surrounding areas are privately owned.
Conservation measures taken: None.

Conservation measures proposed: A proposal for the protection of Miti Rapa Lagoon has been formulated by the Societe d'Ornithologie de Polynesie (MANU) and is currently under consideration.

Land use: None at the lagoon. There are some fish pens in the bay, and pastures and fallow plots in surrounding areas.

Disturbances and threats: The wetlands are under severe pressure from urban development, and some land on the west shore of Port Phaeton has already been reclaimed for development. The introduction of mangroves has disturbed the natural ecosystem of the bay.

Hydrological and biophysical values: No information.

Social and cultural values: None known.

Noteworthy fauna: Miti Rapa is one of the most important sites for the Little (Striated) Heron, *Butorides striatus patruelis*, a threatened subspecies endemic to the island of Tahiti. Flocks of up to 20 Pacific Black Ducks *Anas superciliosa* occur in Port Phaeton, and the species probably breeds around the Miti Rapa lagoon. Pacific Reef Herons (*Egretta sacra*), Pacific Golden Plovers (*Pluvialis fulva*), Wandering Tattlers (*Heteroscelus incanus*) and Great Crested Terns (*Sterna bergii*) occur commonly in the bay, and the introduced Swamp Harrier (*Circus approximans*) is common in the area.

Noteworthy flora: Miti Rapa is one of the last remaining sites on Tahiti where primary vegetation with *Hibiscus tiliaceus* still persists at the edge of the water.

Scientific research and facilities: Some studies have been conducted on the biology of *Butorides striatus*.

Conservation education: Members of the "Mann" group have approached landowners with a view to developing a conservation education programme at the lake.

Management authority and jurisdiction: No information.

Reasons for inclusion: 1a, 2a, 2b. The most extensive coastal wetland on Tahiti, and an important refuge for the threatened endemic subspecies of the Little Heron (*Butorides striatus patruelis*).

Source: Yolande Fontaine, Claude Monnet and Jules Cheffort.

Wetland Name: Papenoo Valley

Country: French Polynesia

Coordinates: 17°38'S, 149°25'W

Location: in the interior of north-central Tahiti, Society Islands.

Area: Unknown.

Altitude: 150-670 m.

Overview: Riverine wetlands along the middle and upper reaches of the Papenoo River and its tributaries in the north-central highlands of Tahiti.

Physical features: The Papenoo River and its tributaries comprise the largest river system in French Polynesia. This system drains the eastern slopes of the Mt Orohena massif (2,241 m) and the northern slopes of the Mt Tetufera massif (1,799 m). There are interesting caves at Pufau and Farehape, and three

impressive waterfalls, Cascade Maroto on the Vaituoru River (the principal tributary of the Papenoo) and Cascade Puraha and Cascade Vaiharuru on the main Papenoo River. The climate is tropical oceanic with an average annual rainfall of 5,300 mm. There is a warm rainy season from November to April and a relatively cool dry season from May to October.

Ecological features: No information.

Land tenure: Privately owned by the Territory.

Conservation measures taken: The Faaiti River (a small tributary on the west bank of the Papenoo) and its catchment area are protected in the Parc Naturel Territorial de Faaiti (750 ha), established by Decree No.678/CM in June 1989.

Conservation measures taken: Dahl (1980) recommended the establishment of a reserve to protect montane forest types and cloud forest in the upper Papenoo drainage, or some combination of conservation areas and recreation areas if a proposal to construct a dam in the valley went ahead.

Land use: Hunting, fishing and harvesting of forest products. A cross-island track follows the valley almost to the source of the Vaituoru River before crossing the Tetufera ridge to Lac Vaihiria.

Possible changes in land use: There is a proposal to dam the Papenoo Valley for the production of hydro-electricity.

Disturbances and threats: The lower reaches of the Papenoo River are now much degraded by mining for sand and gravel. The forests are threatened by clearing for agriculture, heavy grazing by domestic livestock, feral pigs and feral goats, and invasion by the introduced plant species *Miconia calvescens*.

Hydrological and biophysical values: No information.

Social and cultural values: The Papenoo valley is rich in archaeological remains which are currently being studied by the Centre Polynésien des Sciences Humaines. These include alluvial terraces, dwellings, platforms and erect stones.

