Information Sheet on Ramsar Wetlands

Categories approved by Recommendation 4.7 of the Conference of the Contracting Parties.

NOTE: It is important that you read the accompanying *Explanatory Note and Guidelines* document before completing this form.

1. Date this sheet was completed/updated:

July 1998

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DD MM YY

Designation date | Site Reference Number

2. Country: Malaysia

3. Name of wetland: Tasek Bera

4. Geographical coordinates: 03°02.50'N; 102°39.25'E

5. Altitude: 30 - 35m asl. **6. Area:** c.24,270 ha

7. Overview:

Tasek Bera is an alluvial riparian swamp system situated in the catchment of the River Pahang, which comprises swamp forest (90%), *Pandanus-Lepironia* swamp (9%) and open water (1%) with beds of submerged macrophytes. It is a monsoonal wetland system, subject to fluctuations in water levels of up to 5m, which occur in response to local rainfall patterns. The peat swamp forests of Tasek Bera are floristically and structurally unique while the mosaic of wetland habitats contain plant species of conservation interest, and together with adjacent rainforest support a rich diversity of animal life, including globally threatened and endemic species. Some 1250 indigenous Semelai people occur in and around the Ramsar Site, depending to a limited extent upon its resources, and tourism is being promoted as a major use of the site.

8. Wetland Type (please circle the applicable codes for wetland types as listed in Annex I of the *Explanatory Note and Guidelines* document.)

marine-coastal: A • B • C • D • E • F • G • H • I • J • K

inland: L • (M) • (N) • O • P • Q • R • Sp • Ss • (Tp) • (Ts)
U • Va • Vt • W • (Xf) • (Xp) • Y • Zg • Zk

man-made: 1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9

Please now rank these wetland types by listing them from the most to the least dominant: ***Xp, Xf, Ts, Tp, M, N***

9. Ramsar Criteria: (please circle the applicable criteria; see point 12, next page.)

(1a) • 1b • 1c • (1d) • (2a) • (2b) • (2c) • (2d) • 3a • 3b • 3c • (4a) • (4b)

Please specify the most significant criterion applicable to the site: _1d_____

10. Map of site included? Please tick *yes* ✓ -or- *no*
(Please refer to the *Explanatory Note and Guidelines* document for information regarding desirable map traits).

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12. Justification of the criteria selected under point 9, on previous page:

1a: Tasek Bera is a natural freshwater wetland system which is significant in regional terms for the size, variety and quality of wetland habitats represented. A mosaic of wetland habitats occurs, which individually are important as representative areas within the region, including permanent and seasonally flooded marshes and waterbodies, freshwater swamp forest and peat swamp forest. Overall, it has a high ecological diversity and supports a large number of plant and animal species, some which are endangered and/or endemic. Thus the area is of great importance as a gene pool besides being of interest from a scientific, recreational, educational and economic point of view.

1d: Tasek Bera is an example of an inland riverine wetland system which has undergone relatively recent topogenic peat swamp development due to blockage of the river channel. The peat swamp forest which has formed in this situation is quite unique in Peninsular Malaysia, and probably in South-east Asia. It is also one of the few major natural bodies of freshwater in Peninsular Malaysia and supports a biological community which is unique within Malaysia and possibly represented nowhere else in the world.

2a: Flora: 19 noteworthy plant species have been identified at Tasek Bera, of which 7 are wetland species including the aquatic aroid *Cryptocoryne purpurea* which may now be restricted to this site, and the rare sedge *Scirpus confervoides*. Fauna: endangered fish that have been recorded from Tasek Bera include the Asian Bonytongue *Scleropages formosus* and the Silver Shark *Balantocheiros melanopterus* (last recorded here in 1969). The rare crocodile *Tomistoma schlegelii* remains in small numbers and two vulnerable tortoise species occur. At least three endangered and eight vulnerable mammal species and five vulnerable bird species have been recorded.

2b: Tasek Bera represents a range of different wetland habitats including a unique peat swamp forest plant community and supports a high diversity of animal and plant life, including endemic and globally endangered species (refer to Criteria 1d, 2a and 2d).

2c: Mass migrations of fish are known to local residents at Tasek Bera, suggesting that the wetland may be significant in providing habitat for part of the life cycle of fish living in the River Pahang system.

2d: Flora: Ten plant species have recently been recorded from Tasek Bera that are endemic to Peninsular Malaysia (Giesen 1998). Fauna: the Dusky Leaf Monkey *Presbytis obscura* and Malayan Peacock-pheasant (*Polyplectron malacense*) are endemic to the Malay Peninsula. Endemism in other taxonomic groups requires clarification, although the majority of fish species at Tasek Bera are indigenous to Peninsular Malaysia (Furtado & Mori 1982).

