

BirdLife International Vietnam Programme  
in collaboration with the  
Forest Inventory and Planning Institute

**The Conservation of Key Coastal  
Wetland Sites  
in the  
Red River Delta**

**Conservation Report  
Number 8**

The Conservation of Key Coastal  
Wetland Sites  
in the  
Red River Delta

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This report constitutes the results of conservation fieldwork conducted between  
January and June 1996 in the Red River Delta, Vietnam.

**Hanoi, 1996**

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## Conventions Used

Bird names (common and scientific), sequence and species limits follow Inskipp *et al.* (1996).

Diacritical marks are omitted from Vietnamese names due to typographical limitations and the restricted understanding of international readers.

Since this report was written, the names of some provinces have changed. This report uses the names at the time of writing.

## Abbreviations and Acronyms Used

AWB	-	Asian Wetland Bureau, now Wetlands International
CRES	-	Centre for Natural Resources Management and Environmental Studies
Danida	-	Danish International Development Assistance
FAO	-	Food and Agriculture Organization
FIPI	-	Forest Inventory and Planning Institute, Hanoi
IEBR	-	Institute of Ecology and Biological Resources, Hanoi
IUCN	-	The World Conservation Union
MARD	-	Ministry of Agriculture and Rural Development
MERC	-	Mangrove Ecosystem Research Centre
MoF	-	Ministry of Fisheries
MOSTE	-	Ministry of Science, Technology and the Environment
NGO	-	Non-governmental Organization
ppt	-	Parts per thousand
WWF	-	World Wide Fund for Nature

## Executive Summary

The coastal zone of the Red River Delta supports a large inshore fishery which is dependent on the maintenance of the ecological integrity of mangrove forests, intertidal areas and other associated habitats. As a result of an increasing human population coupled with economic growth, utilization of natural resources has become extremely intensive throughout the coastal zone and may no longer be sustainable. The intertidal areas of the Red River Delta have been identified to be of international importance as a feeding and roosting area for several threatened bird species.

Based on this range of threats, the area's conservation importance, the productivity of its fisheries, combined with the under representation of coastal wetlands in the current protected areas system, and a clearly stated government policy relating to protected areas development and wise use of wetlands, there was an urgent need for the identification of sites in the coastal zone of the Red River Delta to ensure their conservation and sustainable use.

Project fieldwork was implemented during a six-month period between January and June 1996 in the coastal districts of Thanh Hoa, Ninh Binh, Nam Ha, Thai Binh and Hai Phong provinces, by a joint team drawn from the Forest Inventory and Planning Institute, Hanoi (FIPI) and BirdLife International. Data were obtained on biological features and current levels of resource-use and land-use by local communities. Sites were then evaluated using established criteria.

The results of the project indicate that there are seven key coastal wetlands in the Red River Delta. The most important single site for conservation is Xuan Thuy Nature Reserve, ranked second was the entire coastal area of Nghia Hung district, ranked third equal were two sites in the Thai Binh estuary, in Thai Thuy and Tien Lang districts, and the Van Uc estuary in Tien Lang district. The newly established Tien Hai Nature Reserve has a relatively low conservation importance and was ranked only sixth by this study. The coastline of southern Thuy Nguyen district was ranked seventh.

Although nature reserves have been established at Xuan Thuy and Tien Hai, minimal resources are currently available and, consequently, there is virtually no conservation management at these sites. All seven sites are threatened by aquacultural development and, probably, unsustainable levels of exploitation of marine products.

The coastal zone of Nghia Hung district, the two sites in the Thai Binh estuary, in Thai Thuy and Tien Lang districts and the Van Uc estuary are all worthy of designation under the Ramsar Convention. The development of an environmentally sensitive coastal development plan for Nghia Hung district and the establishment of nature reserves at the other sites should be considered an urgent priority. General recommendations are made for coastal zone management and numerous detailed management recommendations are made for these key sites. This will not only help secure the conservation of biodiversity but will assist the sustainable management of natural resources for human communities in these districts.



## Tóm Tắt Quá Trình Hoạt Động

Vùng ven biển châu thổ sông Hồng là nơi có tiềm năng lớn về thủy sản, điều đó phụ thuộc vào việc duy trì toàn vẹn hệ sinh thái của rừng ngập nước, các vùng bãi triều cũng như các sinh cảnh có liên quan khác. Do dân số tăng lên nhanh cộng với tăng trưởng kinh tế làm cho việc sử dụng các nguồn tài nguyên ở các vùng ven biển bị quá mức và thiếu tính ổn định. Những vùng triều ở châu thổ sông Hồng đã được xác định là có tầm quan trọng quốc tế bởi đây là những vùng cư trú và sinh sản của một số loài chim đang bị đe dọa.

Dựa vào mức độ đe dọa, tính đa dạng sinh học cao và tầm quan trọng của công tác bảo tồn, tiềm lực của nguồn thủy sản, với sự tồn tại của các vùng đất ngập nước ven biển trong hệ thống các khu bảo vệ cộng với chính sách của Nhà nước về việc phát triển các khu bảo vệ và sử dụng hợp lý đất ngập nước, có một yêu cầu được khẩn thiết được đặt ra là xác định các địa điểm để đảm bảo việc bảo tồn và sử dụng bền vững các khu vực đó.

Các chuyên gia của Viện điều tra Quy hoạch rừng và tổ chức Bảo tồn chim quốc tế đã tiến hành công tác ngoại nghiệp trong sáu tháng kể từ tháng 1 đến tháng 5 năm 1996 ở các vùng ven biển của các tỉnh Thanh Hóa, Ninh Bình, Nam Hà, Thái Bình và Hải Phòng. Đã thu thập được các số liệu về đặc điểm sinh học và tình trạng hiện tại của các nguồn tài nguyên cũng như việc sử dụng đất của nhân dân địa phương. Các tiêu chuẩn chi tiết đã được dùng khi đánh giá các địa điểm này.

Kết quả của dự án chỉ ra rằng có 7 vùng ngập nước ven biển quan trọng ở vùng châu thổ sông Hồng. Vùng quan trọng nhất đối với công tác bảo vệ là Khu Bảo tồn Thiên nhiên Xuân Thủy, xếp thứ 2 là toàn bộ vùng ngập nước ven biển ở huyện Nghĩa Hưng, xếp thứ 3 là hai khu vực cửa sông Thái Bình, ở huyện Thái Thụy và cửa sông Văn Úc ở huyện Tiên Lãng. Khu Bảo tồn Thiên nhiên Tiên Hải mới được thành lập, công tác bảo tồn có ý nghĩa thấp hơn và xếp hàng thứ tư trong nghiên cứu này. Bờ biển ở phía Nam huyện Thủy Nguyên được xếp sau cùng.

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Vùng ven biển huyện Nghĩa Hưng, hai khu vực ở cửa sông Thái Bình, thuộc huyện Thái Thụy và huyện Tiên Lãng và cửa sông Văn Úc có giá trị cao theo tiêu chuẩn của công ước Ramsar. Việc xúc tiến kế hoạch phát triển và quản lý ở huyện Nghĩa Hưng và việc thành lập khu Bảo tồn Thiên nhiên ở các khu vực khác cần được xem xét và quan tâm hàng đầu. Một số gợi ý kiến nghị về việc lập kế hoạch cho các vùng ven biển cũng như các kiến nghị chi tiết về việc quản lý các vùng trọng điểm này đã được đưa ra. Điều này không chỉ giúp cho công tác bảo tồn đa dạng sinh học mà còn giúp cho việc quản lý bền vững nguồn tài nguyên thiên nhiên có giá trị đối với con người ở các huyện này.

# 1. Introduction

The coastal zone of the Red River Delta supports a large inshore fishery based principally on the exploitation of shellfish, crabs and shrimp. The viability of this fishery is dependent on the maintenance of the ecological integrity of the local mangrove forests, intertidal areas and other associated habitats. As a result of an increasing human population, coupled with increasing demand for marine products, the utilization of natural resources has become extremely intensive throughout the coastal zone and may no longer be sustainable. This ecosystem is further threatened by the reclamation of land for aquacultural development, which has resulted in the loss of thousands of hectares of productive intertidal areas and extensive areas of mangrove forest. The destruction of mangrove forest has serious consequences for both the local and national economy as well as for wildlife, since the mangrove forest both acts as a buffer preventing coastal erosion and plays an important role in sustaining the productivity of the inshore fishery by providing a refuge and feeding area for many marine species of major economic importance. Furthermore, the intertidal areas of the Red River Delta have been identified to be of international importance for several threatened bird species. Based on the high levels of biodiversity, conservation importance and the productivity of its fisheries, there is an urgent need for identification and conservation of sites in the Red River Delta to ensure their sustainable use.

## 1.1 Aim of the Project

The aim of this project was to assist the identification, evaluation and conservation of key wetland sites in the coastal zone of the Red River Delta.

## 1.2 Objectives

In order to achieve the aim, the project had the following objectives:

- Review existing and planned conservation and development activities.
- Identify key coastal wetland sites for conservation.
- Provisionally determine the impact of current resource-use by local communities and any future development plans in relation to threatened species, and make conservation management recommendations.
- Explore potential province-level interest in nature-reserve establishment.
- Produce a conservation strategy for key biodiversity sites.
- Develop a proposal for a one-year project to undertake feasibility studies and management plans for priority sites.
- Provide training in survey and conservation assessment for Vietnamese scientific staff at the central and provincial level.

## 1.3 Background

Previously, only short-term studies had been undertaken in the coastal zone of the Red River Delta and only a limited amount of literature was available. The realization of the potential conservation importance of sites within the coastal zone of the Red River Delta followed a brief survey undertaken by the Centre for Natural Resources Management and Environmental Studies (CRES) and the Asian Wetland Bureau (AWB, now Wetlands International) of Xuan Thuy district, Nam Ha province in 1988 (Scott *et al.* 1989). Subsequently, the government of the Socialist Republic of Vietnam (hereafter, Vietnam), signed and ratified the Ramsar Convention and Xuan Thuy was notified as the first Ramsar Site in Vietnam. Later, the site was designated as a nature reserve under national legislation.



Subsequent research was undertaken at the site by CRES, the Australian Wader Studies Group and the then AWB in 1991 (Lane *et al.* 1994), and, more recently, by the Mangrove Ecosystem Research Centre (MERC) and the University of East Anglia (Nguyen Hoang Tri *et al.* 1996). In 1994, the Zoological Museum, University of Copenhagen, together with the Forest Inventory and Planning Institute, Hanoi (FIPI) and the Institute of Ecology and Biological Resources, Hanoi (IEBR), conducted a project in Nghia Hung district, Nam Ha province. The aim of this project was to determine the biological importance of the district and study the sustainability of natural resource-use, especially the exploitation of bivalve molluscs, amongst the coastal communities of Nghia Hung district (Nielsen *et al.* 1994, Pedersen and Nielsen 1995, Le Trong Trai *et al.* 1996, Pedersen *et al.* 1996, Pedersen *et al.* 1998). This and previous projects established beyond doubt the biological and conservation importance of these areas as staging sites for migratory shorebirds and wintering sites for globally threatened bird species (i.e. bird species allocated an IUCN category of threat), especially Black-faced Spoonbill *Platalea minor* and Saunders's Gull *Larus saundersi*, both of which are "keystone species" within the intertidal ecosystem.

#### 1.4 Justification

As human population and development pressures increase in the Red River Delta, the need to regulate current levels of natural resource-use to ensure that it remains within sustainable levels, whilst in addition planning future land-use, becomes ever more important. Ecologically sensitive land-use planning, including the establishment of protected areas, will ensure that the long-term viability of the ecosystem, including its biodiversity, is maintained, which will, in turn, sustain the economic and social fabric of the human communities dependent upon it.

To date, however, only one protected area, Xuan Thuy Nature Reserve (covering 16,000 ha or 1% of the total delta area), has been fully established in the Red River Delta, an area which encompasses more than 1,700,000 ha. More recently, the establishment process for a second protected area, Tien Hai Nature Reserve, has begun. In the document entitled, *Renovation of strategies for forestry development until the year 2000*, the Ministry of Forestry (which has since been incorporated into the Ministry of Agriculture and Rural Development (MARD)) declared the intention of the government of Vietnam to expand the system of special-use forests, comprising national parks and nature reserves, to cover two million hectares and to improve the management of forests in coastal areas. Additionally, as a signatory to the Convention on Biodiversity, the government of Vietnam has, in the *Biodiversity Action Plan for Vietnam* (Anon. 1994a), made a commitment to developing an integrated coastal zone management programme and accorded the development of a wetland conservation strategy the highest priority.

Given the perceived threats to coastal wetlands, the biological and conservation importance of areas surveyed to date, the under-representation of coastal wetlands in the current protected areas system and the above-mentioned government strategic objectives, FIPI and BirdLife International believed that there was a clear and urgent need to fully survey the entire coastal zone of the Red River Delta. This would finally determine, using internationally accepted criteria, the biodiversity and conservation value of all sites along the coastline and would prioritize these sites for conservation action, particularly with regard to nature reserve establishment.

This rationale dovetailed with the objectives of the Asia-Pacific Migratory Waterbird Conservation Strategy 1996-2000, developed by Wetlands International, which aims to promote the development of a system of wetland protected areas throughout the region (Anon. 1996b). Furthermore, BirdLife International is developing a conservation strategy for Black-faced Spoonbill and is currently drafting the Asia Bird Red Data Book. In addition, work will shortly begin on the implementation of BirdLife International's Important Bird Areas programme for Asia. It was hoped, therefore, that the current project would generate valuable data for these other important conservation initiatives.



## 2. Methods

In planning the 1996 field survey, coastal wetlands were identified by reference to 1:50,000 topographic maps based on a series first produced by the United States Army Map Service between 1962 and 1972; 1:100,000 Landsat satellite images from 1992; and the available literature.

The first period of fieldwork comprised a rapid assessment of the entire coastline using an appraisal method developed by Howes (1987). The objectives of this survey were to define the study area and to provisionally identify important coastal wetlands. Coastal wetland sites were provisionally identified and appraised using the following criteria: size of the area; presence of old-growth mangrove forest and associated intertidal areas; diversity of habitats; presence of threatened species of birds; number and diversity of migratory shorebirds; and types and degree of human utilization.

Following this initial appraisal, it was decided to exclude the coastal zone of Quang Ninh province, part of Thuy Nguyen district, Hai Phong province and most of the coastal zone of Thanh Hoa province because these areas lie outside the Red River Delta. The project study area was then finally defined as the coastal zone from Nga Son district, Thanh Hoa province to the Gia River in Thuy Nguyen district, Hai Phong province (Map 1).

The intention was to visit all coastal districts at two different dates during the survey period and to cover high and low-tide periods. This strategy was chosen to detect any seasonal variation in the flora and fauna and any possible variation in human activity. All districts, with the exception of Hai Hau district in Nam Ha province, were visited more than once. Following the initial appraisal, selected sites were targeted for intensive survey and visited up to four times. Thus, survey effort was not equal per kilometre of coastline.

### 2.1 Biological Survey

During the second and main period of field survey up to 26 May 1996, the area of each habitat at each site was estimated, and, during each visit, the habitats were plotted directly onto a 1:100,000 topographical map. At selected sites, plant species lists were compiled (Appendix 2). Different species of shellfish were identified by inspecting catch-bags, collecting shells from middens and visiting local markets (Appendix 4). This method was useful for detecting common species of economic importance. In some areas, in an attempt to monitor the volume of shellfish harvested per man/day, the entire day's catch was purchased from selected shellfish collectors. Information on other marine products of economic importance, including shrimp, crabs, fish and algae was sought by visits to local markets and interviews with shellfish collectors, fishermen and dealers. Samples were frequently taken for subsequent identification.

Systematic counts of birds were undertaken in all coastal areas and species lists generated for all districts and sites (Appendix 3). Ten-minute intensive counts were made in all habitats in the coastal areas and daily three-hour intensive counts were made in the early mornings. High-tide counts of shorebirds were made whilst they were concentrated at roosts. As a result of the height of the tides and the low frequency of diurnal high tides, counts could only be conducted over a short period, every second week. Whenever possible, information was obtained on threatened bird species, particularly in relation to feeding and roosting localities and possible threats.

### 2.2 Socio-economic Survey

Informal but structured interviews were carried out with aquacultural pond-owners and managers,



## *Section 2 - Methods*

hunters, fishermen and shellfish collectors. Species of economic importance and methods of collection were identified. Special attention was paid to shellfish because in some areas this was a major economic activity. General background information was obtained through informal interviews with technical personnel working for district people's committees and demographic data collected via a questionnaire.

## 3. Description of the Red River Delta

### 3.1 Physical Setting

The Red River (known as the Song Hong in Vietnamese) rises in the Van Nam highlands in the People's Republic of China (hereafter, China) and flows south-east for about 1,300 km before it enters the Gulf of Tonkin in the South China Sea, through an extensive delta covering 17,000 km<sup>2</sup> located on the north-east coast of Vietnam (Roop *et al.* 1994, Anon. 1995b). The total catchment area of the Red River covers an estimated 169,000 km<sup>2</sup>, of which 82,400 km<sup>2</sup> is located in China and the remainder lies in northern Vietnam (Anon. 1995b). In addition to the Red River proper, the delta includes the mouths of the Day, Thai Binh and Van Uc Rivers (Map 1). The coastal zone of the Red River Delta which formed the study area for this project, covers 300 km<sup>2</sup> comprising 12 districts in five provinces (Map 1).

**Climate.** The Red River Delta is situated in the sub-tropical monsoon zone. During the year, the north-east monsoon blows from November to late April and the south-west monsoon blows from May to October. The average annual rainfall is 1,900 mm, of which 80% falls from May to October. The climate in the coastal regions is characterised by a wide range in temperature. The coldest month is January, when temperatures can reach 10°C, but the seasonal mean is around 20°C. In summer (May to September), the mean temperature varies from 27 to 29°C. Lower winter temperatures are caused by the southerly extension of a continental air mass over southern China and higher cloud cover leading to a reduced number of sunshine hours. The daily average of 3.1 sunshine hours falls to only 1.3 hours in March. Mean humidity is greater than 80% throughout the year. From July to October, the coastal areas of the Red River Delta are affected by low pressure systems from the South China Sea of varying intensity, from tropical storms to typhoons. These bring heavy rains of about 200 to 250 mm/day with wind speeds of up to 180 km/hour (Nguyen Van Pho and Vu Van Thuan 1994, Anon. 1995b).

