KAMPUCHEA

INTRODUCTION

Area: 181,035 sq.km.
Population: 7,500,000.

Kampuchea is a small country situated almost entirely within the lower Mekong basin between latitudes 10°30' and 14°30'N and longitudes 102°20' and 107°30'E. It is almost completely surrounded by its neighbours Thailand, Laos and Vietnam, and possesses only a short coastline on the Gulf of Thailand in the southwest. Much of the central and southeastern part of the country is only a few metres above sea level and within the inundation zones of the lower Mekong River, Tonle Sap River and Great Lake, while much of the north comprises rolling and dissected plains between 100 and 200m in elevation. Only in the Cardamome range in the southwest and in the Annamite range on the Lao and Vietnamese borders in the extreme northeast do elevations exceed 1,500m.

Kampuchea possesses a wide range of habitat types, large areas of which are less disturbed than in more densely populated parts of Southeast Asia. However, the country has been settled for many thousands of years and it is unlikely that a great deal of primary vegetation remains. Recent estimates of forest cover vary between 24% and 40% of the total land area (MacKinnon & MacKinnon, 1986; Davis *et al*. 1986), compared to 73% in 1965 (Anon, 1968). Deciduous monsoon forest, including dry dipterocarp and semi-evergreen dipterocarp forest, comprises 40% of the total, mostly in the north, but this has been modified by burning in extensive areas. About 30% of cover is hill evergreen rain forest, mainly on the southern uplands and along the Annamite chain in the east (IUCN, in prep).

The climate throughout Kampuchea is dominated by the southwest and northeast monsoons. The wet southwest monsoon lasts from mid-May to early October, while the northeast monsoon dominates from early November to mid-March. Over most of the country, the average annual rainfall is between 1,200 and 1,875 mm, and there is a pronounced dry season from November to March. In the coastal zone and in the highlands of the southwest and extreme east, the rainfall is considerably higher, and the dry season shorter and poorly pronounced (December to February). Temperatures remain high throughout the year, the mean temperature of the coolest month exceeding 18°C.

The country's relatively small population is concentrated in the central rice-growing region, especially south of Tonle Sap and on the Battambang Plain. The population in the coastal zone is sparse, and in the northern and eastern savannas, population densities are less than 4 people per sq.km. The great majority of Kampucheans depend on agriculture and fisheries for their livelihood. During the dry season, the vast floodplains of the Mekong, Tonle Sap and Great Lake are extensively cultivated. Some 93% of the cultivated land is used for rice production which accounts for 40% of the gross domestic agricultural product. Elsewhere in the country, there is insufficient water for irrigation and rice production is very low. The Great Lake, Tonle Sap and Mekong River

support one of the most productive inland fisheries in the world, yielding an annual harvest of some 150,000-200,000 metric tons and providing some 40-60% of the animal protein intake of the people.

Kampuchea suffered prolonged periods of warfare in the 1970s during which agricultural output fell and extensive areas of forest were destroyed by bombing. From 1970 to 1975, a civil war was fought and the country slipped from a position of agricultural surplus to extensive famine conditions. In 1975, the victorious Khmer Rouge instituted a highly disciplined regime in which contacts with the outside world were severely curtailed, foreigners were expelled and towns and cities were forcibly evacuated. Until defeat in 1979 by the Vietnamese, the Khmer Rouge implemented a genocidal policy towards professional cadres, former officials and others. Consequently all forestry and conservation activities ceased. In 1982, some 30,000 Khmer Rouge militia occupied areas in the north of the country, and armed conflict continues to hamper development (IUCN, in prep).

In spite of the fact that much of the country is in military zones, steps have recently been taken to protect some of the country's unique and endangered wildlife. In 1986, Kampuchea signed international agreements with IUCN and her neighbours Laos and Vietnam to cooperate in wildlife conservation. As an initial step in such cooperation, two projects were identified: (a) the protection of endangered wetland birds in the Mekong Delta shared between
Kampuchea and Vietnam, e.g. Sarus Crane *Grus antigone,* Giant This *Thaumatibis gigantea* and White-shouldered This *Pseudibis davisoni;* and (b) the protection of Kouprey Bos *sauveli* (MacKinnon & MacKinnon, 1986).

Summary of Wetland Situation

About 90% of the surface area of Kampuchea lies within the lower Mekong drainage basin, and most central and southern areas comprise part of the floodplain system of this great river. The major wetland areas can be divided into two regions: the Mekong River and its floodplain, and the Great Lake and Tonle Sap floodplain. The Mekong River flows for 486 km in Kampuchea, from the border with Laos in the north to the border with Vietnam in the south. Its floodplain extends downstream from the region of Kompong Cham, 125 km northeast of Phnom Penh, to the southern delta in Vietnam, and is up to 60 km wide between Phnom Penh and the Vietnamese border. This vast plain is flooded to depths of 1.5-7.0 metres for between five and eight months of the year. The Great Lake is the largest lake in Southeast Asia. It lies in a vast shallow basin to the west of the Mekong, and is connected with the Mekong by the Tonle Sap River. During the dry season, the lake covers an area of some 250,000-300,000 ha. As the water level in the Mekong rises in June or July, the flow in the Tonle Sap is reversed and the Mekong floodwaters enter the Great Lake. At the height of the flood season in September and October, the lake and its inundation zone can cover as much as 1,300,000 ha. At this time, the floodplain of the Great Lake and Tonle Sap River extends for over 300 km from the northwestern corner of the country to the Mekong River at Phnom Penh.