Noteworthy fauna: No information is available on the aquatic fauna of the rivers and streams. A tiny population of the endangered Polynesian Pigeon (*Ducula aurorae*) still survives in the forests of the Papenoo Valley. This population was thought to number only 10-12 birds in 1975. Other threatened bird species in the area include the Tahiti Swiftlet (*Aerodramus leucophaeus*) and Tahiti Monarch (*Pomarea nigra*).

Noteworthy flora: No information.

Management authority and jurisdiction: Responsibility for management of the territorial park rests with the Delegation à l'Environnement.

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

Reasons for inclusion: 1a, 2b. The largest river system in French Polynesia. **Source:** Yolande Fontaine, Claude Monnet and Jules Cheffort.

Wetland Name: Lac Temae

Country: French Polynesia

Coordinates: 17°29'S, 149°46'W

Location: at the northeast tip of Moorea island, northwest of the airport, Society Islands.

Area: 18 ha.

Altitude: Sea level.

Overview: A small brackish lagoon surrounded by marshes.

Physical features: Lac Temae is a brackish lagoon with fringing marshes behind a raised beach and barrier reef. The lagoon was formed after the rise in sea level about 5,000 years ago, but is now almost completely silted up. It is fed by brackish groundwater from a layer of sediment that communicates with the sea, and by fresh water from small streams and rivers that drain the surrounding slopes. There is a more or less functional outlet at the northwest end. The maximum depth is over 10 m. The climate is tropical oceanic, with a cool dry season from May to October and a warm rainy season from November to April. Easterly trade winds predominate from October to March.

Ecological features: There is a belt of *Typha domingensis* on the beach side of the lagoon and a belt of

Acrostichum aureum on the southwest (mountain) side.

Land tenure: Non-transferable public property.

Conservation measures taken: None.

Conservation measures proposed: It has been proposed that the lagoon be designated as a protected area, especially the southeastern part.

Land use: A road passes along the western shore of the lake. There is a hotel near the south end, and an airport immediately to the southeast.

Possible changes in land use: There are proposals to create an 18-hole golf course in the area, and to extend the runway of the nearby airport into the catchment area of the lagoon.

Disturbances and threats: In 1979, a natural sill at the outlet of the lagoon was lowered; since then the salinity of the lake and the swamps has risen considerably, destroying the natural vegetation, disturbing the aquatic fauna, and favouring the spread of *Culicoides belkini* (a blood-sucking gnat introduced accidentally). Other threats include disturbance from the nearby airport, pollution from unregulated discharge of domestic waste, the spread of housing along the adjacent coast and the introduction of mangroves.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: A feeding area for the Pacific Black Duck (*Anas superciliosa*) and a stopover site for migratory shorebirds, notably Wandering Tattler (*Heteroscelus incanus*) and Pacific Golden Plover (*Pluvialis fulva*).

Noteworthy flora: No information.

Scientific research and facilities: The hydrological aspects of the lagoon have been described by Burlot *et al.* (1985), Pouchon *et al.* (1985) and Faissolles (1988). Studies have also been carried out on the biology of *Culicoides belkini* and migratory birds.

Management authority and jurisdiction: No information.

References: Burlot *et al.* (1985); Faissolles (1988); Polynesian Society of Water, Electricity and Waste (1990); Pouchon *et al.* (1985).

Reasons for inclusion: 1d, 3b. The lagoon is an example of a hydrobiological system which is rare in Polynesia, and is important habitat for *Anas superciliosa* and migratory shorebirds.

Source: Yolande Fontaine, Claude Monnet and Jules Cheffort.

Wetland Name: Roto Rahi and Roto Itu

Country: French Polynesia

Coordinates: 17°40'S, 150°38'W

Location: in the interior of Maiao Island, Society Islands.

Area: Roto Rahi c.300 ha; Roto Iti c.150 ha.

Altitude: Sea level.

Overview: Two large brackish lagoons with extensive marshes on an "almost atoll".

Physical features: Maiao is an "almost atoll" of 9.5 sq.km with a volcanic ridge to 154 m and fringing coral flats and barrier reef. Much of the interior of the island is occupied by two large brackish lagoons with extensive fringing marshes. Both lagoons are connected to the sea by narrow channels and are connected to one another by a channel which links the southeast corner of Roto Iti to the northern end of Roto Rahi. The climate is tropical oceanic, with a cool dry season from May to October and a warm rainy season from November to April. Easterly trade winds predominate from October to March.