**Soil.** The soils in the coastal zone of the Red River Delta are characterised by their high alluvium and sand content. Alluvium comprises a fine, muddy, river-borne sediment which is slightly acidic and suitable for rice cultivation. Sand has a low organic and a high alkaline content and may not be suitable for agriculture (Roop *et al.* 1994).

**Hydrology.** The Red River is the second largest river system in Vietnam with an average rate of flow of 4,100 m<sup>3</sup>/s (Anon. 1995b). In August, the rate of flow is at its highest, comprising 15 to 35% of the total annual volume. During the year, salinity in the river system changes considerably and ranges from 0.5 to 5.0 ppt in the Thai Binh River. In the Red River system, salinity can be as low as 0.01 ppt during the rainy season and 0.001 to 0.005 ppt when the river is in flood (Phan Nguyen Hong and Hoang Thi San 1993). The tidal regime is mainly diurnal but two semi-diurnal periods occur, each over five to seven days a month. The tidal amplitude is between 3 and 4 m.

**Coastal processes.** The Red River carries large volumes of sediment which give its waters their characteristic reddish-brown colour. Concentrations of sediment reach values of 6 to 7 kg/m<sup>3</sup> during flood periods and 11 g/m<sup>3</sup> during low-flow periods (Hoang Niem 1994). It is estimated that the Red River discharges 120 million tonnes of alluvium/year into the Gulf of Tonkin with a mean content of 1 kg/m<sup>3</sup>. This high sediment load is believed to be caused by extensive and increasing levels of deforestation in the upper watershed of the Red River. The low rate of flow and high volume of water results in the deposition of sediments and a high rate of land accretion in the form of muddy intertidal flats in coastal districts of the delta (Phan Nguyen Hong and Hoang Thi San 1993, Hoang Niem 1994, Nguyen Van Pho and Vu Van Tuan 1994). Although coastal erosion may be a natural process, in the Red River Delta it has been exacerbated by human activities, particularly destruction of mangrove forest (Roop *et al.* 1994, Klemas *et al.* 1995).



### 3.2 Vegetation

The coastal zone of the Red River Delta supports a complex system of natural and semi-natural vegetation types. The natural vegetation consists mainly of salt-tolerant species and plant communities including mangrove, saltmarsh and dune vegetation. In brackish areas, two grassland communities comprising reed *Phragmites* sp. and sedge *Cyperus* sp. are found. As a result of high rates of coastal sedimentation and accretion in the Red River Delta, these plant communities are probably all seral vegetation formations. Away from the coastal zone, no natural habitats remain since the landscape is given over entirely to wet-rice cultivation and areas of human settlement which include groves of bamboo and fruit trees.

**Mangrove.** The mangrove ecosystem comprises mangrove forest and the adjacent intertidal area, which represents a transitional zone between the marine and terrestrial environments. Mangroves are a highly complex and productive ecosystem which prevent coastal erosion, and encourage sediment deposition and accretion. Additionally, they provide food, shelter and sanctuary for birds and mammals, and provide spawning, nursery and foraging areas for a wide variety of marine organisms, including fish, shrimp and crabs (Robertson and Duke 1987, Rasowo 1992). A positive correlation between the extent of mangrove forest and marine production has recently been demonstrated (Amarasinghe and Balasubramaniam 1992).

The mangroves of the Red River Delta are of relatively low stature and show low levels of species diversity compared with southern Vietnam and elsewhere within the region. This results from a number of factors including the soil type of which the alluvium is composed. Other limiting factors include low winter temperatures, prolonged periods of inundation during diurnal high tides, increased insolation and prolonged exposure to the air resulting in high levels of evapo-transpiration during diurnal low tides. The large tidal amplitude may cause erosion in the mangrove and cause high levels of seedling transportation, thereby reducing germination rates locally. Ocean currents also inhibit the spread of some species from the south to the north. Species such as *Rhizophora stylosa* and *Bruguiera gymnorhiza* are common in southern Vietnam but are rarely recorded in the Red River Delta. The most common mangrove species in the Red River Delta is *Kandelia candel*, especially in the southern districts of the delta. Three other regularly occurring species, especially in the northern districts of the delta, include *Acanthus ilicifolius*, *Aegiceras corniculatum* and *Sonneratia caseolaris* (Phan Nguyen Hong and Hoang Thi San 1993).

Table 1: Current Distribution of Mangrove in the Red River Delta

District	Mangrove >30 years old (ha)	Mangrove <30 years old (ha)	Free-living mangrove (ha)	Enclosed mangrove (ha)
Nga Son	0	250	100	150
Kim Son	0	150	50	150
Nghia Hung	0	1,600	960	640
Hai Hau	0	50	50	0
Xuan Thuy	0	800	480	320
Tien Hai	0	900	180	720
Thai Thuy	400	3,000	2,300	1,100
Tien Lang	200	100	50	250
Kien Thuy	0	200	110	90
Do Son	0	0	0	0
An Hai	0	150	100	50
Thuy Nguyen	200	200	350	50
Total	800	7,400	4,730	3,470

**Historical distribution of mangrove.** No precise historical information exists on the former extent of mangrove forest in the Red River Delta. However, the *Dai Nam Geo*, written in the seventeenth century, claims that, before the thirteenth century, mangroves were found throughout the length of the coastal zone. During this period the Kinh (ethnic Vietnamese people) expanded settlement into the delta and began wet-rice agriculture, reducing the extent of mangrove forest (Vo Tri Chung *in litt.*).

The first attempt to estimate the extent and distribution of mangrove in the Red River Delta was by Phan Nhuyen Hong and Hoang Thi San (1993), who determined that, before the Vietnam War, there were 150,000 ha of mangrove in northern Vietnam. FIPI estimated that, by 1983, only 46,400 ha remained in north-east Vietnam, including the Red River Delta, indicating a 70% reduction in area. Today, with the exception of one or two areas, the remaining areas of mangrove have been reduced to small, fragmented patches or strips of forest no more than 5 to 10 m wide. Most of these remnant patches have recently been enclosed within aquacultural ponds, which is causing continued die-back (Table 1). Currently, there are probably no more than 8,200 ha of mangrove remaining, of which only 800 ha constitutes old-growth mangrove more than 30 years old.

**Saltmarsh.** Saltmarsh vegetation has developed on the landward side of dunes and the most extensive areas are in Nghia Hung district, Nam Ha province (Appendix 2).

**Dunes.** Sandy islands with dunes are a common offshore feature along the coast in the Red River Delta. These coastal features are created by a combination of accretion and long-shore drift. The dune plant community is xerophytic and includes *Clerodendron inerme*, *Scaevola taccada* and *Ipomoea pescaprae*. The natural plant community has been modified as a result of extensive afforestation with the Australasian exotic *Casuarina equisetifolia*. The impact of this alien species on the natural dune vegetation is not known.

**Reed and sedge-beds.** In brackish areas, including some aquacultural ponds, and in eutrophic waters, reedbeds composed of *Phragmites* sp. are a characteristic vegetation feature. In Nga Son district in the southern part of the Red River Delta, there are 2,000 ha of the sedge *Cyperus* sp., which is cultivated for use in traditional mattress production.

### 3.3 Fauna

The coastal areas of the Red River Delta support a diverse fauna which is greatly enriched by the arrival of passage migrant birds during the autumn and spring. The mangrove forests, intertidal mudflats and reedbeds provide particularly important habitats for feeding and roosting birds.

**Mammals.** The mammal fauna of mangroves in Vietnam appears both poorly known and poorly documented; Phan Nguyen Hong and Hoang Thi San (1993) list only 17 species of non-volant mammal. The long history of human settlement in this area has greatly modified the extent of natural vegetation. High human population densities combined with high levels of hunting has probably resulted in the local extinction of many mammal species, particularly larger terrestrial species such as Wild Boar *Sus scrofa* and Barking Deer *Muntiacus muntjac*, which are still known from provinces surrounding the Red River Delta. Populations of small carnivores including members of the Mustelidae (such as Eurasian Otter *Lutra lutra* and Oriental Small-clawed Otter *Aonyx cinerea*), Viverridae, Herpestidae and Felidae may persist but at greatly suppressed population levels. During this and previous surveys the authors recorded only Large Bandicoot-rat *Bandicota indica*, Fishing Cat *Prionailurus viverrinus* and, in autumn 1995, an unidentified cetacean (Delphinidae, Phocoenidae or Ziphiidae), which was observed off Xuan Thuy.



**Birds.** The coastal area of the Red River Delta is an important stop-over and wintering site for migratory waterbirds from the families Anatidae and Rallidae and, especially, from the order Ciconiiformes, using the East-Asian or Australasian flyway. During the spring and autumn migrations, thousands of birds stop en-route between their breeding grounds in northern Asia and their wintering sites in the Indo-Malayan and Australasian Regions. A total of 78 species of waterbirds have been recorded from the Red River Delta, including 38 species of shorebirds (Appendix 3). Two major roosting areas for shorebirds exist on offshore islands at Xuan Thuy Nature Reserve and in Nghia Hung district. During 1994, it was estimated that c.120,000 shorebirds used the coastal zone of the Red River Delta during migration (Pedersen *et al.* 1996).

To date, 11 bird species listed by Collar *et al.* (1994) as globally threatened or near-threatened have been recorded from the Red River Delta: Nordmann's Greenshank *Tringa guttifer*, Asian Dowitcher *Limnodromus semipalmatus*, Spoon-billed Sandpiper *Calidris pygmeus*, Grey-headed Lapwing *Vanellus cinereus*, Saunders's Gull, Chinese Egret *Egretta eulophotes*, Black-headed Ibis *Threskiornis melanocephalus*, Black-faced Spoonbill, Spot-billed Pelican *Pelecanus philippensis*, Painted Stork *Mycteria leucocephala* and Japanese Paradise-flycatcher *Terpsiphone atrocaudata*.

The intertidal areas of the Red River Delta comprise a major wintering area for the Critically Endangered Black-faced Spoonbill. This species has an estimated world population of only 323 individuals breeding in the coastal areas of the Korean Peninsula and wintering at three main sites: the Tsen-Wen estuary in Taiwan; the Mai Po Marshes and Deep Bay in Hong Kong; and the Red River Delta in Vietnam (Collar *et al.* 1994). A synchronised count of Black-faced Spoonbills at these wintering sites in February 1996 provided a new world population estimate of 456 birds, 104 (23%) of which were recorded from three sites in the Red River Delta: the Day estuary, Xuan Thuy Nature Reserve, and the Van Uc and Thai Thuy River mouths (Anon. 1996c).

**Reptiles.** The only reptile identified by the authors in the Red River Delta was Green Turtle *Chelonia mydas*, a large specimen of which was found dead on the beach at Xuan Thuy in early 1996.

**Fish.** A list of fish identified from the Red River Delta is provided in Appendix 4.

**Molluscs.** Molluscs are found in both soft and hard substrates and play an important role in the degradation of mangrove litter and in the mangrove ecosystem. Almost all mollusc species found in intertidal mudflats are of some economic importance and are subject to economic exploitation (Appendix 4).

**Crabs and shrimp.** Both crabs and shrimp play an important role in the degradation of mangrove leaf litter and nutrient recycling. Lists of crab and shrimp found in the coastal areas of the Red River Delta are provided in Appendix 4. Mangrove Crab *Scylla serrata* is probably the most common crab in the mangrove and muddy intertidal flats of the Red River Delta. This large species has a high economic importance and is extensively cultivated in aquacultural ponds throughout the Red River Delta.

**Human population.** Vietnam has a human population of about 72 million, which is growing at a rate of 2.1% per year, and has a mean population density of 220 persons/km<sup>2</sup>. The Red River Delta is one of the most densely populated areas in the world, with a mean density of 1,068 persons/km<sup>2</sup> and up to 1,200 persons/km<sup>2</sup> (Fforde 1989).

### 3.4 Land-use and Socio-economic Features

**Historical aspects of land reclamation.** The reclamation of intertidal areas for agricultural land in the Red River Delta has a long history but is first documented during the French Colonial period (Phan Nguyen Hong and Hoang Thi San 1993, Vo Tri Chung *in litt.*). It was during this later period that the



first dikes were constructed and the first intertidal and mangrove areas enclosed. Traditionally, enclosed areas were then irrigated with fresh water to flush salts from the soil. In some areas, *Cyperus* sp. was then cultivated until the salinity was low enough to permit rice cultivation, resulting, on alluvial soils, in up to three crops per year. In areas where this method was not followed, only one rice crop per year was possible. This method is still practised in mangrove forests in Tien Lang and Thuy Nguyen districts. Most recent land reclamation has been for the purpose of aquacultural pond establishment. The aquacultural industry is relatively new and it is not clear what the long-term land-use strategy will be for these areas. In some districts, the creation of salt ponds has provided the justification for reclamation.

**Land reclamation and forestry.** The twin management objectives of land reclamation and coastal protection from the sea, combined with the need to provide fuelwood, have been met in recent years by an active programme of afforestation with the mangrove *Kandelia candel* in intertidal areas and the exotic *Casuarina equisetifolia* on sandy beaches and amongst dunes. It is estimated that there are now 7,400 ha of mangrove in the Red River Delta that result from afforestation. In Thai Thuy, Tien Lang and Thuy Nguyen districts, interplanting *K. candel* with *Sonneratia caseolaris* has occurred but most afforestation comprises a monoculture of *K. candel*.

Reforestation in the Red River Delta is rarer but has occurred in areas where mangrove has been drowned or cleared as a result of aquacultural pond establishment. Once again, the mangrove species *K. candel* has mainly been used for this purpose. The *K. candel* trees are generally planted at an interval of 0.3 to 0.7 m. Thinning of mangrove trees is not generally practised.

**Sources of fuel.** Coal provides the main source of domestic fuel for coastal communities in the Red River Delta but additional and supplementary sources of fuel include the reed *Phragmites* sp., rice straw, branches and needles from *C. equisetifolia*, and branches from mangrove trees. In almost all coastal areas, people cut mangrove trees for firewood. Legislation forbidding the cutting of mangroves exists but is circumvented by cutting wood and allowing it to dry *in situ* before bringing it home or to market.

**Aquaculture.** Aquaculture began about a century ago in the coastal areas of Vietnam (Phan Nguyen Hong 1990). Early attempts used an extensive system in which large ponds relied on tidal action for water exchange. In the Red River Delta, aquaculture is based on a polyculture of crab, shrimp and fish.

Aquacultural activities can cause considerable environmental damage, both in the immediate term through mangrove habitat destruction and in the longer term through pollution and depletion of shrimp, crab and fish larval stocks. It has been estimated that, between 1981 and 1994, 500,000 ha of mangroves were destroyed in Vietnam for aquacultural development and that only 250,000 ha remain, much of which is secondary growth. Much of this development has been carried out in an unsustainable way which has resulted in production failure and low yield in many instances (Roop *et al.* 1994).

**Management methods.** A number of different aquacultural methods are practised in the coastal areas of the Red River Delta. Following the methods described in the Red River Master Plan (Anon. 1994b), these may be defined as follows:

- (a) **Extensive/traditional.** Large ponds where mangroves and intertidal areas are enclosed by dikes. The enclosed mangrove forest usually dies after three to five years. This system relies on natural stocking with crab, shrimp and fish which enter the ponds during high tide;
- (b) **Modified extensive.** Large ponds where mangroves and intertidal areas are enclosed by dikes. The enclosed mangrove forest usually dies after three to five years. This system is dependent on both natural and artificial stocking with crab, shrimp and fish. This method uses fish and the shellfish *Abrina* cf. *declivis* and *Aloides laevis* for supplementary feeding;



- (c) **Semi-intensive.** Small ponds of about 1 to 5 ha in extent from which all natural vegetation has been cleared. The pond bottom is often drained, dried and treated between flooding periods. Supplementary stocking and feeding are routinely used; and
- (d) **Intensive.** Small ponds, less than 1 ha in extent, from which all natural vegetation has been cleared. Artificial stocking, feeding and aeration to maintain dissolved oxygen levels are mandatory.

There is increasing awareness in Vietnam of the vital role mangroves play in aquaculture and the need to develop sustainable methods of aquaculture. There have recently been attempts in Tien Hai and Xuan Thuy Nature Reserves to establish experimental ponds following the *Gei Wai* model employed in the Mai Po Marshes Nature Reserve in Hong Kong (Box).

#### *Gei Wai* Aquaculture in Hong Kong

In 1940, areas of mangrove were converted to aquacultural ponds in Hong Kong. These ponds were managed in a traditional way and, today, 170 ha are located in the Mai Po Marshes Nature Reserve. These ponds are known as *Gei Wais*, which are traditionally managed aquacultural ponds relying on natural productivity. The pond obtains its nutrients from mangrove detritus brought into the *Gei Wais* by tidal flushing and from mangrove and *Phragmites* sp. growing in the *Gei Wai*.

The *Gei Wais* at Mai Po are rectangular and cover approximately 9 ha. On average they each measure 800 by 100 m. The short side of the pond is the seaward side, where a sluice gate links the pond to Deep Bay. Channels have been cut through a belt of mangrove beyond the *Gei Wai* to facilitate the movement of water between the *Gei Wai* and the sea. Inside the perimeter of the *Gei Wai*, channels are dug to a depth of about 1.5 m to provide a sanctuary of deeper, cooler water during prolonged sunny periods. Drained *Gei Wais* provide an important feeding area for waterbirds.

The harvesting regime is governed by the tides. During each harvest, only a small proportion of the total amount of shrimp in the *Gei Wai* is caught. Each *Gei Wai* can, in practice, be harvested 80 times each year and may produce a total of 600 kg of shrimp. Apart from shrimp, a variety of fish is also harvested from the *Gei Wai*. The total production of shrimp from these *Gei Wais* may be lower compared to other aquacultural management methods but the method is entirely sustainable, and *Gei Wai* ecosystems are additionally important because of their diversity of fauna and flora (Melville *et al.* 1989, Young and Melville 1993).

