

BRUNEI DARUSSALAM

INTRODUCTION

Area: 5,765 sq.km.

Population: Approximately 200,000 (1980).

Brunei Darussalam is a small country on the northwest coast of Borneo, between latitudes 4°00'N and 5°05'N and longitudes 114°04'E and 115°22'E. The state is divided into two components by Limbang District of the Malaysian State of Sarawak. To the east lies Lawas District of Sarawak, and to the southwest, Miri District of Sarawak. The entire coastline is approximately 130 km in length, and consists of a high-profile sand beach, aligned in a southwest direction on the coast of the South China Sea, and a complex estuarine, mangrove and mudflat zone within Brunei Bay in the northeast.

Brunei Darussalam has an estimated population of 200,000, the majority of whom are concentrated in the capital, Bandar Seri Begawan, and in the oil-refining area of Seria in the west. The remainder of the country is very sparsely populated and largely undisturbed; it consists of mangrove swamps, peat and freshwater swamp forests, and lowland, sub-montane and montane rain forest.

Because of its oil-based economy, the country is wealthy and the majority of people enjoy a relatively high standard of living for Southeast Asia. The population is well educated, and the Government has a far-sighted policy concerning conservation of nature and natural resources. As a consequence, little of the natural habitat has been exploited or converted to other land-uses. Traditional rural activities such as fishing remain important to the local economy, but these are almost entirely confined to the region of Brunei Bay and a narrow strip along the coast.

The humid tropical climate is influenced by two monsoonal regimes; the northeast monsoon predominates from mid December to mid March, and the southwest monsoon, from mid May to the end of October. The average annual rainfall varies from a minimum of about 2,500 mm on the northeast coast to a maximum of over 4,300 mm in the highlands in the extreme south and east. Temperatures are lowest during the northeast monsoon (maximum 29-30°C), and reach their highest in the transition period before the onset of the southwest monsoon in May (average maximum 33-35°C).

Summary of Wetland Situation

Much the most important coastal wetlands in Brunei Darussalam are on the shores of Brunei Bay. This large shallow bay of about 2,500 sq.km is bounded to the north by the Malaysian Federal Territory of Labuan, to the northeast, east and south by the Malaysian States of Sabah and Sarawak, and to the southwest

mostly by Brunei Darussalam. The Brunei portion is a shallow estuarine complex of mangrove swamps, mudflats and tidal channels, fed by several large rivers.

In the interior of the country, the principal wetlands are the vast peat swamp forests in the basin of the Sungai Belait in the west, and the extensive freshwater lakes, marshes and swamp forests of Tasek Merimbun and Medit on the middle reaches of the Sungai Tutong. Both areas remain in almost pristine condition, and provide excellent examples of habitat types which are rapidly disappearing elsewhere in Borneo.

Wetland Research

A considerable amount of research has been conducted on the mangrove forests, shrimp and fishery resources and avifauna of Brunei Bay, but little work has been carried out in the peat swamp forests and freshwater swamp forests of the interior. The Department of Town and Country Planning has recently been responsible for the preparation of a National Master Plan which has included a Wildlife Conservation and Management Report. This report, completed in 1986, includes a wetlands inventory describing the country's three most important wetland areas (Brunei Bay, Belait Peat Swamp Forest and Tasek Merimbun/Medit). The Natural History Department of Brunei Museum is actively involved in nature conservation, and has carried out a number of surveys including a study of Brunei Bay in collaboration with the Asian Wetland Bureau.

Wetland Area Legislation

There is as yet no national park or conservation area legislation in the country, although few of the areas which have been identified as important for nature conservation are under immediate threat. It is expected, however, that suitable legislation will be considered in the near future. Meanwhile, Brunei Darussalam does enjoy the Wildlife Protection Enactment of 1978. This allows for the establishment, by decree, of wildlife sanctuaries, and lists some 34 protected species including the Proboscis Monkey *Nasalis larvatus*, Clouded Leopard *Neofelis nebulosa*, Dugong *Dugong dugon*, various hornbills (Bucerotidae) and sea-turtles.

Wetland Area Administration

Protected areas are administered by the Conservator of Forests.