Ecological features: Fresh to brackish water marshes.

Land tenure: Public (Domaine Public Maritime et Fluvial).

Conservation measures taken: None.

Land use: Crab harvesting; coconut plantations in surrounding areas.

Disturbances and threats: No information.

Hydrological and biophysical values: No information.

Social and cultural values: There is a site of archaeological interest on the southeast shore of Roto Iti (Ahu Tii).

Noteworthy fauna: No information.

Noteworthy flora: No information.

Management authority and jurisdiction: No information.

References: Dahl (1986).

Reasons for inclusion: la.

Source: Yolande Fontaine.

Wetland Name: Lac Maeva

Country: French Polynesia

Coordinates: 16°42'S, 151°00'W

Location: at the north end of Huahine island, west of the village of Maeva, Society Islands.

Area: 375 ha.

Altitude: Sea level.

Overview: A brackish pond, almost closed off from the sea and bordered in the west by a wide, intermittently flooded swampy area.

Physical features: Maeva Lake (Lac Fauna Nui) is a relict of the once much larger Maeva Lagoon, a lagoon of Quaternary origin which has now largely silted up. The maximum depth is 6.1 m. The lagoon is connected to the open sea by a narrow channel at its southeast end, but variations due to the tide are slight, as the tidal range in the area is only about 20 cm. The climate is tropical oceanic, with a cool dry season from May to October and a warm rainy season from November to April. Easterly trade winds predominate from October to March.

Ecological features: No information.

Land tenure: Non-transferable public waters (riverine, lagoonal or maritime according to the degree of salinity).

Conservation measures taken: Certain archaeological structures around the lake have been listed.

Conservation measures proposed: It has been proposed that an administrative management plan be developed, taking into account, in particular, the archaeological sites. Additional archaeological structures should be listed, and a protection zone designated around the listed sites.

Land use: None at the wetland. The small village of Maeva lies close by, and some adjacent land is used for agricultural purposes. Sand extraction occurs in the area, and there are numerous fallow plots.

Possible changes in land use: There are proposals for a large-scale hotel project and urban

development project in the area.

Disturbances and threats: The swampy area to the west of the lake, important for bird life, is gradually being encroached upon by human settlement, and a major development project has recently been initiated in the area. There is some disturbance from the nearby Huahine airport. The cultivation of melons and water melons on the adjacent coral formations uses techniques that threaten the environment and pollute the groundwater. In particular, there is a risk that pesticides and fertilizers will enter the lagoon. Numerous land-fills have been permitted on public property.

Hydrological and biophysical values: No information.

Social and cultural values: There is an important archaeological site at the wetland. In recent years, local inhabitants have supplemented their incomes by harvesting cockles.

Noteworthy fauna: No information.

Noteworthy flora: No information.

Management authority and jurisdiction: No information.

References: Gabrie (1988); Universite de Bordeaux (1988).

Reasons for inclusion: Ia. A noteworthy cultural and archaeological site and a lagoon with high primary productivity.

Source: Yolande Fontaine, Claude Monnet and Jules Cheffort.

Wetland Name: Wetlands of Tuherahera Motu

Country: French Polynesia

Coordinates: 15°00'S, 148°10'W

Location: in Tikehau Atoll, between Mataiva Atoll and Rangiroa Atoll near the northwestern end of the Tuamotu Archipelago.

Area: Unknown.

Altitude: Sea level.

Overview: Small swampy areas located in the middle of a tiny coral islet ("motu") in Tikehau Atoll.

Physical features: Tikehau is a circular atoll with a diameter of 25-28 km and over 150 small islets or "motu" around the central lagoon. On one of these motu (Tuherehera), there are several low, elongated basins, running east to west in the centre of the island, which are temporarily flooded after heavy rains. When the basins are dry, the groundwater is located at a depth of about 20 cm. The climate is tropical oceanic, with an annual rainfall of 1,000-1,900 mm. There is a cool dry season from May to October and a hot rainy season from November to April. Easterly trade winds predominate except during bad weather when the winds are from the west.

Ecological features: No information.

Land tenure: No information.

