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# **TOPIC 1**

## **Wetland Ecology : Introduction**

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# WETLAND ECOLOGY : INTRODUCTION

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## DEFINITIONS OF WETLANDS

There are over 50 definitions of wetlands in use throughout the world (Dugan, 1990). Wetlands can be defined differently by lay persons, soil scientists, botanists, hydrologists, fish and wildlife biologists, landscape architects, civil engineers, managers, etc.. Several factors, including personal perspective and cumulative experience, personal needs, position in the landscape, and wetland diversity and functions, contribute to the difference of those definitions (Kent, 2001). Several formal definitions have been proposed. For examples :

The term wetland ... refers to lowlands covered with shallow and sometimes temporary or intermittent waters. They are referred to by such names as marshes, swamps, bogs, wet meadows, potholes, sloughs, and river-overflow lands. Shallow lakes and ponds, usually with emergent vegetation as a conspicuous feature, are included in the definition, but the permanent waters of streams, reservoirs, and deep lakes are not included. Neither are water areas that are so temporary as to have little or no effect on the development of moist-soil vegetation (Shaw and Fredine, 1956).

Wetland is defined as land having the water table at, near, or above the land surface or which is saturated for a long enough period to promote wetland or aquatic processes as indicated by hydric soils, hydrophilic vegetation, and various kinds of biological activity which are adapted to the wet environment (Tarnocai, 1979).

Wetlands are “lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface of the land or the land is covered by shallow water” (U.S. Fish and Wildlife Service, 1979; Cowardin et al., 1979).

The broadest and that which is used most widely on an international scale, is provided by the Ramsar Convention. Under the text of the Convention (Article 1.1 and 2.1) (<http://www.ramsar.org/>), wetlands are defined as : ***“areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres and may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands”***.

The Ramsar definition covers all the aquatic habitats utilized by waterfowl, the limit of 6 metres depth in the sea being the maximum depth to which some waterfowl can dive (Maitland and Morgan, 1997).

According to the Ramsar definition, wetlands include a wide range of habitats and ecosystems. The term “wetlands” groups together a wide range of inland, coastal and marine habitats which share a number of common features (Dugan, 1990).

In many Asian countries (especially non-English speaking countries), “wetlands” is a new word recently introduced in the early 1990s. Adoption of different definitions by wetland related sectors and agencies is a basic problem in wetlands management.

## **WETLAND IDENTIFICATION**

Wetlands must have one or more of the following 3 distinguishing features :

1. At least periodically, ***presence of water***, either covered by shallow water at the surface or saturated with water within the root zone, the depth and duration of flooding or soil saturation may vary from year to year and from wetland to wetland;
2. Unique soil conditions, predominantly undrained ***hydric soils*** that differ from adjacent uplands, hydric soils are saturated, flooded or ponded long enough during the growing season to develop anaerobic conditions in the upper horizons; and
3. Organisms, animals and vegetation adapted to the wet conditions, ***hydrophytes***, or absence of flooding-intolerant vegetation.

Wetland identification criteria can include hydrological, physical, and biological criteria, as well as political considerations for regulatory definitions. Hydrological indicators can be direct and indirect evidence of flooding or waterlogging. Physical indicators are hydric soils and wet substrates, plus submerged substrates and periodically flooded rocks or bedrock. Biological indicators are certain plants and animals found in water or wetlands. Wetland delineation needs to look at water-soil-plant/organism relationships.

**Hydrological Field Indicators** widely used for identifying wetlands, and delineating the wetland and upland boundary include :

|   |                                       |
|---|---------------------------------------|
| Direct observation of inundation  | Direct observation of soil saturation |
| Wetland drainage patterns   | Water marks                           |
| Plant morphological adaptations (e.g. adventitious roots, aerenchyma, pneumatophores, multiple trunks, oxidized rhizospheres, tree buttressing) |                                       |
| Surface scouring and water-borne sediment deposits  |                                       |

**Physical Field Indicators (Indicators of Hydric Soils)** include :

|  |                      |
|--|----------------------|
| Organic soils (histosols)                      | Sulfidic materials   |
| Aquic moisture regime                          | Reducing conditions  |
| Soil color                                     | Mottling concretions |
| High organic matter content in surface horizon |                      |

**Biological Field Indicators (Indicators of Hydrophytes)** include :

Hydrophytes - water-loving plant species  
Wetland species e.g. wetland birds, amphibians.