4a: Tasek Bera supports a high diversity of fish species, 94 having been recorded (Mohd Zakaria 1997). The ecology of the fish fauna has been studied in detail, and the majority of species are indigenous to Peninsular Malaysia (see Furtado & Mori 1982).

4b: Refer to criterion 2c. The importance of Tasek Bera as a feeding, breeding and nursery area for fish has yet to be investigated in depth, although it clearly plays a major role.

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13. General location:

Tasek Bera lies within Bera District in the state of Pahang Darul Makmur, Peninsular Malaysia. The nearest town, Bahau (25 km and compass bearing 230°) is located in the neighbouring state, Negeri Sembilan.

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14. Physical features:

Geology and geomorphology:
Morley (1982) describes the origin and history of Tasek Bera, including its geological framework. The majority of sediments in the area consist of arenaceous and argillaceous rocks of Jurassic and Triassic age. These grade from a predominantly marine facies in the west to continental in the east. The western watershed consists mainly of shales mixed with minor bands of sandstones and conglomerates. The proportion of sandstones increases very gradually from west to east. The remaining upland areas are formed of igneous

rocks - granite and basic volcanics. Local alluvial deposits form gently undulating terraces along many of the drainage channels.

The bedrock has played a relatively small part in determining the form of the present landscape, owing to the very long period of erosion and weathering which the area has undergone. The courses of the main rivers and the effect of geologically recent fault movements in the area are much more significant.

The evolution of Tasek Bera has to be seen in a wide context as part of the main drainage system of the Malay Peninsula, where it lies on the primary watershed which divides eastward from westward flowing streams. A second watershed joins the main divide at Tasek Bera, so it occurs at the radiating centre of three major drainage systems. It is suggested that Tasek Bera lies on the ancestral course of Sungai Pahang, which originally flowed south and westwards to the Malacca Straits, before being captured by the Lower Pahang which flowed eastwards to the South China Sea. Crustal movements along a fault zone in the Tasek Bera vicinity may be responsible for changes in the direction of river flow.

Origins
Formerly a river lined with riparian vegetation, the swamps along the Bera River were formed after water stagnated, due to a combination of increasing height of the Pahang River levees, sedimentation along the Bera River, damming of the waters due to the expansion of *Pandanus* vegetation along the Bera, and especially due to tectonic tilting of the Bera sub-basin. Raised deposits followed by a lateral expansion of swamps into the tributary network has created the present dendritic mire system (Morley 1982).

The sequence of vegetation development has been determined from pollen analysis of sediment cores (Morley 1982; Phillips & Bustin 1997), and current trends are assessed by Giesen (1998). In summary, riparian vegetation was present along the Bera channel 4,500 years BP, then a sudden change to swamp vegetation dominated by *Pandanus helicopus* and *Elaeocarpus* is dated at 2,700 years BP. This is followed by gradual diminishing of *Elaeocarpus* (2,700 - 1,000 years BP), increase in Cyperaceae (eg *Lepironia*) and a decrease in *Pandanus* (660-300 years BP), the latter trend continuing to 150 years BP. The arrival of the indigenous Semelai in the area is probably responsible for changes in the vegetation such as the increase in *Lepironia* and *Pandanus* as swamp forest was burned or cleared. Continued burning is likely to result in degradation of swamp forests into *Pandanus-Lepironia* swamp, and further into *Lepironia* reedbeds. Similar processes affect adjacent forests on dry land, where shifting cultivation may degrade the current patchwork of primary and secondary forest into secondary scrub and lalang (*Imperata cylindrica*) grasslands.

Hydrology
The swamp is situated in a north-south longitudinal axis, and drains northwards through a single outlet, Sungai Bera, a tributary of Sungai Pahang. Tasek Bera is a dendritic complex occupying extensive sinuous tracts or arms of water, and wide areas of reed and forest swamp in between patches of raised ground. A large number of isolated steep low hills are found in the catchment, although the overall topographical relief is low and the river gradients are small. The difference in level is less than 5 m from the upstream part to the downstream part of the main channel - a distance of approximately 30 km. A dense network of streams and channels drains the area upstream of the swamp area. As they merge they form a complex system of connected shallow river arms merging into a main channel (Jacobsen 1997).

Although Tasek Bera drains into the Sungai Bera by the main channel, this outlet is narrow and unable to cope with the surface flow in the monsoonal seasons, especially the north-east monsoon (September to January), resulting in marked fluctuations in water level. The water level in the swamp is highly variable according to local rainfall, and rises between 1 and 5 m during the north-east monsoon. In extreme cases when the Sungai Bera and Sungai Pahang are flooded, a reverse flow of water into Tasek Bera may result, but it is a rare event which apparently has only been recorded once.

The littoral has an average depth of 0.8m, while the limnetic region of 2.0m with an average of 2.5 m in channels in the swamp forest and a maximum of 7.0 m in the main channels near the outlet. Data on discharge and streamflow are not currently available.