**Management practice and problems.** The most commonly used aquacultural method in the Red River Delta is the traditional/extensive method, whilst the modified extensive method is used to a lesser degree. The enclosure of mangrove and maintenance of high water levels for extended periods results in initially high, but later declining, yields of shrimp and the death of the mangrove after three to five years. To cope with declining yields, pond-owners usually switch to the modified extensive method in an attempt to maintain their income.

The capital required to excavate and manage a pond is up to VND150 million (US\$13,600) and villagers often join together in groups of four to eight people in order to raise the capital and share the investment risk. Groups of villagers often borrow VND70 to 140 million (US\$6,400 to 12,700) at an interest rate of 2.5 to 3.6% per month. The capital is used for the construction of dikes, sluice gates and temporary shelters. Defaulting on the capital sum and interest repayments is common once pond yields begin to decline. Land tenure arrangements vary and there is no fixed sum per hectare rented or standard period of tenure. Pond-owners often sub-contract labour to manage and harvest the ponds. Dealers visit the ponds and buy Mangrove Crabs for VND60,000 to 120,000/kg (US\$5.5 to 11/kg), depending on seasonality, size and sex. The shrimp *Pennaeus monodon* is sold for VND25,000 to 40,000/kg (US\$2.27



to 3.6/kg), whilst other shrimp and fish species command lower prices of VND10,000 to 14,000/kg (US\$0.9 to 1.27) in local markets. There is a considerable export market for the two principle species to China.

**Other related activities.** In some coastal areas, the algae *Gracilaria verrucosa* is collected from aquacultural ponds and used in the manufacture of agar jelly. The algae are sun-dried locally and sold for VND400,000/tonne (US\$36/tonne). Freshwater fish farming is practised away from the coastal zone in purpose-built ponds and was not considered further in this study.

**Environmental impact of aquacultural ponds.** The environmental impact of aquacultural ponds has been evaluated by Phan Nguyen Hong and Hoang Thi San (1993). On the positive side, the construction of ponds creates the need for daily paid labour, and their management and stocking is an income-generating activity for villagers who would otherwise be engaged in subsistence agriculture and fishing. Value is also added to the product in the processing and marketing stage, although this occurs away from the coastal areas. On the negative side, pond construction destroys foraging and nursery areas for fish, shrimp and crabs, reducing inshore marine productivity and leading to a decline in the inshore fishery. The destruction of mangrove forest exposes the coast to storm damage and saltwater intrusion. Additionally, it destroys the biodiversity value of the local environment.

**Coastal wetland recovery.** Many coastal wetland species show a tendency for dispersion and rapid recolonisation. This makes it possible to restore degraded coastal wetlands or even create new wetlands. Vegetation will return naturally if the site is safe and attractive, or the process can be accelerated by reintroduction. Introduction of alien species may alter a wetland and reduce its conservation or biodiversity value; such species are often difficult to remove from an ecosystem once introduced (Anon. 1994a).

**Fisheries.** The Red River Delta fishery consists principally of a small-boat fleet operating in inshore areas. It is a multi-species fishery, taking riverine, estuarine and pelagic species. This fishery is extremely important to the coastal communities for economic, nutritional and cultural reasons. The smaller inshore boats, made from cement, aluminium, sedge and wood, are between 1 and 4 m in length. Medium-sized boats range from 4 to 6 m and are made from wood. The largest boats are 8 to 12 m in length, range up to 20 km from the coast and fish in 6 to 8 m of water. Gill nets are the most common and widely used capture technique. These are set as a wall of netting placed on the intertidal flats. Mesh size varies but was recorded down to 0.2 mm in Nghia Hung district. Other capture methods used include gape nets, cast nets, walking trawl nets, push nets, Chinese fish traps and electro-fishing.

**Exploitation of shellfish and crabs.** The collection of bivalve shellfish is an important economic activity for women and children in coastal areas. A recent survey in Nghia Hung district showed that 56% of collectors were women, 32% were children and 12% were men (Nielsen *et al.* 1995). Shellfish collectors are organised into guilds according to age and sex, each of which utilises specialised tools to exploit particular species. To some degree, this system mirrors shorebirds that exploit different species of shellfish according to body size and bill length. There is some variation in tool design and technique across districts. Some shellfish species are consumed locally whilst others are exported. Shellfish exploitation is greatest in Nghia Hung, Xuan Thuy and Tien Hai districts, where it is estimated that 330 to 730 kg/ha/year are taken from the intertidal area.

In the intertidal area, Mangrove Crabs are collected by men and young boys using a large touch-sensitive bamboo rake, which is pushed by the operator through the substrate during high tide. The price of Mangrove Crabs varies according to their size and sex. Smaller, immature crabs are collected by boys and sold to pond-owners, who then stock them in their ponds. Larger, mature crabs are sold immediately for consumption.



Table 2: Commonly Exploited Shellfish in the Red River Delta

Species	Use	Price (VND/kg)
<i>Meretrix</i> sp.	Mainly exported for human consumption	3,000 to 5,000
<i>Glaucanome chinensis</i>	Consumed locally by people and also fed to crabs and ducks	900
<i>Albrina</i> cf. <i>declivis</i>	Fed locally to crabs and ducks	500 to 900
<i>Hitula diphos</i>	Used locally and exported for human consumption	4,000
<i>Solen</i> sp.	Used locally for human consumption	2,000 to 4,000
<i>Mactra quadrangularis</i>	Used locally for human consumption	1,000
<i>Aloides laevis</i>	Used locally for crab and duck feed	500 to 900

**Agriculture.** For many years, it has been a tradition to plant rice in mangrove soil even though the yield is low. In Tien Lang district, the rice yield is 1,500 to 1,700 kg/ha/year, compared with a mean yield of 3,200 kg/ha/year (World Bank 1995). Domestic ducks are raised throughout the coastal districts of the Red River Delta, mainly for egg production. Cattle and buffalo browse in the mangrove forest, eating the leaves of *Sonneratia caseolaris*, *Aegiceras corniculatum*, *Kandelia candel* and *Acanthus ilicifolius*. In some areas, mangrove provides the main source of food for livestock.

Honey production represents a sustainable use of mangrove in the Red River Delta. From March to July, bees collect nectar from the flowers of *K. candel* and *A. corniculatum*. A single hive may produce 18 kg/year. The beekeepers are mobile and move around the country with their hives according to the season.

**Salt production.** There is a long tradition of salt production in the coastal zone of the Red River Delta (Phan Nguyen Hong and Hoang Thi San 1993). At present, there are 1,250 ha of salt ponds in the delta (Table 3). Sand is collected from the beach, washed with freshwater which is kept in small, shallow ponds, from which the water is evaporated leaving only the salt. A 1 ha salt pond may yield up to 5,500 tonnes of salt per year. The salt ponds are either owned by agricultural enterprises, communes or districts. Land is leased from the commune or district people's committees in 5 ha plots, for which the tenant pays either a percentage of income or a certain amount of their production as tax. The salt is sold for VND350 to 600/kg (US\$0.03 to 0.05/kg) and is both consumed locally and exported to mountainous regions.

Salt production is an income-generating activity which provides the local and national economy with a vital natural resource. However, mangrove is often destroyed during salt-pond construction and mangrove regeneration is poor in these areas. Salt ponds support low levels of biodiversity but, undisturbed, often provide roosting or loafing areas for shorebirds.

**Hunting.** The seasonal presence of thousands of migrant birds in the Red River Delta has led to the development of hunting as a major activity. Birds are either trapped in mist-nets or baited traps, or are shot. Two kinds of mist-nets are employed. The most common is a fine nylon monofilament net mounted on bamboo poles about 2 m above the ground. The other type, noted in Nghia Hung district, is a double-pocketed, single-shelf net, approximately 4 m tall and between 60 and 120 m long, mounted on 6 to 8 m long bamboo poles. Up to 19.9 km of mist-nets were observed in the intertidal areas of Nghia Hung district.

The use of firearms is also widespread. Airguns are used for smaller birds and shotguns are used to hunt larger quarry such as ducks and geese. A range of different types of baited traps are used to catch egrets, herons and rails. Larger-bodied birds, including ducks, are sold for VND 40,000 to 70,000 (US\$3.6 to 6.3) per bird, whilst geese command VND120,000 to 150,000 (US\$10.9 to 13.6). These larger birds are exported live to China. Smaller-bodied birds, including shorebirds and passerines,

Table 3: Distribution of Salt Ponds in the Red River Delta

District	Area (ha)
Nghia Hung	50
Hai Hau	500
Xuan Thuy	500
Tien Hai	100
Thai Thuy	100
Total	1,250



are sold in local markets for VND5,000 to 8,000 (US\$0.45 to 0.7) per bird.

**Pollution.** Increasing industrial development and population growth are inevitably leading to increasing volumes of untreated industrial waste, possibly including heavy metals, and human sewage, being discharged into the Red River, particularly from large and growing urban centres such as Hanoi. Pesticide and fertiliser run-off from rice-growing areas may also be a significant source of pollution, since pesticides are now used on 90% of agricultural land (Roop *et al.* 1994). Increased volumes of organic waste, containing nitrates and phosphates, are, therefore, leading to increased eutrophication of the delta. Pesticide residues and heavy metal traces may be accumulating in higher organisms in the aquatic and marine food chains, which may include humans and threatened birds such as Black-faced Spoonbill. The impact of water-borne pollution on coastal ecosystems is currently unknown but warrants further investigation.

**Oil.** The South China Sea is now an active zone for oil and gas exploration and exploitation (Roop *et al.* 1994). It also constitutes a major shipping route for oil tankers bound for north-east Asia. Oil pollution is frequently evident on beaches in the Red River Delta and can only have a negative impact on the local ecology and economy.



## 4. District and Site Accounts

This section provides a detailed description of each coastal district in the Red River Delta. The information is presented by district from south to north. For some districts, more detailed site descriptions are presented. For each district, its name, geographical coordinates, number of coastal communes and general information are provided under the heading of location and site description. To give an indication of the amount of effort per site, the number of days spent at each area are expressed as man-days per month. The habitat data provides information about the habitat diversity and species richness of a site. Coastal wetland habitats were classified following Howes (1987). The codes are as follows:

01 Exposed coast	10 Saltmarsh
02 Deep river channel	11 Reedbed
03 Estuaries	12 Sedge-bed
04 Mudflats	13 Mangrove
05 Sand-flats	14 <i>Casuarina equisetifolia</i>
06 Rocky seacoast	15 Aquacultural ponds without mangrove
07 Sandy beach	16 Aquacultural ponds with mangrove
08 Dune	17 Salt ponds
09 Small islands	18 Paddyfields

Offshore currents and coastal processes such as erosion and sedimentation are mentioned where relevant. Information on important flora and fauna recorded at a site are given under this heading. Special mention is made of the flora of the mangrove forest, the avifauna and economically important marine products. Records of rare and threatened species are also mentioned. Lists of the flora and fauna recorded are given in Appendices 2, 3 and 4. Information is provided about the general land-use and socio-economic features of each area or site under the sub-headings of forestry, agriculture, aquaculture, fisheries and hunting. Details of any future development plans likely to affect a district or site are given if known.

### 4.1 Nga Son District

**Location.** Nga Son district (19°57' to 19°59'N, 106°00' to 106°02'E), Thanh Hoa province (Map 2). There are three coastal communes in the district: Nga Thuy, Nga Tan and Nga Tien.

**Man-days visited.** Three in February and two in March: a total of five man-days.

**Site description.** The district has 3 km of coastline and is bordered to the north and south by the Len and Can Rivers. The main vegetation, just inside the main dike, is sedge *Cyperus* sp., extending over an area of 2,000 ha, and a reedbed *Phragmites* sp. On the seaward side of the main dike there is an area of 150 ha of aquacultural ponds supporting mangrove *Kandelia candel* and *Phragmites* sp. An area of newly afforested mangrove was noted on the intertidal flats beyond the aquacultural ponds.

**Habitat codes.** 01, 03, 04, 11, 12, 13, 16.

**Hydrological influence.** The coastal zone of the district is influenced by the estuaries of the Len, Can and Day Rivers, which, according to the district people's committee, provide a bountiful supply of shrimp larvae.

**Mangrove.** Only a few *K. candel* greater than five years old were noted inside the aquacultural ponds. It was estimated that 150 ha are now enclosed within aquacultural ponds.



**Reed and sedge-bed.** In 1995, 163 tonnes of sedge *Cyperus* sp. were harvested, of which 80 tonnes was exported directly to China, whilst the remainder was used locally in the manufacture of mattress and hats. Women were seen cutting *Phragmites* sp., which is used as food for buffalo and cattle.

**Birds.** Around 800 ducks, mainly Northern Shoveler *Anas chrypeata* and Common Teal *A. crecca*, were observed at high tide just beyond the main dike. A group of 60 Saunders's Gulls were observed feeding on the intertidal flats in February. Another threatened species, Black-faced Spoonbill, was reported from but not observed in the area. A roost of 537 egrets and herons comprising Little Egret *Egretta garzetta* (450), Purple Heron *Ardea purpurea* (one), Great Egret *Casmerodius albus* (50), Cattle Egret *Bubulcus ibis* (30) and Black-crowned Night Heron *Nycticorax nycticorax* (six) was observed in the mangrove close to the Len estuary. Previously, there was a waterbird colony in the coastal zone of the district.

**Forestry.** The district people's committee began an afforestation programme in 1991, which has now planted 258 ha of *K. candell* with seedlings obtained from Tien Hai district, Thai Binh province. The areas planted each year were as follows: 1991 (50 ha), 1992 (41 ha), 1993 (67 ha) and 1994 (100 ha).

**Agriculture.** Domestic ducks are fed locally on rice, fish and the shellfish *Albrina* cf. *declivis* and *Aloides laevis*.

**Aquaculture.** Beyond the main dike, there are c.150 ha of aquacultural ponds containing a polyculture of Mangrove Crab, shrimp and fish, utilising the traditional extensive method.

**Inshore fishery.** Stationary gill nets were noted on the intertidal flats.

**Collection of shellfish and other marine products.** Shellfish, comprising *Mactra quadrangularis*, *Meretrix* sp., *Abrina* cf. *declivis* and *Aloides laevis* are collected from the intertidal flats. The fish *Borrichthys sinensis* is caught for export and sold for VND60,000/kg (US\$5.4/kg) or VND3,000/fish (US\$0.2/fish). Other species of crab and snail are also collected in the intertidal area and from the sedge-beds. It was estimated that c.2.6 tonnes of Sentinel Crab *Macrophthalmus japonicus* were collected from March to May. The daily catch of Sentinel Crab in March was 35 kg and a total monthly catch of 875 kg. At a price of VND3,000/kg (US\$0.27/kg), the total value of the season's catch was estimated to be US\$708.

**Hunting.** Traps and mist-nets were observed in the area. Birds, including White-breasted Waterhen *Amaurornis phoenicurus*, are sold for VND3,000/bird (US\$0.27/bird) or VND15,000/kg (US\$1.3) in the local market.

**Future development plans.** By 1997, it is planned to establish 1,320 ha of aquacultural ponds beyond the main dike and to plant 300 ha of *K. candell* on the intertidal flats beyond the aquacultural ponds. The district people's committee proposes to establish a marine products processing plant.

## 4.2 Kim Son District

**Location.** Kim Son district (19°57' to 19°59'N 106°02' to 106°06'E), Ninh Binh province (Map 2). There are four coastal communes in the district: Kim Hai, Kim Tien, Kim Trung and Kim Dong.

**Man-days visited.** Two in March and three in May: a total of five man days.

**Site description.** The district has 9 km of coastline and is bordered to the west and east by the Can and Day Rivers. Beyond the main dike there is an area of aquacultural ponds supporting scattered clumps of sedge *Cyperus* sp., reed *Phragmites* sp. and mangrove *Kandelia candell*. At low tide, an intertidal mudflat is exposed between the two estuaries and beyond the aquacultural ponds.





**Habitat codes.** 01, 03, 04, 11,12, 13, 16.

**Mangrove.** The district people's committee estimate that there are c.400 ha of *K. candel*, of which 90% has now been enclosed within aquacultural ponds and only 100 ha remains alive.

**Birds.** Despite the apparent suitability of the intertidal flats for Black-faced Spoonbill and Saunders's Gull, neither species was recorded during the survey.

**Forestry.** About 50 ha of the mangrove *K. candel* have been planted on the intertidal mudflats beyond the aquacultural ponds.

**Aquaculture.** There are 850 ha of aquacultural ponds beyond the main dike, which are managed using the extensive and modified extensive methods.

**Inshore fishery.** Gill nets and electro-fishing were observed in the area.

**Collection of shellfish and other marine products.** Juvenile Mangrove Crabs are collected from the intertidal flats and sold to pond-owners for VND30,000 to 80,000/kg (US\$2.7 to 7.2/kg). The shellfish *Meretrix* sp., *Macra quadrangularis*, *Solen* sp. and *Glaucanome chinensis* are collected from the intertidal mudflats.

**Hunting.** Hunting was not observed but was reported to occur. Guns and mist-nets are reportedly used.

**Future development plans.** In 1996, permission was granted for the construction of a new main dike on the intertidal mudflats, as part of the government's land-reclamation policy.

### 4.3 Nghia Hung District

**Location.** Nghia Hung district (19°56' to 20°00'N 106°07' to 106°12'E), Nam Ha province (Maps 3 and 4). There are three coastal communes in the district: Nghia Trung, Nam Dien and Nghia Phuc.

**Man-days visited.** Ten in February, six in March and six in May: a total of 22 man-days.

**Site description.** The district has 12 km of coastline and is bordered to the west and east by the Day and Ninh Co Rivers. Adjacent to the Ninh Co estuary is an area with sandy beaches, dunes and saltmarsh. Some of the dunes have been afforested with *Casuarina equisetifolia*, to the west of which is an area with crab ponds supporting a reedbed of *Phragmites* sp. Along the Ninh Co River, there is an area of salt ponds. Beyond the main dike, lies an intertidal area of c.3,500 ha, 60% of which is covered with the mangrove *Kandelia candel*. Five kilometres offshore, there are two small sandy islands, covering 25 ha, which support dunes. The southern island has a small area of saltmarsh and *C. equisetifolia*.

**Habitat codes.** 01, 03, 04, 05, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17.

**Mangrove.** Only one species of mangrove, *K. candel*, was found in the district. The district people's committee estimated that there was 1,600 ha of mangrove in the district, 40% of which is now included in aquacultural ponds.

