

DEFINING THE ENVIRONMENT OF THE MEKONG RIVER BASIN



Course Learning Objectives

At the end of this course you should be able to:

- List major ecosystems in the Mekong River Basin
- Describe the major components of MRB aquatic ecosystems and their interactions
- Provide examples of disturbances to aquatic ecosystems in the MRB
- Describe environmental monitoring approaches for aquatic ecosystems

Lesson Learning Goals

At the end of this lesson you should be able to:

- Define 'ecological sustainability'
- Detail unique hydrological characteristics of the Mekong River
- Give examples of ecological resources under threat in the Basin and describe causative factors
- Discuss the concept of biodiversity and describe ongoing efforts by MRB riparian countries to preserve critical habitat

The Ecological Foundations of Sustainability

- How should we define **environment**, **ecosystem**, and **ecological processes**?
- The natural **environment** is something outside of the human social system which comprises air, water, minerals, solar energy, plants and animals that support human existence
- Populations of plants and animals and their interactions with the air, water, minerals, and solar energy are natural communities known as **ecosystems**

The Ecological Foundations of Sustainability (Cont'd)

- **Ecological processes** cleanse air and water, determine climate and weather patterns, and enable ecosystems to regenerate
- Each ecosystem is separate but influences and is influenced by other larger and smaller ecosystems
- Together, the numerous ecosystems of the earth and the interactions among them make up the **biosphere**

Ecological Sustainability Defined

The maximum rates of resource harvesting and waste generation (i.e., the maximum load) that can be sustained indefinitely without progressively impairing the productivity and functional integrity of relevant ecosystems

Ecological Sustainability in the Mekong River Basin

- The inhabitants of the MRB depend on natural resources to sustain livelihood
- As a result of this dependence, as well as growing populations, increasing development and limited environmental management, the Basin is experiencing declining environmental quality

Ecological Sustainability in the MRB (Cont'd)

- In the absence of sustainable management practices, economic growth and infrastructure development can be expected to further stress water quality and quantity, and ecosystem integrity
- Intensifying development in the Basin will further alter the physical landscape, integrity of its ecosystems and quality of life of its people

Ecological Sustainability in the MRB (Cont'd)

- Development is inevitable
- Therefore, sound management will be necessary to mitigate expected environmental and social impacts and to ensure the long-term sustainability of natural resources, the environment and quality of life of the Basin's people

Mekong River Basin Physiography

- Riparian countries of the MRB, from upstream to downstream, are China (PRC), Myanmar, Lao PDR, Thailand, Cambodia and Vietnam
- Yunnan Province of PRC and Myanmar constitute the Upper Mekong Basin while the Lower Mekong Basin (LMB) comprises Lao PDR, Thailand, Cambodia and Vietnam

Mekong River Basin Hydrology

- The MRB comprises a catchment area of approximately 795,000 km² making it the 21st largest river basin in the world
- Total run-off from the basin is 475,000 million m³ annually; the 8th highest run-off in the world
- At approximately 4,880 km in length, the Mekong River is the longest river in SE Asia and is the 12th longest river in the world

(MRC, 1997)

Hydrology (Cont'd)

- Flow contributions from riparian countries vary widely depending on catchment area:
 - » Lao PDR contributes the highest flow at 35% of total flow from a catchment area constituting 25% of the total MRB
 - » In comparison, Myanmar contributes only 2% of total flow from a catchment area of 3% of the total MRB

(MRC, 1997)

Hydrology (Cont'd)

- Precipitation: NE/SW monsoon, highly variable temporally and spatially (1,000 to 4,000 mm per annum)
- Surface flows 85-90% June to December; 20-30% in September
- Floods inundate 30,000 km² below Phnom Penh
- Water shortages can be severe in some areas (e.g., NE Thailand; Vietnam Central Highlands; Yunnan Province)

(MRC, 1997)

Hydrology (Cont'd)

- Surface water flows in the Mekong River are largely driven by climatic conditions occurring during the wet and dry monsoon seasons
- Large differences in flow levels in the Mekong River are observed, particularly in downstream sections of the river (peak flows in September are 25-30% of total annual flow versus dry season flows of 1-2% of total annual flow)

(MRC, 1997)

Hydrology (Cont'd)

- Approximately 85-90% of total annual discharge occurs during June to December flood season
- Annual flooding of large areas of southern Cambodia and Vietnam - approximately 30,000 km² of the LMB
- During the flood season, high flows in the Mekong River cause a reversal of the flow in the Tonle Sap River increasing volume in the Great Lake and inundating surrounding swamp forests

(MRC, 1997)

Hydrology (Cont'd)