Soil type
The soils of Tasek Bera consist of a mosaic of peat and mineral soils, with peat dominating in the central region and along the central channel, and mineral soils dominating along the margins. Actually, if the

definition of peat (i.e. soil with <25 % mineral soil) is strictly applied, very little real peat occurs in the area, as most of the area's 'peat' soils are actually carbonaceous silts and muck with 30-72 % organic matter (Phillips & Bustin, 1997). These peat soils vary greatly in depth, averaging at 1-3 metres, with a maximum depth of seven metres, underlain by clay, silts and (finally) silty-sand, recorded by Furtado & Mori (1982). Because they have been formed in areas of impeded drainage (in an inland riverine depression), these organosols may be considered 'topographic peat', as opposed to the vast areas of 'ombrogenous peat' that have been formed in the coastal lowlands, inland of the mangrove zone. Although their formation began about 4,500 years BP, this process has not been constant, and the rate of deposition varies from about 1.2 mm/year between 4,500-660 years BP, to 6 mm/year from 660 years BP to the present (Phillips & Bustin, 1997).

Water Quality
The water quality of Tasek Bera was assessed in the early 1970s by Ikusima *et al*. (1982), and more recently by Tong *et al. (*1997) whose results from sampling in July and September 1997 are given here. Water temperature ranged from 26.5 to 33.0 deg C, compared with 23.2 to 26.6 in the earlier study. The pH was found to range from 5.6 to 6.5, compared to 4.6 to 6.8 during the earlier study. Dissolved oxygen content was generally more than 4-mg/l for most areas within the swamp, rising to 6mg/l at a few open sites with faster flow, and with a minimum value of 2.8mg/l. Lower levels were recorded previously, averaging 1.9 mg/l within a range of 0.8 to 4.4mg/l. Conductivity was generally low, ranging from 0.02 to 0.05 mS/cm, yet higher than the 0.01 to 0.02 mS/cm of the previous study. Total suspended solids were low at 2.88 to 11.35mg/l. Total Phosphorus ranged from 0.001 to 0.06 mg/l. Levels of organic constituents in the lake water (in terms of TOC) were quite low, ranging from 3.2 to 6.7 mg/l. Certain sections of the lake water recorded increased levels of Al and Fe during sampling in an extreme dry period, indicative of reducing conditions in the wetland due to the lack of dissolved oxygen. The levels of trace metals were in the range of those expected in natural water and also below the recommended Malaysian Water Quality Criteria for aquatic life. No detectable levels of pesticides were found. In comparison with the earlier study, Tong *et al* (1997) observed an increase in dissolved oxygen, pH, conductivity and water temperature, which is attributed to the development of the catchment and opening up of the swamp area leading to better aeration and exposure to sunlight of the water body, and higher input of dissolved electrolytes. Nitrate and phosphate levels were lower than the previous study, although potassium, calcium and magnesium were higher, possibly from fertilizer use in the catchment.

Catchment Area:
The catchment of 61,383 hectares was originally lowland forest, which has been replaced to a large extent by oil palm and rubber plantations. Lowland forest still covers most immediate surroundings of the wetland, and is largely located within the Ramsar Site. There are also a few patches of forest still remaining outside the Ramsar site, including the headwaters of Sungai Bera which lie within Chini Forest Reserve and Bukit Ibam Proposed Forest Reserve to the north-east of the site.

Downstream area
The lower reaches of Sungai Bera flow through low-lying country dominated by large oil palm and rubber estates and smallholdings. The village of Kampung Kuala Bera lies at the confluence of Sg Bera and Sg Pahang.

Climate
The climate of Peninsular Malaysia is humid tropical with two monsoon periods. At Tasek Bera the annual rainfall is 1200-2500 mm (Jacobsen 1997). The annual variation in rainfall is not regular but in general follows a bimodal pattern with a south-west monsoon in March - May and the more extensive north-east monsoon during September to January. The rainfall distribution is described as patchy and to a large extent determined by local conditions (Furtado & Mori 1982). Mean air temperature is 29.5°C (range 25.2 - 36.8°C).

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15. Hydrological values:

The major hydrological functions of Tasek Bera include flood control, sediment/toxicant retention (patches of swamp forest act as a buffer strip against run-off from surrounding agriculture schemes), nutrient retention and also water transport for the indigenous Semelai and recreational users of the site. The headwaters of Sungai Bera and Tasek Bera are also considered to be a water catchment area by the

water supply department. Water is pumped from Sungai Bera at two stations downstream of Tasek Bera for water supply to local settlements, with a 1997 capacity of 5.5 million gallons per day. Groundwater is not exploited beyond village wells at Pos Iskandar, where a small pocket of alluvial sand occurs. Geohydrological information is too limited to draw conclusions regarding the significance of groundwater at the site, although observed maintenance of river flow during dry periods implies that the site is not entirely surface water fed.

