# Biodiversity status of the Mekong Delta, Vietnam

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# 1 Introduction

Starting from the Tibetan Plateau in China, the Mekong River runs almost 5,000 km through Southeast China (where it is called Lang Cang River) to Myanmar, Laos, Thailand, Cambodia and Vietnam. Before entering the South China Sea (East Sea in Vietnam), the river forms a large and complex delta system called Dong Bang Song Cuu Long (Nine Dragons Delta) with an area of ca. 3.9 million ha. In 2022, about 17.5 million people inhabited the delta across 12 provinces and 1 municipality (Can Tho). Sediment and nutrient flows from the Mekong River provide fertile soils to the delta, which is a major agricultural and fisheries production zone in Vietnam, accounting for more than half of the country's rice production and more than 65% of aquaculture production. The Vietnamese Mekong Delta (VMD) as a key production landscape plays a critical role in the nation's food security and economic development (Nguyen et al. 2022).

Ecosystem services provide conditions that enable agriculture production in the Mekong Delta. However, located in the southernmost part of the Lower Mekong Basin, the VMD has experience rapid biodiversity loss (Nguyen and Tran 2023). It is adversely affected by upstream hydropower development, localized water-engineering systems (dikes), climatic factors, and sea level rise (Tran et al. 2021). Moreover, the development of high-dike polders to intensify rice production has degraded ecosystems and also changed socio-economic patterns (Tran et al. 2023). At the same time, because biodiversity conservation is a most important part of multifunctionality in, consumers in the VMD are willing to pay a higher premium for products that are farmed using environmentally friendly farming techniques to preserve biodiversity (Khai and Yabe 2015). However, there is a lack of comprehensive and up-to-date data on biodiversity status in the VMD. This report aims to provide an up-to-date status report of biodiversity in the Mekong Delta in Vietnam. It also discusses opportunities and challenges for enhancing biodiversity in the region.

This report is developed based on an extensive literature review and in-depth interviews with eight experts and six policymakers who have engaged in developing biodiversity policies and programmes in Vietnam for the last two decades. The research team conducted a policy review and searched journal articles, reports from donors and government agencies to draw out the latest status of biodiversity and lessons learnt from previous biodiversity conservation policies and projects. In-depth interviews provide expert views on the status of biodiversity, and opportunities and challenges for enhancing biodiversity conservation in the Mekong Delta.

# 2 Overview of the Mekong Delta, Vietnam

Situated in the southern part of Vietnam, the Vietnamese Mekong Delta (VMD) has a tropical monsoon climate that is influenced by both north-east and south-west monsoons with two distinct seasons, wet and dry. The average daily temperature is quite stable throughout the year, and typically varies from ca. 26 °C in January to 29 °C in April. The annual average rainfall of the VMD falls mainly during September and October, in the middle of the rainy season, and ranges from 1,600 to 1,800 mm. Rainfall also varies geographically, with 2,000 to 2,400 mm falling in West Sea provinces and 1,400 to 1,600 mm in provinces neighbouring the East Sea (VNMC 2024). The low-lying VMD often floods because of rises in sea level due to climate change.

**Hydrology**. The VMD is comprised of both natural rivers and artificial canals (VNMC 2024), forming a complex hydrological system. Main river system are:

- Tien Giang-Hau Giang (Bassac River) system – main distributaries of the Mekong River in Vietnam
- Vam Co River system – two branches; the Vam Co Tay receives water from the Mekong River in both wet and dry seasons
- Cai Lon-Cai Be River system on the Ca Mau Peninsular – connects with the Bassac River through a number of artificial canals, greatly affecting the hydrology of this system
- Giang Thanh River – a small river originating in Cambodia and running along the international border between the two countries before entering Dong Ho Lake (in Ha Tien) and flowing into the West Sea
- An extensive network of channels and canals – these have been developed in the last two centuries and connect with natural river systems to improve transportation and irrigation in the VMD.

Because of hydrological changes, urban and industrial pollution, agricultural and aquaculture development, climate change, and upstream water resource development, the VMD wetlands are under substantial ecological stress (Nguyen et al. 2017).

The hydrology of the Mekong River is characterized by very regular annual discharge, peaking in the wet season (Adamson et al. 2009). The hydrogeomorphology of the VMD has been significantly altered by natural and anthropogenic drivers. While riverbed incision was the main cause of the statistically decreased water level in the Mekong Delta, the river discharge increased. Decreased water levels in the dry season have been the main cause of increased salinity intrusions (Doan et al. 2021). From the upper delta to the coastal zone, water infrastructure was built or expanded to enable intensive agriculture, thereby tighter control of the hydrological regime (Le et al. 2018). The hydraulic linkage between channels and floodplains differs between different types of floodplains. Floodplains in high ring dikes have a weaker hydraulic linkage; this link is governed by the capacity of the sluice gates. Other floodplains are more directly linked to the channels. Current nundation patterns are therefore patchy, compared to more continuous patterns which would result from pristine floodplain processes (Nguyen et al. 2011).

In river-dominated regions, dams are the main drivers of hydrological changes. During the wet season, dike development has a greater impact than other factors. However, sea level rise will be the main driver of flooding in the VMD (Dang et al. 2018). Floods during the rainy season play an important role in the agricultural system of the delta, but also cause serious problems such as yield losses, riverbank erosion, destruction of infrastructure and human and stock casualties (Vo 2012). During the dry season, however, and because of tidal influences, salinization and the lack of fresh water in coastal areas are the main problems to be addressed. Tides are also causing sedimentation in estuaries and canals, which thereby impedes water flows and increases the risk of flooding. Most recently and further into the future, upstream water usage by neighbouring countries, hydropower dams in the upper reaches and

a higher frequency of extreme weather events due to the changing climate will have a major impact on the flow regime of the Mekong Delta (Vo 2012). It is expected that changes to the flow regime will lead to reduced sedimentation, riverbank erosion and salinity intrusion due to anthropogenic factors (Nguyen et al. 2022).

On the VMD floodplain, irrigation and drainage systems under dike protection test the ineffective implementation of water management policy, posing a challenge for adaptation to exogenous impacts on the hydrological regime. Mekong Delta farmers have increasingly cultivated three rice crops per year in high-dike compartments, ignoring government regulations that call for flood retention (Tran and Weger 2017). The sedimentation and erosion processes related to sea-level changes were found to be important drivers of the distribution of fresh and saline waters. Groundwater recharge of the deeper Mekong Delta groundwater system is very limited (Pham et al. 2019). Since the issuance of Resolution No. 120 in 2017, in places, people have begun to reduce the area if third-crop rice to switch to more nature-based models. However, flood retention is still a problem in water management in the VMD.

**Soils and landforms**. Soils in the Mekong Delta derive from sediment transported by the Mekong River. Three main soil classes are recognized (Le 1994): old alluvial sediments in parts of the northern delta; non-acidic alluvial soils in much of the central area, where land is most suited to rice growing; and acid-sulphate soils, found mainly in the north-west and north-east (Buckton et al. 1999). Following Ngo (2009), due to the uniformity of such soil formation factors as topography, geology, climate and water regime, soils in the Mekong Delta are distributed across large areas with relatively uniform topographic morphology. Examples of these are: (1) rich organic acid-sulphate soils of the Plain of Reeds, (2) acid-sulphate soils of the Long Xuyen quadrangle in Ha Tien, and (3) Bac Lieu-Minh Hai saline acid-sulphate soils on the Ca Mau Peninsula.

Saltwater intrusion, a consequence of climate change and decreased water levels, has been increasingly severe in the Mekong Delta region (Lam and Tran 2021, Lam et al. 2020). Soil salinity and sodicity are widely found as serious environmental problems in agriculture and aquaculture areas in the Mekong Delta (Nguyen et al. 2007; Nguyen et al. 2020). These problems have caused great economic loss because of its impacts on agricultural productivity and food safety (Nguyen et al. 2020).

The Mekong Delta is the most important area for agriculture and aquaculture production in Vietnam, especially in terms of the production of rice, fruits, shrimp and catfish. However, increased rice and shrimp production on both alluvial soils and acid-sulphate soils (ASS) has resulted in degraded soil and water environments. Surface water in the Mekong River was found to have high biological oxygen demand, chemical oxygen demand and nitrate concentrations, all exceeding the limits of the Vietnamese standard for surface water (Vo and Nguyen 2012). In ASS areas, water in the canals had high levels of aluminium, iron and manganese, and toxic metals such as arsenic, cadmium, copper, nickel, lead and zinc. The concentrations of these metals were higher than those in non-ASS areas (Vo and Nguyen 2012).

# 3 Major ecosystems and biodiversity status

In general, the Vietnamese Mekong Delta (VMD)is a very large wetland area, with small patches of limestone and soil hills concentrated in the south-west of the delta in An Giang and Kien Giang provinces. This huge wetland was once dominated by freshwater natural habitats of *Melaleuca* forests, other swampy forests, inundated grassland, and open swamps. The brackish and saline water natural habitats comprised mangroves, brackish swamps and extensive intertidal mudflats. However, due to the devastation of war, specifically because of the napalm and defoliants used in the American War, and latterly due to the massive economic development over the past four decades, most of the delta's natural habitats have disappeared and been replaced by artificial landscapes. Only small areas of natural *Melaleuca* forests and grasslands can now be found in protected areas on the Plain of Reeds (Tram Chim and Lang Sen) and in the peatland areas in U Minh Ha and U Minh Thuong National Parks. Some large mangrove areas can be found in coastal provinces but all of them are plantation, which were established after the extensive exploitation and conversion that occurred in the late 20$^{th}$ century.

The Regional Development Plan for Mekong Delta, Vietnam (Ministry of Planning and Investment 2021) lists the following key natural ecosystems in the delta:

- *Mangroves*: ca. 65,900 ha, distributed in all coastal provinces, largest area is in southernmost tip of Ca Mau Peninsula.
- Melaleuca *forests on peatland*: ca. 22,000 ha, concentrated in Kien Giang and Ca Mau provinces (U Minh area).
- *Freshwater swamps and reed meadows*: ca. 10,000, distributed in Dong Thap, Long An and Tien Giang provinces (Plain of Reeds).
- *Open water in the rivers and canals*: area unknown, Mekong River (all of its distributaries) and other canals.
- *Tidal flats*: area unknown, distributed along the plain margins.
- *Coastal lagoons*: area unknown, found in Ha Tien District and Rach Gia Bay of Kien Giang Province, and Ca Mau Cape of Ca Mau Province.
- *Sea grasses*: ca. 12,800 ha, concentrated around Phu Quoc and other small islands in the West Sea, with some small areas in other provinces.
- *Coral reefs*: area unknown, concentrated around Phu Quoc and other small islands of Kien Giang Province.
- *Evergreen forest*: ca. 22,800 ha, largest area can be found in Phu Quoc islands, small patches in the hilly areas of An Giang and Kien Giang provinces.

The production of some provisioning services, such as rice, fish, shrimps, vegetables and fruits has increased in the Mekong Delta during recent decades. This has increased food security and generated export incomes and economic growth for Vietnam. However, it has led to a decrease in many other interconnected ecosystem services (ES) that greatly affect for peoples' livelihoods and well-being. Intensification of agriculture production has become a major driver of change in the region and impacted 15 of the 24 most important ES identified by stakeholders (Berg et al. 2023). Some innovations, such as installing tap water or replacing wild plants and animals with farmed crops and livestock, have sometimes decreased the pressure on these 24 ES. At the same time, the changes may have decreased people's awareness and urgency around solving the cause of the problems. However, in the process, some degraded ES, of significant importance to people, have been strengthened. In contrast, some fossil-based manufactured products have increased the pressure on the original ES, such as pesticides

killing the natural enemies of pests. Some argue that this has allowed ES to continually and increasingly deteriorate to such an extent that it may be very difficult in future to solve the problems that have arisen. This loss in ES has limited the options for alternative farming strategies and has sometimes forced farmers to rely on manufactured substitutes at an increased cost (Berg et al. 2023).