*Source : Kent (2001)*

Some selected common names for wetlands are described in various books, e.g. in Dugan (1990); Roggeri (1995); Thompson and Finlayson (2001); and UNEP (2004).

**Bog** : a peat-accumulating wetland that has no significant inflows or outflows and supports acidophilic mosses, particularly sphagnum.

**Estuaries** : bodies of water where a river mouth widens into a marine ecosystem, where the salinity is intermediate between salt and fresh water, and where tidal action is an important bio-physical regulator.

**Fen** : a peat-accumulating wetland that receives some drainage from surrounding mineral soil and usually supports marsh-like vegetation.

**Flooded forests** : periodically flooded forests, woody formation on ground that is totally submerged during the high-water season, can be found on low, poorly drained lands adjacent to watercourses or swamps.

**Flooded grasslands** : periodically flooded grasslands, herbaceous formations growing on soil that is completely submerged during flooding.

**Floodplains** : periodic flooding of land between a river channel and raised land on the edge of a valley; areas of low-lying flat ground over which rivers flood during high water.

**Fringing floodplains** : narrow and long flood-prone areas situated in the high-water riverbed.

**Inner deltas** : large alluvial plains where the main watercourse divides into branches.

**Intertidal flats** : wetlands usually unvegetated areas, dominated by muddy substrate.

**Lagoons** : deepwater enclosed or partially opened aquatic system, especially in coastal delta regions; semi-enclosed coastal basin with limited freshwater input, high salinity and restricted circulation which often lies behind sand dunes, barrier islands or other protective features like coral reef of an atoll.

**Lakes** : developed through several processes, some are formed by folding, faulting, or movement of the earth's crust; stream action forms oxbow lakes; humans and animals can create lakes.

**Marshes** : wetlands with predominantly grassy vegetation. A frequently or continually inundated wetland characterized by emergent herbaceous vegetation adapted to saturated soil conditions.

**Non-peatswamps** : wetlands having still water areas around lake margins, and in parts of floodplains e.g. oxbows, where the water rests for longer periods. Their precise characteristics vary according to geographical location and environment.

**Open coasts** : those not subject to the influence of river water and lagoon systems.

**Peatland** : a generic term of any wetland that accumulates partly decayed plant matter (peat).

**Peatswamps** : under normal oxygen-rich conditions, dead plant matter decomposes eventually into carbon dioxide and water. When under low temperature, high acidity, low nutrient supply, water-logging, and oxygen deficient conditions, the process of decomposition is retarded and dead plant matter accumulates as peat.

**Swamps** : wetlands dominated by trees or shrubs. A wide range of vegetation types from mosses, grasses, herbs, shrubs, trees. They are often forested.

**Swamps and marshes** : are characterized by aquatic plants (emergent or submerged vegetation, plants with floating leaves), their growth is encouraged by the presence, for a large part of the year, of shallow stagnant water (in the case of a swamp) or muddy waterlogged soil (in the case of a marsh), both never fully dry out.

**Swamp forests** : developed in still water areas around lake margins, and in parts of floodplains, such as oxbows, where the water rests for longer periods.

Wetlands are not easily defined because they range from near-terrestrial to the aquatic, and because many are dynamic in water regime and, therefore, variable in vegetation patterns. Some vary rather predictably and dramatically by season or year,

and many also are subject to long-term variation owing to large-scale climate patterns and cycles. Therefore, wetlands are sometimes not recognizable by standing water, and their vegetation can be equally deceiving. In addition to the presence of shallow water or wet soil periodically, two other key features of wetlands are the periodic presence of water-adapted plants (hydrophytes), which range from mosses to giant trees, and hydric soils, with biochemical features influenced by anaerobic conditions of flooding (Cowardin et al., 1979).