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16. Ecological features:

Tasek Bera is a relatively young swamp system which comprises a mosaic of habitats: rivers and streams, open water bodies, *Pandanus-Lepironia* swamp, peat swamp forest, freshwater swamp forest, and secondary swamp forest. Lowland forest and heavily disturbed forest surround the wetland. Dorall *et al.* (1998) estimates the total wetland area within the Ramsar site at 7100 hectares. These were grouped into three main habitat types : (1) the open water bodies with fringing *Pandanus* vegetation (1% of the swamp area); (2) the *Lepironia* reed and *Pandanus* stands forming part of the littoral region (9% of swamp area); and (3) the swamp forest stands which form the major part of the littoral region (90% of swamp area) . The species composition of these habitats is described in Giesen (1988), who also discusses their values, as given below.

The conservation value of the specific habitats, as observed from a botanical point of view, can be summarised as follows: rivers and streams are important because they provide a habitat for Malaysia's largest population of *Cryptocoryne*, which at the same time is perhaps the only population of this species world-wide; lakes and ponds are of interest, due to the occurrence of the uncommon sedge *Eleocharis atropurpurea*, and the occurrence of three species of bladderwort; *Pandanus-Lepironia* swamp is of interest because it provides a habitat for the rare sedge *Scirpus confervoides,* which occurs at only three sites in all of Asia; swamp forest is significant for conservation because it is the only large area of peat swamp forest on (inland) topogenous peat in Peninsular Malaysia; and lowland forest provides a habitat for at least six plant species endemic to Peninsular Malaysia, and six uncommon or rare species.

The swamp forests of Tasek Bera display some similarity with swamp forests elsewhere in Malaysia, but have little in common with the coastal peat swamps, both floristically and structurally. The process of peat formation also differs, as Tasek Bera's peat is topogenic in origin and Malaysia's coastal peat areas are largely ombrogenous. Because of this lack of similarity with other swamp forests, Tasek Bera can be considered unique.

Troublesome aquatic weeds such as *Eichhornia crassipes* (water hyacinth), *Pistia stratiotes* (water lettuce) and *Salvinia molesta* (Kariba weed) are absent, as is the noxious wetland shrub, *Mimosa pigra* (Giant Mimosa).

A major portion of the catchment area of Tasek Bera that was initially forested has been replaced to a large extent by oil palm and rubber plantations in the last 20 years. Shifting cultivation by the Semelai has had a profound effect on the remaining lowland forest surrounding the site, much of which was also logged over some time ago. The Semelai have also had a significant impact on aquatic habitats, with progressive clearance of swamp forest in favour of *Pandanus - Lepironia* swamp.

Food chain (summarised from Mizuno & Furtado (1982))
The Tasek Bera ecosystem is characterised by two distinct food chains, the producer and the decomposer food chains. In the producer food chain, the macrophytes of the *Eugenia* swamp forest, the emergents *Lepironia* and *Pandanus* species in the disturbed littoral, the submerged macrophytes such as *Utricularia, Cryptocoryne, Blyxa* and *Nitella* and algae. In the decomposer food chain, the organic detritus contributed by the *Eugenia* swamp forest and other macrophytes is the basis for decomposition. The importance of fungi and invertebrates in facilitating organic decomposition in comparison to bacteria, is due to the limitation of nitrogen and phosphorus for heterotrophic bacterial activity.
Secondary producers occur at three levels in Tasek Bera. Above water, defoliating insects such as the grashopper *Oxya* on *Lepironia*, and herbivorous vertebrates are presumably important. In the water, secondary production occurs in the grazing and detritus food chains. Attached animals (both herbivorous and detritivorous), detritivorous shrimps and benthic invertebrates, and herbivorous and detritivorous fishes are important in these pathways.

The tertiary producers comprise carnivorous invertebrates, fishes and other vertebrates, both above and

in the water. There is no information on the structure and production of these compartments, and on the transfer of materials and energy they effect between the water and the atmosphere of land. Furthermore, the impact of intense predation pressure on the rich speciation of freshwater fishes and aquatic insects is not known.

The litter returns substantial amounts of nutrients to the swamp. The importance of these nutrients to the trophic production and dynamics, particularly the limiting effects of phosphorus, is not known, Tasek Bera is thus a heterotrophic system with an extremely complex food chain that is poorly understood in terms of energy and nutrient flows, symbiotic linkages and speciation.

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17. Noteworthy flora:

A high diversity of 328 species, varieties and forms of algae have been described by Ratnasabapathy *et al.* (1982). However, recent surveys (e.g. Phang & Murugadas 1997) suggest that this diversity has declined. A recent survey by Giesen(1998) recorded a total of 374 plant species of which ten species are known to be endemic to Peninsular Malaysia (Table 1). Among the endemics, perhaps most interesting was the aquatic aroid *Cryptocoryne purpurea.* This species had previously occurred in one other locality in the country but now seems to be restricted only to Tasek Bera (Sim, 1998).