- Great Lake/Tonle Sap system acts as natural flood regulator for the LMB by decreasing the flood peak at the beginning of the flood season and increasing flow during the dry season
- During the dry season, discharges from the Great Lake supplement low flows in the Mekong River by approximately 16% (estimated as high as 1/3 of total flow)

(MRC, 1997)

Hydrology (Cont'd)

- Positive effects of flooding include the enrichment of agricultural lands through the deposition of alluvial sediments and the enhancement of fisheries (e.g., the flooded forests of the Great Lake are very important as fish rearing grounds)
- Natural changes in precipitation can cause either drought or flooding (e.g., drought in Thailand, flash flooding in southern Vietnam)

MRB Water Resources

Description	TERRITORY						
	Yunnan	Myanmar	Lao PDR	Thailand	Cambodia	Vietnam	MRB
Catchment area (km ²)	147,000	24,000	202,000	184,000	155,000	65,000	777,000
Catchment areas % nation/ province	38%	4%	97%	36%	86%	20%	-
Catchment areas % of total MRB	22%	3%	25%	23%	19%	8%	100%
Annual flow (million m ³)	76,500	-	-	-	-	-	475,000
Average flow (m ³ /s) from area	2,410	300	5,270	2,560	2,860	1,660	15,060
Average flow as % of total MRB	16	2	35	18	18	11	100

MRB Ecological Resources

Ecological resources at most risk in the MRB are:

- Terrestrial Flora
- Terrestrial Fauna
- Aquatic Fauna
- Wetlands
- Special Ecosystems
- Biodiversity/Endangered Species
- Protected Areas

Terrestrial Flora

- Terrestrial ecosystems are being degraded as forest coverage, estimated at only 27% of the LMB, which supports much of the biodiversity of the Basin declines
- In addition, many remaining forest areas are of comparatively poor quality (i.e., low biomass density in plantation forests)
- Logging, shifting cultivation, agricultural and urban land encroachment, and fuel wood collection are major contributors to forest loss

(MRC, 1997)

Terrestrial Fauna

- MRB supports numerous populations and high species diversity of terrestrial fauna
- MRC survey indicated that at least 212 species of mammals, 696 species of bird and 213 species of reptiles and amphibians are present; new species are being discovered every year
- Development activities and unsustainable hunting represent a serious threat to populations and biodiversity in the MRB

(MRC, 1997)

Aquatic Fauna

- MRB supports significant aquatic fauna in terms of species composition and diversity (e.g., an estimated 1300 fish species)
 - Inland waters of the MRB in Cambodia, Lao PDR and Thailand and wetlands in Cambodia represent important breeding and nursery habitats for ecologically and economically important fish species
 - Critical habitat are found in:
 - » the estuarine zone of the Mekong River Delta
 - » inland waters of the Mekong River
- (MRC, 2000)

Wetlands

- Wetlands comprises a wide variety of permanently and temporarily wetted areas (e.g., estuarine marsh, flooded crops, natural lakes, and man-made reservoirs)
- Wetland habitats of greatest ecological importance in the MRB include:
 - » the Great Lake and Tonle Sap system in Cambodia
 - » the Plain of Reeds in Cambodia and Vietnam
 - » the Estuary Delta

Wetlands (Cont'd)

Physical wetland functions include:

- water storage
- storm protection and flood mitigation
- shoreline stabilization and erosion control
- groundwater recharge
- retention of nutrients and sediments
- stabilization of local climatic conditions (e.g., rainfall and temperature)

Wetlands (Cont'd)

- Wetlands provide highly productive spawning and nursery habitat for wide variety of aquatic and terrestrial populations in the MRB - supporting ecologically and economically important fish and crustacean populations which are a major protein source for humans in riparian countries
- Wetland foodchains also support rare and endangered mammals, reptiles, amphibians, and resident and migratory birds

Great Lake and Tonle Sap River

- High significance to both ecologically and economically important fish species; flooded forest surrounding the lake is critical to the system's biological productivity
- Provides refuge for a wide variety of birds; several breeding colonies of large water birds including some endangered species which are believed to use the area as breeding grounds (e.g., the Eastern Saurus crane)

(MRC, 1997)

Great Lake/Tonle Sap River (Cont'd)

- Pressure on the forest for the production of fuelwood and charcoal and conversion to agricultural land; forest coverage significantly reduced in last 20-30 years
- Overexploitation of fish from the lake, widespread use of highly destructive harvesting methods, and loss and degradation of habitat are contributing to reduced capture rates
- Inadequate recruitment rates for some species (e.g., large river carp) raises concerns of irreversible population declines