Kampuchea possesses large tracts of freshwater swamp forest, principally in a broad belt around the Great Lake and at certain localities along the banks of the lower Mekong. Estimates in the 1970s put the total area of swamp forest at about 680,000 ha. Much of this forest has, however, since been cleared for firewood, agricultural land and fishponds, and a recent estimate suggests that only 564,000 ha remain. These freshwater swamp forests, which are dominated by *Hydrocarpus anthelmintica* and *Homalium brevidans,* provide spawning and nursery grounds for a large

proportion of the Mekong and Great Lake fishes, and are very important for a wide variety of waterfowl.

The country possesses only 435 km of coastline on the Gulf of Thailand and thus has rather few coastal wetlands. There is one large estuarine system with about 16,000 ha of mangrove forest near Kaoh Kong in the north, and some *Melaleuca* forest, particularly near Kampot in the south.

More than 850 species of fishes have been recorded from the lower Mekong River and Great Lake area. However, many are uncommon and little is known of several hundred species. About ten species form the bulk of the fish catches. In the past, the fishery resources have provided up to 70% of the protein requirement of Kampuchean people. However, the fishery industry has suffered drastically from the recent wars. Fishery production at the Great Lake has fallen from an estimated 110,000 tons at the end of the 1960s to an estimated 63,000 tons in 1984. Apart from the immediate problems caused by war in the area, a number of other factors could, in the long term, have a deleterious effect on the inland fisheries. Deforestation is causing a progressive siltation of the Great Lake, and interference with the flow of the Mekong by a series of barrages is likely to have a serious adverse effect on production from the floodplain fishery (FAO, 1980).

The wetlands of Kampuchea are known to support a wide variety of waterfowl. These include *Tachybaptus ruficollis,* three cormorants *(Phalacrocorax* spp*), Anhinga melanogaster,*
12 herons and egrets (Ardeidae), seven storks (Ciconiidae), four ibises and one spoonbill (Threskiornithidae), ten ducks (Anatidae), *Grus antigone,* at least seven rails, crakes and gallinules (Rallidae), *Heliopais personata,* two jacanas (Jacanidae), nine resident shorebirds and 23 migratory shorebirds, eight gulls and terns (Laridae), and *Rhynchops albicollis.* Several of these are endangered species, notably the Milky Stork, Greater Adjutant, White-shouldered Ibis, Giant Ibis, White-winged Wood-Duck *(Mycteria cinerea, Leptoptilos dubius, Pseudibis davisoni, Thaumatibis gigantea, Cairina scutulata)* and eastern race of the Sarus Crane *Grus antigone sharpii.* Unfortunately, no recent information is available on the status of these or any other waterfowl in Kampuchea. The Giant This appears to be extinct in neighbouring Thailand and Vietnam, and there have been no recent reports from southern Laos. If this species still exists at all, its stronghold is likely to be in the swamp forests of central Kampuchea. In recent years, some 400-500 *G. antigone sharpii* have been found wintering in the Mekong Delta in Vietnam, close to the Kampuchean border, and it is assumed that most if not all of these birds breed somewhere in the vast wetlands of central and southern Kampuchea.

Wetland Research

The lower Mekong basin has been well-studied through the UN-sponsored water and related resources development programme, the Mekong Project, launched in the late 1950s. A Committee for Coordination of Investigations of the Lower Mekong Basin (Mekong Committee) was established in 1957 by the four governments of the riparian countries, Kampuchea, Laos, Thailand and Vietnam, under the auspices of the Economic and Social Commission for Asia and the Pacific (ESCAP) of the United Nations. The goal of this Committee has been the comprehensive development of the water and related resources of the basin for hydro-electric power, irrigation, fisheries, flood control, drainage, navigation improvement, watershed management and water supply. The Committee's Secretariat, based in Bangkok, Thailand, has collected basic data relating to hydrology, climatology, hydrography, topography, pedology, geology, transportation and demography throughout the lower basin. In order to

provide a broad framework for the coordinated development of the lower Mekong basin to the year 2000, the Secretariat completed an Indicative Basin Plan in 1970, on the basis of data collected from field research and pre-investment investigations over a period of more than a decade (Mekong Committee, 1970; Pantulu, 1986a).

Prior to 1975, the Committee conducted a number of studies in Kampuchea, including hydrographic surveys along the Mekong mainstream and tributaries, socio-economic investigations, geological and mineral surveys, and studies of agricultural potential (Mekong Committee, 1978). Preliminary surveys of the fisheries in the Mekong, Tonle Sap and Great Lake, and detailed studies on the fish fauna of the Great Lake, were completed in the 1960s (Mekong Committee, 1976a). The Committee also conducted a general survey of the wildlife of the Mekong Basin which included recommendations for the establishment of a network of protected areas (McNeely, 1975). Most of the Committee's work, however, consisted of investigations on potential water control, hydro-electric and irrigation schemes.

