Information sheet on Ramsar Wetlands

1. **Date this sheet was completed/updated:** 19 November 1997
2. **Country:** Papua New Guinea
3. **Name of Wetland:** Lake Kutubu
4. **Geographical co-ordinates:** Latitude 06° 25.79'S Longitude 143° 20.22'E
5. **Altitude:** 808 m.
6. **Area:** 4924 ha. for Lake Kutubu. Overall watershed estimated at 25,000 ha.

7. **Overview:** Lake Kutubu, the second largest lake in Papua New Guinea (largest perched lake), is of volcanic origin and lies within the Kikori river catchment, the upland areas of which have been described as a dessicated terrain of Darai limestones and interbedded mudstones and sandstones (Sullivan et al., 1990). The lake contains 14 species of fish, 10 of which (71.4%) are endemic to the Lake itself. This level of endemicity exceeds any other lake in the entire New Guinea-Australian region (Allen, 1995). These fish are the major protein source for people living around Lake Kutubu.

8. **Wetland Type:** O - Permanent freshwater lake (over 8 hectares)
M (permanent rivers/streams): e.g. parts of Kaimari and Soro Rivers
Tp (permanent freshwater marshes): refers to the reed dominated (but treeless) swamp that fringes much of the lake especially at the northern and southern end. Further research may clarify the existence of peat swamp fringing the lake.
Xf (freshwater, tree-dominated wetlands): substantial areas of flat-land forest at the southern end of the lake can be considered as swamp forest (inundation can be brief or periodic). This forest is south of Gesege village. Another swamp forest extends up to the Mendi road and across to the Soro River at the northern end of the lake.
Zk (subterranean karst and cave hydrological systems): the majority of water flow to and from the lake appears to be subterranean. Cave hydrological systems were seen underwater during a recent SCUBA survey.

9. **Ramsar criteria:** 1(c)(d), 2(b)(c)(d), 4(a)(b)

10. Map of site included? Pleas tick *yes* [X] -or- *no* [ ]

11. Name and address of the compiler of this form:

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12. Justification of the criteria selected under point 9:

1(d) : Unlike most inland waters of Papua New Guinea, the food chain of this exceptional clearwater lake is based on autochthonous (primary) production rather than on river borne detritus of largely terrestrial origin (Osborne et al., 1990). The exceptional water clarity allows for a high level of primary production and is attributed to the low nutrient status of the lake's epilimnion (i.e. surface waters above the thermocline) with nutrients tending to accumulate in the lake's bottom waters below the level of biological production (Osborne et al., 1990).

2(b) If Lake Kutubu was lost or significantly degraded, the genetic and ecological diversity of the Kikori Basin (and wider afield) would be substantially reduced.

2(d) Lake Kutubu, with 10 known endemic species of fish, has been recognized as the most unique lacustrine habitat for fishes in the New Guinea-Australia region (Allen, 1995). Lake Kutubu is a major part of the Kikori drainage. That drainage contains more endemic fish species (14) than any other region of comparable size in all of New Guinea (PNG and Irian Jaya). This high level of endemism is largely due to the presence of Lake Kutubu and its unique ecosystem, home to ten (71.4%) of these fishes. The surrounding primary rainforest also contains a large variety of endemic and rare terrestrial fauna (see noteworthy fauna).

2(c) Due to the major fish nursery in the lake, and the confinement of 10+ fish species to Lake Kutubu, 2(c) should apply.

4(a) 71.4% of Lake Kutubu's fishes are endemic to the lake. These fishes are a significant componant of global biological diversity.

4(b) Lake Kutubu provides the sole spawning, nursery and feeding gounds for the 10 species of endemic fish. The highly productive Characeae plant beds that dominate much of the lake margins (and the two "reefs" in the centre of the lake) provide the major feeding, spawning and nursery grounds for 9 of the 10 endemic species. The prevalence of Characeae is indicative of the high water clarity (Meier and Voser, 1994).

13. General location: Lake Kutubu is located roughly in the centre of Southern Highlands Province, Papua New Guinea. The nearest town is Mendi, the provincial headquarters, which is about 35 km northeast of the lake.

14. Physical features: Lake Kutubu was formed originally by the blocking of the valley by volcanically derived debris and ash. The lake is about 19 km long , 4 km wide at its widest point, with a maximum depth of about 70 m (Osborne and Totome, 1992). It lies within the Kikori river catchment. The upland areas of which have been described as a dessicated terrain of Darai limestones and interbedded mudstones and sandstones (Sullivan et. al., 1990). Fertile soils occur in valleys where volcanically derived soils are deposited.