A real problem is that many wetlands are temporary, or look very similar to terrestrial or aquatic ecosystems and may be mistaken as such. The major concern is that decisions on management are sometimes made with a poor understanding of all the different wetland characteristics and functions. Also, decisions on management are often made based on wetlands' dry season boundaries lacking understanding of wetland dynamics. For wetland delineation, inventory and mapping, especially for conservation and regulation purposes, it is preferable to use aerial photographs and satellite images taken in both dry and wet seasons to provide the baseline data.

## **WETLAND CLASSIFICATION SYSTEMS**

There are various types of wetlands and many development options depend on the appropriate choice of wetland types. Therefore, it is important to have sufficient knowledge about the types, extent and distribution of wetlands, production levels and the potential functions and values of wetlands and wetland resources.

Wetland classification systems have been developed in order to arrange wetlands into similar groups. This is particularly important for mapping, conducting inventories and watershed planning, assessing biodiversity, evaluating wetland functions, assessing the impacts of wetland alteration and degradation, considering potential wetland restoration, and defining the planning and management framework.

Classification from the natural resources standpoint is the grouping of habitats or natural features into categories with similar characteristics, properties, or functions. The unifying properties vary according to the needs of the classifiers e.g. wetlands may be classified biologically, physically, chemically, hydrogeomorphically, and in other ways, depending on the discipline and interests of the classifiers. Features commonly used to classify wetlands include vegetation, hydrology, water chemistry, origin of water, soil types, landscape position and landform, wetland origin, wetland size, ecosystem form, energy sources, etc..

Various wetland classification systems have been proposed.

“A Directory of Asian Wetlands” (Scott, 1989) listed 22 major wetland types in Asia.

Dugan (1990) classified wetlands into 39 categories (30 categories of natural wetlands and 9 man-made ones) according to their basic biological and physical characteristics. These were simplified into 7 distinct landscape units that were either wetlands or areas of which wetlands formed an important component. These are estuaries; open coasts; floodplains; freshwater marshes; lakes; peatlands; and swamp forests.

Usually wetlands are classified by their basic hydrological features. The following classification is commonly used :

**Marine** : Permanent salt-water systems. Shallow coastal saltwater. Tidal or inter-tidal. Including sandy beaches, rocky shores, shallow seas, seagrasses and coral reefs.

**Estuarine** : Means “of the estuary”. Brackish coastal water. Differs from “Marine” in that water is brackish due to inflow from a river system. Salinity may fluctuate seasonally. As river system carries fine sediments to the estuary, mudflats are commonly found in estuarine wetlands.

**Riverine** : Means “of the river”. Flowing fresh water. Usually with low vegetation cover. Floodplains also belong to the riverine system.

**Lacustrine** : Means “of the lake”. Non-flowing, usually non-tidal fresh water. Bigger ones are called “lakes” and smaller ones “ponds”. Average depth > 2 m. Usually with low vegetation cover (<30%). Relatively open or with sparsely vegetated margins.

**Palustrine** : Means “of the marsh or swamp”. Slow or non-flowing shallow water dominated by trees and shrubs (usually referred as “swamps”), or persistent emergents (usually referred as “marshes”). Vegetation cover is dense (>30%). Average depth < 2 m.