Many studies and government policies emphasize that there is now an urgent need to re-examine food production strategies in the Mekong Delta, to ensure that long-term benefits from multiple ES are not traded off for short-term financial gains from monocultured crops. Loss of ES has an intrinsically strong and direct bearing on people's livelihoods and well-being. It also restricts their options around adapting to the ever-present environmental challenges of, for example, upstream dams and climate change. Management strategies must aim to optimize the multifunctionality of the delta's ecosystems by better understanding the interplay of the various relevant ES. Gains in one set of ES must be balanced against losses in others based on stakeholders' needs and demands. Local knowledge and scientific insights must be used to guide management decisions. Cultural ES must be considered and strengthened to avoid further distancing farming from nature in the knowledge that natural capital cannot be replaced by human-made capital without there being any costs or losses. For such a transformational change of the VMD's food production systems to occur, local knowledge and traditions together with scientific findings would be key to exploring new ways of achieving better and more sustainable agricultural strategies (Berg et al. 2023).

# 4 Species, sites and threats to biodiversity

## 4.1 Species diversity

The Vietnamese Mekong Delta (VMD) once supported very high species diversity before it became massively inhabited and the area converted for agricultural pursuits in the second half of the 20th century. In earlier times, large mammal species such as the tiger *Panthera tigris*, leopard *Panthera pardus*, Asian elephant *Elephas maximus*, and Javan rhino *Rhinoceros sondaicus* lived in the region. Some reptile and even some fish species, especially ones of high economic value, have become locally extinct, including the Siamese crocodile (*Crocodylus siamensis*; last recorded before 2000), Southern River terrapin (*Batagur affinis)*, and Mekong giant catfish (*Pangasianodon gigas*). Many large waterbird species have not been recorded in the past 20 years and are also considered locally extinct in the delta, including the white-shouldered ibis (*Pseudibis davisoni)*, giant ibis (*Thaumatibis gigantea)*, milky stork (*Mycteria cinerea)*, Bengal florican (*Houbaropsis bengalensis)*, greater adjutant (*Leptoptilos dubius)*, masked finfoot *(Heliopais personatus)*, and white-winged duck (*Cairina scutulata)* (Nguyen et al. 2023). In addition, many species within little-studied plant and invertebrate taxa may have disappeared from the delta in the past half century.

Research and surveys on species diversity in the Mekong Delta have been conducted consistently over the past two or three decades by national and international research agencies. However, while information on some groups of vertebrates or higher plants is relatively complete, little research has been done on invertebrates and aquatic biodiversity.

### 4.1.1 Mammals

A recent review (Nguyen et al. 2023) reports 82 species of mammals in the VMD. Compared with data in previous reports, this number has increased significantly due to the addition of recently recorded data on bats and rodents (Nguyen et al. 2009; Vu et al. 2011; Hoang et al. 2015). Of these species, 14 are listed by IUCN (2024) as globally threatened (Table 1).

### 4.1.2 Birds

Thanks to the efforts of research organizations as well as professional and amateur bird watching groups, among all taxa, avian fauna is best researched and has relatively sufficient information for the Mekong Delta. So far, 342 bird species have been reported in the Mekong Delta (Nguyen et al. 2023). Because of the wetland topographic characteristics of the delta, almost 40% of these are waterbirds, or wetland-dependent species of the Anseriformes, Gruiformes, Pelecaniformes, Ciconiiformes, and Charadriiformes orders. Sixteen (16) species recorded in the delta are listed as globally threatened by IUCN (2024) (Table 2). In addition, 11 other species are listed as “near-threatened”.

### 4.1.3 Herptiles

In total, 87 reptile species and 27 amphibian species have been recorded across the VMD. The highest number of species recorded is in Dong Thap, An Giang, Kien Giang and Ca Mau provinces (Nguyen et al. 2023). The numbers of species were found to be unevenly distributed across provinces. This does not necessarily reflect a diversity difference, but says more about the survey efforts, which focused on the protected areas located in the above-mentioned provinces.

**Table 1. Globally threatened mammal species in the Mekong Delta**

| English name | Scientific name | IUCN* | CITES** |
|---|---|---|---|
| Sunda pangolin | *Manis javanica* | CR | I |
| Bengal slow loris | *Nycticebus bengalensis* | EN | I |
| Pygmy slow loris | *Nycticebus pygmaeus* | EN | I |
| Long-tailed macaque | *Macaca fascicularis* | EN | II |
| Indochinese silvered langur | *Trachypithecus germaini* | EN | II |
| Large flying fox | *Pteropus vampyrus* | EN | II |
| Andersen's roundleaf bat | *Hipposideros pomona* | EN | |
| Large-spotted civet | *Viverra megaspila* | EN | |
| Hairy-nosed otter | *Lutra sumatrana* | EN | II |
| Stump-tailed macaque | *Macaca arctoides* | VU | II |
| Lyle's flying fox | *Pteropus lylei* | VU | II |
| Fishing cat | *Prionailurus viverrinus* | VU | II |
| Asian small-clawed otter | *Aonyx cinereus* | VU | I |
| Sambar | *Rusa unicolor* | VU | |

*IUCN: Globally threatened species, listed as Critical Endangered (CR), Endangered (EN) or Vulnerable (VU) by IUCN (2024), **CITES: included in CITES Appendices I and II (CITES 2023)

Source: adapted from Nguyen et al. (2023)

**Table 2. Globally threatened bird species in the Mekong Delta**

| Common name | Scientific name | IUCN* | CITES** |
|---|---|---|---|
| White-winged duck*** | *Asarcornis scutulata* | EN | I |
| Great hornbill | *Buceros bicornis* | VU | I |
| Black-capped kingfisher | *Halcyon pileata* | VU | |
| Bengal florican | *Houbaropsis bengalensis* | CR | I |
| Sarus crane | *Grus antigone* | VU | II |
| Spoon-billed sandpiper | *Calidris pygmaea* | CR | |
| Wood snipe | *Gallinago nemoricola* | VU | |
| Far eastern curlew | *Numenius madagascariensis* | EN | |
| Nordmann's greenshank | *Tringa guttifer* | EN | I |
| Great knot | *Calidris tenuirostris* | EN | |
| Saunders's gull | *Saundersilarus saundersi* | VU | |
| Greater spotted eagle | *Clanga clanga* | VU | II |
| Chinese egret | *Egretta eulophotes* | VU | |
| White-shouldered ibis*** | *Pseudibis davisoni* | CR | |
| Black-faced spoonbill*** | *Platalea minor* | EN | |
| Yellow-breasted bunting | *Emberiza aureola* | CR | |

Source: adapted from Nguyen et al. (2023)

*IUCN: Globally threatened species, listed as Critical Endangered (CR), Endangered (EN) or Vulnerable (VU) by IUCN (2024), **CITES: included in CITES Appendices I and II (CITES 2023)

*** Species with no recent records; they may be vagrant species or species that are locally extinct. White-winged duck ( *Asarcornis scutulata)*: only unconfirmed records in Tram Chim in 1993 (BirdLife International 2001), no more sightings recently. White-shouldered ibis *(Pseudibis davisoni)*: a pair was recorded in Kien Luong District, Kien Giang Province in 1999 (Buckton et al. 1999) and later in 2000 (Nguyen Duc Tu pers. obs.); no more records reported after that. Black-faced spoonbill (*Platalea minor*): a single bird was photographed feeding with a flock of painted stork (*Mycteria leucocephala*) in Tram Chim in 1994 (BirdLife International 2001).

**Table 3. Globally threatened reptile species in the Mekong Delta**

| Common name | Scientific name | IUCN* | CITES** |
|---|---|---|---|
| Chinese water dragon | *Physignathus cocincinus* | VU | II |
| Hon Tre Island rock gecko | *Cnemaspis caudanivea* | VU | |
| Nui Cam Hill rock gecko | *Cnemaspis nuicamensis* | VU | |
| Tuc Dup Hill rock gecko | *Cnemaspis tucdupensis* | VU | |
| Phu Quoc bent-toed gecko | *Cyrtodactylus phuquocensis* | EN | |
| Black and white spitting cobra | *Naja siamensis* | VU | II |
| King cobra | *Ophiophagus Hannah* | VU | II |
| Southeast Asian box turtle | *Cuora amboinensis* | EN | II |
| Yellow-headed temple turtle | *Heosemys annandalii* | CR | II |
| Giant Asian pond turtle | *Heosemys grandis* | CR | II |
| Malayan flat-shelled turtle | *Notochelys platynota* | VU | II |
| Black marsh turtle | *Siebenrockiella crassicollis* | EN | II |
| Asiatic softshell turtle | *Amyda cartilaginea* | VU | II |
| Chinese softshell turtle | *Pelodiscus sinensis* | VU | |
| Green turtle | *Chelonia mydas* | EN | I |
| Hawksbill turtle | *Eretmochelys imbricate* | CR | I |
| Olive Ridley turtle | *Lepidochelys olivacea* | VU | I |
| Leatherback turtle | *Dermochelys coriacea* | VU | I |
| Siamese crocodile | *Crocodylus siamensis* | CR | I |

*IUCN: Globally threatened species, listed as Critical Endangered (CR), Endangered (EN) or Vulnerable (VU) by IUCN (2024),
**CITES: included in CITES Appendices I and II (CITES 2023)

Source: adapted from Nguyen et al. (2023)

While 19 species of reptiles are listed by the IUCN (2024) (Table 3), no globally threatened species of amphibian were recorded. However, the populations of some amphibian species, including the Annam wart frog (*Limnonectes dabanus)* and bony-headed toad (*Ingerophrynus galeatus),* have tended to decline sharply due to habitat loss as wetlands are increasingly narrowed due to conversion to agricultural land and aquaculture or urbanization (IUCN 2024).

Most of the species listed in Table 3 have seen severe population declines due to over-exploitation and habitat loss because of land use conversion and changes in hydrological regimes. Some species are even thought to be locally extinct in this area, such as the yellow-headed temple turtle, giant Asian pond turtle and black marsh turtle. The Siamese crocodile is another reptile that is believed to be extinct in the wild in the VMD, even though the number of individuals of this species in farms is very large (Nguyen et al. 2023).

### 4.1.4 Fishes

Like many other aquatic groups, the diversity of the Mekong Delta's fish fauna has not been comprehensively and systematically studied. Most studies carried out by research institutes have focused mainly on the economic aspects of the VMD's fishery resources (Hoang Duc Huy personal communication, February 12, 2024). Hoang Duc Huy synchronized data from a number of studies from different sites (Nguyen et al. 2023) and found reports of 414 species of fish for the VMD. Of those species, 24 are listed as globally threatened by IUCN the (2024) (Table 4).