The definition of the lake's catchment is complicated by the extensive karst terrain. Rooke (1988) has inferred a line between the inlet north of Iburu Point and Yugoso Village, with predominantly surface runoff from the northwest and mainly groundwater inflow from elevated karst to the southeast. Numerous creeks drain into the lake, but the majority of these have small catchments and flow only from local rain. The most important surface water input is Kaimari Creek in the northwest end of the lake. Tugibu, Sama'a and Gesege Creeks are of secondary importance. It is thought that groundwater inputs may provide the major contribution to the lakes' water balance (Osborne et al., 1990). The outflow for the lake, the Soro River, appears to act as a "spillway" for the lake and thus dampen fluctuations in water level.

Anecdotal information from villagers suggests that water fluctuates at least 2m between what they termed "high tide" levels (ie at the end of a wet period) and "low tide" levels (ie at the end of a dry period). The low tide level roughly coincides with the outer edge of the emergent plant community. Under extreme conditiions water levels would

fluctuate beyond these "normal" ranges. During "low tide" periods, extensive areas of rocky shores may be exposed.

The water in Lake Kutubu is exceptionally clear with a median total suspended solids (TSS) value from ten samples, taken from 0 to 20 m depth, of 1.4 mg/L (Osborne et al., 1990). Secchi disc readings from various studies show a range of 6.5 to 7.8 m, and aquatic plants were observed growing profusely to depths of up to 6m. The water clarity is ascribed to, firstly, the low nutrients in the surface layers of the lake and, hence, a low phytoplankton biomass and, secondly, to the low and short-lived suspended load of inflowing streams. The largest of these streams enters the lake from the northwest across extensive marshes where suspended sediment will tend to settle out.

A rise during the day of oxygen concentrations was consistent with photosynthetic activity, and elevated oxygen values were recorded over the dense fringing beds of benthic lake weed (Characeae). Osborne and Totome (1992) identified a thermocline between 10 and 25m. Above the thermocline, oxygen levels were high whereas below 25m oxygen levels were less than 2mg/L. In addition, the water was alkaline (pH ranged from 7.6 to 8.1) and conductivity ranged from 166 to 203 uS/cm.

Lake Kutubu is classified as an oligomictic lake characterised by distinct thermal stratification with irregular periods of mixing (Osborne and Totome, 1992). This stratification appears to be generally stable, but overturning has occured occasionally, the last time apparently being around 1978. Reportedly, the upwelling does not effect the entire lake but only areas corresponding to the deepest parts. Mixing may be triggered when abnormally cold and stormy weather occurs, resulting in mixing of the deoxygenated hypolimnion with the epilimnion (Osborne and Totome, 1992). This results in low oxygen levels in the upper water column which causes mass fish kills due to asphyxiation. Also, the upwelling of nutrients fertilizes the upper waters triggering phytoplankton blooms, often involving blue-green algae.

Around Lake Kutubu temperatures average 23^{o}C and annual rainfall is 4500 mm (Busse et al, 1993). Rainfall is fairly evenly distributed throughout the year, although the wettest months are usually August, September and October (Busse et al, 1993).

15. Hydrological values: Described in physical features (14). In addition, it could br argued that Lake Kutubu plays an important hydrological role in moderating floods in the Soro River, and thus the Kikori River system, and an important ecological role as the only lake(supporting lacustrine processes and fauna) in the Kikori system.

16. Ecological features: Three main vegetative groupings of lake plants, which could be regarded as "habitat types," were recognized (Houston, 1995):

1) A **tall emergent zone** forming the fringing littoral margins of the lake to a maximum depth of 2.5m (during "high tide"). There appeared to be a zonation pattern with *Phragmites karka* occupying the the more landward margins followed by the broad-leaved grass *Miscanthus floridulus* and *Pandanus* sp. and finally a mixture of the reed *Scirpus grossus, Typha orientalis* and several mat-forming grasses (eg.*Leersia hexandra*). Sometimes the smartweeds of the family Polygonaceae (eg. *Polygonum attenuatum*) formed a dominant componant bordering the tall emergent zone.