Table 1: Plant species recorded at Tasek Bera that are endemic to Peninsular Malaysia.

Family	Species
Amaryllidaceae	*Curculigo villosa*
Annonaceae	*Cyathocalyx pruniferus**
Araceae	*Cryptocoryne purpurea*
Burseraceae	*Canarium pseudosumatranum*
Dipterocarpaceae	*Vatica lobata*
Linaceae	*Ctenolophon parvifolius*
Rubiaceae	*Aleisanthia sylvatica*
	Gardenia pterocalyx
Sterculiaceae	*Scaphium longiflorum*
Verbenaceae	*Clerodendrum breviflorum*

* original distribution range included Singapore, but this species is unlikely to occur there now.

Table 2: Rare and uncommon plant species recorded at Tasek Bera

Family	Species
Annonaceae	*Polyalthia jenkensis*
Araceae	*Cryptocoryne purpurea*
Cyperaceae	*Eleocharis atropurpurea*
	Scirpus confervoides
Euphorbiaceae	*Agrostistachys gaudichaudii*
	Aporusa falcifera
Fagaceae	*Castanopsis rhamnifolia*
Leguminosae	*Ormosia bancana*
	Pithecellobium bubalinum
Myrtaceae	*Eugenia nemestrina*
Podocarpaceae	*Podocarpus wallichianus*

In addition to *C. purpurea,* Giesen (1998) noted ten other species which he considered rare and/or uncommon (Table 2). All of these are trees and shrubs, except for the sedge *Scirpus confervoides* which has an unusual distribution pattern, occurring in Africa, America, and at three known locations in Asia (Kern, 1974).

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18. Noteworthy fauna:

Fish

A total of 94 species of fishes occur in Tasek Bera (Zakaria-Ismail, 1997). The Endangered Asian Bonytongue (*Scleropages formosus*), a highly priced aquarium fish is still encountered within the swamp system although the numbers are dwindling due to over-exploitation for the aquarium trade. Another species of conservation interest is the Giant Catfish (*Wallago leerii)* which may grow to a length of 1.5m. This species is also well known among the locals for its mass migrations for spawning. The Endangered Silver Shark (*Balantiocheilos melanopterus)* was last recorded at Tasek Bera in 1969.
The attractive Harlequin Rasbora (*Rasbora heteromorpha),* another species heavily exploited for the aquarium trade is also abundant in Tasek Bera although generally rare throughout Peninsular Malaysia. Zakaria-Ismail (1997) indicates that habitat alteration is most likely to pose a threat to this species.

Amphibians

A total of 19 species of frogs from 9 genera and 5 families were recorded in a baseline survey at Tasek Bera (Lim 1998).

Reptiles

A rare species of freshwater crocodile, the Malayan False Gharial (*Tomistoma schlegelii)*, a species listed as 'Data Deficient' in the IUCN Red Data List (IUCN, 1996) has been reported to occur in Tasek Bera. Excessive commercial hunting in a three year period (1958 - 1960) is believed to be the main reason for its decline (Simpson *et al.* 1997) although it is still occasionally reported by locals.

Thirteen species of turtles have been recorded at Tasek Bera among which the Asian Giant Tortoise (*Manouria emys*) and Spiny turtle (*Heosemys spinosa)* are categorised as 'Vulnerable' (IUCN 1996). The Malaysian Giant Turtle (*Orlita borneensis*) is listed as "Data Deficient".

A total of 15 species of lizards and 17 species of snakes have been recorded at Tasek Bera (Lim 1998). The reticulated python (*Python reticulatus*) is of conservation concern locally as it is collected in large numbers by the local people for the skin trade.

Mammals

Recent surveys by experts from local universities have contributed significantly to the Tasek Bera mammal list. Of the 68 species of mammals recorded at Tasek Bera (Lopez 1998), the following endangered species have been reported: Asian Elephant (*Elephas maximus*), Otter Civet (*Cynogale bennettii*), and Tiger (*Panthera tigris*). Vulnerable species recorded so far are: Malayan Tapir (*Tapirus indicus),* Pig-tailed Macaque (*Macaca nemestrina*), Clouded Leopard (*Neofelis nebulosa*), Flat-headed Cat (*Prionailurus planiceps),* Smooth-coated Otter (*Lutra perspicillata)* and Hairy-nosed Otter *(Lutra sumatrana);* Gaur (*Bos frontalis*) was recorded in the early 1970s, but not seen recently. Likewise, Dhole (*Cuon alpinus*) has not been seen for some years by local residents. The near-threatened Oriental Small-clawed Otter (*Aonyx cinerea*) occurs at Tasek Bera, while Leopard *(Panthera pardus*) has been recently recorded. The Dusky Leaf Monkey *(Presbytis obscura*) is the only mammal endemic to the Malay Peninsula that has been recorded at Tasek Bera to date. (Conservation status for above species given according to IUCN, 1996)

Birds

Recent baseline surveys (Chong & Lim (1998) and Department of Wildlife and National Parks (1998)) have contributed significantly to the Tasek Bera bird species list, which currently stands 221 species (Lopez, 1998). The scarcity of waterbirds at this site remains an inexplicable phenomenon, although some unconfirmed reports indicate that they were once hunted in large numbers. Other possible explanations include the presence of large predatory fish in the lake.