Conservation measures taken: None.

Land use: None at the wetlands. The wetlands are surrounded by coconut palm plantations, and there is an airstrip on the island. The population of Tikehau Atoll was 266 in 1983.

Disturbances and threats: The proposed expansion of the airstrip would destroy much of the wetland habitat.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: The Spotless Crake (*Porzana tabuensis*) occurs in the swampy vegetation. Tikehau Atoll supports good populations of the Atoll Fruit Dove (*Ptilinopus coralensis*), Blue Lorikeet (*Vini peruviana*) and Tuamotu Reed Warbler (*Acrocephalus atypha atypha*).

Noteworthy flora: No information.

Management authority and jurisdiction: No information.

References: Dahl (1986).

Reasons for inclusion: Id. A good example of a natural swampy area in the interior of a motu; a rare habitat type in the Tuamotus.

Source: Yolande Fontaine, Claude Monnet and Jules Cheffort.

Wetland Name: Niau Atoll

Country: French Polynesia

Coordinates: 16°10'S, 146°22'W

Location: near the west end of the Tuamotu Archipelago, 280 km west of Makemo and 350 km east-northeast of Tahiti.

Area: 5,400 ha (lagoon 3,300 ha, land area 2,100 ha).

Altitude: Sea level.

Overview: A large enclosed lagoon with fringing marshes on a small atoll.

Physical features: Niau is an elliptical atoll comprising a single island with a broad fringing reef and completely enclosed central lagoon. The narrow strip of land surrounding the lagoon has a maximum elevation of 5 m. There is a narrow belt of marsh vegetation around the edge of the lagoon, which is presumably brackish, and there is apparently some freshwater marsh (Dahl, 1980). The climate is tropical oceanic, with an annual rainfall of 1,000-1,900 mm. There is a cool dry season from May to October and a hot rainy season from November to April. Easterly trade winds predominate except during bad weather when the winds are from the west.

Ecological features: No information.

Land tenure: No information.

Conservation measures taken: None.

Land use: The island is intensively cultivated (gardens and coconut plantations), and there is a small village (Tupana) on the northeast side.

Disturbances and threats: No information.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: No information is available on the fauna of the lagoon. The subspecies *gertrudae* of the Tuamotu Kingfisher (*Halcyon gambieri*) is endemic to the island of Niau. The bird is widespread in gardens and coconut groves; the population was estimated at 400-600 birds in 1974. The nominate race of this species, confined to the island of Mangareva, became extinct, probably before 1922 (Collar and Andrew, 1988). The island also has an endemic subspecies of the Tuamotu Reed Warbler (*Acrocephalus aypha niauensis*), which is reportedly common.

Noteworthy flora: No information.

Management authority and jurisdiction: No information.

References: Collar & Andrew (1988); Dahl (1980, 1986).

Reasons for inclusion: Id. Possibly the most extensive fresh to brackish water marshes in the Tuamotus.

Source: Yolande Fontaine.

Wetland Name: Taiaro Atoll

Country: French Polynesia

Coordinates: 15°42'S, 144°34'W

Location: in the Tuamotu Archipelago, 230 km west of Raroia Atoll and 540 km east-northeast of Tahiti.

Area: 2,000 ha.

Altitude: Sea level to 5 m.

Overview: A small circular atoll with an enclosed saline lagoon permanently isolated from the sea since about 1900.

Physical features: Taiaro Atoll is an almost circular atoll comprising a single island 5 km in diameter with a large enclosed lagoon. The lagoon is permanently isolated from the sea, except possibly during severe storms. It is more or less uniformly deep (20-25 m) with a maximum depth of 29 m. The emergent rim of the island is 700 m wide at its widest, and has a circumference of 12 km.

This rim is now continuous, but there are 18 closed channels ("hoa") blocked by boulders which were probably deposited by a tidal wave between 1878 and 1906. With a salinity of 43 p.p.t., the water of the lagoon is slightly saltier than that of the ocean (36 p.p.t.), this being due to excessive evaporation. In recent years, the water level has been falling slowly and the salinity gradually increasing.

The climate is tropical oceanic, with an annual rainfall of 1,000-1,900 mm. There is a cool dry season from May to October and a hot rainy season from November to April. Easterly trade winds predominate except during bad weather when the winds are from the west.