**Birds.** The coastal wetlands of Nghia Hung district support a wide range of waterbirds, including four



threatened or near-threatened species: Nordmann's Greenshank, Asian Dowitcher, Saunders's Gull and Black-faced Spoonbill. A maximum of 16 Black-faced Spoonbills was recorded at the site in February. A high tide roost of shorebirds was located on the southernmost offshore island. Three high-tide counts were made on the island and a maximum of 1,774 shorebirds was recorded during May (Table 4).

**Table 4. High-tide Counts of Shorebirds in Nghia Hung District.**

Species	Scientific Name	Date		
		4/2	23/3	4/5
Whimbrel	<i>Numenius phaeopus</i>			6
Eurasian Curlew	<i>N. arquata</i>			8
Spotted Redshank	<i>Tringa erythropus</i>			640
Common Greenshank	<i>T. nebularia</i>			40
Nordmann's Greenshank	<i>T. guttifer</i>			5
Terek Sandpiper	<i>Xenus cinereus</i>		2	3
Common Sandpiper	<i>Actitis hypoleucos</i>			1
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>			320
Ruddy Turnstone	<i>Arenaria interpres</i>			5
Sanderling	<i>Calidris alba</i>	1		5
Red-necked Stint	<i>C. ruficollis</i>	10	32	270
Dunlin	<i>C. alpina</i>	200	15	
Curlew Sandpiper	<i>C. ferruginea</i>	10		68
Broad-billed Sandpiper	<i>Limicola falcinellus</i>			3
Kentish Plover	<i>Charadrius alexandrinus</i>	800	1,100	
Lesser Sand/Greater Sand Plover	<i>C. mongolus/C. leschenaultii</i>		350	400
Oriental Pratincole	<i>Glareola maldivarum</i>		10	
Total		1,021	1,509	1,774

**Forestry.** Since 1991, the district people's committee has planted 2,000 ha of *K. candel* with a density of 4 trees/m<sup>2</sup> and 85 ha of *C. equisetifolia*.

**Domestic animals.** Domestic ducks are kept locally and fed on the shellfish *Abrina cf. declivis* and *Aloides laevis*.

**Salt ponds.** About 50 ha of salt ponds are located on the north-west side of the Ninh Co estuary.

**Aquaculture.** Three methods of aquaculture are employed in the district: the extensive method is used in the newly established ponds in the mangrove area, the modified extensive method uses supplementary stocking with Mangrove Crab, and smaller ponds are managed exclusively for Mangrove Crab, using the semi-intensive method with limited or no exchange of water. The algae *Gracilaria verrucosa* is harvested from some ponds. This system of ponds was built without the permission of the district authorities.

**Inshore fishery.** Gape nets were noted along the Day River and gill nets with a mesh size as small as 3 mm were noted around the mangrove. Electro-fishing was noted in the area.

**Collection of shellfish and other marine products.** During low tides, about 1,000 people were noted collecting shellfish over 1,500 ha of intertidal area beyond the main dike. The most common shellfish collected were *Meretrix* sp., *Hitula diphos* and *Macra quadrangularis*. There was one dealer in Nghia Hung district exporting shellfish to China. In 1995, he exported 200 to 300 tonnes of *Meretrix* sp.

**Hunting.** Hunting with mist-nets, airguns and shotguns was recorded. In early February, 19.9 km of mist-nets, with a catch area of 79,440 m<sup>2</sup> were observed in the intertidal area of Nghia Hung district.



The main quarry species are ducks and geese, which are sold for export to China. Some hunters were reported to have earned US\$1,500 from this activity in January 1996. There were believed to be 37 hunters in the district. The provincial Forest Protection Department was interested in prohibiting this activity.

**Future development activities.** The district people's committee was interested in the establishment of a nature reserve at the site.

#### 4.4 Hai Hau District

**Location.** Hai Hau district (20°00' to 20°10'N 106°12' to 106°21'E), Nam Ha province (Map 3). There are seven coastal communes in the district: Hai Thinh, Hai Hoa, Hai Trieu, Hai Xuan, Hai Chinh, Hai Ly and Hai Dong.

**Man-days visited.** Two in March.

**Site description.** The district has 23 km of coastline, comprising mainly sandy beaches afforested with *Casuarina equisetifolia*. The district is bordered to the west and north by the Ninh Co and So Rivers. In the centre of the district, the Su estuary serves as a harbour for medium-sized fishing boats, whilst a second harbour is located 200 m up the Ninh Co estuary. Much of the coastline is protected by stone dikes, behind which are dunes and saltmarshes. In the southern part of the district, there is an area of salt ponds and a small holiday resort.

**Habitat codes.** 01, 05, 07, 08, 10, 14, 15, 17.

**Mangrove.** Only a few patches of mangrove were noted, of which the largest area, located in the Su estuary, covered 50 ha and comprised *Kandelia candel* and *Aegiceras corniculatum*. Small clumps of mangrove were noted in the Ninh Co and So Estuaries.

**Birds.** In the saltmarsh area, several species of waterbirds, including Little Grebe *Tachybaptus ruficollis*, Little Egret, Grey Heron *Ardea cinerea* and Great Egret, were seen feeding. As many as 140 egrets and herons were observed at the site during the survey.

**Forestry.** Since 1993, 300 ha of *Casuarina equisetifolia* have been planted in the district.

**Salt Ponds.** There are 500 ha of salt ponds situated in the southern part of the district.

**Aquaculture.** Aquacultural ponds cover 800 ha in the district, of which 75% are shrimp ponds, managed following the modified extensive method by stocking with juvenile shrimp *Pennaeus monodon* and *P. merguensis* from southern Vietnam. The remaining 200 ha are stocked with a polyculture of crab, shrimp, fish and algae *Gracilaria verrucosa*. Between 1993 and 1995, 300 tonnes of algae *G. verrucosa* were harvested.

**Inshore fishery.** About 60 medium-sized fishing-boats were lying in the harbour of the Su estuary. Electro-fishing was observed in the area.

**Collection of shellfish and other marine products.** Shellfish collection was reported from the coastal area but no site visit was made during low tide.

**Hunting.** The use of mist-nets and airguns was reported. Birds were reportedly lured to hunters using playback of bird calls.



**Notes.** The Food and Agriculture Organisation (FAO) has provided funds for dike construction and afforestation with *C. equisetifolia*. A shrimp hatchery is located in the centre of the district.

#### 4.5 Xuan Thuy District

**Location.** Xuan Thuy district (20°10' to 20°17'N 106°21' to 106°33'E), Nam Ha province, (Map 3). There are nine coastal communes in the district: Giao Lam, Bach Long, Giao Phong, Giao Long, Giao Hai, Giao Xuan, Giao Lac, Giao An and Giao Thien.

**Man-days visited.** Six in February, four in March, seven in April and six in May: A total of 23 man-days.

**Site description.** The district has about 25 km of coastline and is bordered by the So River to the south and by the Ba Lat River (the main channel of the Red River) to the north. The southern part of the district is characterised by sandy beaches with associated dune systems, plantations of *Casuarina equisetifolia*, saltmarshes and salt ponds. Xuan Thuy Nature Reserve is situated south of the Ba Lat River. The nature reserve comprises Con Lu island, mangrove forests with associated intertidal mudflats and aquacultural ponds. A detailed description of Xuan Thuy Nature Reserve comprises the next account.

**Habitat codes.** 01, 03, 04, 05, 07, 08, 10, 13, 14, 15, 16, 17.

**Hydrological influence.** The flow of the Red River supplies the northern part of the district with its rich alluvium.

**Birds.** Within the district, the majority of birds occur in Xuan Thuy Nature Reserve (see next account). On sandy beaches in the southern part of the district, 350 Kentish Plovers *Charadrius alexandrinus* and 590 Lesser Sand Plovers *C. mongolus* were recorded. In aquacultural ponds and saltmarshes in the southern part of the district, several species of egret, heron and duck were observed including a roost of 200 Common Teal.

**Forestry.** Most of the mangrove is located in the northern part of the district, within Xuan Thuy Nature Reserve. However, a small fringe of *Kandelia candel* occurs along the banks of the So River. *C. equisetifolia* plantations covering a total area of 135 ha were evident along the coastline.

**Reed and sedge-bed.** About 100 ha of sedge *Cyperus* sp. are harvested annually.

**Salt Ponds.** There are 500 ha of salt ponds in the district, which are managed as a cooperative. In 1995, 3,000 tonnes of salt were produced.

**Aquaculture.** Aquacultural ponds were noted in clusters along the coast. The majority of ponds are situated inside Xuan Thuy Nature Reserve, where they are generally managed using the extensive method. In the buffer zone (part of the Ramsar Site but outside the nature reserve), there is an extensive area of ponds almost devoid of emergent vegetation. These ponds are managed following the semi-intensive method.

**Inshore fishery.** A small quay suitable for larger fishing boats is located in the So estuary. Fish traps and gape nets were observed in the deep river channels. In the intertidal area, stationary gill nets were observed.

**Collection of shellfish and other marine products.** Collection of *Meretrix* sp., *Hitula diphos* and *Mactra quadrangularis* takes place along the coastline. The main collection site is inside Xuan Thuy Nature



Reserve. According to the district people's committee, more than 4,300 tonnes of shellfish were exported in 1995.

#### 4.6 Xuan Thuy Nature Reserve

**Location.** The northern part of Xuan Thuy district (20°17'N 106°23'E), Nam Ha province (Maps 3 and 5).

**Man-days visited.** Four in February, four in March, seven in April and six in May: a total of 21 man-days.

**Background.** In August 1988, the government of Vietnam designated 12,000 ha of northern Xuan Thuy district as the country's first Ramsar Site. In January 1995, 5,640 ha of the Ramsar Site were designated as a nature reserve (Anon. 1993).

**Site description.** The nature reserve is bordered to the north by the Ba Lat estuary and to the west by the Vop River. It is not clear where the southern or eastern borders are for either the nature reserve or the Ramsar Site, since they are in the intertidal zone. The nature reserve includes Con Ngan and Con Lu islands, although Con Ngan is joined to the mainland. Con Ngan island is given over to aquacultural ponds. Between Con Ngan and Con Lu islands runs the deep Tra River channel, along which grows a small fringe of free-living mangrove, 5 to 15 m wide. The majority of ponds retain some *Kandelia candel* or *Phragmites* sp. Con Lu comprises a sandy island with dunes, saltmarshes and sandy beaches. This island now supports an extensive *Casuarina equisetifolia* plantation. Much of the mangrove on Con Lu island has been incorporated into aquacultural ponds.

**Habitat codes.** 01, 02, 03, 04, 05, 07, 08, 09, 10, 11, 13, 14, 15, 16.

**Hydrological influence.** Deposition is occurring in the nature reserve, south of the Ba Lat estuary. A new island, Con Xanh, is being formed 500 m offshore of Con Lu island.

**Mangrove.** Eight hundred hectares of mangrove within the nature reserve have been planted or have colonised since 1989. The dominant species is *K. candel*. A few *Sonneratia caseolaris* have also been planted, whilst *Aegiceras corniculatum* and *Acanthus ilicifolius* have spread naturally. Only two *Avicennia marina* trees were discovered in the nature reserve during the survey. Forty percent of the mangrove is now enclosed within aquacultural ponds.

**Reedbed.** A 300 ha *Phragmites* sp. swamp occurs within the aquacultural ponds on Con Ngan island. The reed is used for fuel and as fodder for cattle.

**Birds.** Xuan Thuy Nature Reserve supports a great variety of birds (Appendix 3). During the spring and autumn migrations, a large number of shorebirds use the site as a staging area. There is a high tide roost at the southern tip of Con Lu island, where, on 7 April, 7,329 shorebirds were observed (Table 5). Seven threatened and near-threatened species were recorded in the nature reserve, including Nordmann's Greenshank, Asian Dowitcher, Spoon-billed Sandpiper, Saunders's Gull, Chinese Egret and Black-faced Spoonbill. As many as 64 Saunders's Gulls and 75 Black-faced Spoonbills were observed in the nature reserve during this survey.

**Agriculture.** Up to 53 buffalo and 42 goats were recorded grazing and browsing on Con Lu island. Travelling apiarists visit the nature reserve from March to July with their hives. During the study, 225 beehives were noted in the nature reserve. The bees pollinate the mangrove trees *Aegiceras corniculatum*



and *K. candel*. The honey-producing season is normally two months and each hive can produce 18 kg of honey, which is sold for VND10,000/kg (US\$0.9/kg) both locally and to an enterprise in Xuan Thuy town. In 1995, a total of 4,050 kg of honey was produced in the nature reserve with a total value of US\$4,050. The nature reserve does not derive any income from this activity.

**Medicinal plants.** The rhizome of the sedge *Cyperus rotundus*, which grows amongst the dunes on Con Lu island, is collected for human consumption. It was reported that 200 kg of rhizomes were collected from Con Lu island in 1995.

**Sand.** Local people regularly collect sand for construction from the north end of Con Lu island.

**Aquaculture.** The traditional extensive method is employed inside the nature reserve, utilising a polyculture of crab, shrimp and fish but focused on shrimp. Almost all the aquacultural ponds at Con Ngan island were more than five years old. None of the pond-owners interviewed had any contract or tenure but were taxed on their income by the district. Pond-owners stated that it was no longer profitable to construct ponds in the nature reserve, since they believed that productivity was lower in areas with densely planted mangrove. The nature reserve authorities have established a demonstration pond following the *Gei Wai* method. The pond, constructed on Con Ngan island, was not working well due to lack of funds needed to complete construction and because of the limited extension advice available.

Table 5: High-tide Counts of Shorebirds in Xuan Thuy Nature Reserve

Species	Scientific Name	Date				
		7/2	21/3	7/4	24/4	3/5
Black-tailed Godwit	<i>Limosa limosa</i>	440	165	5,000	1,160	102
Bar-tailed Godwit	<i>L. lapponica</i>			100	3	
Whimbrel	<i>Numenius phaeopus</i>		3	15	170	61
Eurasian Curlew	<i>N. arquata</i>	35	8	9	60	16
Spotted Redshank	<i>Tringa erythropus</i>			2	200	7
Common Redshank	<i>T. totanus</i>	30	33		20	2
Marsh Sandpiper	<i>T. stagnatilis</i>	45	4	15		
Common Greenshank	<i>T. nebularia</i>	60	30	45	30	42
Nordmann's Greenshank	<i>T. guttifer</i>	3	8			
Terek Sandpiper	<i>Xenus cinereus</i>		1	1	20	11
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>					90
Ruddy Turnstone	<i>Arenaria interpres</i>					1
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>			1		
Asian Dowitcher	<i>L. semipalmatus</i>			3		2
Great Knot	<i>Calidris tenuirostris</i>			25	100	7
Red Knot	<i>C. canutus</i>			52	1	13
Sanderling	<i>C. alba</i>		1	2		
Red-necked Stint	<i>C. ruficollis</i>	15	17	500	300	450
Dunlin	<i>C. alpina</i>	78	618	40		
Curlew Sandpiper	<i>C. ferruginea</i>		80	5	400	520
Spoon-billed Sandpiper	<i>C. pygmeus</i>		1	4	2	
Broad-billed Sandpiper	<i>Limicola falcinellus</i>			50		400
Grey Plover	<i>Pluvialis squatarola</i>	160	19	10		6
Kentish Plover	<i>Charadrius alexandrinus</i>	120	54	250		
Lesser Sand/Greater Sand Plover	<i>C. mongolus/C. leschenaultii</i>	510	880	900		55
Unidentified shorebirds		1,500		300	800	
Total		2,996	1,922	7,329	3,266	1,785



**Algae.** The algae *Gracilaria verrucosa* is collected from aquacultural ponds inside the nature reserve. During the survey, 70 to 80 women were noted collecting algae inside the nature reserve, all of whom were employed by the same individual. The algae collecting season is from April to June. The women earn VND450,000/tonne (US\$41/tonne) of dry algae. During the 1995 season they each earned VND2,000,000 (US\$182). The nature reserve does not derive any income from this activity.

**Inshore fishery.** Gill nets were observed in the intertidal area south of Con Lu island.

**Collection of shellfish and other marine products.** Collection of the shellfish *Meretrix* sp., *Cyclina sinensis*, *Solen* sp. *Macrta quadrangularis* and *Sinonovacula constricta* occurs in the intertidal area in the south of the nature reserve. This activity focuses on *Meretrix* sp., which is cultured in 150 privately managed plots on the intertidal area prior to export to China.

**Hunting.** Mist-nets were noted in the reedbed.

**Future development plans.** The nature reserve authorities plan to afforest 100 ha of mangrove and 10 ha of *C. equisetifolia* during 1996.

**Notes.** In 1992, the Ramsar Commission provided funds to the Ministry of Science, Technology and the Environment (MOSTE) for a project at Xuan Thuy but no final report is currently available. IUCN provided funding to the Ministry of Water Resources during the period 1993 to 1995 for the development of a project entitled, "An Interdisciplinary Approach for Sustainable Utilisation of Coastal Wetlands". Since designation as a nature reserve in 1995, Xuan Thuy has been under the jurisdiction of Nam Ha Provincial People's Committee and has been funded from this source and Programme 327. Funds for implementation of the management plan have not yet been allocated by the government of Vietnam. This effectively means there is currently no conservation management of the site.

#### 4.7 Tien Hai District

**Location.** Tien Hai district (20°17' to 20°28'N 106°23' to 106°36'E), Thai Binh province (Map 6). There are eight coastal communes in the district: Nam Phu, Nam Hung, Nam Thinh, Nam Cuong, Dong Minh, Dong Hoang, Dong Long and Dong Hai.

**Man-days visited.** Two in February, eight in March, 20 in April and three in May: a total of 33 man-days.

**Site description.** The district has 23 km of coastline and is bordered to the south by the main Red River channel, whilst it is bordered to the north by the Tra Ly River. In the centre of the district, the Lan River discharges into the sea through a sandy estuary. North of the Lan River, there are sandy beaches and *Casuarina equisetifolia* has been planted along the coast. West of the Lan estuary, there are 100 ha of salt ponds. Close to the Tra Ly estuary, there are 50 ha of mangrove *Kandelia candel*. In the southern part of the district, there are two islands, Con Vanh and Con Thu, and areas of mangrove which have been incorporated into aquacultural ponds. Tien Hai Nature Reserve lies in the southern part of the district.