**Table 4. Globally threatened fish species in the Mekong Delta**

| Common name | Scientific name | IUCN* | CITES** |
|---|---|---|---|
| Bull shark | *Carcharhinus leucas* | VU | II |
| Milk shark | *Rhizoprionodon acutus* | VU | II |
| Largetooth sawfish | *Pristis microdon* | CR | I |
| Green sawfish | *Pristis zijsron* | CR | I |
| Marbled whipray | *Fluvitrygon oxyrhynchus* | EN | |
| Mekong stingray | *Hemitrygon laosensis* | EN | |
| Bennett's stingray | *Hemitrygon bennetti* | VU | |
| Giant freshwater whipray | *Urogymnus polylepis* | EN | |
| Bengal whipray | *Brevitrygon imbricata* | VU | |
| Black-lined loach | *Ambastaia nigrolineata* | VU | |
| Giant carp | *Catlocarpio siamensis* | CR | |
| Jullien's golden carp | *Probarbus jullieni* | CR | I |
| Small scaled mud carp | *Cirrhinus microlepis* | VU | |
| Mrigal carp | *Cirrhinus cirrhosus* | VU | |
| Mekong labeo | *Labeo pierrei* | VU | |
| Siamese bala-shark | *Balantiocheilos ambusticauda* | CR | |
| Helicopter catfish | *Wallago attu* | VU | |
| Mekong giant catfish | *Pangasianodon gigas* | CR | I |
| Giant pangasius | *Pangasius sanitwongsei* | CR | |
| Striped catfish | *Pangasianodon hypophthalmus* | EN | |
| 'Pa Souay Hang Leuang' | *Pangasius krempfi* | VU | |
| | *Mystus bocourti* | VU | |
| Silver pomfret | *Pampus argenteus* | VU | |
| Fourfinger threadfin | *Eleutheronema tetradactylum* | EN | |

*IUCN: Globally threatened species, listed as Critical Endangered (CR), Endangered (EN) or Vulnerable (VU) by IUCN (2024), **CITES: included in CITES Appendices I and II (CITES 2023)

Source: adapted from Nguyen et al. (2023)

Populations of most species listed in Table 4 are severely declining due to over-exploitation and ongoing changes to the river's hydrological regimes, particularly due to the altered flow of river systems in the delta. Further, the recent emergence of mainstream hydropower dams along the Mekong River has caused a decline in nutrient and sediment flows in its lower reaches. In addition, these dams, together with the hard dike systems created in the delta in recent decades, have created more physical barriers to the breeding and feeding migration of many species, further pushing these species closer to the brink of extinction. Many species have already or have almost disappeared from the delta; examples include the Mekong giant catfish, giant carp, and freshwater stingrays and whiprays. There have been very few records of these species in the Vietnamese part of the Mekong River in the last 10 years (Hoang Duc Huy personal communication, February 12, 2024). Furthermore, compelled by government targets and market forces, most farmers are now producing three rice crops each year by using high dikes, pumping systems, pesticides and fertilizers, However, this has led to a great reduction in the habitat available to wild inland freshwater fish and other aquatic food resources (Nguyen et al. 2019). The fish species and biodiversity indexes in the VMD have decreased with the reduction of salinity from the estuary to up-river locations (Tran et al. 2020). Many poor families who had depended on wild fish caught in the common areas for much of their food have been negatively impacted by this transition; it offers important lessons about the development of other tropical delta regions (Nguyen et al. 2019).

### 4.1.5 Invertebrates

Information on the invertebrate fauna in the VMD is somewhat sporadic. Only a few groups have been researched, and then only on an *ad hoc* basis.

*Dragonflies* (Odonata): Most of data on the Odonata order for the VMD come from the works of Bui (2008) for Phu Quoc National Park, Kien Giang Province and Dang (2008) for Tram Chim National Park, Dong Thap Province (Hoang Duc Huy personal communication, February 12,2024). So far, 87 species of dragonflies have been recorded for the delta. Of them, three species are listed by the IUCN (2024) as globally threatened: *Euphaea cyanopogon* (EN), *Amphicnemis valentini* (EN) and *Podolestes coomansi* (VU). The most important threats to species within Odonata are loss of habitat from land use changes and overuse of chemicals in agricultural production.

*Benthic invertebrates*: As mentioned in Section 4.1.4, the zoo-benthic fauna in the VMD has not been studied sufficiently (Hoang Duc Huy personal communication, February 12,2024). In total, 238 species of this group were reported by Nguyen et al. (2023) (see Table 5).

For this group, not many taxa achieved a good assessment according to the IUCN Red List criteria. However, out of 238 species documented by Nguyen et al. (2023), two species are listed as globally endangered by IUCN (2024); these are: 'Trùng Trục Ngắn' *Oxynaia micheloti* and 'Layar' *Hyriopsis bialata*.

*Land snails*. Very few efforts have been made to study this group. Perhaps the most notable attempt was made in 2007 in the limestone hills of Kien Luong District, Kien Giang Province by Vermeulen et al. (2009). This report lists 65 species of land snails of which 30 were new to science, and 36 species (55% of the fauna) are probably endemic to the area. Indeed, some species are confined to just one or several hills. Therefore, many of them are globally threatened as per different IUCN (2024) categories (see Box 1).

**Table 5. Species composition of benthic invertebrates known in the Mekong Delta**

| Phylum and class | Number of families | Number of species |
|---|---|---|
| Phylum **Mollusca** | 22 | 74 |
| Class Gastropoda | 15 | 39 |
| Class Bivalvia | 7 | 35 |
| Phylum **Annelida** | 58 | 162 |
| Class Polychaeta | 4 | 5 |
| Class Oligochaeta | 3 | 14 |
| Class Decapoda | 20 | 83 |
| Class: Clitellata | 1 | 1 |
| Class Insecta (aquatic) | 17 | 26 |
| Class Malacostraca | 13 | 33 |
| Phylum **Echinodermata** | 1 | 2 |
| Class Holothuroidea | 1 | 2 |
| **Total** | **81** | **238** |

Source: adapted from Nguyen et al. (2023)

**Box 1. Endemic and globally threatened land snails recorded in Hon Chong, Kien Luong District, Kien Giang Province (IUCN 2024)**

*Cyclophorus* sp. nov. 'cave' **EN Endemic**: occurs on two limestone hills in Hon Chong; the actual area occupied by the species is ca. 1.2 km².

*Cyclophorus* sp. nov. 'Periomphalic furrow' **EN Endemic**: occurs on two limestone hills in the Hon Chong area; the actual area occupied by the species is ca. 0.2 km².

*Macrochlamys* sp. nov. 'White, umbilicate' **EN Endemic**: occurs on two limestone hills in Hon Chong; the actual area occupied by the species is ca. 1.4 km².

*Microcystina* sp. nov. 'Kien Luong' **EN Endemic**: occurs on five limestone hills in Hon Chong; the actual area occupied by the species is ca. 0.6 km².

*Notharinia* sp. nov. 'Khoe La' **CR Endemic**: occurs on a single limestone hill in Hon Chong; the actual area occupied by the species is ca. 0.7 km².

*Notharinia* sp. nov. 'Khoe La and Ong' **CR Endemic**: occurs on two limestone hills in Hon Chong; the actual area occupied by the species is ca. 0.9 km².

*Sesara* sp. nov. 'BaiVoi' **CR Endemic**: occurs on a single limestone hill in Hon Chong; the actual area occupied by the species is ca. 0.7 km².

*Burmoniscus* sp. nov. 'HC-first segment white' **EN Endemic**: occurs in two caves on one limestone hill in Hon Chong; the actual area occupied by the species is ca. 0.5 km².

*Ceratophysella* sp. nov. 'HC' **CR Endemic**: occurs in a single cave on one limestone hill in Hon Chong; the actual area occupied by the species is presumed to be far less than 1 km².

*Eostemmiuluscaecus* **CR Endemic**: only known from the type locality, Mo So cave on Bai Voi hill in Hon Chong.

*Eustra honchongensis* **EN Endemic**: occurs on a single limestone hill in Hon Chong; the actual area occupied by the species is ca. 0.5 km².

*Gnomulusbedoharvengorum* **EN Endemic**: occurs on three limestone hills in Hon Chong; the actual area occupied by the species is ca. 1.23 km².

*Harvengia vietnamita* **EN Endemic**: occurs on four limestone hills in Hon Chong; the actual area occupied by the species is ca. 1.19 km².

*Isometrus deharvengi* **EN Endemic**: occurs on four limestone hills in Hon Chong; the actual area occupied by the species is ca. 1.5 km².

### 4.1.6 Vegetation and plants

The VMD used to be known as a large, forested wetlands. However, after the country's reunification in 1975, mass conversion of natural and semi-natural wetlands into other production lands, especially for rice and aquaculture intensification, made the delta become a heavily artificial landscape. Natural and

semi-natural ecosystems only remain in small and fragmented patches that are mainly found in a few protected areas. Communities of natural vegetation reflect the climatic, soil and hydrological conditions found in the delta, and can be divided into freshwater and saline communities (Buckton et al. 1999).

**Inland and freshwater vegetation**

Evergreen and semi-evergreen forests cover a few thousand hectares and are found only in the hills of Kien Giang Province (Kien Luong and Hon Dat districts) and An Giang Province (That Son area). A recent survey by the Southern Institute of Ecology (Luu Hong Truong personal communication, January 08, 2024) indicates that some important isolated remnants of tropical closely vegetated semi-evergreen forests and sparse shrubby vegetation are found in the delta and thus having endemic species. The forests are dominated by the Fabaceae and Dipterocarpaceae. A number of endemic species from these hills were recently described as being new to science, such as *Begonia bataiensis* (VU Endemic) and *Ornithoboeae marginata* (CR Endemic) (Luu Hong Truong personal communication, January 08, 2024).

Swamp forest is very rare now in the VMD and can only be found in small patches. Most notable are swamp forests in the Tram Chim National Park, Dong Thap Muoi Ecological Reserve and Lang Sen Wetland Reserve on the Plain of Reeds; in the peatland areas of U Minh Ha and U Minh Thuong National Parks of the Ca Mau Peninsula; and some areas in Tra Su *Melaleuca* Protection Forest, An Giang Province in the Long Xuyen quadrangle. The dominant tree species of swamp forests in the VMD is *Melaleuca cajuputi*. This species forms semi-natural forest in some areas, although the majority is plantation. Species forming the ground layer in swamp forests vary according to local conditions, but include *Phragmites vallatoria* and *Eleocharis* spp. grasslands (Buckton et al. 1999).

Seasonally inundated grassland has almost disappeared from the delta and now only exists in small areas in the protected areas. Le (1994) and Tran (1999) divided them into four types of vegetation:

- grassland on areas of deep and prolonged freshwater inundation that are dominated by *Eleocharis dulcis*, *Oryza rufipogon* and *Phragmites vallatoria*, occurring on potential or light active acid-sulphate soils
- grassland on active acid sulphate soils that are dominated by *Eleocharis dulcis*, *E. ochrostachys*, *Ischaemum rugosum* and *Lepironia articulata*, and inundated with freshwater to a moderate depth and for a moderate duration
- grassland on sandy and old alluvium soils that are dominated by *Eragrostis atrovirens*, *Setaria viridis*, *Mnesithea laevis* and *Panicum repens*, and inundated only to a shallow depth and for a short time
- grassland affected by brackish water that is dominated by *Paspalum vaginatum*, *Scirpus littoralis*, *Zoysia matrella*, *Eleocharis dulcis* and *E. spiralis*. They are affected by brackish water and can be inundated on a daily basis due to tides.

Floating vegetation is very rare; it occurs in small areas found in the open swamps in protected areas on the Plain of Reeds such as at Tram Chim and Lang Sen. Open swamps at these sites are dominated by the lotus species *Nelumbo nucifera*, with *Nymphaea nouchali*, *N. pubescens*, and *N. tetragona* also occurring. *Eleocharis dulcis*, *Ludwidgia adscendens*, *Centrostachys aquatica*, *Hymenachne acutigluma*, *Coix aquatica*, and *Leersia hexandra* also occur.

Other types of floating vegetation can be found in the canals in areas of *Melaleuca* forests that support a diverse community of floating, aquatic and subaquatic species, including *Eichhornia crassipes*, *Pistia stratiotes*, *Salvinia cucullata*, *Ipomoea aquatica*, *Ludwidgia adscendens*, *Centrostachys aquatica*, *Azolla pinnata*, *Spirodela polyrrhiza* and *Lemna aequinoxialis* (Buckton et al. 1999).