Ecological features: There are three main habitats along the lagoon shore: sandy detritus, coral pavement and algae. Most of the island is covered with an open bush vegetation including *Lepidium* spp., *Morinda citrifolia*, *Pandanus* spp., *Suriana* spp., *Pemphis acidula*, *Erithalis polygama*, *Petesia carnosa*, *Guettarda speciosa*, *Scaevola* sp., *Tournefortia* spp., *Pentacarya anoniala*, *Myoporum* spp., *Boerhavia* spp., *Achyranthes* spp., *Cassytha* spp., *Euphorbia ramosissima*, *Urtica* spp., *Digitaria* spp., *Psilotum* spp., *Polypodium* spp., *Asplenium* spp. and *Ramalina* spp. There are some coconut palms (*Cocos nucifera*), but far fewer than on most other atolls in the Tuamotus.

Land tenure: Private property; owned by W.A. Robinson.

Conservation measures taken: The lagoon was proclaimed a strict nature reserve (Reserve Integrale W.A. Robinson) by its owner, with the agreement of the Governor of French Polynesia by Decree No.2456/AA of 1 August 1972. In February 1973, the reserve was extended to cover the entire atoll and a surrounding protective offshore buffer zone one km wide. The reserve was accepted as a Biosphere Reserve in January 1977. There is close cooperation between the owner of the atoll, the Administrative Committee of the reserve and the Governor of French Polynesia for the protection of the atoll, lagoon and surrounding sea. The management objectives are currently being reviewed.

Land use: Scientific research. Until recently, the atoll was inhabited by the guardian of the reserve and his family. Access to the reserve is restricted to scientists who have been granted permission by the Administrative Committee, and there is no fishing or tourism.

Disturbances and threats: Several plant species, including the coconut palm, appear to have been introduced onto the island in the past. The only known threat at present is the natural threat of cyclones.

Hydrological and biophysical values: No information.

Social and cultural values: During the 1700s, the island was the centre of a small but flourishing Polynesian kingdom, and is now of some archaeological interest.

Noteworthy fauna: The lagoon supports an abundant fish and invertebrate fauna with 55 species of fish, 104 species of molluscs, three sponges and two echinoderms. Of the molluscs, the giant clam *Tridacna maxima*, *Pinctada maculata*, *Codakia divergens* and *Gafrarium pectinatum* are particularly abundant. There is, however, only one species of coral, *Porites lobata*, which occurs down to a depth of 1.5 m. In the past, the lagoon coral fauna was much richer, several fossil species having been recorded.

Coconut crabs (*Birgus latro*) occur on the island, and there are some breeding seabirds. The fauna of the outer reefs is summarized by UNEP/IUCN (1988).

Noteworthy flora: No information.

Scientific research and facilities: Research has been carried out on two species of mosquito (one indigenous and one introduced) by the Pacific Research Section of the National Institute of Allergy and Infectious Diseases based in Honolulu, Hawaii. Scientists from the Museum National d'Histoire Naturelle (Paris) and the Ecole Pratique des Hautes Etudes (Tahiti) visited the atoll in 1972 to study the fauna, flora and geomorphology of the island and the hydrology of the lagoon. The owner of the island provides accommodation for visiting scientists.

Management authority and jurisdiction: The reserve is administered by the Administrative Committee Secretariat based at the Delege de la Commission des Monuments

Naturels et Sites in Tahiti.

References: Dahl (1986); IUCN (1991); UNEP/IUCN (1988).

Reasons for inclusion: 1a, 2b. The atoll offers excellent opportunities for research into the ecology and evolution of atoll lagoon ecosystems as well as the archaeology of the region.

Source: See references.

Wetland Name: Tahanea Atoll

Country: French Polynesia

Coordinates: 16°50'S, 144°45'W

Location: in the west-central Tuamotu Archipelago, 100 km west-southwest of Makemo and 475 km east-northeast of Tahiti.

Area: Unknown.

Altitude: Sea level.

Overview: A large uninhabited atoll with numerous tiny islets ("motu"), important for the Tuamotu Sandpiper.