**Habitat codes.** 01, 03, 04, 05, 07, 08, 11, 13, 14, 17.

**Hydrological influence.** The current from the main channel of the Red River turns south on entering the sea and deposits only a small part of its rich alluvium in Tien Hai district. Instead, the current erodes the southern end of Con Vanh island and the river cuts a deep channel at this point.



**Mangrove.** According to the district people's committee, there are more than 1,500 ha of mangrove in the district but this estimate is based on old data. This survey located 900 ha of living mangrove, of which 80% is enclosed in aquacultural ponds.

**Birds.** A roost of 1,000 gulls, mainly Heuglin's/Vega Gull *Larus heuglini*/*L. vegae*, and 2,000 ducks, mainly Northern Shoveler, were observed in the intertidal area of the Tra Ly estuary in early February. During the same visit, two Saunders's Gulls were observed.

**Forestry.** Afforestation with *K. candell* at a density of 6 to 9 trees/m<sup>2</sup> has been undertaken by the district people's committee. An estimated 160 ha of *C. equisetifolia* has been planted on the two islands and along the sandy beaches.

**Salt ponds.** In Dong Minh commune, there are 100 ha of salt ponds.

**Sand.** Sand is removed from the beach in the Tra Ly estuary for use in house construction.

**Aquaculture.** According to the district people's committee, there are 1,800 ha of aquacultural ponds using the extensive method. However, in Dong Minh commune, the Fu Chun Fishery Company from Taiwan established 40.5 ha of shrimp ponds utilising an intensive method in 1995. On Con Vanh island, a 10 ha demonstration pond using the *Gei Wai* method, supported by the Rockefeller Brothers' Fund, was established by the Centre for Natural Resources Management and Environmental Studies (CRES) in November 1995.

**Inshore fishery.** Stationary gill nets and electro-fishing were noted.

**Collection of shellfish and other marine products.** The intertidal area covering 750 ha, between the Lan and Tra Ly Rivers is used for the collection of shellfish. During the period from 21 to 25 April, about 935 people a day were recorded collecting shellfish at low tide, of whom 420 were collecting *Solen* sp. with hooks and 515 were collecting *Meretrix* sp., and *Mactra quadrangularis* using small rakes. In the intertidal area south of the Lan River, the brachiopod *Lingula* sp. was the main quarry species. In the intertidal area north of the Lan River, *Solen* sp. and *M. quadrangularis* were collected. From the area between the Lan and the Tra Ly Rivers, it was estimated that 3.5 tonnes of shellfish were collected during one day in mid-April. The total value of the catch from this area was estimated to be US\$548 per day in April or US\$84,223 per year. The 30 dealers operating in the area were reluctant to divulge the volume of the shellfish they exported to China. During May, jellyfish are washed ashore in large quantities; these are collected, sun-dried and exported to China for VND2,000 (US\$0.1/each) each.

**Hunting.** Hunting has been forbidden since 1994. However, the use of airguns was observed in the district.

#### 4.8 Tien Hai Nature Reserve

**Location.** The southern part of Tien Hai district (20°17' to 20°22'N 106°23' to 106°35'E), Thai Binh province (Maps 6 and 7), including the coastal areas of Nam Phu, Nam Hung and Nam Thinh communes.

**Man-days visited.** One in February, six in March, 16 in April and three in May: a total of 26 man-days.

**Background.** The southern part of Tien Hai district was designated as a nature reserve in October 1995. By May 1996, no funds had yet been allocated and no management was occurring at the site.



**Site description.** The nature reserve, covering 12,500 ha, is situated in the southern part of Tien Hai district and is bordered by the Lan River to the north, the Ba Lat River to the south and the main dike to the west. The border to the east is not currently defined. Two sandy islands, Con Vanh (2,000 ha) and Con Thu (50 ha), are included in the nature reserve. The islands have been planted with *Casuarina equisetifolia*. Con Thu island is situated about 4 km from the mainland and the associated intertidal area between is composed of sand-flats. Between Con Vanh island and the mainland, there is a deep water channel, the banks of which are covered by mangrove, mainly *Kandelia candel*, of which 90% is included in aquacultural ponds. North of the Ba Lat River, there is an extensive area devoted to aquaculture, where the dominant plant inside the ponds is *Phragmites* sp. The remaining part of the area extending to the Lan River is predominantly sandy and afforested with *C. equisetifolia*; here the intertidal area is sandy.

**Habitat codes.** 01, 02, 03, 04, 05, 07, 08, 09, 11, 13, 15, 16.

**Birds.** During the spring migration, Whiskered Terns *Chlidonias hybridus* were observed feeding over the aquacultural ponds and several species of warbler, including Oriental Reed Warbler *Acrocephalus orientalis* and Dusky Warbler *Phylloscopus fuscatus*, were found roosting in the reedbed. A high tide roost of 447 shorebirds was counted on Con Thu island in mid-April (Table 6). A group of six Black-faced Spoonbills was observed feeding along the muddy banks of the Ba Lat estuary.

**Table 6: High-tide Counts of Shorebirds on Con Thu Island, Tien Hai Nature Reserve**

Species	Scientific Name	Number
Bar-tailed Godwit	<i>Limosa lapponica</i>	2
Common Greenshank	<i>Tringa nebularia</i>	10
Terek Sandpiper	<i>Xenus cinereus</i>	1
Great Knot	<i>Calidris tenuirostris</i>	4
Sanderling	<i>C. alba</i>	28
Red-necked Stint	<i>C. ruficollis</i>	100
Curlew Sandpiper	<i>C. ferruginea</i>	3
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	2
Grey Plover	<i>Pluvialis squatarola</i>	40
Lesser Sand/Greater Sand Plover	<i>Charadrius mongolus/ leschenaultii</i>	257
Total		447

**Forestry.** One hectare of *K. candel* has been planted in the Ba Lat estuary.

**Agriculture.** Domestic ducks were seen feeding on Con Vanh island. Cattle and buffalo were recorded grazing in the aquacultural ponds along the main dike.

**Aquaculture.** The traditional extensive and the modified extensive methods were used in the agricultural ponds on Con Vanh island.

**Inshore fishery.** Medium-sized fishing boats were regularly noted at the southern tip of Con Vanh island. Gill and gape nets are used in the southern part of the nature reserve. Catching of the fish *Borrichthys sinensis* was noted.

**Collection of shellfish and other marine products.** The Lan estuary in the northern part of the nature reserve includes an intertidal area of 900 ha. Between 21 and 25 April, 920 people were recorded collecting shellfish at low tide, of whom 820 were collecting *Lingula* sp., 70 were collecting *Glauconome chinensis*, while 30 were collecting *Meretrix* sp., *Mactra quadrangularis* and *Cyclina sinensis*. The estimated daily harvest from this area is 1.9 tonnes, with an estimated value of US\$529/day and US\$81,314/year.

**Hunting.** Hunters were observed carrying shotguns and airguns.

**Notes.** Although a management plan has been completed for the site, it lacks infrastructure and no state funding is yet forthcoming.

#### 4.9 Thai Thuy District

**Location.** Thai Thuy district (20°28' to 20°37'N 106°36' to 106°38'E), Thai Binh province (Map 6). There are seven coastal communes in the district: Thai Do, Thai Hoa, Thai Thuong, Xuan Hai, Thuy Xuan, Thuy Truong and Thuy Tan.

**Man-days visited.** Two in February, 10 in March, 17 in April and six in May: a total of 35 man-days.

**Site description.** The district has 16 km of coastline and is bordered by the Tra Ly and Thai Binh Rivers. Con Den island (300 ha) lies in the southern part of the district, north-east of the Tra Ly estuary, and a deep, mangrove-lined channel divides this island from the mainland. On the mainland, the aquacultural ponds are dominated by *Phragmites* sp. Part of Con Den island is covered with mangrove but it is estimated that 70% of the island consists of beach, dunes and *Casuarina equisetifolia*. In the centre of the district, the Diem Dien River discharges into the sea. Upstream, close to Diem Dien town, there is a harbour where fish are landed and goods are exported to China. A large area of salt ponds is situated in the northern part of the district. The entire coastline has been planted with *Kandelia candel*. Near the Thai Binh estuary, there are 400 ha of old-growth mangrove dominated by *Sonneratia caseolaris*, most of which has now been enclosed in aquacultural ponds. The area between the Diem Dien and Thai Binh Rivers is described in detail in the next account.

**Habitat codes.** 01, 02, 03, 04, 05, 07, 08, 09, 10, 11, 13, 14, 16, 17.

**Hydrological influence.** The Thai Binh River deposits alluvium in the intertidal area of the district.

**Mangrove.** In the southern part of the district, between the Tra Ly and Diem Dien Rivers, there are still some areas of mangrove which have not yet been incorporated into aquacultural ponds. According to the district authorities, the mangrove on Con Den island is seven years old. The dominant mangrove species are *K. candel*, *S. caseolaris*, *Acanthus ilicifolius* and *Aegiceras corniculatum*.

**Reedbed.** *Phragmites* sp. was observed in the aquacultural ponds at the Tra Ly estuary.

**Birds.** In the district, the majority of birds were observed in and around the area of old-growth mangrove forest close to the Thai Binh estuary. However, in the southern part of the district, a roost of egrets and herons, comprising 12 Little Egrets, 115 Grey Herons and eight Great Egrets, was recorded in the aquacultural ponds near the Tra Ly estuary.

**Forestry.** A mangrove afforestation programme was started in 1994 by the Danish Red Cross, in collaboration with the Thai Thuy Red Cross and Thai Thuy District People's Committee, with technical support from the Mangrove Ecosystem Research Centre (MERC). Between 1994 and 1996, 2,000 ha of *K. candel* were planted. The project produced out-reach materials and distributed them amongst schools and interested parties. The project was supported by the Danish government and private Danish funds. Actmang, a Japanese NGO, has also planted 150 ha of *K. candel* in the northern part of the district. *K. candel* has been planted at a density of 6 to 9 seedlings/m<sup>2</sup> because of the vulnerability of this area to flooding and storm damage. Fifty hectares of *C. equisetifolia* have been planted in the district. Mangrove trees are felled and used to reinforce the dikes, and wood from the old mangroves is collected for firewood.

**Salt ponds.** In the northern part of the district, there are 100 ha of salt ponds, which, in 1995, produced 5,500 tonnes for domestic consumption.

**Aquaculture.** There are about 1,000 ha of aquacultural ponds in the district, of which 900 ha currently include some mangrove. The ponds are distributed all along the coastline and are managed using the extensive and modified extensive methods. Most pond-owners have an eight-year contract with the district people's committee.

**Inshore fishery.** The mudskipper *Boleophthalmus chinensis* and the eel *Pisoodonopsis boro* are collected in the Tra Ly estuary. It was estimated that 100 kg were collected per day, with a total annual value of US\$3,400. Up to 35 small fishing boats were observed beached in the Diem Dien estuary. These craft normally fish 5 km from the coast in 3 to 4 m of water. About 500 m upstream, close to Diem Dien town, larger ships were observed landing fish.

**Collection of shellfish and other marine products.** The most commonly collected species included *Lingula* sp., *Meretrix* sp., *Macra quadrangularis* and *Solen* sp. In the northern part of the district, collection focused on *Glauconome chinensis*. An agricultural enterprise close to Diem Dien town specialised in crushed shells, which are used as an additive in chicken meal.

**Hunting.** The use of mist-nets, shotguns and airguns was observed.

**Future development plans.** The government of Vietnam has recently authorised the construction of a new port adjacent to Diem Dien town.

#### 4.10 Thai Binh Estuary (Thai Thuy District)

**Location.** The coastal area between the Diem Dien and Thai Binh Rivers (20°33' to 20°37'N 106°35' to 106°38'E), Thai Thuy district, Thai Binh province (Maps 6 and 8).

**Man-days visited.** One in February, six in March, 13 in April and four in May: a total of 24 man-days.

**Site description.** The site is bordered by the Diem Dien River to the south and the Thai Binh River to the north. The northern boundary follows the Thai Binh River 2 km upstream until Police Station 64. The site includes 400 ha of mangrove dominated by *Sonneratia caseolaris* but including *Kandelia candel*, *Aegiceras corniculatum* and *Acanthus ilicifolius*. This old-growth forest is estimated to be 50 years old, however, almost all of it is comprised of *K. candel*. To the west is situated an area of salt ponds. Adjacent to the Diem Dien River is an area of aquacultural ponds and *K. candel*.

**Habitat code.** 01, 03, 04, 05, 11, 13, 14, 15, 16, 17.

**Reedbed.** *Phragmites* sp. was observed in most of the aquacultural ponds in the northern part of the area.

**Birds.** The old mangrove forest and the associated intertidal mudflats support very diverse wildlife. During winter and early spring, three threatened or near-threatened species were observed in the area: Black-headed Ibis, Black-faced Spoonbill and Saunders's Gull. Up to 14 Black-headed Ibis were observed feeding on the intertidal mudflats on several occasions. As many as 23 Black-faced Spoonbills and 147 Saunders's Gulls were recorded. On 28 April, 769 roosting egrets and herons, comprising 10 species, were recorded (Table 11).

**Mangrove products.** On several occasions, local people were seen eating raw *S. caseolaris* pneumatophores.



Despite a local law prohibiting the cutting of mangrove, the sound of axes could be heard daily and people were seen removing wood from the forest.

**Agriculture.** Buffalo and cattle were noted grazing in the mangrove forest. Domestic ducks from Tien Lang district were seen feeding in the mangrove at the intertidal flats.

**Reed.** Women were seen collecting *Phragmites* sp. from the aquacultural ponds for fuel.

**Aquaculture.** In the old-growth forest, extensive aquacultural methods based on Mangrove Crab and fish are used. At this site, there is some supplementary stocking. Adjacent to the Diem Dien River, aquacultural ponds are managed following the modified extensive and semi-intensive methods involving supplementary stocking with Mangrove Crab and food. The district Department of Agriculture and Rural Development annually arranges extension courses for pond managers with instructors from Thanh Hoa province.

**Algae.** *Gracilaria verrucosa* is harvested from the aquacultural ponds close to Diem Dien town. About 7 to 10 tonnes/ha of fresh algae are collected during the season which lasts from May to June.

**Collection of shellfish and other marine products.** Almost all the intertidal flats in this part of the district have been afforested with mangrove trees, reducing their utility for shellfish collection. At the mangrove edge, c.80 children were seen collecting *Solen* sp., whilst 50 adults were seen collecting either *Meretrix* sp. or *Macra quadrangularis*. Up to 300 people were observed collecting *Glauconome chinensis*. In mid-March, it was estimated that 5,000 kg were collected daily, which was sold directly to dealers from Tien Hai or Tien Lang districts for c.VND500/kg (US\$0.04/kg).

**Hunting.** Mist-nets, airguns and shotguns were used in the old-growth forest.

**Table 7: Egrets and Herons Roosting in Old-growth Mangrove, Thai Binh Estuary**

Species	Scientific Name	9/4	25/4	27/4	28/4	29/4	30/4
Little Egret	<i>Egretta garzetta</i>	35	40	78	54	21	
Grey Heron	<i>Ardea cinerea</i>		2	10		5	
Purple Heron	<i>A. purpurea</i>			10	28	12	
Great Egret	<i>Casmerodius albus</i>			10	10	11	
Cattle Egret	<i>Bubulcus ibis</i>	6		20	27		20
Chinese Pond Heron	<i>Ardeola bacchus</i>		60	419	463	11	184
Little Heron	<i>Butorides striatus</i>			3	1	3	1
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	80	160	14	174	179	115
Yellow Bittern	<i>Ixobrychus sinensis</i>		2	4	12	18	5
Total		121	264	568	769	260	325

#### 4.11 Tien Lang District

**Location.** Tien Lang district (20°37' to 20°41'N 106°38' to 106°42'E), Hai Phong province (Map 9). There are four coastal communes in the district: Dong Hung, Tien Huy, Vinh Quang and Hung Thang.

**Man-days visited.** Two in February, eight in March and nine in April: a total of 19 man-days.

**Site description.** The district has about 13 km of coastline and is bordered by the Van Uc and Thai Binh Rivers. South of the Van Uc estuary, there are 50 ha of *Sonneratia caseolaris*, estimated to be more

than 100 years old, which has largely been enclosed in aquacultural ponds. Between the main dike and the trees, there is an area of grass and sedge 100 m wide. An area with saltmarsh and small lakes is found behind the dunes in the southern part of the district. Along both estuaries, there are areas of old-growth mangrove dominated by *S. caseolaris*, which have all been incorporated into aquacultural ponds. The district contains two sites, the Thai Binh estuary and the Van Uc estuary, which are described in Sections 4.12 and 4.13.

**Habitat codes.** 01, 03, 04, 05, 07, 08, 10, 13, 14, 15, 16, 18.

**Mangrove.** It was estimated that there are 300 ha of mangrove in the district, dominated by *S. caseolaris* but including *Kandelia candel* and *Aegiceras corniculatum*, of which 200 ha is estimated to be more than 50 years old.

**Birds.** Maximum counts of 16 Black-faced Spoonbills and 30 Saunders's Gulls were recorded. During high tides, shorebirds roosted on drained aquacultural ponds and in paddyfields. At the end of April, a total of 1,037 shorebirds, comprising 18 species, was observed inland during a high tide (Table 8).

**Forestry.** An Actmang project has afforested 50 ha with *K. candel* and has assisted in establishing a nursery for *S. caseolaris* in Vinh Quang commune, next to the Van Uc estuary. There are two small areas, totalling 40 ha, of *Casuarina equisetifolia* forest in the district. Local women were observed collecting needles for fuel. In the forest close to the Van Uc estuary, a man was hired by the district to protect the forest and he took VND200/sack (US\$0.01/sack) from the women as tax.

**Agriculture.** Along the Van Uc River, 100 ha of rice is cultivated in aquacultural ponds and between mangrove trees. Rice and marine products are harvested in alternate years. Rice yield varies from 1,500 to 1,700 kg/ha. This traditional method is encouraged by the authorities.