Three major project proposals were developed in Kampuchea. Two of these, Stung Treng and Sambor, concerned hydro-electric dams on the Mekong mainstream, while the third concerned a barrage on the Tonle Sap to regulate the seasonal reversal in flow between the Great Lake and the Mekong. However, in 1975 Kampuchea's participation in the Committee was interrupted. All major projects were shelved, and no further studies have been carried out by the Mekong Committee in Kampuchea since then.

No research has been carried out on the water birds of Kampuchea, and indeed very little information has ever been available. Some work has been conducted on the larger terrestrial mammals, but very little seems to be known about the cetaceans, reptiles and amphibians. In 1979, the Government created a Directorate General of Fisheries under the Ministry of Commerce, with a Division of Statistics and Planning responsible for fisheries research, but so far the lack of qualified staff and facilities have made it impossible to carry out such work (FAO, 1980). Further research on the climate, hydrology and biological resources of the wetlands is urgently required if a sound programme for their rational utilization is to be developed.

Wetland Area Legislation

There is currently no protected areas legislation. During the French colonial period, a number of wildlife reserves were established and although these sites are still recognized by the current government, they are not properly mapped, demarcated, protected or managed. Royal Ordinance No. 24 of January 1940 regulated hunting and afforded protection to a number of species. Prakas No. 194 of 1960 prohibited the hunting of large wild animals, whilst in the same year a number of faunal reserves were established (IUCN, in prep). However, these regulations have lapsed with subsequent changes in government. According to Suran (1985), there are still 172 production forest reserves covering 3,875,000 ha and six forest reserves for wildlife protection covering 2,222,000 ha, along with one national park (Angkor Wat) of 10,717 ha.

Wetland Area Administration

Prior to 1975, wildlife protection was the responsibility of the Water. Forest and Hunting Service of the Ministry of Agriculture. Responsibility now lies with the new Forestry Department, which includes divisions of conservation, sylviculture, reafforestation and plantations, forest management, timber

technology and forest research (Suran, 1985). However, the number of professional staff in all fields, including forestry, was severely depleted during the 1975-1979 period, and a lack of professional staff continues to hamper forestry and conservation (MacKinnon & MacKinnon, 1986).

Organizations involved with Wetlands

- Forestry Department, Ministry of Agriculture

Responsible for wildlife protection.

- Directorate General of Fisheries, Ministry of Commerce

The Division of Statistics and Planning is responsible for fisheries research.

WETLANDS

Site descriptions based on information received from Dr Le Dien Duc and Mr Tran An Phong of the University of Hanoi, and the literature.

Wetland name: Mekong River
Country: Kampuchea
Coordinates: 13°55'N, 105°58'E to 10°55'N, 105°08'E;
Location: the Mekong River from the border with Laos in the north to the border with Vietnam in the south.
Area: 486 km of mainstream river; over 2,000,000 ha of floodplain wetlands including 1,600,000 ha of the Mekong Delta.
Altitude: c.65m in the north down to 3m in the south.
Biogeographical Province: 4.10.4.14.5.1.
Wetland type: 11, 13, 14, 15, 18, 19 & 21.
Description of site: The Mekong River is one of the great rivers of Asia, ranking twelfth in the list of longest rivers of the world. It rises at about 5,000m in the Tanghla Shan Mountains, on the northeast rim of the great Tibetan Plateau, and flows for 4,200 km through or along the borders of six countries: China, Burma, Laos, Thailand, Kampuchea and Vietnam. In terms of mean annual discharge, the Mekong ranks sixth in the world. The total drainage basin of 783,000 sq.km includes 160,000 sqkm in China, 12,000 sq.km in Burma, and 611,000 sq.km in Laos, Kampuchea, Thailand and Vietnam (the lower Mekong basin).
Approximately nine-tenths of Kampuchea (154,730 sq.km) lie within the lower Mekong basin. The river itself flows for 486 km across Kampuchean territory from the Lao border in the north to the Vietnamese border in the south. Leaving the southeast edge of the Korat Plateau in southern Laos and eastern Thailand, the Mekong plunges over the Khone Falls at the Laos-Kampuchea border and reaches the lowlands of northern Kampuchea after crossing a series of rapids. Below Kompong Cham, the river forms a fluviatile lowland landscape with high natural levees, broad floodplains and extensive backwater swamps, many of which remain flooded throughout the dry season. Beyond the backswamps are parallel belts of paddy fields. The mainstream habitats range from sandy-gravel bars to deep pools up to 100m deep and several kilometres long, interspersed with rocky rapids. In several places between the Lao border and Phnom Penh, the river divides into two or more channels, creating large islands and extensive sand banks. The Mekong receives the waters of its last major tributary, the Tonle Sap, at Phnom Penh. Immediately below this confluence, the Mekong divides to form the Mekong and the Bassac (Song Hau Giang), the two major channels of the delta. The triangular delta, with its apex at Phnom Penh, forms a vast fertile plain covering 49,520 sq.km. Some 16,000 sq.km of this delta are within Kampuchea.
The lower Mekong exhibits pronounced seasonal variations in flow, reflecting rainfall patterns. Water levels are lowest in April and May; at this time, many water bodies in the inundation zone are isolated, and the smaller tributaries tend to dry out. With the onset of the monsoon rains in late May, almost the entire region is transformed into a sheet of muddy water. Rivers, tributaries and numerous small ponds, oxbows and ditches are engulfed. The river starts to rise shortly after the onset of the monsoon, and attains its maximum level in September or October. It then falls rapidly until December and slowly thereafter to reach its lowest level in April. Extensive flooding takes place on both banks, but the by-pass flow on the western bank escapes towards the Great Lake (site 2). The main channel also

adds its flow to the waters of the Great Lake through the Tonle Sap River which reverses direction during the rising flood. The Great Lake thus acts as a natural flood retention basin, without which the delta would be flooded to even greater depths. Towards the end of the rainy season in September and October, some seven million ha of lowlands in the delta and around the Great Lake are covered with water at various depths of flooding.