2) **Aquatic mixed plant beds** comprising either a mixture of cosmopolitan species or one of the following species as a single species stand- *Hydrilla verticillata, Ceratophyllum demersum, Najas tenuifolia, Vallisneria natans, Ottelia allisimoides* and *Potemogeton malaianus*. Interestingly, *N. tenufolia* while recorded as present by a plant study in 1979 (cited in Osborne et al., 1990) was not listed as a dominant species by the Osborne et al., 1990) study. The mixed community generally occured in shallow waters to depths of 3 m although it was observed to at least 4 m on occasions and may extend into deeper waters.

3) **Aquatic Characeae plant beds** dominated by *Nitella* sp. This species formed a dense monospecific mat over the bottom of the lake. The characeae community either abutted the mixed community, the tall emergent commmunity or the lake edge itself where the bank was steep. Depth distribution of this aquatic plant bed was observed to range from 2.5m to depths of 4.5 or 7.5m. In earlier studies it was recorded as deep as 8m (Osborne et al., 1990).

• The trophic structure of Lake Kutubu is based on the primary productivity of the lake's marginal and submerged vegetation. Adequate water quality is required to maintain this

productivity and any activity causing prolonged turbidity would adversely effect the ecology of the lake (Osborne et al., 1990).

• Two aquatic plants found in Lake Kutubu are recognised as having pest potential (*Pistia stratiotes* and *Hydrilla verticillata*) but neither seem to present a weed problem on the lake. No *Salvinia* or water hyacinth have been seen in the lake but the potential for weed introduction to the lake has been enhanced by recent improvements in road access and increased population movements.

17. Noteworthy flora:

One tree species (***Eucalyptopsis***) has been recorded only in two parts of the country. In both these locations it is believed to be wiped out by logging; it occurs within the proposed Ramsar site. This species has been assessed in Australia for anti-tumour activity (Balun, 1995). The aquatic flora is described above in section 16. - Ecological features. (*Appendix - 1. List of plant collections from Lake Kutubu*).

18. Noteworthy fauna:

The fauna and flora of the Lake Kutubu watershed and the rest of the Kikori Basin is described in Harshorn *et al* (1995). Species lists are provided in appendices to this R.I.S.

Terrestrial fauna (non-flying mammals) - In the Kikori Basin, 60 species; nearly 50% of PNG's total nonflying mammal fauna, have been recorded. 50 % of those recorded species live in the Lake Kutubu watershed. Included are **Doria's Tree Kangaroo,** *Dendrolagus dorianus*), considered uncommon and vulnerable. Two New Guinea-endemic, rare species of mammal (**Three-striped Dasyure,** *Muexia longicaudata* and **Rock-dwelling Rat,** *Xenuromys barbatus*) were also found in the area *(Appendix - 2. Mammal (non-flying) checklist).*

Butterflies - Forests surrounding Lake Kubutu harbour more species of birdwing butterfly than any other known site in Papua New Guinea. All are listed on Appendix II of the Convention on International Trade in Endangered Species: Goliath birdwing, the world's second largest butterfly (*Ornithoptera goliath*); Paradise birdwing (*Ornithoptera paradisea*); Meridionalis birdwing (*Ornithoptera meridionalis*); and Priamus birdwing (*Ornithoptera priamus*). Foodplants often grow on well-drained soils on ridges above the lake.

Avifauna - 155 species have been recorded in the Kikori Basin, of which over 70% are known only from New Guinea. This includes two IUCN **"vulnerable"** species (**New**

Guinea Harpy-Eagle *Harpyopsis novaeguineae* and **Vulturine Parrot** *Psittrichas fulgidus*). The three IUCN **"near threatened"** species are **Dwarf cassowary** (*Casuarius bennetii*), **Palm Cockatoo** (*Probosciger aterrimus*), and **New Guinea Bronzewing** (*Henicophas albifrons*). One IUCN **"data deficient"** species (**Banded Yellow Robin** *Poeclodryas placens*) was also recorded. Brief surveys have yielded over 75 bird species recorded from the Lake Kutubu watershed, including 12 species of waterbirds (Jaensch, *manuscript*). *Appendix 3* contains a checklist of bird species recorded.