**Domestic animals.** Up to 72 buffalo and cattle were observed grazing in the intertidal area.

**Aquaculture.** Aquacultural ponds cover 250 ha, from which crab, shrimp and fish are harvested, using mainly the extensive method but also the modified extensive method. Aquacultural extension is provided by the district authorities in collaboration with the Centre for Planting and Breeding Sea Products, Hai Phong.

**Inshore fishery.** During mid-April, 150 men were seen spearing the eel *Pisodonopsis boro*, whilst 150 men and women were seen collecting the fish *Mugil kelaarti*.

**Collection of shellfish and other marine products.** The collection of marine products focused on crabs and snails. The shellfish *Abrina cf. declivis* and *Aloides laevis*, were caught using electro-fishing. Two men working together were able to collect 1,000 kg/day of *Abrina cf. declivis* and *Aloides laevis*, which was sold for VND2,000/kg (US\$0.18/kg). This was used both as food for domestic ducks and Mangrove Crabs. Mudskippers were also collected.

**Hunting.** The use of mist-nets, shotguns and airguns was noted.

**Future development plans.** The district people's committee wishes to establish a resort in the Van Uc estuary and a Hai Phong-based company plans to build a hotel.



Table 8: High-tide Count of Shorebirds in Tien Lang District on 20 April 1996

Species	Scientific Name	Number
Bar-tailed Godwit	<i>Limosa lapponica</i>	4
Whimbrel	<i>Numenius phaeopus</i>	7
Eurasian Curlew	<i>N. arquata</i>	4
Spotted Redshank	<i>Tringa erythropus</i>	394
Common Redshank	<i>T. totanus</i>	33
Marsh Sandpiper	<i>T. stagnatilis</i>	27
Common Greenshank	<i>T. nebularia</i>	88
Wood Sandpiper	<i>T. glareola</i>	15
Terek Sandpiper	<i>Xenus cinereus</i>	19
Common Sandpiper	<i>Actitis hypoleucos</i>	2
Great Knot	<i>Calidris tenuirostris</i>	1
Red-necked Stint	<i>C. ruficollis</i>	202
Curlew Sandpiper	<i>C. ferruginea</i>	16
Grey Plover	<i>Pluvialis squatarola</i>	6
Little Ringed Plover	<i>Charadrius dubius</i>	1
Kentish Plover	<i>C. alexandrinus</i>	12
Lesser Sand Plover	<i>C. mongolus</i>	2
Greater Sand Plover	<i>C. leschenaultii</i>	204
Total		1,037

#### 4.12 Thai Binh Estuary (Tien Lang District)

**Location.** Thai Binh estuary (20°37' to 20°38'N 106°36' to 106°39'E), Tien Lang district, Hai Phong province (Maps 9 and 10).

**Man-days visited.** Two in February, eight in March and nine in April: a total of 19 man-days.

**Site description.** The site comprises the old-growth mangrove and connected intertidal flats along the Thai Binh River, covering an estimated 2,000 ha and including 100 ha of old-growth mangrove. The old-growth mangrove is dominated by *Sonneratia caseolaris* but also includes *Kandelia candel*, *Aegiceras corniculatum* and *Acanthus ilicifolius*. It was estimated that 95% of the old-growth mangrove was included in aquacultural ponds.

**Habitat codes.** 01, 03, 04, 05, 07, 08, 10, 13, 14, 16.

**Birds.** Three Saunders's Gulls were recorded on 10 February and 16 Black-faced Spoonbills on 7 March. On several occasions, birds were seen flying up the river to roost in the old mangrove forest. On 28 April, approximately 50,000 Barn Swallows *Hirundo rustica* and Sand Martins *Riparia riparia*, and 1,150 Yellow Wagtails *Motacilla flava* were counted flying to roost.

**Forestry.** Cutting of mangrove for firewood is very common in the old-growth forest. On several occasions people were noted removing up to 30 kg of wood from the forest.

**Agriculture.** Up to 3,300 domestic ducks were observed feeding on the intertidal flats.

**Sand.** People were observed collecting sand for use as a construction material.



**Aquaculture.** The extensive method is used to harvest fish. Pond-owners complained about decreasing yields. Most of them have a 15-year contract with the district people's committee and pay VND90,000/ha (US\$8.1/ha) in tax per year.

**Inshore fishery.** Gill nets were noted in the intertidal area.

**Hunting.** More than 500 m of mist-nets, with a catch area of 275 m<sup>2</sup>, were observed among the mangroves close to the Thai Binh estuary.

#### 4.13 Van Uc Estuary

**Location.** Van Uc estuary (20°40' to 20°41'N 106°41' to 106°42'E), Tien Lang district, Hai Phong province (Maps 9 and 11).

**Man-days visited.** Two in February, eight in March and nine in April: a total of 19 man-days.

**Site description.** An area of old-growth mangrove forest lies to the south of the Van Uc estuary, beyond which lies saltmarsh and a *Casuarina equisetifolia* plantation.

**Habitat codes.** 01, 03, 04, 05, 07, 08, 10, 13, 14, 15, 16, 18.

**Mangrove.** There remains 100 ha of old-growth mangrove forest at the site, all of which is included in aquacultural ponds. The mangrove is dominated by *Sonneratia caseolaris* but *Kandelia candel*, *Aegiceras corniculatum* and *Acanthus ilicifolius* are also present.

**Birds.** Up to eight Black-faced Spoonbills were recorded at the site on 5 February. Maximum daily counts of herons and egrets included: 50 Little Egrets, 45 Grey Herons, 50 Cattle Egrets *Bubulcus ibis*, 140 Chinese Pond Herons *Ardeola bacchus* and 16 Black-crowned Night Herons. A flock of 121 Black Kites *Milvus migrans* was recorded on 10 March, and 1,610 Black Bazas *Aviceda leuphotes* were observed migrating over the site on 19 April.

**Aquaculture.** The aquacultural ponds were managed using the traditional extensive method with a polyculture of crab, shrimp and fish, with fish as the principle catch.

**Hunting.** The use of airguns and dazzling with torches was noted.

#### 4.14 Kien Thuy District

**Location.** Kien Thuy district (20°41' to 20°42'N 106°42' to 106°46'E and 20°44' to 20°47'N 106°44' to 106°46'E), Hai Phong province (Map 9). There are nine coastal communes in the district: Dai Hop, Tan Thanh, Doan Xa, Tan Trao, Vu Phuc, Kien Quoc, Hai Thanh, Dai Hop and Tan Thanh.

**Man-days visited.** Two in February and three in May: a total of five man-days.

**Site description.** The district has a 13 km coastline, divided by the Do Son peninsula. To the north, the district is bordered by the Lach Tray River and the open sea of Ha Long Bay. The Lach Tray estuary is very narrow and deep. Close to the estuary, the narrow intertidal flat is fringed with mangroves which are mostly enclosed in aquacultural ponds. Just behind the main dike along the highway to Do Son, there is an area of aquacultural ponds. The coastline to the east is exposed to the open sea and has sandy



beaches. The south of the district is bordered by the Van Uc River and the open sea, where *Casuarina equisetifolia* has been planted along sandy beaches and dunes. Close to the Do Son Peninsula, a small area of intertidal flats has been planted with *Kandelia candel*.

**Habitat codes.** 01, 02, 03, 04, 05, 07, 08, 10, 13, 14, 15.

**Mangrove.** The belt of mangrove along the northern coastline is 50 to 100 m wide in places and 50% is now included in aquacultural ponds. The dominant species are *Sonneratia caseolaris* and *K. candel*, although *Rhizophora stylosa* is present in small numbers.

**Birds.** A roost of 410 Black-headed Gulls *Larus ridibundus*, 70 Grey Herons and 300 shorebirds (mainly Common Redshank *Tringa totanus*) were seen on the intertidal flats in the southern part of the district close to the Do Son peninsula.

**Forestry.** In the southern part of the district, 100 ha of *K. candel* has been planted.

**Agriculture.** Along the southern coastline, cattle graze on the dune vegetation. Beyond the main dike, an area of aquacultural ponds containing mangrove was found. These ponds are managed by the extensive method.

**Algae.** *Gracilaria verrucosa* is grown in the aquacultural ponds inside the main dike.

**Inshore fishery.** A quay for medium-sized fishing boats was observed on the beach in the southern part of the district. Electro-fishing, mainly for shrimp, was noted.

**Collection of shellfish and other marine products.** Collection of the shellfish *Meretrix* sp. was observed and reported for other species.

**Hunting.** A hunter with a shotgun was observed.

#### 4.15 Do Son District

**Location.** Do Son district (20°40' to 20°47'N 106°46' to 106°49'E), Hai Phong province (Map 9). There are no coastal communes in the district.

**Man-days visited.** Two in February and three in May: a total of five man-days.

**Site description.** A rocky peninsula extending over 1,000 ha having a north-west to south-east orientation in the Gulf of Tonkin. Most of the peninsula is hilly and covered with pine trees. The southern coastline, at the tip of the peninsula, is rocky, whilst the northern coastline has mainly sandy beaches, the total length of which is estimated to be 15 km.

**Habitat codes.** 01, 06, 07.

**Hydrological influence.** The peninsula is exposed to the open sea.

**Birds.** No species of interest were noted but the area could be an important staging place for migratory species.

**Land-use and socio-economic features.** All of the peninsula is a tourist resort with discos, restaurants,





hotels and a casino.

#### 4.16 An Hai District

**Location.** An Hai district (20°47' to 20°51'N 106°44' to 106°46'E), Hai Phong province (Map 9). There are three coastal communes in the district: Trang Cat, Nam Hai and Dong Hai.

**Man-days visited.** One in February and two in March: a total of three man-days.

**Site description.** The district has 9 km of coastline which is bordered by the Lac Tray River to the south and the Cam River to the north and east. The intertidal area of the Cam River mouth is very narrow and deep. There is only a narrow fringe of mangrove along the coastline. Dinh Vu and Vu Yen islands, situated in the Cam River, are both given over to aquacultural ponds, in which the dominant vegetation is *Phragmites* sp. A muddy intertidal area is located at the southern tip of the district close to the Lac Tray estuary. Along both rivers, areas of sedge *Cyperus* sp. were observed.

**Habitat codes.** 01, 02, 03, 04, 09, 11, 12, 13, 15, 16.

**Mangrove.** The area supports 150 ha of mangrove composed of *Kandelia candel*, *Acanthus ilicifolius* and *Aegiceras corniculatum*.

**Reedbed.** A large reedbed of *Phragmites* sp. was located in the northern half of Dinh Vu island.

**Birds.** One Black-faced Spoonbill and 17 Saunders's Gulls were recorded in the Lac Tray estuary. A roost of 1,400 shorebirds (mainly Lesser Sand Plover and Greater Sand Plover *Charadrius leschenaultii*), 470 Heuglin's/Vega Gulls and 500 Black-headed Gulls was recorded in the intertidal area.

**Forestry.** The district authorities have planted *K. candel* since 1991 and, in 1995, planted 100 ha of mangrove, which now represents the only mangrove not included in aquacultural ponds.

**Aquaculture.** There are more than 200 ha of aquacultural ponds in the district, which are mainly managed following the extensive method.

**Inshore fishery.** Gill-nets were observed in the southern part of the district.

**Collection of shellfish and other marine products.** The collection of Mangrove Crab was observed in the intertidal area. More than 40 dealers were seen sitting at the main dike waiting for crab and shrimp collectors to return with their catches.

**Hunting.** Hunting with shotguns was observed.

**Future development plans.** According to the district people's committee, there are plans to establish an industrial harbour on Dinh Vu island.

#### 4.17 Thuy Nguyen District

**Location.** Thuy Nguyen district (20°53' to 20°59'N 106°44' to 106°46'E), Hai Phong province (Map 9). There are six coastal communes in the district: Duong Quan, Lap Le, Pha Le, Phuc Le, Tam Hung, Minh Duc and Gia Duc.



**Man-days visited.** 2 in March and 6 in April: a total of eight man-days.

**Site description.** The district has 23 km of coastline, bordered to the south by the Cam River and to the north by the Da Bach River. The district is bisected by the Gia River, which also represents the northern border of the project area. The southern coastline of the district is fringed by a 100 to 300 m belt of old-growth mangrove.

**Habitat codes.** 02, 04, 13, 15, 16, 18.

**Mangrove.** According to the district people's committee, there are 400 ha of mangrove, comprising 200 ha of *Sonneratia caseolaris*, which is estimated to be more than 30 years old. It is estimated that only 50 ha of the old-growth forest is included in aquacultural ponds.

**Forestry.** Since 1992, the district authorities have planted 150 ha of *Kandelia candel* and *S. caseolaris*: seedlings of *K. candel* were obtained from within the district, whilst *S. caseolaris* was translocated from the coastal areas of Quang Ninh province. The district authorities plan to plant 50 ha of *K. candel* in 1996.

**Agriculture.** Domestic ducks were seen feeding on the intertidal areas in the district. In the northern part of the district, rice is cultivated in aquacultural ponds amongst the mangrove trees.

**Aquaculture.** The most common method used is the extensive method, with a polyculture of crab, shrimp and fish.

**Inshore fishery.** Electro-fishing was observed in the district.

**Collection of shellfish and other marine products.** Collection of *Meretrix lyrata* was observed.

**Hunting.** Hunting is forbidden by law in the district. However, the use of traps and airguns was noted.

**Notes.** The district authorities have declared an area of old-growth mangrove forest situated south of the Gia River as a protected area (see next account).

#### 4.18 The Southern Coast of Thuy Nguyen District

**Location.** Thuy Nguyen district (20°53' to 20°56'N 106°44' to 106°46'E), Hai Phong province (Maps 9 and 12).

**Man-days visited.** One in March and six in April: a total of seven man-days.

**Description of site.** The site is bordered by the Bach Dang dike to the west, the Gia River to the north and the Cam River to the south. The northern part of the site has 7 km of coastline, fringed by a belt of mangrove 100 to 300 m wide, which covers 100 ha. The forest is mainly dominated by 30 year old *Sonneratia caseolaris* but includes *Aegiceras corniculatum* and *Kandelia candel*. It was estimated that only 150 ha of old-growth forest was included in aquacultural ponds. South of the old forest is an area of aquacultural ponds fringed by a belt of *S. caseolaris* 5 to 10 m wide. Adjacent to the Cam River, the coastline is fringed with aquacultural ponds.

**Background.** In 1994, the district people's committee declared the old-growth mangrove a protected area. A man was hired by the district authorities to prevent the construction of aquacultural ponds and

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logging. This decision was prompted due to the need for coastal protection from typhoons.

**Habitat codes.** 02, 04, 13, 16.

**Birds.** Passerines were observed roosting in the old-growth mangrove during migration. Some were species only rarely recorded in the Red River Delta, such as Dollarbird *Eurystomus orientalis*, Blue-tailed Bee-eater *Merops philippinus*, Racket-tailed Treepie *Crypsirina temia*, Black-naped Oriole *Oriolus chinensis* and Ashy Minivet *Pericrocotus divaricatus*.

**Agriculture.** Domestic ducks were seen feeding in the intertidal areas and buffalo were seen grazing in the mangrove.

**Aquaculture.** The district authorities encourage pond-owners to maintain mangrove inside their aquacultural ponds but many pond-owners think it harms the shrimp and crabs. The ponds are mainly managed following the extensive method but a few use the modified extensive method.

**Inshore fishery.** Electro-fishing was observed.

**Notes.** The district authorities have requested assistance in the management of the area.



## 5. District and Site Evaluations

In order to evaluate the biological and conservation value of the districts and sites surveyed, it was essential to establish a set of quantitative criteria by which the districts and sites could be judged. This was done by utilising and, where necessary, modifying existing criteria used elsewhere, including a set of criteria for identification and selection of nature reserve sites in the UK (Ratcliffe 1977), two sets of criteria used to identify internationally important wetlands (Ramsar 1985, Wetlands International 1996) and a system to identify globally threatened bird species (Collar *et al.* 1994). Some of the criteria, for example Ramsar (1985), were considered rather vague and, in order to reflect the local conditions in the Red River Delta, they were made quantitative. Furthermore, some additional criteria were developed based on standard management planning principles. In total, 17 criteria were used in district and site assessment, which broadly fall under the headings of area (one), diversity (two), rarity (two), abundance (three), naturalness (one), fragility (one), maintaining biodiversity (one), position in an ecological unit (one), sustainability (one) and future potential (four).

In order to help judge the most important districts and sites for conservation, a district or site fulfilling a criterion was allocated a numerical score. Thus, the overall score for a particular district or site is a quantitative measurement of its biodiversity value and an assessment of its conservation importance. The districts and sites were then ranked to reveal the priority districts and key coastal wetland sites for conservation in the Red River Delta. The criteria used and the rationale for their use are presented below. In the district and site inventory which follows, a criterion is generally only listed if it is fulfilled.

- (a) **Area (size or extent).** The inclusion of this criterion is based on the idea that larger sites are better because they may contain more species and that there is a minimum area which needs to be safeguarded in order to maintain the conservation interest of the locality. Sites were ranked using an order-of-magnitude scale as follows: 0 to 9 ha (Score: 1), 10 to 99 ha (Score: 2), 100 to 999 ha (Score: 3), 1,000 to 9,999 ha (Score: 4), 10,000 to 99,999 ha (Score: 5). This criterion was not applied to districts, since to do so would diminish the utility of the criterion. Thus, their areas were not evaluated.
- (b) **Diversity (habitat).** The total number of habitats within a district or site is a measure of its diversity. This criterion is based on the rationale that the number of habitats is positively correlated with the number of animal and plant communities and the overall number of animal and plant species present within a site. It is, therefore, an indirect measure of overall biodiversity. This criterion was scored as follows: zero to eight habitats (Score: 1), 9 to 12 habitats (Score: 2) and 13 to 16 habitats (Score: 3).
- (c) **Diversity (species).** Diversity is often measured in terms of either the overall total number of species or the number of endemic species occurring in a district or at a site. The greater the number of species in either category, the more important the district or site. In this study, diversity was defined as the number of species endemic to Vietnam or East Asia (China, Hong Kong, Japan, Korea, Russia) occurring in a district or at a site. The occurrence of such a species in a district or at a site merited a score of 1.
- (d) **Rarity (habitat).** Rarity can be thought of as an expression of value. One of the most important functions of a nature reserve is to protect rare species and rare communities. Following an overview of the extent and frequency of occurrence of different habitats within the entire Red River Delta, the following habitats were defined as rare: mangrove forest more than 30 years old; sedge-bed more than 100 ha in extent; reedbed greater than 100 ha in extent; saltmarsh; and a habitat mosaic comprising saltmarsh and small wetlands greater than 10 ha. The presence of each habitat at a site merited a score of 1.