Organizations Involved with Wetlands

a) Governmental Organizations

- Ministry of Development
- Commission of Town and Country Planning

The Commissioner, Dato Haji Ibrahim Bin Haji Mat Yassin, is also Chairman of the ASEAN Experts Group on the Environment and Chairman of the Master Plan Committee.

- Forestry Department
- Department of Fisheries
- Department of Agriculture
- Department of Public Works

The Department conducts water quality surveys.

- Brunei Museum, Ministry of Culture, Youth and Sports

The Department of Natural History is actively involved in wildlife research and nature conservation.

b) Non-governmental Organizations

- Brunei Nature Society

Based in Bandar Seri Begawan.

- Panaga Natural History Society

An active group of bird-watchers based in Kuala Belait, particularly interested in shorebirds.

c) Universities

- University of Brunei Darussalam

The university has conducted some studies in mangrove swamps.

WETLANDS

Site descriptions compiled by Mohammad Jaya bin Haji Sahat of the Brunei Museum, Euan G. Ross of the Commission of Town and Country Planning and John R. Howes of the Asian Wetland Bureau.

Wetland name: Brunei Bay

Country: Brunei Darussalam

Coordinates: 4°45'-5°02'N, 114°5'-115°10'E;

Location: east of Bandar Seri Begawan. The Brunei portion of the bay is in two sections separated by a finger of Sarawak (Limbang) about 6 km wide at the coast.

Area: c.50,000 ha in Brunei territory; entire bay c.250,000 ha.

Altitude: Sea level.

Biogeographical province: 4.25.12.

Wetland type: 01, 02, 06, 07 & 21.

Description of site: Brunei Bay is a deeply indented bay with an area of about 250,000 ha, shared between Brunei Darussalam and the East Malaysian States of Sarawak and Sabah. A chain of islands including the large Malaysian island of Labuan forms the boundary between the bay and the South China Sea. Most of the east and south shores of the bay are covered in extensive mangrove forests with associated mudflats and sandflats at the mouths of the major estuaries. The mangrove forests form a continuous, intact forest within Bruneian territory, but those within the adjacent Sarawak territory have been largely clear-felled to supply the wood-chip industry. Freshwater flows into the bay via a labyrinth of interconnecting channels and waterways. The major rivers entering the Brunei Estuary in the southwest are the Brunei, Limbang, Temburong, Bangau and Trusan. The Limbang and Temburong drain catchments which are predominantly primary rain forest, and carry high silt loads. The smaller Brunei River receives the drainage from the city of Bandar Seri Begawan and its environs, and is therefore subject to considerable urban pollution. Several smaller rivers drain the extensive peat swamp forests of Temburong District. These carry very small silt loads, but are rich in peat and woody debris.

The outer bay varies in depth from about 20 to 40 meters; the inner bay is generally less than 5m deep. The massive inflow of freshwater reduces the salinity to only 2.6 p.p.t. in places, compared with a mean offshore salinity of 31.5 p.p.t. The retention time for water in the bay has been estimated at 2-4 weeks. The tides are diurnal for two or three days in each month and substantially diurnal for the remainder of the month. There is a secondary tide, however, which gradually increases and decreases in magnitude so that for a few days in each month there are semi-diurnal tides of similar amplitude. The tidal amplitude at Muara ranges from about 2.0m at spring tides to 0.9m at neap tides.

Climatic conditions: Equatorial climate characterized by relatively high temperatures (average 28°C), high humidities (average 82%) and high average

annual rainfall (about 2,800 mm in the north and 3,500 mm in the south). The region is under the influence of the northeast monsoon from mid December to mid March, and the southwest monsoon from mid May to the end of October. No clear cut seasonal pattern of rainfall is evident, although November, December and January tend to be the most reliable months in terms of total monthly rainfall. Rainfall generally occurs as short, intense downpours caused by convective thunderstorms.