Fish fauna - Lake Kutubu is home to fourteen species of fish, including at least ten endemics (Jenkins & Buston, 1997). It is the most unique lacustrine habitat for fishes in PNG and Irian Jaya (Allen, 1995). There is no other lake with so many endemic fishes in the entire New Guinea-Australian region. A 1995 biological survey yielded these species from the lake: (endemic species in **bold**), Indian short finned Eel (*Anguilla bicolor*); Southern Tandan (*Neosilurus equinus*); **Kutubu Tandan** (*Oloplotosus torobo*); Mosquitofish (*Gambusia affinis*) (an introduced exotic species); **Lake Kutubu Rainbowfish** (*Melanotaenia lacustris*); Mountain Rainbowfish (*Melanotaenia monticola*); **Kutubu Hardyhead** (*Craterocephalus lacustris*); **Adamson's Grunter** (*Hephaestus adamsoni*); **Kutubu Goby** (*Glossogobius* sp. 12); **Bluntsnout Goby** (*Glossogobius* sp. 8); **Twinspot Goby** (Glossogobius sp. 6); **Black Mogurnda** (*Mogurnda furva*); **Lake Kutubu Mogurnda** (*Mogurnda kutubuensis*); **Blotched Mogurnda** (*Mogurnda spilota*); **Variegated Mogurnda** (*Mogurnda variegata*); **Striped Mogurnda** (*Mogurnda vitta*); and Frimbriate Gudgeon (*Oxyeleotris frimbriata*) *(Appendix - 5. Fishes Checklist)*

19. Social and cultural values:

Lake Kutubu was one of the most inaccessible areas in the country, with access only by light aircraft or on foot until recently. The development of oil and gas in the region has increased access with the development of road links and regular flights.

Southern Highlands Province was the last to be penetrated by the Australian administration. The first government patrol post was established at Wasemi Island, Lake Kutubu, in 1939. The Southern Highlands Provincial Government was established in 1978, and is responsible for providing social and other services to the area, although the Kutubu Joint Venture petroleum project is carrying out certain of these responsibilities.

Tourism, outdoor recreation, education and scientific research, agricultural production, grazing, water supply, fisheries production have not been developed. The wetland area is pristine and the potential for such developments is high. Petroleum production in the region has brought about many changes. The major change is from the traditional economy of subsistence agriculture and trade into the cash economy. This has resulted in increased agricultural and fisheries production. Current levels of education and scientific research are associated with the development of oil and gas in the region and the recent establishment of the area into a Integrated Conservation Development Project (ICDP).

Grazing, water supply and outdoor recreation have not been developed despite the enormous potential. Tourism is the industry most likely to be pursued by the community.

"Sites of traditional significance are mainly natural features associated with origin stories myths or particular cultural; practices and sites of known former occupation by a clan. Lake Kutubu is the locale for a number of traditional myths and is the most prominent site in this category" (NSR Environmental Consultants Pty Ltd, 1990, Kutubu Petroleum Development Project Environmental Plan). The lake is host to a number of archaeological sites, such as major and minor occupational sites, single find localities, traditional sites related to clan origins, and human burial sites (burial caves or ossuaries).

20. Land tenure/ownership of: (a) site (b) surrounding area

All land in the Lake Kutubu catchment is under customary ownership. Two major cultural or language groups exist in the area. The Foe, numbering about 2,500 people, live in some 12 villages on the shores of the lake. Fasu people are spread widely to the west and south west of Lake Kutubu and own the land in which the oil fields are located.

Clan societies are male-dominated and patrilineal. Each clan segment holds communal and individual ownership of areas of land, which are passed down from father to son. A person may acquire rights to other land through marriage or exchange. In the Foe area there are 45 main clans and a number of these have further divided into additional sub clans, making a total of 78 (M. Rule, 1993).

21. Current Land use: (a) site (b) surrounding

Land use practices have changed little since the first European contact some 60 years ago. The general area is one of the least densely populated areas of the country.

The villages around the lake are principally sago subsistence agriculturist, with sago providing 75% of their food volume (KPDP - EP, NSR, et al., 1990). There are extensive sago stands in the area. These are exploited mainly for sago starch, but also for collection of sago grubs for food and fronds for building purposes.

People divide their time between permanent villages and temporary hunting and fishing settlements. Subsistence gardens are developed near both the permanent villages and the hunting and fishing settlements. There is no shortage of gardening land, with fallow periods of 15 years or more being common.

Villages and gardens are located on the ridges or hill slopes surrounding the lake. All villages surrounded by land are in various stages of the garden cycle, including regrowth and dense primary forest. There were several attempts to introduce cash crops as cocoa and coffee but with little success because of transportation problems. Pasture potential does exist north-east of the lake, however this has not been developed.

The upgrading of Moro Airstrip and a new road into the area may increase environmental problems due to in-migration. Resettlement will result in catchment disturbance, thus reducing water quality (clarity) due to surface runoff, nutrient enrichment, waste disposal and physical damage to fringing vegetation.