**Saline vegetation**

In the 1940s, natural mangrove forests covered more than 200,000 ha in the VMD (Phan and Hoang 1993). The dominant mangrove species in the coastal VMD included species of the *Avicennia*, *Rhizophora*, *Bruguier* and *Sonneratia* genera. War, forest fires, collection of wood for fuel and timber, coastal erosion, as well as other human activities, especially the mass conversion for aquaculture ponds in the 1980s and 1990s, have resulted in a reduction of mangrove forest areas in the VMD. The total area of mangroves in the delta decreased from 185,800 ha in 1973 to 102,160 in 2020 at a rate of approximately 2150 ha/year because of aquaculture expansion and 430 ha/year because of erosion (Pham et al. 2022). Furthermore, mature natural mangroves no longer exist in the delta and have now been replaced by plantations in places. In some areas, especially in the estuarine protected areas, semi-natural mangroves have been established. Mangrove forests in the VMD support high floristic diversity, with more than 40 true mangrove species recorded (Nguyen et al. 2023). In the delta, *Avicennia alba* dominates on newly accreted land that is often inundated even at low tide, with some *Bruguiera* also occurring. In higher areas, which are only inundated at high tide, *Rhizophora* species, primarily *R. apiculata*, dominate. Where land is only inundated by particularly high spring tides, plant communities including *Lumnitzera racemosa*, *Ceriops tagal*, *Excoecaria agallocha* or the palm *Phoenix paludosa* can be found. Brackish areas are characteristically home to stands of the rhizomatous palm *Nypa fruticans* (Buckton et al. 1999).

### 4.1.7 Flora

To date, there are no comprehensive and no focus studies on the flora of the entire VMD, but a number of earlier studies documented some of the flora of this region. Pham et al. (1992) recorded 592 species of vascular plants on the Plain of Reeds. Tran et al. (2000) recorded 94 species of grass and reeds from Ha Tien Plain. Some other studies recorded 130 plant species in Tram Chim (SubFIPI 1998), 156 species in Lang Sen (WETTI 2010), 226 species in U Minh Thuong (Tran 2000), 79 species in U Minh Ha (UMH 2007), 60 species in Mui Ca Mau National Park (FFI 2007) and 197 species in Bac Lieu Bird Sanctuary (Southern Institute of Ecology 2013). Luu et al. (2014) announced there were 1,693 species of vascular plants (ca. 1,400 wild species) reported for the delta; however, no reliable evidence for this figure has been provided (Luu Hong Truong personal communication, January 08, 2024). Most recently, Nguyen et al. (2023) synchronized available data and came up with a total number of 726 species of vascular plants (701 species of angiosperms and 25 fern species) from 111 families.

Combined with data for limestone areas (CBD 2009), we confirmed 733 species of vascular plants for the delta. Of these, five are listed by IUCN (2024) as globally threatened: *Begonia bataiensis* (VU), *Dipterocarpus alatus* (VU), *Hopea odorata* (VU), *Ornithoboea emarginata* (CR) and *Sonneratia griffithii* (CR). In addition, two species are listed as ‘near-threatened’: *Phoenix paludosa* and *Sonneratia ovata*.

## 4.2 Important sites for biodiversity conservation

### 4.2.1 Protected areas

Under the pressure of widespread economic development in the Mekong Delta over the past five decades, when the area of natural habitats has severely narrowed due to land use conversion and human disturbance, the biodiversity of the delta has also decreased and now occupies a few main strongholds. Most important of those are the protected areas.

In Vietnam, the only official protected area system is restricted to one category of forest management, i.e., special-use forests. While a few marine protected areas have been declared, most are only components of established special-use forests. In addition, there are few provincial-level conservation areas established under decisions of the Provincial People's Committees, and most of these sites are wetland areas.

There are several types of protected areas recognized within the framework of international treaties to which Vietnam is a signatory party, including Ramsar sites, UNESCO biosphere reserves, and ASEAN heritage parks. However, most of these sites are also special-use forest or have core zones that are special-use forest and occupy provincial-level conservation areas (e.g., the Biosphere Reserve case) (Table 6 and Figure 1).

In addition, a few other sites are proposed or planned for biodiversity conservation purposes, such as:
- Ap Canh Dien Species and Habitat Conservation Area, Bac Lieu Province
- Hon Chong (Kien Luong's Karst Hill Species and Habitat Conservation Area), Kien Giang Province
- Medicinal Plant Conservation Areas for Plain of Reeds in Moc Hoa District, Long An Province
- My Phuoc *Melaleuca* Forest Species and Habitat Conservation Area, Soc Trang Province
- Cu Lao Dung Mangrove Nature Reserve, Soc Trang Province.

**Tram Chim National Park** (WDPA ID 555543096) covers 7.313 ha in Tam Nong District, Dong Thap Province. The site was upgrade to 'national park' status in 1998 and designated as a Ramsar site in 2012 (RAMSAR 2012). The vegetation of the park comprises a mixture of seasonally inundated grassland, regenerating *Melaleuca* forest and open swamp. In the 1980s and 1990s, Tram Chim was the most important site for eastern sarus crane (*Grus antigone sharpii)* in Vietnam, with peak numbers reaching more than 1,000 birds in 1988. In addition, there was a population of Bengal florican (*Houbaropsis bengalensis)* recorded in the park in 1999 (Buckton et al. 1999). However, due to the failure in hydrological management (storing water too long in the hope of preventing forest fires) since the early 2000s, numbers of waterbirds in general and sarus crane in particular have rapidly decreased, even to there being no records of sightings in the last few years. Fortunately, with the help of research and conservation agencies, management of the park's hydrological regime has been improved since 2023. People in the buffer zone are also supported to reduce intensive farming around the park.

**Table 6. Established protected and conserved areas in the Mekong Delta**

| Site | Province | SUF | P-PA | Ram | BR | AHP | KBA |
|---|---|---|---|---|---|---|---|
| Tram Chim National Park | Dong Thap | x | | x | | | x |
| Mui Ca Mau National Park | Ca Mau | x | | x | x | | x |
| U Minh Thuong National Park | Kien Giang | x | | x | x | x | x |
| U Minh Ha National Park | Ca Mau | x | | | x | | |
| Phu Quoc National Park | Kien Giang | x | | | x | | |
| Lang Sen Wetland Nature Reserve | Long An | x | | x | | | x |
| Thanh Phu Nature Reserve | Ben Tre | x | | | | | |
| Lung Ngoc Hoang Nature Reserve | Hau Giang | x | | | | | |
| Bac Lieu Bird Sanctuary | Bac Lieu | x | | | | | x |
| Phu My Grassland Nature Reserve | Kien Giang | | x | | x | | x |
| Tra Su Landscape Protected Area | An Giang | x | x | | | | |

Keys: SUF: Special-use forest; P-PA: Provincial-level protected area; Ram: Ramsar site, BR: UNESCO biosphere reserve; AHP: ASEAN heritage park; and KBA: Key biodiversity area.

Source: VNForest (2021)

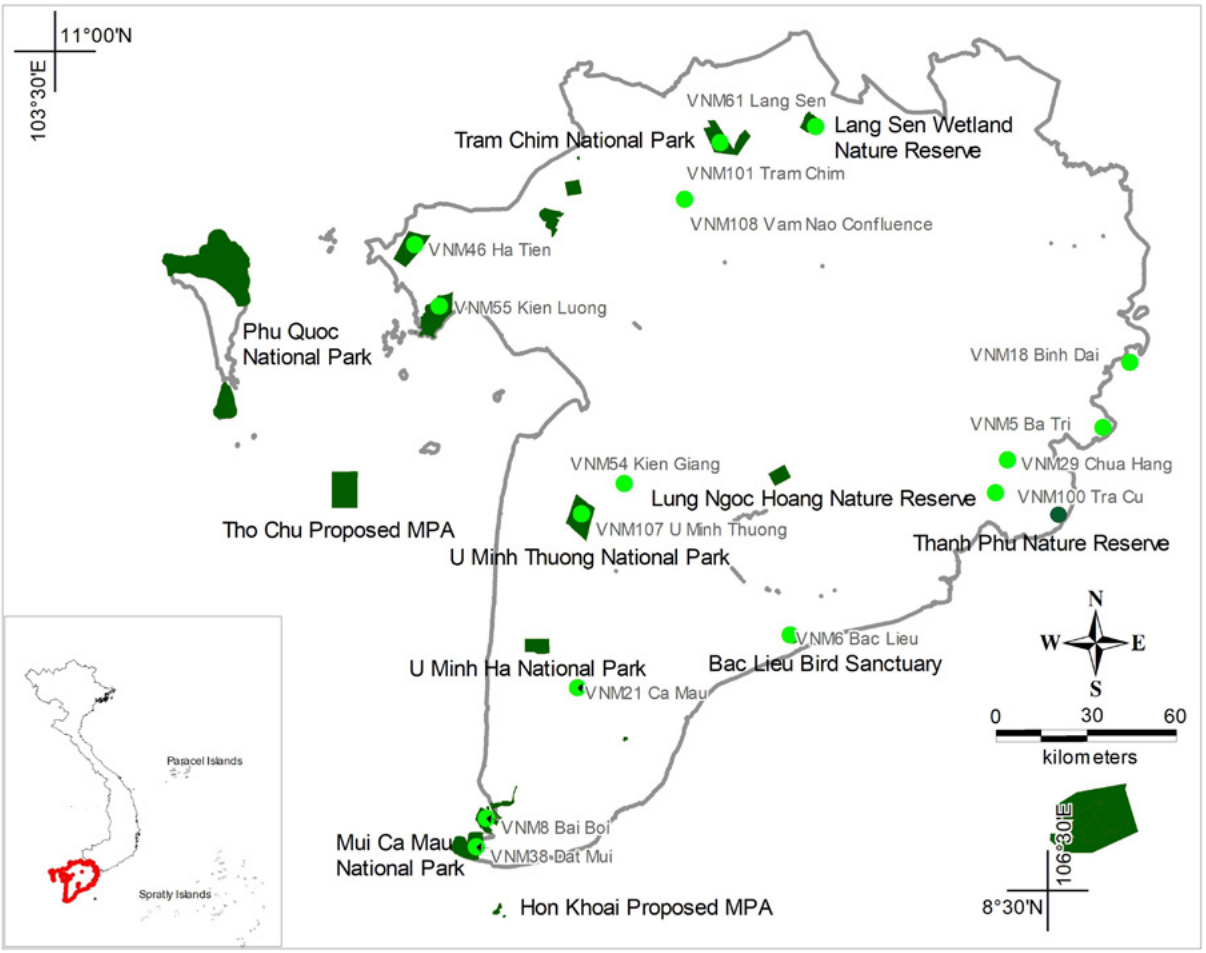


**Figure 1. Map of Mekong Delta showing existing and proposed special-use forests (SUFs), marine protected areas (MPAs) and key biodiversity areas (KBAs)**

Source: Authors' own work

Thanks to that, the number of waterbirds has increased significantly. A very good sign is that four sarus cranes have re-visited the park in the dry season of 2024 (Nguyen Hoai Bao personal communication, January 09, 2024).

**Mui Ca Mau National Park** (WDPA ID: 555555595) covers 41.862 ha. Of this, 15,262 ha of special-use forest and 26,600 ha of marine protected area are found in Ngoc Hien District, Ca Mau Province. The site was upgraded to 'national park' status in 2003 and designated as a Ramsar site in 2013 (RAMSAR 2013). The park contains extensive areas of intertidal mudflat, and large areas of mangrove forest that provide important habitats for migratory birds in the East Asian–Australian Flyway.