Principal vegetation: Mangrove swamps dominated by species of *Rhizophora*, notably *R. apiculata*, with mature forest up to 30m in height. Howes and Sahat (in prep) recognized six distinct vegetation zones within their survey area in Brunei Estuary:

1. *Avicennia/Sonneratia* forest on the seaward edge, dominated by *A. marina* and *S. alba*, with some immature *Rhizophora apiculata* and *Lumnitzera coccinea*;
2. *Rhizophora* forest dominated by *R. apiculata*, with other species such as *Bruguiera gymnorhiza*, *Sonneratia acida* and *Aegiceras corniculatum* in the less frequently inundated zone;
3. a belt of the nipa palm *Nypa fruticans* between the major rivers in the lower reaches of the estuary and along the upper reaches of the rivers;
4. *Heritiera/Excoecaria* forest dominated by *H. littoralis* and *E. agallocha*, forming a landward extension of the *Nypa* belt;
5. peat swamp forest with species such as *Dyera* spp mixed with a variety of mangrove associates along the riverbanks in the upper reaches of the tidal influence;
- 6 sandy areas on exposed coasts and offshore islands with *Casuarina equisetifolia* and some *Melastoma malabaricum* and *Barringtonia asiatica*.

The vegetation to the landward of the mangrove in Temburong District is dominated by peat swamp forest, with mangrove extending along the major rivers.

Land tenure: The wetland is state owned (Government of Brunei); some of the surrounding land is privately owned.

Conservation measures taken: Some 11,483 ha of mangrove forest and peat swamp forest in north Temburong District are included within the Labu-Selirong Wildlife Sanctuary, established in 1948 (2,499 ha) and 1954 (8,984 ha). In addition, there are small protected areas of mangrove forest along the Sungai Brunei. Wildlife enjoys some protection under the Brunei Wildlife Protection Enactment of 1978.

Conservation measures proposed: There is a proposal to include all uninhabited islands within a conservation management zone. It has been

recommended that a large proportion of the mangroves and intertidal mudflats within Brunei Bay be protected in an International Coastal Resource Conservation Zone (Howes & Sahat, in prep). This would involve liaison between Brunei Darussalam and the Malaysian States of Sarawak and Sabah, to form a continuous zone of protected land in sectors of the bay where mangroves and intertidal flats predominate. Caldecott (1987) has proposed that a Joint Management Commission for Brunei Bay be established, with the participation of the national governments of Brunei Darussalam and Malaysia, and the state governments of Sarawak and Sabah. The Commission would be formally responsible for the permanent management of the bay's natural resources on a rational and sustained basis.

Land use: Fishing for finfish and prawns, some rearing of Green Mussels *Perna viridis* for local markets, and some harvesting of mangroves and mangrove products for local use. The mangroves were formerly used for firewood and for the production of charcoal and tannin, but in recent years the main use has been for piling material which resists waterlogged soils. The fronds of *Nypa fruticans* are used for roofing material and weaving, while the sap is used to make a sweet drink and the fruits are eaten. The waterways are still very important for inter-urban transport between coastal towns and the detached portion of Brunei (Temburong). A commercial port, a naval base and various recreation facilities are located in the northwest of the area. Over 40 super-tankers are laid up at moorings within the bay.

Possible changes in Land use: Proposals have been made to clear areas of mangrove for brackishwater aquaculture schemes, particularly in Temburong District. It seems likely, however, that the high sulphide content of the soil would render such areas highly unsuitable for aquaculture (Howes & Sahat, in prep).

Disturbances and threats: The Sungai Brunei receives the untreated domestic sewage from a "water village" of 36,000 inhabitants near Bandar Seri Begawan, as well as the sewage effluent and urban runoff from the city itself. As a result, there is now a significant amount of pollution in the inner bay, and this is increasing. The most immediate threat to Brunei Bay as a whole, however, is destruction of mangrove forest. In Brunei, the cutting of wood for poles and for making charcoal has been carried out at such a low intensity that there appears to have been no serious damage to the mangrove's role in fishery maintenance. However, in recent years the mangroves within Malaysian territory have been seriously over-exploited, and this may now be affecting the fishery resources throughout the bay. Extensive logging activities and clear-felling in the water catchment areas of the rivers also pose a threat to the bay by affecting the water regime. Some mangrove is being cleared for urban and industrial development along the Sungai Brunei, and this could increase in the future.