Ramsar Classification System for Wetland Type groups wetlands into 3 main categories :

#### **Marine/Coastal Wetlands**

- A – Permanent shallow marine waters; in most cases < 6 m deep at low tide, including sea bays and straits
- B – Marine subtidal aquatic beds; including kelp beds, seagrass beds
- C – Coral reefs
- D – Rocky marine shores; including rocky offshore islands, sea cliffs
- E – Sand, shingle or pebble shores; including sand bars, spits and sandy islets, dune systems
- F – Estuarine waters; permanent water of estuaries and estuarine systems of deltas
- G – Intertidal mud, sand or salt flats
- H – Intertidal marshes; including salt marshes, salt meadows, saltings, tidal brackish and freshwater marshes
- I – Intertidal forested wetlands; including mangrove swamps, nipah swamps and tidal freshwater swamp forests
- J – Coastal brackish/saline lagoons; brackish to saline lagoons with at least one relatively narrow connection to the sea
- K – Coastal freshwater lagoons; including freshwater delta lagoons
- Zk(a) – Karst and other subterranean hydrological systems, marine/coastal

#### **Inland Wetlands**

- L – Permanent inland deltas
- M – Permanent rivers/streams/creeks; including waterfalls
- N – Seasonal/intermittent/irregular rivers/streams/creeks
- O – Permanent freshwater lakes; including large oxbow lakes
- P – Seasonal/intermittent freshwater lakes; including floodplain lakes
- Q – Permanent saline/brackish/alkaline lakes
- R – Seasonal/intermittent saline/brackish/alkaline lakes and flats
- Sp – Permanent saline/brackish/alkaline marshes/pools
- Ss – Seasonal/intermittent saline/brackish/alkaline marshes/pools
- Tp – Permanent freshwater marshes/pools; ponds, marshes and swamps on inorganic soils, with emergent vegetation water-logged for at least most of the growing season
- Ts – Seasonal/intermittent freshwater marshes/pools on inorganic soils, including sloughs, potholes, seasonally flooded meadows, sedge marshes
- U – Non-forested peatlands; including shrub or open bogs, swamps, fens

- Va – Alpine wetlands; including alpine meadows, temporary waters from snowmelt
- Vt – Tundra wetlands; including tundra pools, temporary waters from snowmelt
- W – Shrub-dominated wetlands; shrub swamps, shrub-dominated freshwater marshes
- Xf – Freshwater, tree-dominated wetlands; including freshwater swamp forests, seasonally flooded forests, wooded swamps on inorganic soils
- Xp – Forested peatlands; peatswamp forests
- Y – Freshwater springs; oases
- Zg – Geothermal wetlands
- Zk(b) – Karst and other subterranean hydrological systems, inland

### **Human-made Wetlands**

- 1 – Aquaculture (e.g. fish/shrimp) ponds
- 2 – Ponds; including farm ponds, stock ponds
- 3 – Irrigated land; including irrigation channels and ricefields
- 4 – Seasonally flooded agricultural land; including ricefields, intensively managed pasture
- 5 – Salt exploitation sites; salt pans
- 6 – Water storage areas; reservoirs/barrages/dams/impoundments
- 7 – Excavations; gravel/brick/clay pits, mining pools
- 8 – Wastewater treatment areas; sewage farms, settling ponds, oxidation ponds
- 9 – Canals and drainage channels, ditches
- Zk(c) – Karst and other subterranean hydrological systems, human-made

Bordering the South China Sea, coastal wetlands can be of marine/coastal, inland, and manmade wetland types. Under the UNEP/GEF Project “*Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand*”, the key coastal wetlands that are focused on, include peatswamps, non-peatswamps, lagoons, estuaries, and tidal flats (according to the Ramsar Classification System, they are mainly in types : A, F, G, H, I, J, K, L, M, U, Xf, Xp, 1, 5, 9).

The Asian Wetlands Inventory supports the classification based on 5 landform attributes and 4 hydrological characteristics that result in 13 wetland categories (Finlayson et al., 2002) as follows.

- Permanently inundated basin
- Seasonally inundated basin
- Intermittently inundated basin
- Seasonally waterlogged basin
- Permanently inundated channel
- Seasonally inundated channel
- Intermittently inundated channel
- Seasonally waterlogged channel
- Permanently inundated flat
- Seasonally inundated flat
- Seasonally waterlogged flat
- Seasonally waterlogged slope
- Seasonally waterlogged highlands

A “Wetland Classification System of the Lower Mekong Basin” was developed based on the system described by Dugan (1990) using a stepwise hierarchical approach, and adopted in 1993 at the meeting of experts of the Inventory and Management of Wetlands in the Lower Mekong Basin Project of the Mekong River Commission in Vientiane (Mekong Secretariat, 1993). The system has since been used in varying

degrees in the four Lower Mekong Basin countries. Thailand has adopted, modified, amended, and used this classification system in wetland mapping, inventory, and semi-detailed survey at site level (Department of Land Development, 1993, 1994, 2000). In Cambodia, Lao PDR and Vietnam, the system is still limitedly used.