**U Minh Thuong National Park** (WDPA ID: 555626104 covers 8,038 ha in U Minh Thuong District, Kien Giang Province. The site was upgraded to 'national park' in 2002 and designated as a Ramsar site in 2015 (RAMSAR 2015a). The site supports one of the last significant areas of peat swamp forest remaining in Vietnam (the other area is in U Minh Ha National Park). The vegetation of the park comprises *Melaleuca* forests on both peat and mineral soils; seasonally inundated grasslands; open swamps; and natural streams and canals. The site is most important for conservation of small carnivorous fauna in the Mekong Delta, with recent records of hairy-nosed otter (*Lutra sumatrana)*, Sunda pangolin (*Manis javanicus*) and fishing cat (*Prionailurus viverrinus*) (Save Vietnam's Wildlife 2021). U Minh Thuong is very important for bird conservation, with 187 species being recorded (Buckton et al. 1999), including a number of species of conservation concern. The site also supports a bird colony with globally significant

congregations of a number of the more common waterbird species, including purple swamphen (*Porphyrio porphyrio*), little cormorant (*Phalacrocorax niger*), purple heron (*Ardea purpurea*) and glossy ibis (*Plegadis falcinellus*) (UMT NP 2013).

**U Minh Ha National Park** (WDPA ID: 555594123) covers 32,761.1 ha of special-use forest in U Minh and Tran Van Thoi districts of Ca Mau Province. The site, formerly known as Vo Doi Nature Reserve, was upgraded to a national park in 2006. Major vegetation types of U Minh Ha are semi-natural (originally planted but no longer tended) *Melaleuca* forest and seasonal inundated grassland. Recent camera trapping results in U Minh Ha confirm the importance of this site for some globally threatened species such as Sunda pangolin (*Manis javanica;* CR), hairy-nosed otter (*Lutra sumatrana*; EN), and small-clawed otter (*Aonyx cinereus*; VU). There is no updated information on the avifauna of the site. Buckton et al. (1999) confirmed that this area supports high bird species richness, especially of common species.

**Phu Quoc National Park** (WDPA ID: 10398, and 303088) covers 70,505.47 ha. Of this, 29,596.00 ha of special-use forest and 40,909.47 ha of marine protected area are found in Phu Quoc District, Kien Giang Province. The inland component of the park supports evergreen broadleaf forest, *Melaleuca* forest, and mangrove forest ecosystems. Moreover, the marine component supports some of most intact coral reef and seagrass ecosystems of Vietnam. In the park, 1,397 species of vascular plants, and 28 mammal, 119 bird, 47 reptile, and 14 amphibian species have been identified. In addition, 152 species of seawater fish, and 132 mollusc and 32 echinoderm species have been recorded. The marine component is known to provide habitats for the green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), dugong (*Dugong dugon*) and Irrawaddy dolphin (*Orcaella brevirostris*) (Luong ed. 2013).

**Lang Sen Wetland Nature Reserve** (WDPA ID: 555626103) covers 2,156.25 ha of special-use forest in Tan Hung District, Long An Province. The site was included in the Prime Minister's Decision No. 192/2003/QD-TTg, dated 17 September 2003 on approving the Strategy for the Management of Vietnam's Special-use Forest Systems to 2010. In 2004, Long An PPC issued Decision No. 199/QD-UB to establish the Lang Sen Wetland Reserve. The site was designated as a Ramsar site in 2015. Lang Sen is a wetland complex comprising a mosaic of seasonally inundated grassland, riverine *Melaleuca* and mixed forest, and open swamp. The site supports the best sample for natural riverine forests in the Mekong Delta. Lang Sen provides habitat for a wide diversity of wetland birds (Buckton et al. 1999) and is also highly important for fish species, especially those of conservation importance (RAMSAR 2015b).

**Thanh Phu Nature Reserve** (WDPA ID: 303036) covers 4,510 ha of special-use forest in Thanh Phu District, Ben Tre Province. This coastal area of intertidal mudflats and mangroves is now severely degraded due to both human impacts and sand intrusion and is no longer important for biodiversity conservation. No mention is made of this site in Ben Tre's Provincial Plan for Biodiversity Conservation to 2030 (Document 1527/KH-UBND dated 20 March 2023 of the Ben Tre Provincial People's Committee).

**Lung Ngoc Hoang Nature Reserve** (WDPA ID: 303028) covers 2,805.37 ha of special-use forest in Phung Hiep District, Hau Giang Province. The establishment of the site was approved by a Prime Minister's Decision No 13/2002/QD-TTg, January 14, 2002. On June 20, 2011, Hau Giang PPC issued Decision No. 22/2011/QD-UBND establishing a Nature Reserve's management board. Lung Ngoc Hoang is a large, flooded, lowland area stretching from the west of the Hau River and comprises *Melaleuca* forests, open swamps, and grasslands (Can Tho University 2017; Nguyen et al. 2021).

**Bac Lieu Bird Sanctuary** (WDPA ID: 303101) covers 125.8 ha of special-use forest in Bac Lieu city, Bac Lieu Province. The site was listed as a special-use forest by Decision 194/CT in 1986. The vegetation at the site comprises small areas of mangrove forest dominated by *Lumnitzera racemosa* and the palm *Phoenix paludosa*; plantations of *Thespesia populnea* and *Acacia auriculiformis* scattered with the shrub *Wedelia biflora*; and small patches of seasonally inundated grasslands (Buckton et al. 1999). The site supports some of the largest and most important bird colonies in the VMD. Although no globally

threatened species are recorded for the site, the site supports important populations of several near-threatened and more common species such as painted stork (*Mycteria leucocephala*), black-headed ibis (*Threskiornis melanocephalus*), oriental darter (*Anhinga melanogaster*), spot-billed pelican (*Pelecanus philippensis*), great cormorant (*Phalacrocorax carbo*), and Indian cormorant (*Phalacrocorax fuscicollis*). Of these, populations of oriental darter and Indian cormorant might exceed the 1% threshold of the global populations (Buckton et al. 1999; Southern Institute of Ecology 2013).

**Phu My Grassland Nature Reserve** (WDPA ID: nil). Phu My was declared a protected area by Kien Giang Province in January 2016, covering a core zone of 1,070 ha and a buffer zone of 1,700 ha (Tran et al. 2019). The site is the last remaining unexploited area of the Ha Tien Plain important bird area (IBA) (Tordoff 2001). Phu My supports two main natural wetland habitat types – seasonally inundated grasslands and *Melaleuca* shrubs. Phu My is one of the most important non-breeding sites for the eastern Sarus crane (*Grus antigone sharpii*) in Vietnam. During recent decades, the Sarus crane population in Cambodia and Vietnam has experienced a rapid decline, going from 850 recorded in 2013 to just 358 cranes in 2017 (Tran et al. 2017). Phu My and the nearby Anlung Pring Sarus Crane Sanctuary in Kam Pot Province Cambodia now host 40 to 50% of sarus cranes during the dry season months from January to April (Tran et al. 2019).

**Tra Su Landscape Protected Area** (WDPA ID: nil) covers 1,050 ha of special-use forest established by An Giang Provincial People's Committee in 2003. Tra Su supports a small block of *Melaleuca* plantation (that is no longer tended) and seasonally inundated grassland and swamp. The site holds a sizable bird colony with relatively large number of common bird species. In the past, few important records were made at this site for the sarus crane (*Grus antigone*) and milky stork (*Mycteria cinerea*) (Robson 2003); in fact, the latter is the only confirmed recent record of this species from Vietnam. The site is now a well-known tourism destination especially for domestic visitors.

### 4.2.2 Marine protected areas

Only one marine protected area was gazetted in the Mekong Delta, the Phu Quoc Marine Protected Area. However, this area is already included as a component in the Phu Quoc National Park (c. 41,000 ha, see Section 4.2.1). Mui Ca Mau National Park also has a marine protected area component (26,600 ha, see Section 4.2.1). Some other areas were proposed by different actors in the last few decades as marine protected areas in the region, including the Nam Du Archipelago (Kien Giang Province) and the Hon Khoai Islands (Ca Mau Province). However, no protection status has been given to these sites.

### 4.2.3 Ramsar sites

Four Ramsar sites were designated in the Mekong Delta. All of them overlap with existing special-use forests (see Section 4.2.1) - Tram Chim, Mui Ca Mau, U Minh Thuong and Lang Sen.

### 4.2.4 UNESCO biosphere reserves

Two biosphere reserves have been recognized for the Mekong Delta.

- **Kien Giang Biosphere Reserve** (designated in 2006) is located on the south-western tip of Vietnam. The reserve has a total surface area of 1,188,105 ha. It includes 25,899 ha (terrestrial: 12,037 ha; marine: 13,862 ha) of core areas (Phu Quoc National Park, U Minh Thuong National Park, Kien Luong Protected Area); 172,578 ha (terrestrial: 116,791 ha; marine: 55,787 ha) of buffer zones; and 978,591 ha (terrestrial: 189,439 ha; marine: 789,152 ha) of transition zones. The reserve contains various tropical forest ecosystems including primary and secondary vegetation types, limestone forests, seasonally flooded forest, mangrove ecosystems, coastal mudflats and lakes, and coral reef and seagrass ecosystems. In total, 1,480 vascular plant species and 860 animal species were recorded for the reserve (Luong 2013). The reserve supports 57 plant and 36 animal species that are endemic to Vietnam. The marine fauna includes 89 hard coral species, 19 soft corals, 125 coral

reef fishes, 132 molluscs and 32 echinoderms. There are also 62 species of seaweed. The seagrass beds are important habitats for marine turtles, dugong (*Dugong dugon*), the scaly clam (*Tridacna squamosa*), and commercial top shell (*Rochia nilotica*).

- **Mui Ca Mau Biosphere Reserve** (designated in 2009) is located in the southernmost tip of Vietnam. The reserve constitutes a transition area (ecotone) between mangrove and *Melaleuca* forests, which heightens its conservation value, and serves as a reproduction and breeding area for aquatic species. The reserve has a total surface area of 371,506 ha, including 17,329 ha (terrestrial: 14,773 ha; marine: 2,556 ha) of core areas (Mui Ca Mau National Park and U Minh Ha National Park); 43,309 ha (terrestrial: 8,775 ha; marine: 34,534 ha) of buffer zones; and 310,868 ha (terrestrial: 94,688 ha; marine: 216,180 ha) of transition zones. The reserve supports a very diverse complex of marine and wetland ecosystems – semi-evergreen forest, inundated forest, brackish marshland, intertidal flats, mangroves, seagrass beds and small areas of coral reefs. This reserve provides very important staging and wintering habitats for many important migratory waders using the East Asian-Australian Flyway.

### 4.2.5 Key biodiversity areas (KBAs)

A total of 15 KBAs were identified for the Mekong Delta. Most of them were last assessed by BirdLife International under an IBA identification effort in 2001 (Tordoff 2001) and information on them is already out of date. Only Vam Nao Confluence and Kien Giang were recently included in 2018. Some of these KBAs have already been included in official protected areas, but some others remain unprotected.