Between Kompong Cham and Phnom Penh, the plains adjacent to the river are flooded to a depth of 1.0-1.5m for the four months from August to November. Further inland, the water level is higher (up to 3m) and the flooding persists for five, six or sometimes seven months of the year. In the Trans-Bassac area, there is a very large floodplain wetland between the Stung Takeo and Chau Doc rivers which is flooded to a depth of l.5-3.Om for five to eight months of the year. In the Cis-Bassac area, flooding occurs to a depth of 2.5-4.5m for five to seven months. Between the Mekong and the Tonle Tauch river to the east, flooding can reach a depth of 7m, while to the east of the Tonle Tauch, on the edge of the delta, only shallow flooding occurs (03-1.0m), for a period of one to three months.

The sediment loads in the Mekong are relatively low compared to other major Asian rivers such as the Ganges, Irrawaddy, Yellow and Yangtze. However, the organic content of the sediments is high, which explains the considerable secondary production in the Mekong (Pantulu, 1986a). River temperatures fluctuate between 25-30°C, while the pH varies between 6.2 and 6.5. The stagnant waters of ponds and rice fields generally have high temperatures (28-30°C at the surface and 26-28°C at the bottom) and are alkaline (pH 8.0-8.6). The Mekong's water is generally very soft, with low mineral content. With the onset of the floods, water temperature, turbidity and hardness increase, while pH decreases sharply (Pantulu, 1986b).

Climatic conditions: The Kampuchean portion of the Mekong lies within the tropical wet and dry zone, with a pronounced dry season during winter (at least one month with less than 60 mm of rainfall). The average annual rainfall ranges from 1,250 to 1,875 mm, with about 80% of the rain falling during the southwest monsoon in May-October. Both diurnal and annual temperature ranges are relatively high.

Principal vegetation: No information is available on the aquatic vegetation. There are large tracts of seasonally flooded freshwater swamp forest in some places along the river, but widespread deforestation has taken place due to the demand for agricultural land and firewood. The principal tree species in the swamp forest include *Barringtonia acutangula, Hydrocarpus anthelmintica, Terminalia chabula, Homalium brevidans* and *Amelia asiatica.*

Land tenure: No information.

Conservation measures taken: None.

Conservation measures proposed: None

Land use: Fishing and agriculture, mainly the cultivation of rice. Of the one million hectares under cultivation in the Kampuchean portion of the Mekong Delta, some 800,000-900,000 ha are utilized for rice production.

Possible changes in land use: The Mekong Committee has considered some 230 possible development projects on the lower Mekong River and its tributaries. Twelve large projects have been implemented, and 149 projects are currently considered as feasible. Feasibility or pre-feasibility studies have been carried out for 17 of these projects, including two in Kampuchea, and desk studies have been made for the remainder, including 35 in Kampuchea.

One of the largest of the possible mainstream water storage projects is the Stung Treng Dam project. This was also considered to be one of the most viable projects. The project involves the construction of a dam 77m in height across the Mekong below its confluence with the Tonle San and Tonle Kong rivers, some 40 km south of the Lao border. The dam would create a reservoir of 797,000 ha; it would

generate 3,600 MW of electricity, irrigate an area of about 1,287,000 ha (in both Kampuchea and Vietnam), and lower flood peaks at Kompong Cham by 1-2 meters. Some site investigations were carried out prior to 1975, but no full reconnaissance study was made, and the project has been shelved, at least temporarily. The construction of a second mainstream hydro-electric dam, capable of producing 875 MW of electricity, was proposed at Sambor, about 100 km downstream from Stung Treng. A feasibility report was completed in 1969, but this project has also been shelved (Mekong Committee, 1976b).

One of the primary objectives of Mekong River Basin development has been the elimination of seasonal flooding in the downstream delta areas of Kampuchea and Vietnam. Lands that are now seasonally inundated would be utilized for irrigated agriculture. Eliminating seasonal flooding will require the upstream storage of flood waters, primarily in the Pa Mong reservoir in Laos and the proposed Stung Treng reservoir in Kampuchea and secondarily behind the proposed Tonle Sap barrage, as well as the diking of river banks throughout the delta region and the diking of the perimeter of the Great Lake. Full implementation of these water management projects would decrease the annual Mekong flood discharge at Phnom Penh from 40,000 cubic meters per second to 23,000 cubic meters per second, lowering the high water level at this location by three meters, and would result in the loss of as much as 92% of the entire high-water surface area of the inundation zone. The possible impact of these projects on the basin's fisheries has been discussed in a report entitled Fisheries and Integrated Mekong River Basin Development (Mekong Committee, 1976a).