Vulnerable bird species recorded so far are Lesser Adjutant (*Leptoptilos javanicus*), Crested Fireback (*Lophura ignita*), Crestless *Fireback (Lophura erythrophthalma*), Wrinkled Hornbill (*Aceros corrugatos*), and the Malayan Peacock-pheasant (*Polyplectron malacense)*, a species endemic to the Malay Peninsula, which is frequently trapped and consumed by local people at Tasek Bera.

Near-threatened species include: Black Hornbill (*Anthracoceros malayanus),* Helmeted Hornbill (*Rhinoplax vigil),* Grey-headed Fish-eagle *(Ichthyophaga ichthyaetus)*, Large Green Pigeon *(Treron capellei),* Grey-breasted Babbler *(Malacopteron albogulare),* White-chested Babbler *(Trichastoma rostratum),* and Black Magpie *(Platysmurus leucopterus).*

Invertebrates
Results of a baseline survey on aquatic invertebrates under the DANCED project are awaited. Furtado and Mori (1982) provides a detailed account of the aquatic invertebrate fauna of Tasek Bera. They reported a low abundance of zooplankton (i.e. 64 taxa recorded), attributable to low pH. An abundance of aquatic insects and benthic invertebrates was reported, although Lim and Furtado (1982) indicate that the scarcity of animals with shells in Tasek Bera is mainly due to the low calcium content. Only one species of mollusc, *Pila ampullacea and* two shrimp species, *Macrobrachium trompi* and *Caridina thambipillai* are reported to occur. A freshwater crab (*Potamon johorense*) has been recorded (Mizuno, 1982). *P.ampullacea* is still encountered in the swamp and this species is consumed by the local people in Tasek Bera.

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19. Social and cultural values:

Tourism currently occurs on a small scale as access, facilities and promotion are still being developed. A nature-based tourism development plan is in preparation which will guide future development. There is currently one resort operating at the site. Tourism has the potential to be compatible with conservation management if effectively controlled.

The area has a history of research into freshwater ecology (Furtado & Mori, 1982) and anthropology (Hood Salleh 1978). These interests have been maintained over recent years and there has been increased research activity during the last two years as a result of an integrated management project at the site (see section 24). The project aims to sustain research and educational activity at the site in future by providing field study centre facilities. Environmental education camps have been held in the last year under the same project, and local schools are being encouraged to make use of the site.

Tasek Bera has been inhabited for over 600 years by indigenous peoples, and currently has a population of around 1,250 Semelai (i.e. indigenous ethnic group). The Semelai have a strong cultural attachment to Tasek Bera and still depend on its natural resources to an extent, although there is trend of increasing outside employment away from the community. See Mohd Shahwahid (1996, 1997) for further details.

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20. Land tenure/ownership:

The Ramsar site is owned entirely by the Pahang State Government. The buffer zone is also government owned land, consisting of oil palm and rubber estates managed by FELDA Plantations Sdn. Bhd., Forest Reserves managed by the Forestry Department, and aboriginal people's (Orang Asli) Reserves managed by the Orang Asli Affairs Department. Land in the Orang Asli Reserves which has been planted with rubber is currently being allocated to individual households in small parcels.

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21. Current land use:

A. Land uses within the Ramsar Site are described below. Mohd Shahwahid (1997) provides information on exploitation of natural resources by the Semelai, including an assessment of shifting cultivation.

Agriculture
Most of the agricultural activities are concentrated around the vicinity of the 'Orang Asli Reserves' and resettlement area (which actually form part of the buffer zone, although they lie in the centre of the site). The majority of these areas have been recently planted with rubber. There is some encroachment of lowland forest in the Ramsar Site itself for shifting cultivation purposes (hill rice, maize, and other crops).

Fisheries
The fishes of the area are of great importance to the indigenous people in 2 ways:

a. Protein source and sale of food fish species ;
b. Income from trade in aquarium fish: approx. 50 species of aquarium fish occur of which at least 20 are considered special, and two are intensively exploited.