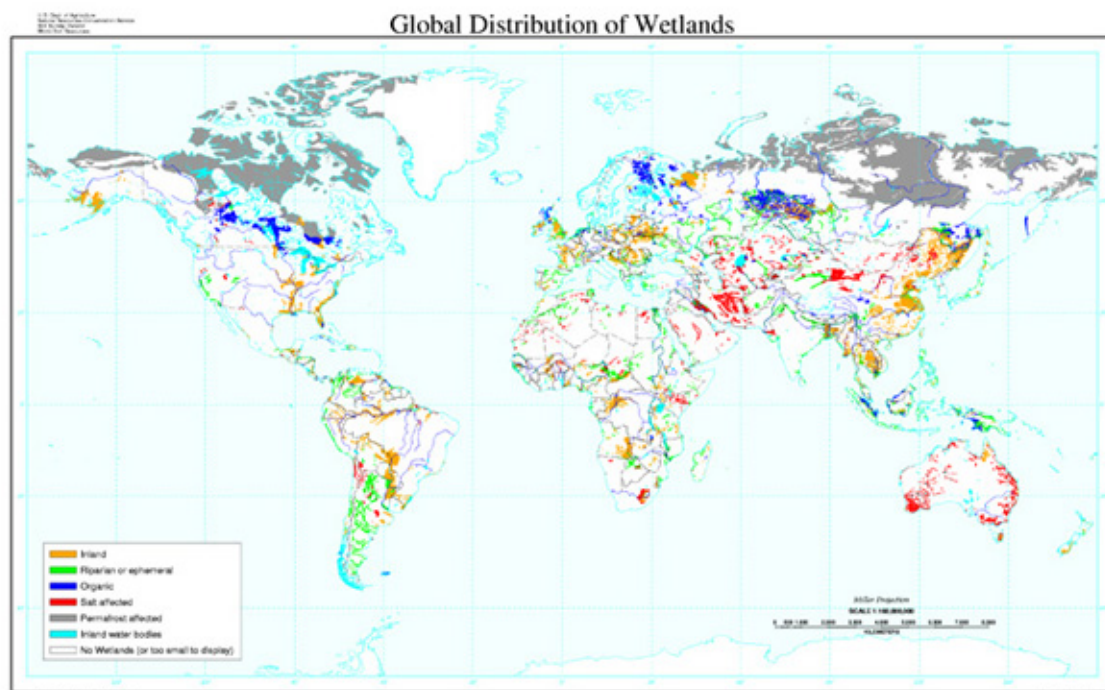
## **GLOBAL AND REGIONAL EXTENT AND DISTRIBUTION OF WETLANDS**

Wetlands cover approximately 4 - 6% of the Earth's land surface or some 7 - 9 million sqkm (Mitsch and Gosselink, 2000; Thompson and Finlayson, 2001). The greatest proportion is made up of bogs (30%), fens (26%), swamps (20%) and floodplains (15%), with lakes accounting for just 2% of the total (UNEP, 2004).

The global distribution map of wetlands can be accessed from :  
<http://soils.usda.gov/use/worldsoils/mapindex/wetlands.html> .

### **General extent and distribution of the world's wetlands.**

Source : <http://soils.usda.gov/use/worldsoils/mapindex/wetlands.html> .