Disturbances and threats: Major developments on the Mekong which are likely to conflict with fisheries interests include various proposed irrigation projects, hydro-electric power projects, other industrial development and flood control projects. Dam construction and operation will change the hydrology of the river downstream, reducing seasonal flow peaks and minimizing access to floodplains for feeding and spawning. Changes in water quality and the timing of peak flows are likely to have adverse effects on fish migrations and spawning, and dams will create obvious problems for long distance longitudinal migrants. Impoundment will reduce sediment flow, particularly in the main channels, and thereby affect the nutrient regime downstream (Pantulu, 1986b).

The water quality in the lower Mekong has been affected by domestic wastes and agricultural runoff carrying pesticides and fertilizers. Though localized at present, such problems are expected to increase. Industrial activities, such as pulp and paper mills, textile mills and chemical factories, are increasing within the basin, and these, together with increased waste from shipping, are likely to create a serious pollution problem in the future (Pantulu, 1986a).

Economic and social values: The lower Mekong River supports one of the world's largest inland fisheries. The total fishery of the Mekong inundation zone from Kratie to the Vietnamese border (but excluding the Great Lake-Tonle Sap inundation zone) was estimated to be about 75,000-80,000 metric tonnes in the 1970s (Mekong Committee, 1976a). The annual flooding is of vital importance in maintaining this fishery for several reasons. The inundation zone provides the spawning and nursery grounds which supply the bulk of the young fish to repopulate most water bodies in the basin, including the main river and its tributaries, the many swamps and oxbows, and the paddy fields. The floods transfer millions of tons of suspended and dissolved solids into the water from highlands to lowlands and from the surface of land which has been lying fallow for several months. The flooding also releases nutrients from the soil, vegetation and inundated organic debris. Water enriched in this manner annually supports an explosive expansion of the riverine fish populations.

Fauna: The dry season fish fauna of the Mekong River is dominated by species of carp (Cyprinidae; 54%), catfish (Siluridae, Clariidae, Schilbeidae, Bagridae, Sisoridae and Akysidae; 19%) and murrels (Chanidae and Ophicephalidae; 8%). The remaining 19% consist of featherbacks (Notopteridae),

herring (Clupeidae), climbing perch and gouramis (Anabantidae) and other miscellaneous groups. Some 85-95% of the freshwater fish populations in the Mekong basin follow the inundation spawning pattern, undertaking lateral migrations from the mainstream and tributaries into the inundation zones to spawn and rear young between July and September (Pantulu, 1986b).
One of the most remarkable of the Mekong's endemic fishes is the Giant Catfish *Pangasianodon gigas.* This species, which can attain a length of over three meters and a weight of 250-300 kg, is a main channel migrant, reportedly migrating over a distance of several thousand kilometers from the region of Phnom Penh to spawning grounds in the province of Yunnan in China. It was once quite common in the lower stretches of the Mekong, with several thousand being caught each year below Khone FOR. However, over-exploitation of existing stocks and environmental changes consequent on development activities in the region have contributed to a serious decline in the population, and the species is now almost extinct below Pak Sane in northern Laos (Pantulu, 1986b).
Three species of dolphins have been recorded from the lower Mekong in Kampuchea: the Irrawaddy Dolphin *Orcaella brevirostris* (the only species known to occur upstream of Khone Falls), Chinese White Dolphin *Sotalia chinensis* (rare) and Black Finless Porpoise *Neophocaena phocanoides* (uncommon). Other wetland mammals known to occur include the Smooth-coated Otter *Lutra perspicillata* (quite rare) and Fishing Cat *Felis viverrina.*
Although the entire area is known to be very rich in water birds, no studies have been carried out in recent years and no details are available.
Special floral values: No information.
Research and facilities: The Mekong Committee carried out a number of investigations on the Mekong River and its fisheries between 1957 and 1975. The fisheries research was directed principally at assessment of the effects of water resource management projects on fisheries production.
References: FAO (1980); McNeely (1975); Mekong Committee (1970, 1976a, 1976b, 1978, 1981 & 1984); Pantulu (1975, 1986a & 1986b).
Criteria for inclusion: 123.
Source: Le Dien Duc, Tran An Phong and references.

Wetland name: Great Lake and Tonle Sap River
Country: Kampuchea.
Coordinates: 11°40'-13°30'N, 103°05'-105°05'E;
Location: in the lowlands of central Kampuchea from the region of Siem Reap in the northwest to Phnom Penh in the southeast.
Area: Great Lake 250,000-300,000 ha; total inundation zone c.1,500,000 ha.
Altitude: 7-15m.
Biogeographical Province: 4.10.4.
Wetland type: 11, 13, 14, 15, 17, 18, 19 & 21.
Description of site: The Great Lake is the largest permanent freshwater lake in Southeast Asia. The entire lake basin extends for some 250 km from northwest to southeast and is up to 100 km wide. At low water level, the lake is about 120 km long and up to 35 km wide. It covers an area of 250,000-300,000 ha and has a mean depth of less than one meter. The lake is surrounded by a broad belt of freshwater swamp forest, generally some 20-30 km wide, but extending for 65 km west from the west end of the lake. This forest contains numerous small rivers and streams, and innumerable lakes and ponds. The belt of swamp forest is in turn surrounded by a broad belt of rice paddies, up to 25 km wide, which borders on extensive forested areas. Silts and clays comprise much of the soils.