Coastal Ecosystems

- Mekong Delta coastline approximately 650 km in length; 350 km borders the South China Sea and 300 km borders the Gulf of Thailand
- Estuaries are particularly important in supporting many shrimp and fish species which depend on the rich habitat and abundant food for spawning and rearing
- Coastal forest ecosystems also serve as important natural barriers to the erosional effects of the wave action on the shoreline

(MRC, 1997)

Coastal Ecosystems (Cont'd)

- Population growth, expansion of aquaculture and agriculture activities, urban and industrial development have accelerated destruction of mangrove wetlands and coastal forests
- Loss of wetland and coastal forest ecosystems linked to rapid erosion of shorelines with corresponding impacts to coastal communities and agricultural activities
- Conversion of mangrove wetlands for aquaculture and agriculture likely to have adversely affected coastal fish populations

Biodiversity

- All LMB countries have high biodiversity:
 - » Cambodia (1st ranked) supports best preserved biodiversity and richest wetland system
 - » Lao PDR (2nd) has lower species diversity covering large areas
 - » Thailand (3rd) has small pockets of extremely high biodiversity
 - » Vietnam (4th) has moderately high biodiversity in it's southern wetlands and Central Highland forests

Biodiversity (Cont'd)

- ➔ Richest biodiversity is generally located along country borders; biodiversity hot spots include:
 - » the border triangle of Cambodia, Lao PDR, and Vietnam
 - » along the Lao PDR and Vietnam border
 - » along the Cambodia and Thai border
 - » the border quadrangle of Lao PDR, Myanmar, Thailand and Yunnan Province
 - » along the Lao PDR and northeastern Thai border

Regional Biodiversity

Feature	Laos	Cambodia	Myanmar	Thailand	Vietnam	Yunnan
Mammals, total	157	117	300	282	275	255
Mammals, endemic	1	1	6	8	5	n/a
Birds, total	609	545	1,000	930	744	766
Birds, endemic	3	0	3	2	4	n/a
Freshwater fish	n/a	850+	n/a	650	n/a	n/a
Amphibians, total	37	28	75	107	80	n/a
Amphibians, endemic	n/a	n/a	n/a	13	n/a	n/a
Reptiles, total	66	82	360	298	180	n/a
Swallowtail butterflies	39	22	68	56	37	n/a
Insects	n/a	n/a	n/a	n/a	6,000	n/a
Vascular plants	8,290	7,570	1,071	2,742	4,800	n/a
Endemic plants	1,457	1,175	1,071	2,742	4,800	n/a
Ferns	n/a	n/a	n/a	600	800	n/a
Fungi	n/a	n/a	n/a	3,000	600	n/a

Protected Areas

- Protection of rare and endangered species in the MRB is closely linked to the establishment of protected areas
- Existing protected areas cover approximately 61,493 km² or 8% of the MRB; less than the international guideline of 12% but improving
- MRB countries have been active in establishing transboundary protected areas to protect contiguous areas of habitat on each side of a border but additional measures are needed

(MRC, 1997)

Protected Areas (Cont'd)

- Few protected areas are actively managed due to weak institutional and enforcement capacity in many countries which compromises effective management and achievement of conservation goals
- Protected areas fall into different categories:
 - » National Parks
 - » Wildlife sanctuaries/Nature reserves
 - » Protected landscapes/Cultural/Environmental
 - » Multiple Use areas

Protected Areas (Cont'd)

- A major dilemma faced by governments in establishing protected areas is in making trade-offs between maintaining ecological integrity and allowing consumptive uses of the land to continue
- Competing management priorities include:
 - » maintenance of ecosystems
 - » preservation of species
 - » preservation of cultural heritage
 - » harvesting of economically valuable resources

Protected Areas in the MRB

Country	Type of Protected Areas	Area, '000 ha	% of Total Area
Cambodia	Declared: 9 wildlife sanctuaries, 7 national parks (2 established), 3 protected cultural landscapes, 4 multi-use areas	3,400	19.0
Lao PDR	Declared: 20 national biodiversity conservation areas	3,157	13.4
Myanmar	Existing: 14 wildlife sanctuaries	620	0.8
Thailand	Existing: 78 national parks, 33 wildlife sanctuaries and 43 non-hunting areas	6,500	12.6
Vietnam	Existing: 8 national parks, 50 nature reserves (3 more proposed), 29 cultural/environmental protection areas	980	3.0
Yunnan	Existing: 33 protected areas	730	5.2

Concluding Thoughts

Important points to remember are:

- Hydrological conditions in the MRB are extremely important for maintenance of the Basin's structure and function
- Ecosystems found in the MRB are among the richest and most varied in the world
- Ecological resources are vulnerable and under severe pressure as human populations and development activities in the Basin increase