Collection of forest and wildlife resources:

The collection of various forest products and hunting of wildlife continue to be of economic importance and subsistence to the indigenous community. These include collection of rattan (6 species), resin, bamboo, fibres (from 6 plant species), wild fruits (6 species), timber (10 species), mammals (6 species), birds (5 species), reptiles (9 species) and amphibians (1 species).

B. The buffer zone and catchment area

The buffer zone of the site (27,500 hectares - a large part of the catchment) consists of mainly government owned plantation schemes (oil palm and rubber) although there are still a few scattered patches of forest. There is a new trend of grazing cattle in oil palm plantations, which occurs in some estates in the area**.**

Chini Forest Reserve to the north-east of the site is managed for forestry purposes, as will be the proposed Ibam Forest Reserve adjacent to this. Bera Forest Reserve is in the process of degazettement prior to gazettement of the Ramsar Site. There are also scattered settlements of indigenous people in the area, who practice shifting cultivation.

The buffer zone has been identified in the Bera District Structure Plan for land uses involving environmental protection (e.g. water catchment area) and restricted development (mainly agricultural estates).

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

The main pressures identified so far (Prentice 1997) are as follows:

- Clearance of lowland forest within the Ramsar Site and its buffer zone for shifting cultivation and in some cases rubber. This is currently ongoing, with about 70ha being cultivated in 1997 in the area. This poses a serious threat to the remaining lowland forest unless it is contained. It also presents a risk of uncontrolled fires which could destroy large tracts of forest, including swamp forest
- Use of fire by the Semelai for hunting turtles and keeping navigation channels clear. This practice had already resulted in the conversion of 32% of the former swamp forest area to open water and *Pandanus - Lepironia* swamp by the early 1970s (Furtado & Mori, 1982). This process is still ongoing and threatens the remaining swamp forests.
- Localised cutting of trees, reported as a problem in one particular locality (Jelawat), and poles are taken from a number of areas by people living in the vicinity of Tasek Bera.
- Localised collection of bamboo.
- Intensive exploitation of fish including fish poisoning activities. Fish poisoning by outsiders is a serious problem on Sungai Bera which occurs regularly and appears to be damaging fish stocks. Use of nets across Sungai Bera also poses a threat to fish populations and other aquatic vertebrates unless controlled and catches are monitored.
- Harvesting of the protected and endangered Asian Bonytongue (*Scleropages formosus*) as well as other unprotected species for the aquarium fish trade. Collection and trade is currently unregulated and is unlikely to be sustainable.
- Commercial trading in wildlife, including pigs, deer, snakes and turtles. Limited control and no monitoring of exploitation levels at present, so sustainability is in doubt.
- Hunting of wildlife in the forest around Tasek Bera. No additional protection or enforcement possible until site is legally gazetted.
- Potential disturbance from visitors in future, if not controlled. Current levels of use are relatively low, but this will certainly increase as tourism is developed.
- Water quality and hydrological impacts from surrounding plantations. Inadequate monitoring data available at present to quantify these impacts, but monitoring and mitigation measures such as riparian buffer zones along channels in agricultural plantations will be essential for the long term security of Tasek Bera.

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23. Conservation measures taken:

Tasek Bera was nominated as Malaysia's first Ramsar Site in 1994. Since that time, no development has been permitted within the Ramsar Site area except for the establishment of tourism facilities. The Ramsar Site has been included in the Bera District Structure Plan as an area for conservation and tourism

purposes only, and its buffer zone identified for environmental protection and restricted development. The State Government has currently frozen all applications for development projects within the Ramsar Site and in its buffer zone pending the completion of a site management plan.

The Ramsar Site is in the process of being gazetted as a protected area under national legislation. Part of the Ramsar Site currently lies within Bera Forest Reserve, which will be degazetted in order to permit gazettement of the Ramsar Site.

In 1995, the Government of Malaysia signed a project agreement with Denmark for a three year project to support Malaysia in meeting its obligations under the Ramsar Convention through establishing the integrated management of Tasek Bera. This project commenced in June 1996, with the aim of conserving the biodiversity of Tasek Bera and its catchment area. Wetlands International - Asia Pacific is providing technical assistance to the Pahang State Government in implementing the project. See section 24 for further details.

At present, the area receives routine monitoring and enforcement attention from fisheries, forestry and wildlife department personnel, and channel clearance is contracted out annually by the Drainage and Irrigation Department to local people. Orang Asli Affairs Department staff administer the Orang Asli reserves and resettlement area.

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24. Conservation measures proposed but not yet implemented:

The project “Integrated Management of Tasek Bera” is currently in progress. This has been made possible through funds from DANCED (Danish Co-operation for Environment and Development).

The goal of the project is ***to conserve and enhance the biodiversity of Tasek Bera Ramsar Site and its buffer zone, and ensure the wise use of its wetland resources.*** This will be accomplished through a wide range of cooperative activities over the three years of the project, which will prepare the basis for subsequent long term management of the Ramsar Site as determined by the Pahang State Government.