Economic and social values: The mangrove forests and mudflats are of great importance to the economy of most human communities located around the bay, since they support abundant populations of finfish, prawns and other aquatic animals which are routinely harvested for subsistence consumption or sale. It has been estimated that the mangrove swamps initiate a food chain by

depositing sufficient plant material to allow each hectare to support up to 90 kg of prawns each year. In 1985, the full-time registered fishermen in the Brunei portion of the bay landed 2,330 metric tonnes of finfish and prawns. The total number of full-time and part-time inshore fishermen active in the bay as a whole almost certainly exceeds 10,000 individuals (Caldecott, 1987). The waterways are very important for transportation, and the area has considerable potential for outdoor recreation, conservation education and scientific research.

Fauna: Howes and Sahat (in prep) collected 79 species of fishes belonging to at least 34 families in mangrove areas within Brunei Estuary. About half of these species were of some importance in the Brunei markets. The most commonly encountered species, using a variety of sampling techniques, were catfish (Ariidae), *Caranx spp*, *Sardinella spp*, *Drepane punctata*, *Coilia dussumieri*, *Liza vaigiensis*, *Mugil sp*, *Plotosus anguillaris*, *Scatophagus argus*, *Scomberomorus guttatus* and *Siganus spp*.

The intertidal mudflats and sand flats provide foraging areas for a number of migratory shorebirds. Censuses at seven sites in October and November 1986 produced a total of 633 shorebirds of 17 species (Howes & Sahat, in prep). The commonest species were *Pluvialis dominica*, *Charadrius mongolus*, *Numenius phaeopus*, *Tringa totanus*, *Xenus cinereus*, *Actitis hypoleucos* and *Heteroscelus brevipes*. Species typical of muddy substrates, such as *Limnodromus semipalmatus*, *Calidris tenuirostris* and *C. ruficollis*, were very scarce. Other waterfowl recorded during the survey included 39 *Egretta sacra*, small numbers of *Butorides striatus*, *Egretta garzetta*, *E. alba*, *Ardea sumatrana* and *Leptoptilos javanicus*, and over 360 terns of seven species, mainly *Chlidonias hybrida*, *C. leucoptera*, *Sterna dougallii* and *S. albifrons*. The rare and possibly endangered Chinese Egret *Egretta eulophotes* appears to be a regular winter visitor to Brunei Bay in small numbers. Howes and Sahat observed 12 during their survey of the Brunei Estuary in October/November 1986, and reported a maximum of 13 in the nearby Sarawak portion of the bay in May 1986.

The mangrove forests support significant populations of the Proboscis Monkey *Nasalis larvatus* and leaf monkeys *Presbytis sp*, as well as large colonies of flying foxes *Pteropus vampyrus*.

Eleven species of prawns have been recorded in the bay. Three of these, *Penaeus merguensis*, *P. indicus* and *Metapenaeus brevicornis*, are of high commercial importance, and two others are of minor commercial importance.

Preliminary studies suggest that the intertidal flats support a rather poor zoo-benthos compared with that at many other sites in Southeast Asia. In a recent study, five major taxonomic groups were found from eight sampling sites. Crustacea (Natantia) were the most abundant group, followed by Polychaeta, Bivalvia, Pisces and Gastropoda. Natantia (prawns) were more abundant in the outer estuary, whilst Polychaeta dominated in the mangrove channels near Bandar Seri Begawan sewage outflow (Sahat, 1987; Howes & Sahat, in prep). The poor zoo-benthos may be attributable to the high acidity of the water draining into the bay from the peat swamp forests behind the mangroves.

Special floral values: Brunei Bay contains one of the largest tracts of relatively undisturbed mangrove forest in eastern Asia.

Research and facilities: A considerable amount of research has been carried out on the finfish and prawn fisheries of Brunei Bay. The Natural History Department of Brunei Museum and the Asian Wetland Bureau (Interwader Programme) conducted a joint study of the littoral ecosystem in Brunei Estuary in 1986.