Physical features: Tahanea is a large atoll, approximately 48 km long by 15 km wide, with about 55 small islets ("motu") around a large lagoon. There are three deep channels between motu on the north side of the lagoon. The tides are semi-diurnal with an amplitude of about 40 cm. The climate is tropical oceanic, with an annual rainfall of 1,000-1,900 mm. There is a cool dry season from May to October and a hot rainy season from November to April. Easterly trade winds predominate except during bad weather when the winds are from the west.

Ecological features: Beach communities, atoll scrub and coconut plantations.

Land tenure: Many of the key motu for Tuamotu Sandpipers are owned by Michael Tapi on Faaite Atoll.

Conservation measures taken: None.

Conservation measures proposed: Lovegrove *et al.* (1989) recommended that some of the motu be given reserve status to safeguard their breeding populations of Tuamotu Sandpipers. Recognizing that there was already much sympathy and fondness for the sandpipers ("titi") amongst the inhabitants of neighbouring atolls, Lovegrove *et al.* suggested that an education programme be developed with appropriate islanders to help persuade them of the importance of maintaining the Tuamotu Sandpipers, and how this might be done.

Land use: The atoll is not permanently inhabited, although there are coconut plantations on some of the motu.

Disturbances and threats: The Tuamotu Sandpiper is extremely vulnerable to predation from introduced rats and cats. Every effort should be taken to prevent the accidental introduction of these or other predators onto motu with breeding sandpipers. Pigs have already been introduced onto some of the larger motu, and these would almost certainly render the islets unsuitable for the birds by destroying the dense vegetation and leaf litter which seems to be important to the species (Lovegrove *et al.*, 1989).

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Good populations of Tuamotu Sandpipers (*Prosobonia cancellatus*) were discovered on four tiny motu on the south side of the atoll in April 1989 (Lovegrove *et al.*, 1989). The one motu which was surveyed properly (Tohete motu, only 100 m long by 60 m wide) held 12-15 sandpipers. Similarly high densities were found on the three other motu visited, and it was thought that there could be many more motu with sandpipers. Five other species of waterbirds were recorded in small numbers during this brief survey: Pacific Reef Heron (*Egretta sacra*), Pacific Golden Plover (*Pluvialis fulva*), Wandering Tattler (*Heteroscelus incanus*), Bristle-thighed Curlew (*Numenius tahitiensis*) and Great Crested Tern (*Sterna bergii*). Breeding seabirds included large numbers of Greater Frigatebird (*Fregata minor*), Red-footed Booby (*Sula sula*), Brown Noddy (*Anous stolidus*) and Black Noddy (*A.*

minutus). The only land birds on the atoll, Atoll Fruit Dove (*Ptilinopus coralensis*) and Tuamotu Reed Warbler (*Acrocephalus aypha*), were both moderately common.

Noteworthy flora: No information.

Scientific research and facilities: Four of the motu on the south side of the atoll were visited by ornithologists in April 1989 (Lovegrove *et al*, 1989).

Management authority and jurisdiction: No information.

References: Lovegrove *et al* (1989).

Reasons for inclusion: 2a. One of the few atolls still known to support a good population of the Tuamotu Sandpiper.

Source: See references.

Wetland Name: Raevski Atolls

Country: French Polynesia

Coordinates: Tepoto Atoll 16°50'S, 144°16'W; Hiti Atoll 16°45'S, 144°05'W; Tuanake Atoll 16°40'S, 144°12'W

Location: in the west-central Tuamotu Archipelago, 45-65 km southwest of Makemo.

Area: Unknown.

Altitude: Sea level.

Overview: A group of three small uninhabited atolls in the west-central Tuamotus, thought to be important for the Tuamotu Sandpiper.

Physical features: Tepoto Atoll is a small atoll, approximately 4 km long by 3 km wide, with two main islands and one small pass into the central lagoon. Hiti Atoll, 20 km to the east-northeast, is slightly larger (9 km by 6 km), with one large island and no deep entrance to the central lagoon. Tuanake Atoll, 20 km north-northeast of Tepoto, is intermediate in size (8 km by 6 km), with two large and four small islands and a single narrow pass into the central lagoon. The tides are semi-diurnal with an amplitude of about 40 cm. The three atolls together comprise the Raevski Group.

Ecological features: Atoll scrub, sandy beaches and reef flats.

Land tenure: No information.

Conservation measures taken: None.

Land use: None of the atolls is permanently inhabited, although there is some seasonal occupation.