1. **VNM5 Ba Tri, Ben Tre** covers 2,204 ha in Ben Tre Province and was recognized under Criteria A1 'Threatened species' and D1 'Demographic aggregations'. This KBA consists of the mouth and riverside areas of the Bai Lai River, which opens out onto sandy flats and shallows in Ba Tri District. There is no official protection status for that site yet. The site used to be a very important staging and wintering site for shorebirds, including the globally vulnerable Chinese egret (*Egretta eulophotes*) and the spoon-billed sandpiper (*Eurynorhynchus pygmeus*). However, after more than 20 years, especially after the Ba Tri sea dike was completed in 2012, most of important habitats for shorebirds were removed. Numbers of shorebirds using this site have sharply reduced (Nguyen et al. 2023).
2. **VNM6 Bac Lieu** covers 588 ha in Bac Lieu Province and was recognized under Criterion D1 'Demographic aggregations'. The site is included in the special-use forest system of Vietnam (see more details at 4.2.1 above).
3. **VNM8 Bai Boi, Ca Mau** covers 5,525 ha in Ca Mau Province. It is coastal area inside Mui Ca Mau National Park, a special-use forest of Vietnam. The site was recognized under Criteria A1 'Threatened species' and D1 'Demographic aggregations' as it supports a significant population of Chinese egret (*Egretta eulophotes*).
4. **VNM18 Binh Dai, Ben Tre** covers 9,882 ha in Ben Tre Province and was recognized under Criteria A1 'Threatened species' and D1 'Demographic aggregations'. It has an area of muds and sandy flats, with marshlands and mangroves in the coast of Binh Dai District. There is no official protection status for that site yet. Similar to Ba Tri (VNM5), this site used to be a very important staging and wintering site for shorebirds but is highly degraded now.
5. **VNM21 Ca Mau** covers 433 ha in Ca Mau Province and was recognized under Criterion D1 'Demographic aggregations' because pf a bird colony inside Ca Mau City Public Park. Due to inappropriate management, the number of birds roosting and breeding on this site has gradually reduced (Nguyen Hoai Bao personal communication, January 08, 2024).
6. **VNM29 Chua Hang, Tra Vinh** covers a 2 ha bird colony in a Khmer pagoda in Tra Vinh Province. It has no protection status yet. The site was recognized under Criterion D1 'Demographic aggregations'. In the same context as for other areas in the Mekong Delta, the number of birds roosting and nesting in this pagoda has also decreased sharply in recent years.

7. **VNM38 Dat Mui, Ca Mau** covers 6,389 ha in Ca Mau Province. The coastal area lies inside Mui Ca Mau National Park, a special-use forest of Vietnam. The site was recognized under KBA Criteria A1 'Threatened species' and D1 'Demographic aggregations' as it supported significant populations of Chinese egret (*Egretta eulophotes*)*s*, Asian dowitcher (*Limnodromus semipalmatus*), and Eurasian curlew (*Numenius arquata*).
8. **VNM46 Ha Tien, Kien Giang** covers 7,032 ha in Kien Giang Province and was recognized under Criterion A1 'Threatened species'. Almost 7,000 ha of natural grassland was proposed by BirdLife International in early 2000s. In the last 20 years, this area was heavily encroached upon and is now mostly converted into rice paddies and aquaculture lands. Until 2016, only ca. 1,000 ha of it was gazetted as the Phu My Species and Habitat Conservation Area by Kien Giang Provincial People's Committee.
9. **VNM54 Kien Giang** covers 153,251 ha of Kien Giang Province. This large KBA was proposed in 2018 under Criterion B1 'Individual geographically restricted species' because of a newly describe crustacean species, *Caridina uminensis*.
10. **VNM55 Kien Luong** covers 7,536 ha in Kien Giang Province and was recognized under Criterion A1 'Threatened species'. In the late 1990s, early 2000s, the site supported the largest population of eastern sarus crane (*Grus antigone sharpii*) in Vietnam. However, most of the natural and semi-natural wetland habitats in this area have been converted into other production lands. No cranes were recorded in recent years. The most important biodiversity value of the site is now concentrated in the remaining unquarried karst hills (ca. 150 ha), which support the globally endangered Indochina silver langur (*Trachypithecus germaini*) and many other globally threatened and endemic plants and invertebrates. In the last 20 years, some international organizations and national institutes had made great efforts to encourage the national and provincial governments to establish a protected area in this KBA, but without success so far.
11. **VNM61 Lang Sen** covers 3,301 ha in Long An Province and was recognized under Criterion A1 'Threatened species'. The site is a nature reserve, an official protected area (special-use forest) of Vietnam (see more details at 4.2.1 above).
12. **VNM100 Tra Cu** covers a 2 ha bird colony in a Khmer pagoda in Tra Vinh Province. It has no protection status yet. The site was recognized under Criterion D1 'Demographic aggregations'. In the same context as for other areas in the Mekong Delta, the number of birds roosting and nesting in this pagoda has also decreased sharply in recent years.
13. **VNM101 Tram Chim**. covers 8,022 ha in Dong Thap Province and was recognized under Criteria A1 'Threatened species' and D1 'Demographic aggregations'. The site is a national park, an official protected area (special-use forest) of Vietnam (see more details at 4.2.1 above).
14. **VNM107 U Minh Thuong** covers 8,025 ha in Kien Giang Province and was recognized under Criteria A1 'Threatened species' and D1 'Demographic aggregations'. The site is a national park, an official protected area (special-use forest) of Vietnam (see more details at 4.2.1 above).
15. **VNM108 Vam Nao Confluence** covers 42,516 ha in An Giang Province and was recognized under Criterion A1 'Threatened species'. The site supports populations of giant pangasius (*Pangasius sanitwongsei*; CR) and Jullien's golden carp (*Probarbus jullieni*; EN).

**Other important sites (for migratory birds)**

Nguyen et al. (2023) synchronized data from recent surveys and surveillances done by professional researchers and by amateur bird watchers and photographers and compiled a list of important sites for migratory birds, especially the shorebirds that use the East Asian–Australian Flyway. Some of these sites are not included in any protected area network and nor were they listed by other hotspot identification efforts in the past (see, for example, Buckton et al. 1999; Moore and Nguyen 2001; Tordoff 2001).

In the past few decades, there have been many studies on biodiversity carried out in the Mekong Delta. However, most are single studies targeting specific taxa, or focus on specific sites. There is a lack of a comprehensive study synthesizing full data on the biodiversity of the region. According to

compiled data, at least 82 species of mammals, 342 species of birds, 114 species of herptiles, and 414 species of fish have been recorded for the VMD. Of these, 73 species are globally threatened (IUCN 2024). Although the invertebrate fauna have not been fully studied, nearly 400 species of dragonflies, benthic invertebrates, and land snails have been recorded. As regards the flora, 733 species have been recorded, including 5 globally threatened species (IUCN 2024). Although the delta areas usually do not support a high level of endemism, on the large island of Phu Quoc and in the limestone hills of the Kien Luong area, relatively many narrowly endemic species have been recorded, especially limestone plants and invertebrates.

Biodiversity in the VMD is mainly concentrated in a handful of protected areas. There are currently 11 protected areas established in the VMD with a total area of about 80,000 ha on land that is home to special-use forest and 67,000 ha of marine protected areas. figure has only reached about 2% of land area and about 0.6% of sea area, still very far from the goal of the post-2020 biodiversity framework, even much less than the national target (i.e. 9% of land area, 3-5% of sea area). Moreover, as the assessment of most of those KBA was carried out a long time ago (more than 20 years), the status of these areas has changed a lot, and some areas no longer support high biodiversity value.

**Table 7. List of important sites for migratory birds**

| Name of site | Approximate coordinates | Description of landscape at site | Protection status | Species of conservation concerns recorded | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | SBS | SG | GK | FEC | CE | SG |
| **Tien Giang Province** | | | | | | | | | |
| Tan Thanh mudflats | 10°16’17.6”N 106°45’52.2”E | An extensive area of intertidal flats in Tan Thanh commune, Go Cong District, that is part of a proposed IBA (Tan Thanh-Con Ngang) with remnant strips of mangroves. | Unprotected | x | x | x | | x | |
| Con Ngang | 10°12’10.3”N 106°46’31.6”E | A strip of intertidal flats and a mudflat island flanked by mangrove forests that is part of the proposed Tan Thanh-Con Ngang IBA on the south bank of the Tien Giang tributary. | Unprotected | | x | x | x | x | x |
| **Ben Tre Province** | | | | | | | | | |
| Ba Tri | 9°59’28.2”N 106°39’50.2”E | IBA (see 4.2.5 above) | Unprotected | x | x | x | x | x | |
| Binh Dai | 10°02’16.5”N 106°42’58.2”E | IBA (see 4.2.5 above) | Unprotected | | x | x | | x | |
| **Ca Mau Province** | | | | | | | | | |
| Dat Mui-Bai Boi | 8°37’28.7”N 104°45’34.9”E | IBAs (see 4.2.5 above) | Partly protected in Mui Ca Mau National Park | | | | x | x | |

Keys: SBS: Spoon-billed sandpiper *Calidris pygmeus* (CR); SG: Spotted greenshank *Tringa guttifer* (EN); GK: Great knot *Calidris tenuirostris* (EN);FEC: Far eastern curlew *Numenius madagascariensis* (EN); CE: Chinese egret *Egretta eulophotes* (VU); and SG: Saunders’s gull *Saundersilarus saundersi* (VU).

Source: adapted from Nguyen et al. (2023)

## 4.3 Threats to biodiversity in the Mekong Delta

Biodiversity attributes of the Mekong Delta have been threatened by different factors, that can be divided into following categories:

### 4.3.1 Habitat loss and destruction

Under the pressure of population explosion and economic development, most of the natural habitats of the Mekong Delta have disappeared over the past half century. Habitat loss and destruction come in different forms.

***Changes in area of wetland habitat*** have been due to channelization, drainage and conversion to agriculture and aquaculture, urbanization, coastal erosion, and climate change. In the 1980s and 1990s, natural grasslands in the delta, which support very high biodiversity values, were deemed to be 'not-in-use', and therefore seen as 'wasteland' (Buckton et al. 1999). Therefore, they were subjected to large-scale conversion, especially into rice fields to serve the purpose of making Vietnam the world's leading rice exporter. Along with that, the intensive dike network created in that period changed the hydrological regime and led to the degradation of natural wetland systems, making them no longer able to provide necessary ecosystem functions, including the role of supporting biodiversity. To date, only small areas of natural and semi-natural grasslands remain, mostly inside the protected areas. The loss of grassland leads to the reduction and even local extinction of grassland-dependent species; most noteworthy are the eastern sarus crane (*Grus antigone sharpii*), Bengal florican (*Houbaropsis bengalensis*) and white-shouldered ibis (*Pseudibis davisoni*).

Natural mangrove forests of the Mekong Delta have been almost entirely lost, mostly due to clearance for aquaculture in the late 1980s and through exploitation of forest products. Since the mid-1990s, efforts to replant mangrove have been made intensively, leading to an expansion in terms of forest cover now. However, mangrove planting regimes often fail to maximize the potential for restoration of biodiversity conservation, and in some areas can actually be detrimental. Reasons for this may be: i) planting too densely and sometimes planting unsuitable species on newly established mudflats, where mangrove trees can be established naturally; ii) the planting of mono-species, leading to low-biodiversity areas; and iii) planting in unsuitable places such that it even leads to the destruction of important habitats for important species, especially those for migratory shorebirds and aquatic species. Furthermore, most intertidal flats in the coastal areas are heavily disturbed by human activities, including land reclamation and coastal aquaculture, especially white-clam farrming along the east coast of the delta.

***Mining,*** particular limestone quarrying, permanently removed and destroyed parts of the limestone hills in Kien Giang Province, which supports very high endemism of plants and invertebrates, as well as the most important population of the Indochinese silvered langur (*Trachypithecus germaini*).

In addition, sand mining is also a problem that changes the river bed and water flows, furthers river bank erosion and directly affects aquatic species as well as indirectly impacting wetland habitats, especially those of biodiversity conservation importance.

***Changes in hydrological regime in the catchment*** have been brought about by the construction of dams and water reservoirs in the Mekong River basin. In particular, the new mainstream dams along the Mekong River in Laos PDR may lead to changes in flooding regimes, with major repercussions for the agricultural system in the delta. Flooding renews soil fertility by depositing large amounts of silt over agricultural land. It also flushes out pollutants, acidification and salinity. Furthermore, the dams cause severe changes in sediment and nutrient flows in the downstream region (Mekong Delta of Cambodia and Vietnam) that threaten the aquatic biodiversity. Dam construction may also restrict the movement of many migratory fish species, especially those of very high economical and biological value such as *Pangasius* species.