References: Caldecott (1987); Currie (1979a, 1979b, 1980 & 1982); Farmer (1986); Farmer *et al.* (1986); Howes & Sahat (in prep); Karpowicz (1985); Lindley (1982); Sahat (1987); Teng (1970 & 1971); UGL Consultants Ltd (1983).

Criteria for inclusion: 123.

Source: John R. Howes, Mohammad Jaya bin Haji Sahat and Euan G. Ross.

Wetland name: Belait Peat Swamp Forest

Country: Brunei Darussalam

Coordinates: 4°15'-4°39'N, 114°05'-114°29'E;

Location: the western part of Brunei Darussalam on the Sarawak border, from the coast and Seria south for 40 km.

Area: 85,000 ha.

Altitude: 0-15m.

Biogeographical province: 4.25.12.

Wetland type: 21.

Description of site: A vast area of lowland peat swamp forest extending from the sandy coastal zone inland along the Sungai Belait. The site contains full undisturbed peat bog lenses with all six characteristic vegetation types. There are several ephemeral lakes, and some hot springs and mud volcanoes. The swamp is fed by one main river, the Sungai Belait, and its tributaries, rising in the hills of southern Brunei. Heavy local rainfall causes flooding to a depth of about one meter several times a year.

Climatic conditions: Tropical monsoonal climate with an average annual rainfall of about 2,900 mm. The region is under the influence of the northeast monsoon from mid December to mid March, and the southwest monsoon from mid May to the end of October.

Principal vegetation: Extensive undisturbed tracts of *Shorea albida* forest and other peat swamp forest communities.

Land tenure: Most of the site is state owned, except in the coastal zone, where large areas are under concession to the Brunei Shell Petroleum Company. Surrounding areas are partly state owned and partly privately owned.

Conservation measures taken: The swamp forest receives some protection under the Forest Policy of 1951. The area is managed by the Forestry Department.

Conservation measures proposed: Various proposals have been made to establish wildlife sanctuaries, managed forest reserves and research forests.

Land use: Oil wells and an LNG plant in the coastal area, some logging in the forest, and some shifting cultivation along the Belait River. A water pumping station, supplying two coastal towns, is situated on the river. Oil-drilling extends up to 32 km offshore along the adjacent coast.

Disturbances and threats: The forest concessions are still fairly limited, but excessive and uncontrolled logging may affect the sustainable yield of the swamp forest in the future.

Economic and social values: The wetland is an important forestry resource and provides a reliable source of water for the nearby coastal towns. It is an excellent example of a habitat type which is rapidly disappearing in other parts of Borneo, and thus has considerable value for scientific research.

Fauna: Little information is available. The area is believed to support most if not all of the fauna typical of north Bornean peat swamp forests, but few studies have been carried out in the area. The Estuarine Crocodile *Crocodylus porosus* is still occasionally reported.

Special floral values: The swamp forest is noted for its abundance of pitcher plants.

Research and facilities: Very little research has been carried out in the area, and the fauna and flora remain poorly known.

References: Anderson (1973); Anon (1983); Farmer *et al.* (1986); Hydraulics Research Station (1979).

Criteria for inclusion: lb, le, 2b.

Source: Mohammad Jaya bin Haji Sahat and Euan G. Ross.

Wetland name: Tasek Merimbun and Merit

Country: Brunei Darussalam

Coordinates: 4°35'N, 114°40'E;

Location: about 25 km south of Tutong Town, Tutong District.

Area: 2,500 ha.

Altitude: Less than 15m.

Biogeographical province: 4.25.12.

Wetland type: 14 & 21.

Description of site: A complex of shallow, freshwater lakes and marshes surrounded by a large area of seasonally flooded peat swamp forest, to the west of the Sungai Tutong. The lakes are fed by three streams and overflow from the Tutong River during the rainy season (August to December). The maximum depth of water in the lakes is about 4m; the pH is low. Parts of the lakes and the peat swamp forests dry out during the dry season.

Climatic conditions: Tropical monsoonal climate with an average annual rainfall of about 3,000 mm. The region is under the influence of the northeast monsoon from mid December to mid March, and the southwest monsoon from mid May to the end of October. The average maximum temperature is 28.1°C and the average minimum, 23.6°C; the average maximum relative humidity is 94.6% and the average minimum, 73.1%.