Although a recent global analysis of the extent of wetlands has raised many concerns about such figures, due to differences in definitions and methodologies, and poorly or inaccurately compiled data, it is estimated that about 56 % of the estimated total wetland area are found in tropical and subtropical regions. About one-third of the world's wetlands are located in Asia (Mitsch and Gosselink, 2000). The amount of wetland area in South and East Asia has been estimated at 1.2 million sqkm.

Asia is gifted with wetlands. The Himalayan mountain range dominates southern Asia. Its snowfields and glaciers give rise to some of the world's mightiest rivers,



among them the Ganges, Brahmaputra, Indus, Mekong and Yangtze. The silt enriched valleys and huge deltas of these rivers contain extensive wetlands. Other several major wetlands are situated in the lower basins, floodplains, and deltas of big rivers e.g. the Yangtze, the Mekong, the Red, the Chao Phraya, the Irrawaddy, the Indus, and the Mahaweli Ganga. The most extensive wetlands of Malaysia, Indonesia and the Philippines are typically coastal mangrove swamps with their associated mudflats, and freshwater and peat swamp forests which often occur inland (Chan et al., 2001). Asia's peat swamp forests are among the greatest habitat types in the world.

As of 22 October 2007, there are 156 Contracting Parties to the Convention on Wetlands (Ramsar Convention), with 1,676 wetland sites totaling 150,273,533 hectares designated for inclusion in the Ramsar List of Wetlands of International Importance (<http://www.ramsar.org>).

### **WETLANDS BORDERING THE SOUTH CHINA SEA**

The South China Sea is bordered by China to the north, the Philippines to the east; Malaysia, Singapore, Indonesia and Brunei to the south; Thailand, Cambodia and Vietnam to the west.

Total extent or surface area of wetlands of international importance (Ramsar Sites) in **7 countries bordering the South China Sea** are listed below.

| Country     | Convention of Wetlands came into force | Number of Ramsar Sites | Total surface area (ha) |
|-------------|--|------------------------|-------------------------|
| Cambodia    | 23/10/1999                             | 3                      | 54,600                  |
| China       | 31/07/1992                             | 30                     | 2,937,481               |
| Indonesia   | 08/08/1992                             | 3                      | 656,510                 |
| Malaysia    | 10/03/1995                             | 5                      | 55,355                  |
| Philippines | 08/11/1994                             | 4                      | 68,404                  |
| Thailand    | 13/09/1998                             | 10                     | 370,600                 |
| Vietnam     | 20/01/1989                             | 2                      | 25,759                  |

Source : <http://www.ramsar.org>.

Ramsar List of sites of wetlands of international importance, their extent and distribution in **7 countries bordering the South China Sea** is presented below. Bordering the South China Sea, there are 12 Ramsar sites with a total area of 364,832 hectares (see Map : Distribution of Ramsar Sites in Asia, Source : [www.wetlands.org](http://www.wetlands.org)). The Ramsar Sites bordering the South China Sea are listed below.

| Country      | Site   | Date of designation | Region, Province, Sate | Area (ha) | Coordinates      |
|--------------|--|---------------------|------------------------|-----------|------------------|
| Cambodia (3) | Boeng Chhmar & Associated River System and Floodplain      | 23/06/99            | Kampong Thom           | 28,000    | 12°48'N 104°16'E |
|              | Koh Kapik & Associated Islets *                            | 23/06/99            | Koh Kong               | 12,000    | 11°28'N 103°04'E |
|              | Middle Stretches of the Mekong River north of Stoeng Treng | 23/06/99            | Stoeng Treng           | 14,600    | 13°44'N 105°58'E |
| China (30)   | Bitahai Wetland  | 07/12/04            | Yunnan                 | 1,985     | 27°42'N 100°01'E |
|              | Chongming Dongtan Nature Reserve, Shanghai                 | 11/01/02            | Shanghai               | 32,600    | 31°38'N 121°58'E |