***Failures in hydrological management leading to changes in the water regime of wetlands of international and national importance*** have occurred, particularly in protected areas. With the hard dike system, water stays too deep for too long on the site, such that the original habitats no longer exist for important wildlife species. This is the case in Tram Chim, U Minh Thuong, Lang Sen, Phu My and many other sites. Furthermore, drainage and channelization for fire prevention purposes in protected areas meant that the peatland layer dried out (case in U Minh Thuong) or increased the oxidation of acid-sulphate soils, resulting in acidification of surface waters (cases in Phu My and Tram Chim). The landscape of U Minh in southern Vietnam contains the country's last remaining fragments of peat swamp forest and is home to several globally threatened species. Despite the presence of two national parks, habitat loss due to failures in water management, double with illegal hunting and fishing by local communities have led to a decrease in these endangered populations (Nuwer and Bell 2013).

### 4.3.2 Over-exploitation

Although the situation has improved significantly in recent years, due to pressures from daily living demands, birds and other animals are still widely hunted in the delta, especially outside protected areas. The catching of migratory birds in the Mekong Delta has been a tradition for generations. Mist-nests are widely used along the coast in migratory seasons. Other birds are being hunted using different tools and methods including nets, bird decoys, sound playback as well as poison baits and shotguns. This unsustainable hunting has affected a large number of species, such as swallows, bulbuls, rails, herons and others (Nguyen et al. 2023). Fisheries provide the main source of protein for many people living in the delta, as well as providing an important export commodity. Over-exploitation of fisheries using unsustainable methods has led to serious declines in aquatic biodiversity.

### 4.3.3 Pollution

According to all interviewees, pollution in the delta, which is damaging fisheries and wildlife resources on which many people depend, comes from different sources. Firstly, pollutants come from agricultural run-off (nutrients, pesticides and herbicides); and secondly from industry, motorized boats, manufacturing and processing factories, and domestic waste.

### 4.3.4 Climate change

Long-term trends in global climate change may lead to the delta becoming increasingly susceptible to flooding and saltwater inundation.

By 2060, the average annual basin-wide increase in temperature could be between 0.4 °C and 3.3 °C, depending on the trajectory of global greenhouse gas emissions. Average change in rainfall by 2060 under a dry-climate scenario is projected to fall by 16%, and under a wet-climate scenario, to increase by 17%. Sea level is projected to rise by approximately 15 cm by 2030 and by approximately 30 cm by 2050 (Mackay and Russell 2011). These will affect the survival and distribution of organisms in the Mekong Delta through habitat changes related to water and the adaptive temperature of organisms. For example, with the most extreme scenario of climate change, the habitats of typical Mekong Delta mangroves and other plant species *Avicennia alba*, *Rhizophora apiculata* and *Melaleuca cajuputi* could be reduced by 33% by 2027 (Dang et al. 2022). Other climate-related extreme hydrological events such as flood, drought, erosion and salinity intrusion have already produced adverse impacts on the natural and production ecosystems as well as on wildlife populations (Tuyet-Chinh 2019).

### 4.3.5 Alien invasive species

Invasion by non-native plants (e.g., *Mimosa pigra* and water hyacinth (*Eichhornia crassipes*)) has resulted in the deterioration of native communities of flora and fauna. Water hyacinth forms dense mats on the water surface, which reduces the amount of sunlight reaching beneath the water surface,

and out-competes most other aquatic plants. It also blocks canals and rivers. *Mimosa* is a more recent invader and can tolerate waterlogged soils. It can form dense stands and grows rapidly. Despite its strong impact on protected areas, the potential impacts of this species on agricultural land are poorly known (Buckton et al. 1999). Several animal species have been introduced to the delta, such as: *Angulyagra polyzonata*, *Corbicula fluminea*, *Sermyla riqueti*, *Sinotaia aeruginosa*, *Pomacea canaliculate*, and *Neritina rubida*. Of these, the most significant is the apple snail (*Pomacea* sp.). These are now common in the delta, and are often considered to be a major rice pest (Buckton et al. 1999; Nguyen et al. 2023).

Both U Minh Thuong and Tram Chim wetlands have been invaded by alien plant species that are threatening the natural biodiversity of the area (Nguyen et al. 2022).

# 5 Legal framework on biodiversity conservation

Although decentralization of legal powers has been strongly promoted in Vietnam over the past few decades, in the field of biodiversity conservation, this progress has not occurred. The reasons for this vary, but are mostly due to a lack of knowledge and/or technical resources at sub-national levels. Most provinces only implement directive and legal documents related to biodiversity conservation issued from the central level.

This section will list and discuss the selected international and national laws and how they can influence biodiversity in the delta.

## 5.1 International treaties (multilateral environment agreements – MEAs)

***Vietnam Nationally Determined Contribution (2022).*** Vietnam commits to carrying out sustainable management of forest resources associated with biodiversity protection and the enhancement of ecosystem services as part of its key policies and measures to adapt to and mitigate climate change.

***The Convention on Biological Diversity* (CBD)** – Vietnam ratified the CBD in 1995 with the Ministry of Natural Resources and Environment (MoNRE) playing a role as the national focal point. In implementing this important regulation, Vietnam has taken a number of actions, such as preparation of national reports (most recent is the 6$^{th}$ National Report in 2022), issuing action plans and national strategies (the 1$^{st}$ National Action Plan was approved in 1995 and the most recent one is National Strategies on Biodiversity, approved by Decision 149/QD-TTg in 2022). In addition, in the last 30 years, the Government of Vietnam has enacted a number of items of legislation to support implementation of the CBD; the most notable one was the country's first Biodiversity Law in 2008, later amended in 2018.

***Kunming–Montreal Global Biodiversity Framework (2022).*** Vietnam expressed its political commitment to implement the Global Biodiversity Framework in Vietnam by identifying opportunities for cooperation, mobilizing resources, and engaging society and private-sector relevant stakeholders to achieve national and global biodiversity objectives while promptly enhancing the system of biodiversity conservation organizations and establishing a robust biodiversity database (VNA 2023).

***Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES)** – Vietnam joined CITES in 1994. The Forest Protection Department (FPD) of the Ministry of Agriculture and Rural Development (MARD) was assigned as the national management authority. The Institute of Ecology and Biological Resources (IEBR) and the Centre for Natural Resources and Environmental Studies (CRES) of Hanoi National University were designated as the scientific authorities. A CITES office was established in the FPD to manage the species listed in CITES appendices and was deemed responsible for CITES-related certification in the country. In 2022, the Prime Minister issued Decree 11/2002/ND-CP to support implementation of CITES. This decree is now improved by Decree 06/2019/ND-CP dated 22 January 2019 on the Management of Endangered, Precious and Rare Species of Forest Fauna and Flora and Implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

***Convention on Wetlands of International Importance (Ramsar Convention)*** – Vietnam was the first Southeast Asian country to join the Ramsar Convention when it successfully designated the country's first Ramsar site, Xuan Thuy, in 1989. The Natural and Biodiversity Conservation Agency of MoNRE was

assigned as the national focal point. To date, Vietnam has designated nine Ramsar sites; of them, four sites are located in the Mekong Delta – Tram Chim National Park (2012), Mui Ca Mau National Park (2013), U Minh Thuong National Park (2015) and Lang Sen Wetland Reserve (2015). Thanks to the hard work of governmental agencies with support from international non-governmental organizations (NGOs), in the last few decades, the views on wetlands and their importance for both human beings and wildlife conservation have changed significantly. A number of legal instruments and policies have been issued to support wetland conservation, including the most recent National Action Plan for Conservation and Sustainable Development of Wetland Areas for the 2021–2030 Period, approved by the Prime Minister's Decision 1975/QD-TTg dated 24 November 2021.

***Other international agreements*** – Vietnam is also a signatory party to many other intergovernmental environment-related agreements, such as the Cartagena Protocol on Biosafety, United Nations Convention to Combat Desertification (UNCCD), the World Heritage Convention, UN Convention on the Law of the Sea (UNCLOS), and the UN Convention on International Water, among others. It is a national member of a number of regional initiatives, such as the Mekong Agreement 1995, agreement on Establishment of ASEAN Centre for Biodiversity, East Asian–Australian Flyway Agreement, and Indo–Burma Ramsar Regional Initiative.

## 5.2 National laws and policies

The Constitution of the Socialist Republic of Vietnam states "the land, water resources, mineral resources, resources in the sea and airspace, other natural resources and property invested and managed by the State are public properties, coming under ownership of the entire people represented and uniformly managed by the State" (Article 53), and "the State has a policy to protect the environment; to manage and effectively and stably use natural resources; to protect nature and biodiversity; to take initiative in prevention and resistance against natural calamities and respond to climate change." (Article 63). Based on that, biodiversity conservation in Vietnam has been regulated by a number of laws and under-law legislations.

**Land Law (45/2013/QH13)** was issued in 2013 and is subject to amendment in late 2024. For the land ownership, this law prescribes powers and responsibilities of the state in representing the Vietnamese people's ownership of land and uniformly managing land, the land management and use regimes, and the rights and obligations of land users over the land in the territory of Vietnam. This provides a basis for the development of many other laws and legislation relating to biodiversity conservation.

**Law on Fisheries (18/2017/QH14)** was issued in 2017. This law contains revised provisions for the fisheries sector in Vietnam. Its provisions concern, among other things, co-management in fishery resources protection; planning for protection and exploitation of aquatic resources; establishment of marine protected areas (MPAs); and protection of MPAs and habitats from fishing activities, fisheries resources assessment, and import and export of aquatic species prescribed in the Appendices of CITES documents (CITES 2023).

**Forestry Law (16/2017/QH14)** was issued in 2017. This law provides for the management, protection, development and use of forests; and processing and trading of forest products. It regulates most activities around conservation of terrestrial biodiversity including management of protected areas (special-use forests) and wild faunal and floral species.

**Law on Environmental Protection (72/2020/QH14)** was issued in 2020. This law provides for environmental protection activities that include articles on biodiversity conservation especially those on natural heritage sites (protected areas) and species of conservation concern.

**Biodiversity Law (20/2008/QH12)** was issued in 2008 and was later amended in 2018 as per National Assembly Official Document No. 32/VBHN-VPQH, 10 December 2018. The law prescribes the bases for most biodiversity conservation efforts, both area-based and species conservation actions in the country.

Key under-law documents (decrees, a directive and a decision) and political resolutions are as follows:

- PM's Decree No. 65/2010/ND-CP of 11 June 2010 on Detailing and Guiding a Number of Articles of the Biodiversity Law.
- PM's Decree No. 156/2018/ND-CP of 16 November 2018 on Enforcement of a Number of Articles of the Law on Forestry, amended by the Decree 27/2024/ND-CP of 6 March 2024 on Amending and Supplementing a Number of Articles of Decree No. 156/2018/ND-CP of 16 November 2018.
- PM's Decree No. 117/2010/ND-CP of 24 December 2010 on Organization and Management of the Special-Use Forest System.
- PM's Decree No. 57/2008/ND-CP of 8 May 2008 on Promulgation of Regulation Governing Marine Protected Areas of National and International Importance.
- PM's Decree No. 35/2019/ND-CP of 25 April 2019 on Processing of Administrative Infringements on Forest Management and Protection and Forest Product Management.
- PM's Decree 06/2019/ND-CP of 22 January 2019 on Management of Endangered, Precious and Rare Species of Forest Fauna and Flora and Implementation of Convention on International Trade in Endangered Species of Wild Fauna and Flora.
- PM's Decree No. 66/2019/ND-CP dated 29 July 2019 on Preservation and Sustainable Use of Wetlands.
- PM's Directive No. 04/CT-TTg of 17 May 2022 on Urgent Tasks and Solutions to Conserve Wild and Migratory Birds.
- PM's Decision No. 1623/QD-TTg of 27 December 2022 on Prevention and Combat of Biodiversity Crimes through 2030.