Principal vegetation: No information is available on the aquatic vegetation. *Dryobalanops rappa* and *Dactylocladus stenostachys* are the dominant trees in the peat swamp forest. Rubber (*Hevea brasiliensis*) has been planted on adjacent, slightly higher ground.

Land tenure: The wetland is state owned; a small area of the adjacent higher ground is privately owned.

Conservation measures taken: The wetland is included within the recently designated Tasek Merimbun National Park, which initially covers an area of 7,800 ha. The National Park is still under development, and enforcement of the park regulations has not as yet been fully implemented.

Conservation measures proposed: It has been proposed that the National Park be categorized into three zones: an intensive visitor use area, a low intensity visitor use area, and a conservation area. The low intensity visitor use area and conservation area would be strictly reserved for educational and scientific research purposes.

Land use: There is a little fishing by the residents of Kampong Merimbun, particularly for eels. A few cash crops and hill paddy are cultivated on the adjacent high ground.

Disturbances and threats: Hunting and trapping of wildlife are insignificant, but littering may become a problem unless adequate enforcement measures are taken.

Economic and social values: The lakes support a small subsistence fishery, and the area has considerable potential for outdoor recreation, conservation education and scientific research.

Fauna: The lakes support a rich fish fauna, including eels. Up to 30 *Anhinga melanogaster* and 30 *Ardea purpurea* are present all year round, and many other species of waterfowl occur as visitors. Mammals include *Cervus unicolor* and *Sus barbatus*. The Estuarine Crocodile *Crocodylus porosus* was formerly common in the area, but is now rare.

Special floral values: None known.

Research and facilities: Brunei Museum carried out a one year project on the natural history of the area in 1983-84.

References: Farmer *et al.* (1986); UGL Consultants (1982).

Criteria for inclusion: 1b, 2b.

Source: Mohammad Jaya bin Haji Sahat and Euan G. Ross.

REFERENCES

Alfred, E.R. (1970). Occurrence of the pentacerotid fish *Histioporus typus* Temminck & Schlegel off the Brunei coast. Brunei Museum Journal 2(1): 318-319.

Anderson, J.R. (1961). The ecology and forest types of peat swamp forests of Sarawak and Brunei in relation to their silviculture. Ph.D. thesis, University of Edinburgh, Scotland.

- Anderson, J.R. (1963). The flora of the peat swamp forests of Sarawak and Brunei including a catalogue of all recorded species of flowering plants, ferns and fern allies. *Gardens Bulletin Singapore* 20: 131-228.
- Anderson, J.R. (1964). The structure and development of the peat swamps of Sarawak and Brunei. *Journal of Tropical Geography* 18: 7-16.
- Anderson, J.R. (1973). A report on a reconnaissance forest inventory survey of the peat swamp forest of Belait District, Brunei. Unpublished report.
- Anon. (1976). Fisheries in Brunei. *Petroleum di Brunei* (April): 10-13. (In Malay and English).
- Anon. (1983). Salt intrusion study: Belait River, February-April 1983. Seria: Brunei Shell Petroleum Co. Ltd.
- Beales, R.W., Currie, D.J. & Lindley, R.H. (eds). (1982). Investigations into fisheries resources in Brunei. *Monograph of the Brunei Museum Journal* 5.
- Caldecott, J.O. (1987). International Co-operative Management of Brunei Bay. Paper presented at the Conference on Wetland and Waterfowl Conservation in Asia, 23-28 February 1987, Malacca, Malaysia. IWRB and Interwader.
- Currie, D.J. (1979a). Settlement and growth of the oyster *Saccostrea cucullata* in Brunei waters. *Brunei Museum Journal* 4(3): 182-198.
- Currie, D.J. (1979b). Some aspects of the hydrology of the Brunei Estuary. *Brunei Museum Journal* 4(4): 199-239.
- Currie, D.J. (1980). A key to Brunei Bay prawns. Brunei Fisheries Department Report No.FM/01.
- Currie, D.J. (1982). Studies on the biology of penaeid prawns and the prawn fishery in the Brunei Estuary. *Monograph of the Brunei Museum Journal* 5: 134-187.
- Eden, S. (1982). *Betta macrostoma*: A fish "rediscovered" in Brunei. *Brunei Museum Journal* 5(2): 165-167.
- Eden, S. (1984). Some freshwater aquarium fish of Brunei. *Brunei Museum Journal* 5 (4): 181-202.
- Farmer, A.S.D. (1986). Negara Brunei Darussalam Master Plan. Background Paper: Fisheries and Aquaculture. Huszar Brammah & Associates and Department of Town and Country Planning, Bandar Seri Begawan.