The Great Lake is connected to the Mekong River at Phnom Penh, some 120 km to the southeast, by the Tonle Sap River. In June or early July, shortly after the onset of the rainy season, the elevation and strength of the Mekong discharge begins to act as a dam on the Tonle Sap River. Initially, this causes the Tonle Sap to spread laterally, but subsequently its current reverses and carries the Mekong floodwaters into the basin of the Great Lake. To the south of the lake, there are many natural and man-made diversions which spread the floodwaters over a wide area. The Mekong reaches its highest levels in August and September, and by the end of September or early October, flooding in the Great Lake basin covers 1,100,000-1,300,000 ha, a large proportion of which is swamp forest. At this time, the lake has a mean depth of 8-10m. The water level falls rapidly between January and March, and the lowest levels occur in April and May.

Open water temperatures in the lake range from 28-29°C at the surface and 26-28°C at the bottom, while temperatures in the shaded waters of the inundated forest may exceed 29°C. The water of the Great Lake is always extremely turbid; this is attributed to shallowness coupled with wind-induced turbulence which constantly churns the bottom sediments. The pH of the lake fluctuates between 6.6-6.9, while that of the tributaries varies between 6.1-7.1 (Pantulu, l986b). Some of the smaller water bodies around the Great Lake contain humic acids which become highly concentrated during the dry season.

The Great Lake was at the heart of the ancient Khmer Empire. The holy Mount Mahendra (Phnom Koulen) lies to the north of the lake, and the famous ruins of Angkor City are located only 10 km from the northwest shore (13°18'N, 103°52'E). The ruins are situated in a region of fertile plains with a number of canals and reservoirs, up to 1,600 ha n extent, built during historic times.

Climatic conditions: The Great Lake lies within the tropical wet and dry zone. About 80% of the annual rainfall occurs during the southwest monsoon from May to October, and there is a pronounced dry season during winter with at least one month having less than 60 mm of rainfall. The average annual rainfall at Siem Reap, northwest of the lake, is 1,432 mm (maximum 2,056, minimum 466); the mean annual temperature is 26.7°C (maximum 40.3°C, minimum 9.5°C).

Principal vegetation: No information is available on the aquatic vegetation of the lake. The lake is surrounded by extensive seasonally flooded freshwater swamp forests dominated by *Hornalium brevidans, Hydrocarpus anthelmintica, Barringtonia acutangula, Terminalia chabula* and *Amelia asiatica. In 1960,* the total area of freshwater swamp forest in Kampuchea was estimated at 681,400 ha, most of this being around the Great Lake. Large areas have since been cleared for rice cultivation, and the total has recently been estimated at 564,000 ha.

Land tenure: No information.

Conservation measures taken: The ruins of Angkor City and the surrounding forests, including 2,000 ha of swamp forest, have been protected in the Angkor Wat National Park (10,717 ha) since 1925.

Conservation measures proposed: McNeely (1975) proposed the establishment of a large reserve along the southwest shore of the lake to protect a significant tract of freshwater swamp forest and its associated fauna. This reserve would extend from the Pursat River northeast along the south side of the lake to Mongkol Borey, and south to the polder dikes built to help irrigate parts of Pursat and Battambang districts.

Land use: Fishing and agriculture, mainly cultivation of rice. The fishery of this region is perhaps unparalleled in the world for its extreme intensity and for the ingenious variety of gear involved. Much of the fisheries exploitation results from the straining of fishes during the gradual recession of the floodwaters.

Possible changes in land use: One of the primary objectives of development in the Mekong River Basin has been the elimination of seasonal flooding in the downstream delta area of Kampuchea and Vietnam. Eliminating seasonal flooding would require the upstream storage of flood waters on the Mekong itself, the regulation of flow in the Tonle Sap River, the diking of river banks throughout the delta region, and the construction of dikes around the perimeter of the Great Lake. The Mekong Committee's Indicative Basin Plan includes a barrage project to regulate the inflow and outflow of water from the Great Lake via the Tonle Sap River, tentatively in the Stung Baribo area. Full implementation of upstream water management projects on the main Mekong River would lower the high water level at Phnom Penh by three meters. This would result in a decrease of about 300,000 ha in the maximum surface area of the lake. Full project implementation would also result in an increase in the lake's low water level, further reducing its flood storage capacity. The positive values of the Tonle Sap barrage would be related to providing water for irrigation during the dry season, and countering the effects of siltation in the lake. The possible impacts of these projects on the basin's fisheries have been discussed in a report entitled Fisheries and Integrated Mekong River Basin Development (Mekong Committee, 1976a). The authors of this report estimated that a loss of US dollar 12.4 million could be expected in the Great Lake fisheries if the various projects were instituted as planned.

The Central Water and Power Commission of India began an overall study of the Tonle Sap Barrage Project in 1961. Phase I, which dealt with the barrage design and cost estimates, was completed in 1964. Further studies were carried out in 1973-75, but the project was interrupted by the war in 1975, and no further progress has been made (Mekong Committee, 1976b).