Timber stands in the area around the lake have commercial logging potential; small-scale sawmilling already exists. Petroleum development in the area increases the potential of environmental damage, including development of the new Moran oil field, whose aquifers almost certainly drain into the lake. New townships have been built at Moro and Iagifu Ridge.

22. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects: (a) at the site (b) around the site

Population expansion in the area is a primary factor affecting the ecological character of the wetland area. Increased access by way of the Kutubu-Poroma road will have an adverse impact to the wetland area. Water quality will be affected as a result of construction work and also in-migration. In-migration, resulting from the development of the petroleum project in the area, will also have a profound impact on the ecological character of the wetland area. Factors such as increased land clearing for settlement and slash-and-burn agriculture will negatively impact the area.

As a result of the development project, camp sewage effluents disposal, abstraction of water from the lake for reservoir pressure maintenance or oil contamination from production facilities is eminent. Potential pipeline oil spillage (rapture or of accidental discharge) could affect the site.

In the absence of any intervention, itroduction of exotic species (e.g. common house rats, exotic fishes and cats) could become a major problem. The United Nations Development Program, in conjunction with the PNG Fisheries Authority, recently completed a project which introduced several new exotic fish species into Yonki reservoir in Eastern Highlands Province. A local person, after seeing those fish at Yonki, or other exotic fish in other locations, could easily assume those fish would improve the Kutubu subsistence fishery if introduced, and proceed to make an introduction.

Proposed expansion of the project will result in increased noise and air pollution from machinery, burning of excess gas and increased land usage.

23. Conservation measures taken:

Lake Kutubu and the immediate catchment area around the lake was gazetted as a Wildlife management Area (WMA), on the 25th of June 1992 (Gazette No. J52, June

1992). An approved management Plan for the WMA (Lake Kutubu WMA Administrative Arrangements and Community Action) was drawn but has not as yet been implemented. The overall catchment area is within the WWF Kikori Integrated Conservation-Development area of interest. The project WWF Kikori ICDP office lies only a few kilometres from the lake. Chevron's petroleum development activities are monitored by WWF in cooperation with Chevron, and this produces a form of conservation monitoring for the entire catchment.

24. Conservation measures proposed but not yet implemented

The area is proposed herein as an area to be included under the Ramsar Convention.

25. Current scientific research and facilities:

The Field Biodiversity Study conducted in 1995, covered such aspects as mammal (non-flying and flying), bird, fish, reptile, moth, aquatic heteroptera surveys and plant diversity surveys. Followup surveys have been carried out in some areas by the WWF ICDP environmental coordinator, with the assistance of various researchers.

The WWF Kikori ICDP has its offices about 15 km away from Lake Kutubu within the Chevron Niugini Moro camp, and has accommodated scientists at these facilities.

26. Current conservation education:

Since the establishment of World Wildlife Fund-USA's Kikori Basin integrated conservation-development program in 1994, there has been a series of conservation education activities, particularly related to subsistence fisheries, in the Lake Kutubu area. This has consisted of village visits, community workshops, and interactions with visiting scientists. Videos and slide shows have been incorporated into the community conservation awareness meetings.

In the next year, it is planned that the WWF Kikori ICDP will produce and distribute education pamphlets and posters on the Kutubu resource to local schools and institutions.

Due to the high conservation value of the wetland, the potential for conservation education is equally high. This is predicated on making the findings of investigative studies available in a comprehensive way to local teachers, along with teaching aids to assist them. There is a high level of interest from students in the schools to learn about their environment and what it has to offer educational, socially and economically.

27. Current recreation and tourism:

Presently the wetland area is not used for any tourism or recreational purposes. There is a high potential for tourism and recreational outings if the facilities are developed.

28. Jurisdiction:

The wetland area is under the jurisdiction of the sovereign state of Papua New Guinea. It is within the provincial boundary of the Southern Highlands Province and is within the jurisdiction of the Pimaga Local Level Government. The Authority with the functional powers for conservation is the Department of Environment and Conservation.

29. Management Authority:

The Kutubu Wildlife Management Committee is the management authority of the wetland as per Gazetted (Papuan New Guinea National Government Gazette No. 52, June 25, 1992). The committee, in consultation with members of the communities, established wildlife management rules for the Kutubu Wildlife Management Area, as well as penalties for infractions. They are the local enforcing and monitoring agent for the protected area.

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