|                        |   |          |                            |         |                  |
|------------------------|---|----------|----------------------------|---------|------------------|
|                        | Dafeng ( <i>Elaphurus davidianus</i> ) National Nature Reserve                                | 11/01/02 | Jiangsu                    | 78,000  | 33°05'N 120°49'E |
|                        | Dalai Lake National Nature Reserve, Inner Mongolia  | 11/01/02 | Inner Mongolia             | 740,000 | 48°33'N 117°30'E |
|                        | Dalian National Spotted Seal ( <i>Phoca vitulina</i> ) Nature Reserve                         | 11/01/02 | Liaoning                   | 11,700  | 39°15'N 121°15'E |
|                        | Dashanbao   | 07/12/04 | Yunnan                     | 5,958   | 27°24'N 103°20'E |
|                        | Dongdongtinghu  | 31/03/92 | Hunan                      | 190,000 | 29°19'N 112°59'E |
|                        | <b>Dongzhaigang *</b>   | 31/03/92 | Hainan                     | 5,400   | 19°59'N 110°35'E |
|                        | Eerduosi National Nature Reserve  | 11/01/02 | Inner Mongolia             | 7,680   | 39°48'N 109°35'E |
|                        | Eling Lake  | 07/12/04 | Qinghai                    | 65,907  | 34°56'N 097°43'E |
|                        | Honghe National Nature Reserve  | 11/01/02 | Heilongjiang               | 21,836  | 47°49'N 133°40'E |
|                        | <b>Huidong Harbor Sea Turtle National Nature Reserve *</b>                                    | 11/01/02 | Guangdong                  | 400     | 22°33'N 114°54'E |
|                        | Lashihai Wetland  | 07/12/04 | Yunnan                     | 3,560   | 26°53'N 100°08'E |
|                        | <b>Mai Po Marshes &amp; Inner Deep Bay *</b>  | 04/09/95 | New Territories, Hong Kong | 1,540   | 22°29'N 114°02'E |
|                        | Maidika   | 07/12/04 | Tibet Autonomous Region    | 43,496  | 31°08'N 093°00'E |
|                        | Mapangyong Cuo  | 07/12/04 | Tibet Autonomous Region    | 73,782  | 30°44'N 081°19'E |
|                        | Nan Dongting Wetland & Waterfowl Reserve  | 11/01/02 | Hunan                      | 168,000 | 28°50'N 112°40'E |
|                        | Napahai Wetland   | 07/12/04 | Yunnan                     | 2,083   | 27°51'N 099°38'E |
|                        | Niaodao ("Bird Island")   | 31/03/92 | Qinghai                    | 53,600  | 36°50'N 100°10'E |
|                        | Poyanghu  | 31/03/92 | Jiangxi                    | 22,400  | 29°10'N 115°59'E |
|                        | San Jiang National Nature Reserve   | 11/01/02 | Heilongjiang               | 164,400 | 47°56'N 134°20'E |
|                        | <b>Shankou Mangrove Nature Reserve *</b>  | 11/01/02 | Guangxi                    | 4,000   | 21°28'N 109°43'E |
|                        | Shuangtai Estuary   | 07/12/04 | Liaoning                   | 128,000 | 41°00'N 121°47'E |
|                        | Xi Dongting Lake (Mupinghu) Nature Reserve  | 11/01/02 | Hunan                      | 35,000  | 29°01'N 112°05'E |
|                        | Xingkai Lake National Nature Reserve  | 11/01/02 | Heilongjiang               | 222,488 | 45°17'N 132°32'E |
|                        | Xianghai  | 31/03/92 | Jilin                      | 105,467 | 44°02'N 122°41'E |
|                        | Yancheng National Nature Reserve  | 11/01/02 | Jiangsu                    | 453,000 | 33°31'N 120°22'E |
|                        | Zhaling Lake  | 07/12/04 | Qinghai                    | 64,920  | 34°55'N 097°16'E |
|                        | Zhalong   | 31/03/92 | Heilongjiang               | 210,000 | 47°12'N 124°12'E |