- (e) **Rarity (species).** A bird species was defined as rare if it was listed as threatened or near-threatened in Collar *et al.* (1994). This criterion was scored for each species as follows: Critically Endangered (Score: 4), Endangered (Score: 3), Vulnerable (Score: 2), Near-threatened (Score: 1).
- (f) **Abundance (species population concentration).** Species which congregate in assemblages at some stage in their annual or life-cycle are vulnerable to external threats arising as a consequence of either human or environmental factors. Such sites are, therefore, of particular conservation importance and should be protected. This is acknowledged under the Ramsar Convention and defined here as districts and sites which regularly support more than 1% of a population of a species. In this study, each species meeting the 1% threshold merited a score of 1.
- (g) **Abundance (20,000 waterbirds).** This criterion is a second measure of abundance and is based on the principle that the total number of individuals of different waterbird species occurring in a district or at a site reflects its overall conservation importance. It is based on an arbitrary threshold set under the Ramsar Convention. In this study, a district or site regularly supporting more than 20,000 waterbirds merited a score of 1.
- (h) **Abundance (5,000 migratory shorebirds).** A district or site merited a score of 1 if 5,000 or more migratory shorebirds were recorded during a single count. This is a third measure of abundance stipulated under the Ramsar Convention.
- (i) **Naturalness.** Naturalness is often a rare habitat condition in countries or areas with a high human population density but the argument is that habitats least modified by humans should be given priority for conservation. In this study, a district or site supporting mangrove forest greater than 30 years old was defined in this way and merited a score of 1.
- (j) **Fragility.** This is an indication of the degree of sensitivity of habitats, communities and species to environmental change and human impact. Certain landscape forms and plant and animal communities are particularly fragile and, therefore, are deemed to be of high conservation importance and worthy of protection. In this study, five vegetation types (dune, saltmarsh, reedbed, sedge-bed and mangrove vegetation) were classified in this way, and a district or site merited a score of 1 for each vegetation type present.
- (k) **Special role in maintaining biological diversity.** A district or site of special value for maintaining the genetic and biological diversity of a region because of the quality and/or uniqueness of its flora and fauna. This is a criterion listed under the Ramsar Convention but it is somewhat subjective and difficult to define or quantify. For the purposes of this study, it was defined as a site with mangrove forest greater than 30 years old and/or the occurrence of a bird species listed in Collar *et al.* (1994). Such a site merited a score of 1 for each feature and/or species. This is seen as an imperfect definition since both these attributes are covered by other criteria, so such a definition merely adds emphasis to a district or site with these important features.
- (l) **Sustainability (traditional aquacultural management).** A district or site determined to be a particularly good example of a specific type of wetland characteristic of the region. This, again, is a criterion under the Ramsar Convention. In this study, it was used as a measure of sustainability of resource-use and defined as a district or site where traditional extensive methods of aquaculture were predominant. It should be remembered that sustainable use does not always equate with a practice which promotes the conservation of biodiversity.



Traditional aquaculture as practised in the Red River Delta often results in mangrove die-back. However, such a district or site merited a score of 1.

- (m) **Position as an ecological unit.** Where practicable, and without lowering the standards of selection, it is desirable to include within a single geographical location as many as possible of the important and characteristic formations, communities and species of an area. For example, a mangrove area adjoining mudflats may enhance the value of the site. In this study, this criteria was defined as a district or site contiguous either with another area of natural or semi-natural habitat. Such a district or site merited a score of 1.
- (n) **Potential conservation value.** Whilst, arguably, any site of biological importance has conservation value, the definition used here was designed to reflect the existing degree of political will to protect a district or site. It was, therefore, defined as a district or site currently either designated or proposed as a protected area or subject to restricted access or land-use. Such a district or site merited a score of 1.
- (o) **Potential education and cultural value.** A district or site presenting unique opportunities for environmental education or tourism. These may be landscape features, or historical or cultural sites with associated infrastructure such as access roads. Such a district or site merited a score of 1.
- (p) **Potential role for NGOs.** A district or site currently unprotected and/or suffering levels of human usage deemed to be unsustainable, which will lead to degradation of the district or site without intervention. Such a district or site merited a score of 1.
- (q) **Potential economic value.** A potential economic activity which is sustainable and which does not degrade the environment merited a score of 1. If traditional, extensive aquacultural techniques were practised over more than 75% of a district or site, they were deemed to be potentially sustainable. Non-sustainable and environmentally degrading activities merited a negative score of 2 each. Furthermore, if a district or site was planning an extension of its aquacultural pond area, it also merited a negative score of 2.

**Constraints on management.** Although no specific criterion was selected to assess constraints on management, the preceding four criteria are, to some degree, a reflection of management constraints. No attempt was made to quantify constraints further. However, in the district and site accounts which follow, current management regimes are evaluated and discussed where relevant.

## 5.1 Nga Son District

**Diversity (habitat).** Nga Son district has the shortest coastline in the Red River Delta but seven different habitats were recorded, including the largest sedge-bed *Cyperus* sp. in the entire Red River Delta.

Score: 1

**Diversity (species).** Saunders's Gull was recorded, which is endemic to East Asia. Black-faced Spoonbill was only reported from the district.

Score: 1

**Rarity (habitat).** Sedge-beds are becoming increasingly scarce in the Red River Delta due to the continued establishment of aquacultural ponds.

Score: 1



**Rarity (species)**

Saunders's Gull (Endangered) was recorded in the district.

Score: 3

**Abundance (species population concentration).** Two percent of the estimated world population of Saunders's Gull was noted feeding on the intertidal flats.

Score: 1

**Fragility.** The district supports three fragile habitats: reedbed, mangrove and sedge-bed.

Score: 3

**Special role in maintaining biological diversity.** One threatened species, Saunders's Gull occurs in the district.

Score: 1

**Sustainability (traditional aquacultural management).** Traditional extensive aquaculture was widely practised in the district.

Score: 1

**Position as an ecological unit.** Nga Son and Kim Son districts belong to the same ecological unit, since they are both situated in a secluded bay and are influenced by the same river system.

Score: 1

**Potential education and cultural value.** A waterbird colony formerly existed in the mangrove forest along the River Len and there is still a egret and heron roost at the site. The re-establishment of this colony would constitute a potential tourist and educational attraction.

Score: 1

**Potential role of NGOs.** The area is not currently under any sustainable management regime. Roles for NGOs exist in the fields of environment awareness, aquacultural extension and afforestation.

Score: 1

**Potential economic value.** Aquacultural ponds are currently managed following the traditional extensive method. However, a huge aquacultural pond extension is planned which will lead to the further destruction of sedge-beds, mangrove forest and the intertidal area. The impact of marine product exploitation and hunting could not be quantified.

Score: -1

**Total score: 14**  
**District rank: 3**

## 5.2 Kim Son District

**Diversity (habitat).** The coastal zone contains seven different habitats.

Score: 1

**Diversity (species).** The mudflats appear to provide suitable habitat for Saunders's Gull and Black-faced Spoonbill but there are currently no records of these species from the district. It has been suggested that the district supports an endemic, but as yet undescribed, species of sedge *Scirpus* sp. *nova* (Nguyen Khac Khoi 1993 and Nguyen Khac Khoi pers comm.).

Score: 0



**Fragility.** The district includes three fragile habitats: sedge-bed, reedbed and mangrove. Score: 3

**Sustainability (traditional aquacultural management).** Traditional extensive aquaculture was widely practiced in the district. Score: 1

**Position as an ecological unit.** Nga Son and Kim Son districts belong to the same ecological unit since they are both situated in a secluded bay and are influenced by the same river system. Score: 1

**Potential role of NGOs.** The district is not currently under any sustainable management regime. Roles for NGOs exist in the fields of environment awareness, aquacultural extension and afforestation. Score: 1

**Potential economic value.** The traditional extensive method is mainly used but the continued allocation of land for aquacultural construction poses a threat to the intertidal area. Score: -2

**Total score: 5**  
**District rank: 7 =**

### 5.3 Nghia Hung District

In this evaluation, Nghia Hung district is considered both as a district and as a site. The score for area is only included in the site score.

**Area (Size or extent).** At low tide, the coastal zone of the district covers 7,600 ha. Score: 4

**Diversity (habitat).** The coastal zone of Nghia Hung district supports 13 different habitats and is one of the most diverse areas in the Red River Delta. Score: 3

**Diversity (species).** The district supports five bird species endemic to East Asia: Black-faced Spoonbill, Chinese Egret, Saunders's Gull, Spoon-billed Sandpiper and Nordmann's Greenshank. Score: 5

**Rarity (habitat).** The southernmost island supports the largest saltmarsh in the Red River Delta. Two small offshore islands are noteworthy because they support a high-tide shorebird roost. Score: 1

**Rarity (species).** During this and a previous survey in 1994 (Pedersen *et al.* 1998), eight bird species listed in Collar *et al.* (1994) were recorded: Black-faced Spoonbill (Critical), Chinese Egret (Endangered), Nordmann's Greenshank (Endangered), Saunders's Gull (Endangered), Spot-billed Pelican (Vulnerable), Spoon-billed Sandpiper (Vulnerable), Black-headed Ibis (Near-threatened) and Asian Dowitcher (Near-threatened). The believed-to-be-endemic sedge *Scirpus* sp. *nova* may be found on the intertidal flats (Nguyen Khac Khoi 1993 and Nguyen Khac Khoi pers comm.). Score: 19



**Abundance (species population concentration).** The district regularly supports more than 1% of the world population of Saunders's Gull and 4% of the world population of Black-faced Spoonbill.

Score: 2

**Abundance (20,000 waterbirds).** During April 1994, it was estimated that more than 30,000 shorebirds were in the district (Pedersen *et al.* 1996). It was estimated that 8,000 shorebirds passed through the district during the spring of 1996.

Score: 1

**Abundance (5,000 migratory shorebirds).** During the spring of 1994, the maximum number of shorebirds observed during a single count was 6,549 individuals (Pedersen *et al.* 1996). The maximum count during this study was 1,776 shorebirds.

Score: 1

**Fragility.** All five fragile habitats were recorded in the district making it particularly noteworthy. In addition, these habitats are threatened in the district by unregulated aquacultural development.

Score: 5

**Special role in maintaining biological diversity.** The district supports eight bird species listed by Collar *et al.* (1994).

Score: 8

**Sustainability (Traditional management).** Traditional extensive aquaculture was dominant in the district but other methods were also followed.

Score: 1

**Potential conservation value.** The district is currently without protection. Given the suite of threatened species occurring at the site and the numbers of shorebirds, the site is of very high conservation value.

Score: 0

**Potential role for NGOs.** Since the district is unprotected and current levels of resource use are believed to be unsustainable, there is a potentially major role for NGOs in the fields of management plan development, forestry, aquaculture, and monitoring shellfish exploitation.

Score: 1

**Potential economic value.** The traditional extensive method was mainly used in the district. The sustainability of shellfish collection and hunting was not quantified.

Score: 1

**Constraints on management.** There is no coastal zone management plan for the district. There is insufficient technical capacity amongst the district Forest Protection Department and lack of awareness of the biological value of mangrove and the intertidal mudflats. Aquacultural development is unregulated and there is no extension service available to pond operators. There is lack of baseline data to monitor trends in bivalve populations and no enforcement of regulations prohibiting bird hunting.

**Total score for district: 48**

**District rank: 1**

**Total score for site: 52**

**Site rank: 2**



#### 5.4 Hai Hau District

**Diversity (habitat).** Eight habitats were recorded in the district.

Score: 1

**Rarity (habitat).** This was the only district or site to support the habitat mosaic comprising saltmarsh and small wetlands.

Score: 1

**Fragility.** Two fragile plant communities were identified.

Score: 2

**Potential education and cultural value.** The presence of sandy beaches may indicate some tourist potential.

Score: 1

**Total score: 5**  
**District rank: 7 =**

#### 5.5 Xuan Thuy District

This account evaluates the coastal zone of Xuan Thuy district, excluding Xuan Thuy Nature Reserve. A detailed site evaluation is given for Xuan Thuy Nature Reserve in Section 5.6.

**Diversity (habitat).** The district, one of the most diverse in the Red River Delta, supports 15 habitats. However, outside the nature reserve, this figure is reduced to 11.

Score: 2

**Fragility.** Three fragile plant communities were recorded outside the nature reserve.

Score: 3

**Potential role for NGOs.** Provision of aquacultural extension services.

Score: 1

**Potential economic value.** Aquacultural ponds were mainly managed intensively.

Score: -2

**Total score: 4**  
**District rank: 10**

#### 5.6 Xuan Thuy Nature Reserve

**Area (size or extent).** According to the current management plan, Xuan Thuy Nature Reserve covers 5,640 ha (Anon. 1993). However, on the map it covers 6,200 ha. In the government of Vietnam's letter of submission, the Ramsar Site covers 12,000 ha. In the management plan, the area of the Ramsar Site is quoted as 9,400 ha, which conforms to the measurement on the site-map.

Score: 4

**Diversity (habitat).** A total of 14 different habitats were found in the protected area and all the major types of habitats found in the Red River Delta were represented in the nature reserve. The site does not,



however, support any stands of old-growth mangrove forest.

Score: 3

**Diversity (species).** Black-faced Spoonbill, Chinese Egret, Saunders's Gull, Spoon-billed Sandpiper and Nordmann's Greenshank are all regionally endemic species occurring at the site. The sedge *Scirpus* sp. *nova* may be found on the intertidal mudflats (Nguyen Khac Khoi 1993 and Nguyen Khac Khoi pers comm.).

Score: 5

**Rarity (habitat).** The nature reserve includes 300 ha of *Phragmites* sp., which form the largest reedbed in the Red River Delta.

Score: 1

**Rarity (species).** To date, nine species of threatened and near-threatened birds have been recorded from the nature reserve: Black-faced Spoonbill (Critically Endangered), Chinese Egret (Endangered), Nordmann's Greenshank (Endangered), Saunders's Gull (Endangered), Spot-billed Pelican (Vulnerable), Spoon-billed Sandpiper (Vulnerable), Painted Stork (Near-threatened), Asian Dowitcher (Near-threatened) and Grey-headed Lapwing (Near-threatened). Six of these species were recorded during this study.

Score: 20

**Abundance (species population concentration).** On 5 February 1996, 75 Black-faced Spoonbills, 17% of the estimated world population were observed at Xuan Thuy Nature Reserve. This represents the largest single flock recorded in the Red River Delta and establishes Xuan Thuy Nature Reserve as the third most important wintering area in the world for this species (Anon. 1996a). During the survey, 2% of the estimated world population of Saunders's Gull were recorded at the site.

Score: 2

**Abundance (20,000 waterbirds).** During surveys in 1988 (Scott *et al.* 1989) and 1994 (Pedersen *et al.* 1996), more than 20,000 waterbirds were observed. It was estimated that 33,000 shorebirds passed through the nature reserve during spring 1996.

Score: 1

**Abundance (5,000 migratory shorebirds).** A total of 7,329 shorebirds were recorded at a high tide roost on a sand bar south of Con Lu island.

Score: 1

**Fragility.** Four fragile habitats are located in the nature reserve: dune, saltmarsh, reedbed and mangrove.

Score: 4

**Special role in maintaining biological diversity.** Although there is no old mangrove in this protected area, nine bird species listed in Collar *et al.* (1994) have been recorded.

Score: 9

**Sustainability (traditional aquacultural management).** Traditional aquaculture, or variants with some degree of intensification are practised in most of the aquacultural ponds in and around the nature reserve.

Score: 1

**Position in an ecological unit.** Xuan Thuy Nature Reserve is located immediately south of the mouth of the Red River. The future of the nature reserve is dependent on the flow and discharge of the Red



River. On the northern shore of the Red River mouth is Tien Hai Nature Reserve, which supports a number of habitats which are also present in Xuan Thuy Nature Reserve. Although the Red River acts, to some degree, as a natural barrier, the two nature reserves should be considered part of the same ecological unit.

Score: 1

**Potential conservation value.** The nature reserve is the only wetland area in Vietnam meeting the Ramsar Convention designation. The designation of the site under national law and an international convention shows a high level of political will to protect the site.

Score: 1

**Potential education and cultural value.** It was estimated that fewer than 20 tourists visited the nature reserve in 1995. This reflects the site's remote location and difficult access. Tourists are not permitted to enter the nature reserve without a written permit. Very basic accommodation is available at the headquarters on Con Ngan island. As Vietnam's first Ramsar Site, Xuan Thuy Nature Reserve has a very important potential function as a site to educate the public and train forest protection staff from other wetland protected areas.

Score: 1

**Potential role of NGOs.** There is an obvious need at the site for NGOs to assist in revising the management plan, so that the staff engage in activities which are compatible with the objectives of nature conservation, rather than coastal protection, land reclamation and aquaculture. Formulation of a new reserve finance structure is desirable so that aquacultural activities in the nature reserve and buffer zone subsidise the protected area and help to meet management costs. Assistance is further required in researching the sustainability of human activities in the nature reserve and buffer zone, species and habitat monitoring, and staff training.

Score: 1

**Potential economic value.** The volume of honey harvested from the nature reserve has recently declined as a result of construction of aquacultural ponds. Annual yield in 1988 was estimated at 50 tonnes, but this had declined to four tonnes by 1996 (Anon. 1993). The collection of honey is a sustainable human activity which is dependent on the existence of a healthy mangrove forest. Within the nature reserve, traditional extensive methods of aquaculture are mainly practised. There are insufficient data to determine whether capture and cultivation of the shellfish *Meretrix* sp. is undertaken in a sustainable manner.