Disturbances and threats: In recent decades, the accelerated clearance of freshwater swamp forest around the lake for agriculture, firewood and fishponds has increased siltation, threatening the existence of the lake. McNeely (1975) concluded that at the current rates of sedimentation, the lake would continue to diminish in size and might disappear in a relatively short time. Further loss of freshwater swamp forest could lead to serious reductions in fish populations, thereby reducing piscivorous wildlife and damaging a lucrative commercial fishing industry (Pantulu, 1986a). Full implementation of the water resources management projects advocated by the Mekong Committee could lead to a loss of as much as 92% of the high-water surface area of the inundation zone, and cause the near or eem1ete elimination of the seasonal inundation zone fishery (Mekong Committee, 1976a).

In recent years, there has been some contamination of the wetlands with toxic materials released in jute production.

Economic and social values: The Great Lake is the heart of Kampuchea. It serves as a vital, natural regulator of Mekong floods in the rainy season, thereby protecting delta areas in southern Kampuchea and Vietnam from even deeper flooding.

The lake supports one of the world's most productive freshwater fisheries, which provides a large proportion of the protein requirement of Kampuchean people. The great productivity has been brought about by the inflow of organic matter into the lake from vegetation on the floodplain. Most records indicate a commercial productivity in the lake of 40-50 kg/ha/yr, representing a total annual yield of 36,000 metric tonnes. The inundation zones of the Great Lake and Tonle Sap are of vital importance as spawning and nursery grounds for a wide range of fish species. By far the greatest production support for the entire lowland delta fishery derives from the aquatic production in this floodwater complex. The fishery of the inundation zone has, however, been steadily declining, ostensibly due to increased fishing pressure and accelerated siltation in the Great Lake (Mekong Committee, 1976a). Mean annual yields from the entire Great Lake-Tonle Sap inundation zone were estimated at 139,000 tonnes during

the period 1939-51 and 101,700 tonnes during the period 1956-61 (Pantulu, l986b). In the early 1970s, the total catch, including the subsistence take, for this zone was thought to be between 50,000 and 80,000 metric tonnes (Mekong Committee, l976a); in 1984, the total production was estimated at 63,000 tonnes.

The ruins of Angkor City, the capital of the Khmer empire from about 800 A.D. to 1432, are widely regarded as the finest ruins in Southeast Asia. The centre-piece is Angor Wat, a temple constructed in 1100-1150 A.D. and dedicated to Vishnu, a Hindu God. Prior to the warfare of the 1970s, Angkor Wat was the most popular tourist destination in the country, attracting 70,000 visitors in 1968. This tourism declined almost to zero during the war years, but a few tourists have been able to visit the site in the last two or three years.

Fauna: The lake, together with its surrounding seasonal swamp forests, is home to a large number of endemic fish species and provides a refuge for a w de variety of water birds.

Approximately 38 commercially important species of fishes have been recorded in the area. Because of the considerable annual variation in water volume of the system, most fishes exhibit migratory behaviour patterns, with major movements between spawning grounds in the inundated forests and dry season refuges in the major river channels. The Great Lake fishes are usually categorized as either "Poissons Blancs" or "Poissons Noirs", depending upon their migration patterns. "Poissons Blancs" annually migrate with the Mekong flood up the Tonle Sap to the lake; they include carp, clupeids, schilbeid catfish of the genus *Pangasius,* threadfins and drums. The "Poissons Noirs" are permanent residents in the lake, and include the murrels *Channa* spp*, Anabas testudineus,* catfish of the genera *Saccobranchus, Clarias,* the spiny eel *Mastacembelus* spp and the sand goby *Oxyeleotris marmoratus* (Pantulu, 1986b).

Although water birds are reported to be very common throughout the Great Lake basin, very little detailed information is available. Several breeding colonies of large water birds have been found in recent years, and several endangered species such as the Milky Stork, Giant Ibis, White-shouldered This and Eastern Sarus Crane *(Mycteria cinerea, Thaumatibis gigantea, Pseudibis davisoni* and *Grus antigone sharpii)* are believed to breed in the area. *Leptoptilos javanicus* was reported in the Siem Reap area in the 1960s (Luthin, 1984).

Mammals known to occur in the Angkor Wat National Park in the 1970s included Eld's Deer *Cervus eldi* and Banteng *Bos javanicus.*

Special floral values: No information.

Research and facilities: No research has been carried out since the onset of hostilities in the early 1970s, and most of the area remains closed to outsiders because of continuing threats from the Khmer Rouge militia.

References: FAO (1980); IUCN (in prep); Karpowicz (1985); Luthin (1984); McNeely (1975); Mekong Committee (1970, l976a, l976b, 1978, 1981 & 1984); Pantulu (1975, 1986a & l986b).

Criteria for inclusion: 123.

Source: Le Dien Duc, Tran An Phong and references.

Wetland name: Stung Sen

Country: Kampuchea.

Coordinates: 13°40'-14°20'N, 104°30'-lO5°1O'E;

Location: in northern Kampuchea near the Thai border, north and east of the town of Phum Kulen and 80- 150 km west of the Mekong River, Preah Vihear Province.