Disturbances and threats: No information.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Tuamotu Sandpipers (*Prosobonia cancellatus*) were discovered on all three atolls in the 1920s. The islands do not appear to have been visited by ornithologists since then. However, Lovegrove *et al* (1989) were informed by fishermen from neighbouring atolls that there were still "plenty" of sandpipers (locally known as "titi") on Hiti and Taunake when they last visited these atolls in 1984. The fishermen had no reason to suppose that the birds had disappeared since then, and also indicated that the species might still exist on Tepoto.

Noteworthy flora: No information.

Management authority and jurisdiction: No information.

References: Dahl (1986); Lovegrove *et al* (1989).

Reasons for inclusion: 2a. Possibly an important group of atolls for the Tuamotu Sandpiper.

Source: Yolande Fontaine and references.

Wetland Name: Matura du Sud and Maturei Vavao Atolls

Country: French Polynesia

Coordinates: Maturaia du Sud, 22°00'S, 135°00'W; Maturei Vavao 21°45'S, 136°00'W

Location: in the southeastern part of the Tuamotu Archipelago.

Area: Unknown.

Altitude: Sea level.

Overview: Two uninhabited, rat-free atolls in the southeastern Tuamotus, important for the Tuamotu Sandpiper.

Physical features: Maturaia du Sud is a large atoll, approximately 18 km long, with many small islets ("motu") and one deep pass into the central lagoon. Maturei Vavao, in the Actaen Group, is a low atoll with an enclosed lagoon. The tides are semi-diurnal with an amplitude of about 40 cm.

Ecological features: Atoll scrub, sandy beaches and reef flats. Both atolls are free of introduced Brown Rats (*Rattus rattus*).

Land tenure: No information.

Conservation measures taken: None.

Conservation measures proposed: Dahl (1980) has recommended the establishment of reserves on some of the motu in Maturei Vavao Atoll to protect the threatened birds (Tuamotu Sandpiper and Polynesian Ground Dove) and the atoll vegetation.

Land use: Both atolls are used for the cultivation of coconuts, and are visited for the harvest, but neither is permanently inhabited. There is some pearl fishing at Maturaia du Sud.

Disturbances and threats: Vegetation on Maturei Vavao has been cleared for replanting of coconut plantations, and this may have affected bird habitats (Dahl, 1986).

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: The Tuamotu Sandpiper (*Prosobonia cancellatus*) was found commonly on both atolls in 1969, and was presumed to be breeding. The threatened Polynesian Ground Dove (*Gallicolumba erythroptera erythroptera*) was recorded as uncommon on Maturei Vavao in 1968 (Lacan and Mougin, 1974). This is the only site at which the species has been recorded in recent decades (Hay, 1985). (The other subspecies, *G. e. pectoralis*, which is known only from the Society Islands, may now be extinct).

Noteworthy flora: No information.

Scientific research and facilities: Lacan and Mougin (1974) have surveyed the avifauna of the two atolls, while Renaud-Mornant *et al.* (1970) have studied the benthos of the lagoon. The atolls do not appear to have been visited by biologists since the 1960s.

Management authority and jurisdiction: No information.

References: Dahl (1980, 1986); Hay (1985); Lacan & Mougin (1974); Renaud-Mornant *et al.* (1970).

Reasons for inclusion: 2a. Important atolls for two threatened species, the Tuamotu Sandpiper and Polynesian Ground Dove, when last surveyed in the 1960s.

Source: See references.

Wetland Name: Wetlands of Rurutu Island

Country: French Polynesia

Coordinates: 22°28'S, 151°20'W

Location: near the western end of the Austral Islands, 550 km south-southwest of Tahiti.

Area: Unknown.

Altitude: Sea level.

Overview: Small riverine wetlands along the lower courses of the island's major rivers, utilized for the cultivation of taro.

Physical features: Rurutu Island is a volcanic high island with a fringing coral reef, some elevated limestone reefs, and a rugged interior rising to a peak at 389 m. The island is approximately 11 km long by 3.5 km wide and has an area of 29 sq.km. Small rivers rising in the interior of the island create swampy areas along their lower courses, and these have

been modified by the local inhabitants for the cultivation of taro.