The objectives of the project are as follows:

1. To demarcate and gazette the boundaries of Tasek Bera Ramsar Site, and formalise protection of its buffer zone.
2. To establish the legal, administrative and institutional basis, and trained staff resources for the management of Tasek Bera;
3. To establish a sound scientific and organisational basis for the sustainable management of Tasek Bera and the biodiversity it supports through the development of a site management plan;
4. To ensure full and formalised integration of local communities, especially the Semelai, into management, wardening and tourism services, etc.; to establish sustainable natural resource use projects involving the Semelai in particular; and to promote the equitable sharing of benefits from development activities at Tasek Bera.
5. To develop a master plan for nature-based tourism development at Tasek Bera;
6. To foster local and wider support for the conservation and wise use of Tasek Bera by providing education and raising awareness of the nature, values and functions of Tasek Bera and wetlands in general;
7. To establish a field study centre and applied research programme to encourage wetland-related educational and research activities at Tasek Bera;
8. To transfer the experience gained during the project to assist the implementation of obligations under the Ramsar Convention at other wetland sites.

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25. Current scientific research and facilities:

The project mentioned above aims to establish a field study centre and applied research programme to encourage wetland-related educational and research activities at Tasek Bera. The project is currently designing infrastructure to cater for this.

The most detailed ecological study of Tasek Bera was conducted in the early 1970’s under the auspices of the International Biological Programme as a collaborative effort by Malaysian and Japanese scientists

(Furtado & Mori, 1982). This provides valuable baseline ecological information on Tasek Bera, before major land clearances took place in the catchment. Sporadic visits by other researchers took place after this project, including Merton (1962). An EIA on power transmission lines (IPT-AWB, 1991) included ecological studies of Tasek Bera, and an overview of site management issues was later compiled by IPT Asian Wetland Bureau (1993). The fish population of Tasek Bera was investigated as part of a Pahang River Basin study in 1992-3 (Khan *et al*., 1996).

Significant anthropological research on the Semelai people was conducted by Hood Salleh (1978) and Gianno (1990) while economic studies of the utilisation of wetland and forest products were carried out at Tasek Bera by Mohd Shahwahid and Nik Mustaffa (1991).

In 1997-8, a number of baseline surveys were conducted under the DANCED project on fauna, flora, water quality, hydrology and socio-economics (see references for details). In addition, the project has supported or collaborated with postgraduate research at Tasek Bera including a PhD study at University of British Columbia on the development of organic sediments and their potential for coal formation; a study on small mammals by University Kebangsaan Malaysia has just been completed; another study at University Malaya is looking into phytoplankton and their possible utilisation as biological indicators; and an assessment of the potential of ecotourism at Tasek Bera by students at Roskilde University.

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26. Current conservation education:

On-site conservation education has been limited due to the lack of facilities and infrastructure. However, an education programme is in progress under the DANCED project which is developing a 'Teachers Kit' on wetland education for primary schools, organising nature-based education activities, training teachers in environmental education, and setting up nature clubs in local schools. The site has considerable potential for education, as there are few sites in Malaysia with good facilities or adequate baseline information for interpretation.

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27. Current recreation and tourism:

Recreation and tourism activities are on a very low scale with a higher number of visitors coming in at weekends and public holidays. No statistics are available on annual visitor numbers, but at present few visitors are not Malaysian nationals, and most are of local origin (ie from Pahang State). This will change as the site is promoted.

A resort opened at Tasek Bera in May 1998, which has 2 dormitory units, 2 bungalows and 4 hotel rooms. The accommodation facilities are currently able to cater for a total of 50 people. Recreational activities presently offered by the resort include jungle trekking, camping, canoeing, fishing and visits to the Semelai (indigenous ethnic group) villages. The resort also offers conference facilities for a total of 30 people. An area of the forest close to the lake has been used as a camp-site by various groups.

A local Semelai resident has been operating boats for a number of years on a low scale (i.e. 7 boats).

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28. Jurisdiction:

a. Territorial jurisdiction

The Bera District Office (Pahang State Government) currently has jurisdiction over the Ramsar Site and its buffer zone.

b. Functional Jurisdiction for conservation purposes

Various sectoral agencies have normal management, monitoring and enforcement duties relating to Tasek Bera , including Department of Environment, Department of Irrigation and Drainage, Department of Fisheries, Department of Wildlife and National Parks, Department of Forestry and Department of Orang Asli Affairs. The institutional capacity to carry out carry out activities at Tasek Bera varies between agencies and is limited.

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29. Management authority:

At present, there is no overall site management authority for Tasek Bera, as the area is not yet gazetted under national law. Options for site management are currently being evaluated under the DANCED project. The Bera District Office currently has responsibility for control of the area.

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Bera District Office
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Pahang Darul Makmur
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