Farmer, A.S.D., Caldecott, J.O., Phillipps, A., Prince, G. & Thomson, N. (1986). Negara Brunei Darussalam Master Plan. Special Report: Wildlife Conservation and Management. Huszar Brammah & Associates and Department of Town and Country Planning, Bandar Seri Begawan.

Harrison, T. (1976). Green Turtles in Borneo. Brunei Museum Journal 3(4): 196-198.

Howes, J.R. & Sahat, M.J.Hj. (in prep). A Study of the Littoral Ecosystem in Brunei Estuary, Brunei Darussalam. A joint project between Brunei Museum and Interwader (East Asia/Pacific Shorebird Study Programme).

Hunting Technical Services Ltd. (1969). Land Capability Study: Vol. 1 Summary; Vol. 2 Physical resources and development priorities; Vol. 3 Map annexure. Government of the State of Brunei.

Hydraulics Research Station. (1979). Brunei Water Resources Study: the effect of increased freshwater abstractions on saline intrusions in the Tutong and Belait estuaries. Brunei: Brunei Shell Petroleum Co.

Karpowicz, Z. (1985). Wetlands in East Asia - a preliminary review and inventory. ICBP Study Report No. 6. Cambridge: ICBP.

Lindley, R.H. (1982). Studies on the growth and aquaculture potential of green mussel *Perna viridis* in Brunei waters. Monograph of the Brunei Museum Journal 5: 125-133.

Marsden, D. (1986). Negara Brunei Darussalam Master Plan. Background Paper: Forestry. Huszar Brammah & Associates and Department of Town and Country Planning, Bandar Seri Begawan.

Mittermeier, R.A. (1980). Conservation in Brunei. Brunei Museum Journal 4(4): 251-261.

Sahat, M.J.Hj. (1987). Evaluation of Coastal Wetland in Brunei Bay: a joint project between Brunei Museum and Interwader. Paper presented at the Conference on Wetland and Waterfowl Conservation in Asia, 23-28 February 1987, Malacca, Malaysia. IWRB and Interwader.

Sawyer, R.T., Taylor, A. & Sahat, M.J.Hj. (1982). The leeches of Brunei (Annelida Hirudinea), with a checklist and key to the known and expected freshwater, terrestrial and marine leeches of Borneo. Brunei Museum Journal 5(2): 168-201.

- Teng, S.K. (1970). A preliminary report on the species of planktonic marine diatoms found in Brunei waters. *Brunei Museum Journal* 2(1): 279-293.
- Teng, S.K. (1971). Observations on certain aspects of the biology of *Metapenaeus brevicornis* (H. Mime-Edwards) and *Penaeus merguensis* (de Man) in the Brunei Estuarine System. M.Sc. thesis. University of Singapore, Singapore.
- Tubb, J.A. (1964). Preliminary report on the fisheries industry, State of Brunei. Bangkok: FAO Regional Office for Asia and the Far East.
- ULG Consultants Ltd. (1982). Brunei Agriculture and Forestry Development Study: Final Report. Vol.4: Fisheries Report. Government of Brunei.
- ULG Consultants Ltd. (1983). Temburung Renewable Resources Study: Draft Fisheries Report for the Temburung District. March 1983. Report submitted to the Government of Brunei.
- Vowles, R.S. & Vowles, G.A. (1982). A study of waders in southwest Brunei. *Brunei Museum Journal* 5(2): 144-162.