Ecological features: Riverine wetlands under cultivation for taro (*Colocasia esculenta* and *Cyrtosperma* sp.). Natural plant communities on the island include limestone forest in the lowlands, and grassland and fernland on the upper slopes with forest remnants in ravines. However, most of the native forest has been destroyed by burning and overgrazing by feral goats and cattle.

Land tenure: No information.

Conservation measures taken: None.

Land use: Cultivation of taro. There were about 1,970 inhabitants on the island in 1983.

Disturbances and threats: Reclamation of land from public maritime waters to circumvent the problem of collective ownership of land. Several hectares of wetland have already been filled for collective use.

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.

Reasons for inclusion: Ia. Traditional agricultural areas threatened with destruction by land fills.

Source: Yolande Fontaine, Claude Monnet and Jules Cheffort.

Wetland Name: Clipperton Island

Country: French Polynesia

Coordinates: 10°18'N, 109°13'W

Location: in the East Pacific, 1,300 km from the Pacific coast of Mexico, 2,800 km from Hawaii and 5,200 km from Tahiti.

Area: 600 ha.

Altitude: Sea level to 5 m (volcanic plug 29 m).

Overview: An isolated "near atoll" with a completely enclosed lagoon; the only atoll in the East Pacific east of Ducie (Pitcairn Islands). The lagoon is of considerable limnological interest, and the fauna and flora are of biogeographical interest on account of their Indo-Pacific and American relationships.

Physical features: Clipperton Island is an egg-shaped "near atoll" with a completely enclosed lagoon oriented northwest-southeast. The atoll rim consists of a narrow band of rock generally 100-200 m wide, but reaching 400 m wide in the west and narrowing to 45 m in the northeast where waves occasionally spill over into the lagoon. There is a small volcanic plug covered with lichens and guano at the southeast end of the island. The island is surrounded by a reef flat exposed at low tide. The closed lagoon has permanently deoxygenated water; there is a strong halocline, and the waters are highly eutrophic and almost fresh at the surface. The climate is tropical oceanic. Northeasterly trade winds predominate, but are replaced occasionally in the summer by tropical storms and sometimes cyclones from the southeast.

Ecological features: Higher plants and algae are reported to be abundant in the lagoon. The island is largely covered with scrub vegetation, but there are a few coconut palms.

Land tenure: French Government.

Conservation measures taken: None.

Conservation measures proposed: The island is to be legally protected by the French Government, but this is expected to take some time to implement. Visits by tuna fishermen should be prohibited. It has been recommended that the island be protected as a natural laboratory for scientific studies.

Land use: Phosphate was worked from 1898 to 1917, but the island is now uninhabited

although it is sometimes visited by U.S. tuna fishermen. Meteorological stations have occasionally been set up on the island. Access is difficult because of the heavy oceanic swell.

Disturbances and threats: Coconuts were planted in 1897. Introduced pigs were destroyed in 1958 to prevent a decline in seabird populations. There is a possibility that a permanent meteorological and/or satellite observation post could be set up on the island. This would be likely to have a major effect on the atoll. There is also a proposal to open up the lagoon in order to build a port.

Hydrological and biophysical values: The closed lagoon is of particular interest as a model for modern formation and sedimentation of phosphate and carbonate diagenesis. Apatite has been discovered in the intertidal modern deposits along the shore.

Social and cultural values: None known.

Noteworthy fauna: The lagoon supports an impoverished invertebrate fauna. Breeding seabirds include a frigatebird (*Fregata* sp.), two boobies (*Sula* spp.), two noddies (*Anous* spp.) and two terns (*Sterna* spp.). Other fauna includes the lizard *Emoia cyanura* and the crab *Geocarcinus planatus*.

Noteworthy flora: No information.

Scientific research and facilities: A number of scientific expeditions have visited the islands; these are listed by Sachet (1958) and UNEP/IUCN (1988). Studies of the invertebrate fauna of the lagoon are listed in UNEP/IUCN (1988).

Management authority and jurisdiction: The island is under the authority of the Governor of French Polynesia.

References: Sachet (1958); UNEP/IUCN (1988).

Reasons for inclusion: 1a, 2b. Clipperton is one of the least altered island systems in the Pacific. The fauna and flora consist of an unusual assemblage including both Panamic (American) and Indo-Pacific forms.

Source: UNEP/IUCN (1988).

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