## 5.3 National strategies and action plans

**National biodiversity strategies and action plans (NBSAPs)**

After signing the CBD in 1994 (CBD 2016), and with support from the international community, particularly from the CBD's Global Environmental Facility (GEF), the Government of Vietnam attempted to develop the country's first biodiversity action plans. After that, several more NBSAPs have been issued in the last three decades. Under the Biodiversity Law, the ministry that is primarily responsible for guiding and monitoring the implementation of these strategies is MoNRE.

- The first national biodiversity action plan (NBAP) was prepared in 1994 and approved by Prime Minister's Decision No. No. 845/TTg on 22 December 1995. For more than 10 years, this NBAP guided biodiversity conservation activities, especially those financed by international donors and NGOs (more than 70% of its proposed priority projects were fully or partly supported by international organizations).
- The second NBAP was approved by Prime Minister's Decision 79/2007/QD-TTg on 31 May 2007 for the period of 2007 to 2010. However, for many reasons, this NBAP was not well recognized by key parties outside MoNRE and implementation was spotty.
- The National Biodiversity Strategy and Action Plan to 2020 with a vision to 2030 was approved by Primary Decision No. 1250/QĐ-TTg dated 31 July 2013. This NBSAP was prepared to guide biodiversity conservation in Vietnam and in response to its commitments to international agreements, especially CBD and its Aichi Targets.
- The National Biodiversity Strategy and Action Plan to 2030 with a vision to 2050 was approved by Primary Decision No. 149/QD-TTg. This NBSAP is partly in response to the CBD's post-2020 Global Biodiversity Framework. Under the strategy, among other things, the government aims to

increase the area of protected ecosystems to 9% of the country's land surface, marine protected areas to 3–5% of the sea area, and will give priority to conservation of wildlife species, particularly endangered faunal and floral species.

**Vietnam Forestry Development Strategy for the 2021–2030 period, with a vision to 2050** was approved by Prime Minister's Decision No. 523/QD-TTg of 1 April 2021. The strategy sets specific targets for development as regards managing, protecting and developing forest biodiversity; and emphasizes the role of special-use forests, among other targets. For the Mekong Delta, the strategy requires efforts be made "to consolidate, protect and preserve biodiversity in special-use forests including Tram Chim, Mui Ca Mau, U Minh Ha, U Minh Thuong, and Phu Quoc National Parks; other nature reserves; restore and develop mangrove and *Melaleuca* forest ecosystems to serve environmental protection and economic development…".

**Vietnam Fishery Development Strategy for the period to 2030, with a vision to 2045** was approved by Prime Minister's Decision No. 339/QD-TTg dated 11 March 2021. Although it has a strong focus on fishery production, the strategy emphasizes the importance of natural fishery resources conservation, especially the needs of a powerful marine protected area system in this matter.

**Strategy for Management of Special-Use Forests, Marine Protected Areas and Inland Water Protected Areas in Vietnam to 2020 with a Vision to 2030** was approved by Decision No. 218/QD-TTg of 07 February 2014. The strategy's target for the total protected areas was to reach 9% of the country's land area and 0.24% of its sea area by 2020. This strategy is quite general and requires that a new plan for a special-use forest system shall be prepared in the same year (i.e., 2014), and continue to implement the already approved plans for Marine Protected Areas and Inland Water Protection Areas.

**Plan for Development of Special-Use Forest System in Vietnam to 2020, with a Vision to 2030** was approved by Decision No. 1976/QD-TTg of 30 October 2014. The plan redesigns special-use forest systems in Vietnam and proposes a new system with 176 sites. Of them, 20 sites are in the Mekong Delta with a total area of ca. 120,000 ha.

**Plan for Inland Water Protection Area System to 2020** was approved by PM's Decision No. 1479/QD-TTg of 7 October 2008. The plan proposes to establish 31 inland water protected areas, with 7 sites in the Mekong Delta. However, this decision has almost never been implemented in practice.

**Plan for Marine Protected Area System to 2020** was approved by PM's Decision No. 742/QD-TTg of 26 May 2010. The plan proposes a list of 16 marine protected areas to be established by 2020 including 1 site in the Mekong Delta, i.e. Phu Quoc.

## 5.4 Regional and provincial strategies and plans

**Regional Plan for Mekong Delta 2021–2030 Period**, with a vision to 2050, was approved by Prime Minister's Decision No. 287/QD-TTg. This plan is an important foundational document for socio-economic development in the VMD. The plan calls for a more nature-based approach in economic development and emphasizes the importance of conservation of natural resources. This also provides guidelines and a basis for development of the provincial plans in future.

At provincial level, aside from provincial socio-economic development plans, as required by the Biodiversity Law and Law of Planning, a number of biodiversity action plans (under different names and formats) were prepared to guide biodiversity conservation in the provinces. However, due to the lack of technical capacity at this level, the plans are updated in only some provinces but not all. Moreover, the quality of those provincial plans is varied (Table 8).

**Table 8. Provincial biodiversity action plans of some provinces in the Mekong Delta**

| No. | Province | Name of plan | Approval document |
|---|---|---|---|
| 1 | An Giang | Plan for Biodiversity Conservation to 2020, Vision to 2030 | Decision No. 2566/QĐ-UBND, 15 September 2016 |
| 2 | Bac Lieu | Plan for Biodiversity Conservation to 2020, Vision to 2030 | Decision No. 1655/QĐ-UBND, 18 September 2017 |
| 3 | Ben Tre | Action Plan for Biodiversity Conservation to 2030 | Document No. 1527/KH-UBND, 20 March 2023 |
| 4 | Ca Mau | Plan for Implementation of National Strategy for Environment Protection to 2030, Vision to 2050 in the Ca Mau Province[a] | Document No. 263/KH-UBND, 15 November 2023 |
| 5 | Can Tho | NA | NA |
| 6 | Dong Thap | Plan for Biodiversity Conservation of 2021–2025 Period | Document No. 185/KH-UBND, 14 June 2021 |
| 7 | Hau Giang | NA | NA |
| 8 | Kien Giang | NA | NA |
| 9 | Long An | Project Outline on Plan for Biodiversity Conservation to 2020, Vision to 2030 | Decision No. 1240/QĐ-UBND, 13 April 2015 |
| 10 | Soc Trang | Plan for Biodiversity Conservation to 2020 | Resolution No. 28/2012/NQ-HDND, 12 December 2012 |
| 11 | Tien Giang | NA | NA |
| 12 | Tra Vinh | Project Plan for Biodiversity Conservation, Restoration of Ecosystems to Maintain the Integrity and Natural Linkages between Terrestrial and Marine Ecosystems | Under preparation |
| 13 | Vinh Long | Plan for Biodiversity Conservation of 2021–2025 Period, Vision to 2030 | Decision No. 2269/QĐ-UBND, 27 September 2016 |

Source: Authors' own compilation

a Not directly under Biodiversity Law's streams; however, has a component on biodiversity conservation.

There are limited data to date on the effectiveness of these plans on the ground. However, according to all interviewees, law enforcement regarding as well as compliance of stakeholders with these policies and strategies are limited. For example, unsustainable farming practices were widely found in core zones of protected areas and national parks in the Mekong Delta (Tuyet-Chinh 2019). The interviewees also highlighted the lack of sustainable financing and technical expertise at provincial level to implement and monitor these plans

# 6 Conclusions and recommendations

A thorough examination of biodiversity data from the literature has been presented in this report. However, due to limited time and resources, no field survey has been undertaken to validate the information obtained from those secondary sources.

The Mekong Delta was once a large area of natural habitats that supported very high biodiversity. At that time, people lived in harmony with nature and vice versa, and natural systems continuously brought to the delta's people an abundant source of life. However, over the years, especially after the country's unification, the delta's natural resources have become increasingly depleted under the pressures of population growth and rapid economic development. The delta has now become a leading region of Vietnam in terms of rice and fishery production. Along with the impacts of hydrological works in the basin, from hydropower dams, irrigation constructions, dike systems, etc., the area with the greatest number of natural habitats has narrowed, habitat quality is degraded, and species, especially species with high conservation value, are in decline.

The consequences of inappropriate development have gradually been recognized in recent years, especially in the context of climate change bringing new and unpredictable risks. New policies and planning for the region are now aiming at a greener and more nature-based economy. Typically, Resolution 120/NQ-CP in 2017 created conditions for regional linkages and de-intensification of farming systems, and emphasizing nature-based development, among other initiatives. This opens up new opportunities for diversity conservation in the region. However, to be able to base future change on nature, the first important thing is to understand the existing natural conditions of the delta.

Therefore, in the coming time, there needs to be a more comprehensive study to review in detail the current status of biodiversity to provide a basis for development plans and actions in the delta. One could take advantage of new climate initiatives such as high-quality carbon markets to promote the value of biodiversity conservation. Future research studies need to focus on accurately determining the current status of species and ecosystem diversity of the delta, identifying indicator species and initiating the monitoring systems to preserve and strengthen species populations, and maintain ecosystem functions.

As the major biodiversity values of the delta are now concentrated in the protected areas, there is a need to improve the quality of these areas to ensure maximizing their roles as biodiversity conservation hotspots. Recently, with the support of several international organizations, some protected areas in the Mekong Delta have evaluated and updated the Management Effectiveness Monitoring Tool (METT) (U Minh Thuong, Tram Chim, Lang Sen, and Phu My, among others), applying the Spatial Monitoring and Reporting Tool (SMART) to support conservation monitoring and planning (U Minh Ha and U Minh Thuong). These tools have helped significantly improve biodiversity management at the sites. Furthermore, a number of protected areas in Vietnam are evaluating their performance using the IUCN Green List standard[1]. This standard has been widely accepted globally, allowing protected and conserved areas to assess their performance against a set of criteria that are globally consistent and locally relevant. In Vietnam, Green List assessment processes have begun for more than 10 protected areas and 2 protected areas have been listed (Van Long Wetland Nature Reserve and Cat Tien National Park). Some areas in the Mekong Delta with support from Mekong River Commission also

1 https://www.iucn.org/resources/conservation-tool/iucn-green-list-protected-and-conserved-areas

expressed their interest in implementing this assessment (Luu Hong Truong personal communication, January 08, 2024). Participation in the IUCN Green List programme can help sites in the Mekong Delta improve governance, ensure good planning, improve management efficiency and achieve successful conservation outcomes.

There is a need to review the protected area system and make sound recommendations for expanding the system to ensure that key biodiversity values are conserved in protected and conserved areas. In the immediate future, it is necessary to review the KBAs in the delta, consider proposing to remove them from the KBA list and adding new areas with high biodiversity value, for example, two areas in the Tien Giang coastal area.

With the current development status of the Mekong Delta, the remaining land available for establishing new protected areas is very limited. Therefore, it is necessary to consider the options of improving biodiversity conservation outside protected areas. Other effective site-based conservation measures (OECMs) are an opportunity to expand the conserved area within the delta. Recognition, assessment and reporting of OECMs will help improve biodiversity in nature-based agricultural and fisheries production models with the potential to deliver both economic benefits and contribute to typical high biodiversity models such as shrimp–rice, shrimp–lotus, or shrimp–mangrove models. Unforeseen effects will likely be aggravated by climate change in the near future, suggesting a need to rethink the scale of planning towards a more integrated hydrological approach (Le et al. 2018).

Finally, there is a need to research and provide feasible proposals and technical guidelines on improving biodiversity in mangrove and terrestrial forest restoration projects, especially those related to the carbon market. This would deliver dual carbon and biodiversity benefits and take advantage of incentives from climate initiatives to improve the biodiversity of the delta.

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This report aims to provide an up-to-date status report of biodiversity in the Mekong Delta in Vietnam. It also discusses opportunities and challenges for enhancing biodiversity in the region. This report is developed based on an extensive literature review and in-depth interviews with eight experts and six policymakers who have engaged in developing biodiversity policies and programmes in Vietnam for the last two decades.

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