|                        | <b>Zhanjiang Mangrove National Nature Reserve *</b>   | 11/01/02 | Guangdong                  | 20,279  | 20°54'N 110°08'E |
| <b>Indonesia (3)</b>   | <b>Berbak National Park *</b>   | 08/04/92 | Jambi                      | 162,700 | 01°24'N 104°16'E |
|                        | Danau Sentarum  | 30/08/94 | Kalimantan Barat           | 80,000  | 0°51'N 112°06'E  |
|                        | Wasur National Park   | 16/03/06 | Irian Jaya                 | 413,810 | 08°38'S 140°23'E |
| <b>Malaysia (5)</b>    | Pulau Kukup   | 31/01/03 | Johor                      | 647     | 01°19'N 103°25'E |
|                        | Sungai Pulai  | 31/01/03 | Johor                      | 9,126   | 01°23'N 103°32'E |
|                        | Tanjung Piai  | 31/01/03 | Johor                      | 526     | 01°16'N 103°31'E |
|                        | <b>Tasek Bera Peatswamp *</b>   | 10/11/94 | Pahang                     | 38,446  | 02°58'N 102°36'E |
|                        | Kuching Wetlands National Park  | 08/11/05 | Sarawak                    | 6,610   | 01°41'N 110°14'E |
| <b>Philippines (4)</b> | Agusan Marsh Wildlife Sanctuary   | 12/11/99 | Mindanao                   | 14,836  | 08°17'N 125°53'E |
|                        | Naujan Lake National Park   | 12/11/99 | Oriental Mindoro           | 14,568  | 13°10'N 121°11'E |
|                        | Olango Island Wildlife Sanctuary  | 01/07/94 | Cebu                       | 5,800   | 10°16'N 124°03'E |
|                        | Tubbataha Reefs National Marine Park  | 12/11/99 | Sulu Sea                   | 33,200  | 08°52'N 119°52'E |
| <b>Thailand (10)</b>   | Bung Khong Long Non-Hunting Area  | 05/07/01 | Nong Khai                  | 2,214   | 17°59'N 103°59'E |
|                        | <b>Don Hoi Lot Intertidal flats *</b>   | 05/07/01 | Samut Songkhram            | 87,500  | 13°21'N 099°59'E |
|                        | Had Chao Mai Marine National Park – Ta Libong Island Non-Hunting Area – Trang River Estuaries | 14/08/02 | Trang                      | 66,313  | 07°22'N 099°24'E |
|                        | Kaper Estuary – Laemson Marine National Park – Kraburi Estuary                                | 14/08/02 | Ranong                     | 122,046 | 09°36'N 098°39'E |
|                        | Krabi Estuary   | 05/07/01 | Krabi                      | 21,299  | 07°58'N 098°55'E |
|                        | <b>Kuan Ki Sian of the Thale Noi Wildlife Non-Hunting Area *</b>                              | 13/05/98 | Songkhla                   | 494     | 07°50'N 100°08'E |
|                        | Mu Koh Ang Thong Marine National Park   | 14/08/02 | Suratthani                 | 10,200  | 09°37'N 099°41'E |
|                        | Nong Bong Kai Non-Hunting Area  | 05/07/01 | Chiang Rai                 | 434     | 20°14'N 100°02'E |
|                        | Phang Nga Bay Marine National Park  | 14/08/02 | Pang Nga                   | 40,000  | 08°17'N 098°36'E |
|                        | <b>Princess Sirindhorn Wildlife Sanctuary (Phru To Daeng Wildlife Sanctuary) *</b>            | 05/07/01 | Narathiwat                 | 20,100  | 06°12'N 101°57'E |
| <b>Vietnam (2)</b>     | <b>Xuan Thuy Natural Wetland Reserve *</b>  | 20/09/88 | Nam Ha                     | 12,000  | 20°10'N 106°20'E |
|                        | Bau Sau (Crocodyle Lake) Wetlands and Seasonal Floodplains                                    | 04/08/05 | Dong Nai                   | 13,759  | 11°28'N 107°23'E |

\* Ramsar Sites bordering the South China Sea.

Source : <http://www.ramsar.org> ; accessed 22 October 2007.

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