Area: Area of wetlands unknown; c.120 km of the Sen River in a region of c.300,000 ha.

Altitude: 35-80m.
Biogeographical Province: 4.10.4.
Wetland type: 11, 12, 13, 15, 18 and 21.
Description of site: The upper reaches of the Stung Sen and its tributaries on the northern plains of Kampuchea. There are large areas of seasonally flooded marshes and grassland along the river banks. Throughout this region, the original deciduous forests were cleared during the Angkor period and have been burned annually ever since. The resulting savanna grasslands with patches of mixed deciduous forest and dry dipterocarp forest provide excellent habitat for a variety of large mammals.
Climatic conditions: Tropical wet and dry climate, with an average annual rainfall of about 1,250 mm. There is a distinct dry season from December to May.
Principal vegetation: No information is available on' the aquatic vegetation. The principal vegetation throughout the region is dry dipterocarp forest and semi-evergreen rain forest with extensive tracts of man-made savannas. Most of the forest undergrowth is burned off annually, and with repeated burning, large areas have become savanna grassland, with only scattered trees and groves along water courses. Typical tree species include *Shorea obtusa, Dipterocarpus obtusifolius, D. tuberculatus* and *Pentarme siamensis.*
Land tenure: No information.
Conservation measures taken: None.
Conservation measures proposed: The site lies within the proposed Preah Vihear Reserve (1,467,000 ha); this comprises much of Preah Vihear Province north to the borders with Thailand and Laos, and extends east to the Mekong River. McNeely (1975) suggested that this area might be considered for designation as a Biosphere Reserve. In 1986, the Vietnamese Army agreed to issue orders that Kouprey are to be prohibited game for the army patrols.
Land use: No information. The region is sparsely populated.
Disturbances and threats: The area was little disturbed during the late 1960s and early 1970s, but since 1975, wildlife populations throughout the region have been exposed to well-armed bands of Khmer Rouge fighters, National Liberation Front fighters and the forces of the Vietnamese and Kampuchean armies, living and fighting in these forests and largely dependent on game meat for food (MacKinnon, l986b).
Economic and social values: No information.
Fauna: No recent information is available on the waterfowl. The Giant This *Thaumatibis gigantea* is known from the area (McNeely, 1975), and this and several other endangered species such as *Pseudibis davisoni* and *Cairina scutulata* may still occur. The endangered Siamese Crocodile *Crocodylus siamensis,* a species endemic to the Mekong Basin, is also thought to occur in the region.
As recently as the 1960s, the savanna grasslands supported a rich assortment of grazing animals, including herds of Kouprey, Banteng, Gaur, Eld's Deer, Asian Elephant and Wild Water Buffalo *(Bos sauveli, B. javanicus, B. gaurus, Cervus eldi, Elephas maximus* and *Bubalis bubalus)* along with attendant Tiger *Panthera tigris* and Leopard *P. pardus* (McNeely, 1975). Populations have been greatly reduced by hunting since then, and little is known of their current status. Some 1,000 Kouprey were thought to survive in Kampuchea in 1951, but these had been reduced by hunting to about 200 by 1964, since when the survivors have become dispersed and locally exterminated. A few animals are believed to linger on in Preah Vihear Province (MacKinnon, 1986b).
Special floral values: No information.
Research and facilities: The region has been closed to researchers for many years. The site lies within a security area where the Vietnamese army is still conducting sweeping actions to remove pockets of Khmer Rouge resistance.

References: IUCN (in prep); MacKinnon (1986a & l986b); MacKinnon & MacKinnon (1986); McNeely (1975); Pantulu (l986a).
Criteria for inclusion: 0.
Source: See references.

Wetland name: Stung Kaoh Pao and Stung Kep Estuaries
Country: Kampuchea.
Coordinates: 11°23'-11°40'N, 10256'-103°1O'E;
Location: on the Gulf of Thailand near the Thai border, south of Kaoh Kong, western Kampuchea.
Area: c.30,000 ha.
Altitude: Sea level.
Biogeographical Province: 4.5.1.
Wetland type: 02, 05, 06, 07, 06 & 11.
Description of site: A complex of tidal channels and creeks, low islands, mangrove swamps, tidal mudflats and coastal lagoons in the estuarine systems of the Kaoh Pao and Kep rivers. There are extensive intertidal mudflats at the head of Kaoh Kong Bay to the south. The rivers rise in the forested Cardamome Range to the east. Kaoh Kong Bay is protected from southwest storms by the large, hilly island of Kaoh Kong, which rises to 420m.
Climatic conditions: Tropical monsoonal climate, with heavy rainfall for most of the year and a short, semi-humid period from December to February. Temperatures are high throughout the year, and the annual range in temperature is exceeded by the diurnal range.
Principal vegetation: Mangrove forest (c.16,000 ha). Evergreen and deciduous forests cover the Cardamome Range to the east.
Land tenure: No information.
Conservation measures taken: None.
Land use: No information.
Disturbances and threats: No information.
Economic and social values: No information.
Fauna: No information.
Special floral values: The site contains the only significant stands of mangrove forest in Kampuchea.
Criteria for inclusion: 0.
Source: Operational Navigation Charts.

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