Score: 3

**Constraints on management.** Nature reserves are a category of special-use forest according to the management regulations issued by the then Ministry of Forestry. Under these regulations, it is prohibited to "change the landscape, introduce grazing domestic animals, introduce any plant or animal species and to engage in activities affecting wildlife" (Ministry of Forestry 1987). These regulations are very similar to the internationally accepted definition of a nature reserve as defined by IUCN (1994) which state that the purpose of a nature reserve should be to preserve habitats, ecosystems and species in as undisturbed a state as possible; maintain genetic resources in a dynamic and evolutionary state; maintain established ecological processes; secure examples of the natural environment for scientific studies; minimise disturbance by careful planning and execution of research and other approved activities; and limit public access. These two sets of definitions form the basis for the following evaluation of the current Xuan Thuy Nature Reserve management plan (Anon.1993).

Under the current management plan, the following management programmes are defined: protection, forestry, research, training, awareness, education and tourism, and socio-economics. The aim of the protection programme is to protect wildlife by establishing guard stations and observation posts and



through border demarcation. Although the terrestrial boundaries of the nature reserve are marked with concrete marker posts, the eastern and southern boundaries which lie in the intertidal area are neither defined in the management plan nor marked-out. However, it is in this ill-defined area where high tide shorebird roosts are located. These roosts are vulnerable to disturbance by fishermen and, because of the ambiguity regarding the boundary, it is currently difficult for the staff to adequately protect these areas.

Although the entire nature reserve is zoned as strictly protected, the staff acknowledge the rights of local people to engage in aquaculture, collect marine products and graze domestic animals within its boundaries with unrestricted access and with impunity. The impact of these activities on wildlife remains unquantified. However, grazing of domestic livestock, especially goats, is likely to have a negative impact on the fragile dune vegetation. Competition may exist for shellfish between shorebirds and local people. Since the specified management regime is clearly not currently being implemented, it would appear to be more appropriate to try and regulate human resource-use by zoning the protected area to ensure that particularly important habitats and roosting and feeding areas for birds are managed in accordance with the area's primary purpose and in line with IUCN guidelines (IUCN 1994). Between the designation of the Ramsar Site in 1989 and 1994, there was a 130% increase in the number of aquacultural ponds on Con Ngan and Con Lu islands (Nguyen Hoang Tri 1996). This trend has continued since.

The aim of the forestry programme is to protect existing forest and to engage in afforestation. The current management plan proposes the afforestation of 1,350 ha of *Kandelia candel*, 810 ha of *Casuarina equisetifolia* and 1,700 ha of *Acacia auriculiformis* and *Bambusa* sp. (Anon. 1993). Afforestation runs contrary to permitted activities in nature reserves as defined by the government of Vietnam, since it changes the landscape and results in the introduction of alien plant species. This management programme is incompatible with biodiversity conservation and instead reflects an agenda which is focused on land stabilisation and reclamation. The sand islands and their dune vegetation communities represent a natural landscape feature and habitat which are totally transformed by the planting of *C. equisetifolia* and *A. auriculiformis*, and which are under-represented in the national protected areas system.

Afforestation with a monoculture of *K. candel* results in the loss of intertidal mudflats, which are an important habitat for Black-faced Spoonbill and Saunders's Gull, as well as migratory shorebirds. Indeed, these two species are mudflat specialists. The high density at which mangroves are currently planted results in low tree growth rates and suppressed marine productivity in the mangrove. Productivity is reduced because of lower levels of sunlight penetration as a result of shading, resulting in lower rates of leaf-litter decomposition (D. Mackintosh pers. comm.). Thinning of the mangrove would produce a more natural forest with high marine productivity, which would be of greater value to people and wildlife. If afforestation is to be continued, planting density should be reduced, as should the practice of planting a monoculture.

As part of the ongoing afforestation programme, the nature reserve staff routinely apply three different pesticides to newly planted *K. candel* in order to suppress insect attack. Two of the pesticides used are Padan and Dipterex (Diptorech), which are both extremely toxic to fish (S. Johnsen pers. comm.). In Vietnam, the toxicity of these chemicals is clearly indicated on the labels. The third pesticide, *Sat Trung Linh*, a Chinese product, is so toxic that its use is banned by the government of Vietnam. The impact of these harmful chemicals on the marine environment can only be guessed but none of them should be used in the nature reserve.

There is currently no research programme at the nature reserve but resources available under this budget heading should be used to obtain baseline data on the nature reserve, its habitats and its species. Particular emphasis should be given to monitoring the status of threatened species, including Black-faced Spoonbill and Saunders's Gull. Dynamic environmental processes, such as rates of coastal accretion and saltwater



intrusion, should also be a focus for study as should levels of resource use by local people, particularly their impact on shellfish populations.

Of the nine nature reserve staff, six have had a higher education, including two graduates from the College of Forestry and the College of Agriculture, two graduates from the College of Economic Planning and two from the National Economic College. Thus, there is a lack of personnel with a biological and conservation background. Since sound management is only likely to be achieved with staff having at least a basic knowledge of biology and conservation principles, staff training is considered essential. Mai Po Marshes Nature Reserve in Hong Kong has unparalleled expertise within the region in coastal wetland conservation management. WWF Hong Kong also has considerable experience in running training courses for wetland reserve staff from China. Therefore, the idea of developing training programmes with Mai Po Marshes Nature Reserve and other WWF Hong Kong staff appears highly desirable.

The current proposed buffer zone programme focuses on afforestation to provide fuel and on the improvement of aquacultural ponds through the construction of better dikes and sluices. Since, by definition, the buffer zone is situated outside the nature reserve, this programme has not been approved by the government of Vietnam. Clearly, with such high levels of human use of the nature reserve's resources, a buffer zone plan is urgently required which will both significantly reduce the pressure on, and support the management objectives of, the nature reserve.

Xuan Thuy Nature Reserve is currently funded by Nam Ha province and the central government. However, up until May 1996, the nature reserve had not received any funds from the central government to assist with implementation of the management plan. This lack of funding has seriously limited protection and conservation measures at the site. The profits derived by villagers, whether engaged in honey collection, shellfish exploitation, algae collection or aquaculture either go directly to households or into the coffers of the district people's committee. However, the nature reserve could be financed using a proportion of profits derived from these activities, especially aquaculture. This would not only ensure the management of the nature reserve but would give tax-payers a stake in the protected area thus helping to make local people aware of the value of the nature reserve.

**Total score: 58**

**Site rank: 1**

## 5.7 Tien Hai District

This account evaluates the coastal zone of Tien Hai district, excluding Tien Hai Nature Reserve. A detailed site evaluation is given for Tien Hai Nature Reserve in Section 5.8.

**Diversity (habitat).** Tien Hai district has one of the longest coastlines in the delta and includes a total of 14 different coastal habitats.

Score: 2

**Diversity (species).** Saunders's Gull, endemic to East Asia, was recorded.

Score: 1

**Rarity (species).** Saunders's Gull (Endangered) was recorded in the coastal zone.

Score: 3

**Fragility.** The coastal zone of the district supports three habitats judged to be fragile: dune, reedbed and mangrove.

Score: 3



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**Special role in maintaining biological diversity.** One species of bird listed in Collar *et al.* (1994) was recorded in the district.

Score: 1

**Potential conservation value.** Tien Hai Nature Reserve has already been designated as a protected area.

Score: 0

**Potential role for NGOs.** A need exists for the provision of aquacultural extension services.

Score: 1

**Potential economic value.** The inshore fishery and the collection of shellfish were judged economically important activities but their sustainability at current levels are unknown. No data were obtained on current levels of hunting. Although of economic importance both as a fuel source and in coastal defence, *Casuarina equisetifolia* plantations alter the dune vegetation community. The traditional extensive method for aquacultural management is mainly used.

Score: 1

**Total score: 12**  
**District rank: 4**

### 5.8 Tien Hai Nature Reserve

**Area (size or extent).** According to the management plan, Tien Hai Nature Reserve covers an area of 12,500 ha (Anon. 1995a) but, according to the map, it covers only 6,000 ha.

Score: 4

**Diversity (habitat).** The site includes 12 habitats.

Score: 2

**Diversity (species).** Black-faced Spoonbill was recorded during this survey.

Score: 1

**Rarity (species).** Black-faced Spoonbill is Critically Endangered.

Score: 4

**Abundance (species population concentration).** The Black-faced Spoonbill record accounts for 1% of the world population.

Score: 1

**Fragility.** The nature reserve supports examples of three fragile habitats: dune, reedbed and mangrove.

Score: 3

**Special role in maintaining biological diversity.** Black-faced Spoonbill occurs.

Score: 1

**Sustainability (traditional aquacultural management).** Traditional extensive aquaculture is practised at the site and the *Gei Wai* method has been introduced.

Score: 1

**Position as an ecological unit.** The nature reserve is situated at the mouth of the Red River, which in turn separates the nature reserve from Xuan Thuy Nature Reserve. The site can thus be considered part



of a contiguous ecological unit.

Score: 1

**Potential conservation value.** The site is designated as a nature reserve but is subject to high levels of exploitation by local people.

Score: 1

**Potential education and cultural value.** Habitats throughout most of the nature reserve are degraded and birds and other wildlife are not easily observed. Access is also difficult. The site is therefore judged to have a low potential education and cultural value.

Score: 0

**Potential role for NGOs.** Although the site is nominally protected, the high levels of human utilisation, degraded nature of the habitats, poor infrastructure and inadequate management plan are all points which indicate opportunities for collaboration between the nature reserve authorities and conservation NGOs.

Score: 1

**Potential economic value.** The traditional extensive aquacultural method is mainly used in the area. The *Gei Wai* method offers a sustainable alternative and should be promoted. The high numbers of people collecting shellfish in intertidal areas is an indication of its importance as an economic activity but it is not known if levels of exploitation are sustainable. Hunting was observed in the area but it was not possible to collect any information on the level of hunting pressure. *Casuarina equisetifolia* plantations located along the coast provide a significant source of fuel for local communities and assist in coastal zone stabilisation but probably impact on natural dune vegetation.

Score: 1

**Constraints on management.** Lack of reserve infrastructure, including staff, and an inadequate management plan are currently constraints on conservation management of the site. With reference to the existing protected area regulations (Ministry of Forestry 1987) and the internationally acknowledged objectives of a nature reserve (IUCN 1994), the following evaluation has been made of present human activities at the site and the current management plan for Tien Hai Nature Reserve.

In the current management plan for Tien Hai Nature Reserve (Anon. 1995a), six different management programmes are specified: protection, forestry, research, training, awareness and education, and socio-economics. The aim of the protection programme is to protect the habitats and wildlife within the nature reserve through the establishment of guard stations and control points (Anon. 1995a). In the management plan, the nature reserve is not zoned because of the overall high levels of pressure on the site. However, land-use zoning could reduce human pressure on the most important areas within the nature reserve. The eastern boundary of the protected area has not yet been defined, and this has the potential to cause confusion and misunderstandings between staff and local people.

The aim of the forestry programme is both afforestation and protection of the existing forest inside the nature reserve. Under the current management plan, it is proposed to afforest 220 ha with *C. equisetifolia* and 4,800 ha with *Sonneratia caseolaris*, *Kandelia candel* and *Aegiceras corniculatum* (Anon. 1995a). Afforestation is not permitted in nature reserves under both the existing national and international legislation. Therefore, it should not be a management duty of Tien Hai Nature Reserve to engage in afforestation since the management objectives of coastal protection and land reclamation may conflict with coastal wetland conservation. Afforestation with the alien *C. equisetifolia* may affect the native dune vegetation community; and afforestation with mangroves reduces the area of mudflats which are an important habitat for feeding shorebirds and are a part of the coastal wetland ecosystem that the



nature reserve is designed to protect.

According to the management plan, there should be 2,000 ha of mangrove within the nature reserve (Anon. 1995a). However, during the survey, only a very small area of mangrove was located inside the main dike, 90% of which was located in aquacultural ponds. It seems that the figure of 2,000 ha may refer to the area of ponds rather than the actual area of mangrove.

No research programme is detailed in the management plan but one is needed to establish baseline data on the biodiversity of the protected area, since this is a poorly known site. The current lack of knowledge will constrain future management options. There is an acute need to increase awareness in the local community about the benefits of the nature reserve. The aim of the socio-economic programme is to improve the living standards of local people living in the surrounding communes. It currently includes afforestation, introduction of alternative fuel and improved health and education components. It is not known whether this programme has been approved by the government. It is essential in any buffer zone programme that linkages exist so that the services offered have a direct benefit to the site. Lack of finance currently ensures that no management occurs at the site. To guarantee future finance of the protected area, consideration should be given to the development and introduction of a scheme which taxes users of the nature reserve and buffer zone.

**Total score: 21**  
**Site rank: 6**

## 5.9 Thai Thuy District

This account evaluates the coastal zone of Thai Thuy district, excluding the Thai Binh estuary. A detailed site evaluation is given for the Thai Binh estuary (Thai Thuy district) in Section 5.10.

**Diversity (habitat).** The coastal area of Thai Thuy district is one of the most diverse areas in the Red River Delta. Excluding the Thai Binh estuary, no less than 14 different habitats were found in the district.

Score: 3

**Fragility.** Four fragile habitats dune, saltmarsh, reedbed and mangrove all occur in the district.

Score: 4

**Sustainability (traditional aquacultural management).** Traditionally managed extensive aquacultural ponds are widespread in the district.

Score: 1

**Potential role of NGOs.** The district is not currently under any sustainable management regime. Roles for NGOs exist in the fields of environment awareness, aquacultural extension and afforestation.

Score: 1

**Potential economic value.** The major aquacultural method used in the district is the traditional extensive method. The collection and sale of marine products provides an important source of income to local communities but it is not known whether this is sustainable.

Score: 1

**Total score: 10**  
**District rank: 5**



### 5.10 Thai Binh Estuary (Thai Thuy District)

**Area (size or extent).** The site, defined as the area of mangrove and mudflats south of the Thai Binh River mouth, covers 4,000 ha.

Score: 4

**Diversity (habitat).** The site comprises 10 different habitats.

Score: 2

**Diversity (species).** The site is known to support two species endemic to East Asia: Black-faced Spoonbill and Saunders's Gull.

Score: 2

**Rarity (habitat).** The site includes 400 ha of old-growth mangrove forest, which is the largest remaining area in the Red River Delta.

Score: 1

**Rarity (species).** The site is of particular importance for its populations of globally threatened species. The site produced the second highest count of Black-faced Spoonbill (Critically Endangered), the largest population of Saunders's Gull (Endangered) and the only wintering population of Black-headed Ibis (Near-threatened) during the survey.

Score: 8

**Abundance (species population concentration).** The site supports more than 1% of the estimated world populations of Saunders's Gull and Black-faced Spoonbill.

Score: 2

**Naturalness.** The site supports the largest and best remaining example of old-growth mangrove in the Red River Delta.

Score: 1

**Fragility.** The site supports two fragile habitats, reedbed and mangrove.

Score: 2

**Special role in maintaining biological diversity.** The site supports old mangrove and three bird species allocated a category of threat.

Score: 4

**Sustainability (Traditional aquacultural management).** Traditional extensive aquacultural methods are followed.

Score: 1

**Position as an ecological unit.** Located on the southern shore of the Thai Binh River, the site is ecologically contiguous with a site on the northern shore of the river mouth in Tien Lang district.

Score: 1

**Potential conservation value.** The site is currently without protection. Given the suite of threatened species occurring at the site and the extensive area of old mangrove forest, the site is of very high conservation value but its potential is not being realised.

Score: 0



**Potential education and cultural value.** The unique area of mangrove forest at the site has educational value.

Score: 1

**Potential role for NGOs.** Given the absence of protection at this important site, there is a significant potential role for conservation NGOs in management planning and site protection.

Score: 1

**Potential economic value.** The traditional extensive method is mainly practised at the site, resulting in the die-back of mangrove. Currently, only *Sonneratia caseolaris* survives in the ponds, since its longer pneumatophores allow it to survive in deeper water. The collection of marine products is judged to be extremely important to the local economy but it is not known if this is currently being conducted on a sustainable basis.

Score: 1

**Constraints on management.** Before this project, local and central governments were completely unaware of the importance of the site.

**Total score: 31**

**Site rank: 3 =**

## 5.11 Tien Lang District

For the purposes of the evaluation, Tien Lang district was sub-divided into two sites: the Thai Binh estuary (Tien Lang district) and the Van Uc estuary. There is, therefore, no separate account for Tien Lang district. Detailed site evaluations the two sites which comprise the district are given in Sections 5.12 and 5.13.

## 5.12 Thai Binh Estuary (Tien Lang District)

**Area (size or extent).** The site covers 2,000 ha in the southern part of the district.

Score: 4

**Diversity (habitat).** A total of 10 habitats were recorded at the site.

Score: 2

**Diversity (species).** Two East Asian endemic bird species were recorded: Black-faced Spoonbill and Saunders's Gull.

Score: 2

**Rarity (habitat).** The site supports 100 ha of old-growth mangrove forest, estimated to be more than 50 years old (Phan Nguyen Hong pers. comm.), which is one of only four remaining such areas in the entire Red River Delta. Some of the old mangrove occurs in scattered clumps, with individual trees estimated to be more than 100 years old.

Score: 1

**Rarity (species).** Three threatened or near-threatened bird species have been observed at the site: Black-faced Spoonbill (Critically Endangered) and Saunders's Gull (Endangered) during this survey, and Black-headed Ibis (Near-threatened) during a previous survey (Pedersen *et al.* 1998).

Score: 8



**Abundance (species population concentration).** A total of 30 Saunders's Gulls and 16 Black-faced Spoonbills, equivalent to 1% and 4% of the respective world populations were recorded at the site.  
Score: 2

**Naturalness.** The existence of old mangrove forest merits a score under this criterion.  
Score: 1

**Fragility.** Two fragile habitats, saltmarsh and mangrove were recorded at the site.  
Score: 2

**Special role in maintaining biological diversity.** The site supports old mangrove and three bird species listed in Collar *et al.* (1994).  
Score: 4

**Sustainability (traditional aquacultural management).** Traditional and extensive aquaculture is mainly practised at the site.  
Score: 1

**Position in an ecological unit.** The site forms part of the Thai Binh estuary ecosystem and is contiguous with the Thai Binh estuary (Thai Thuy district) to the south and with the Van Uc estuary to the north.  
Score: 1

**Potential conservation value.** The site is currently unprotected. Given the suite of threatened species occurring at the site and the area of old-growth mangrove forest, the site is of very high conservation value but its potential is not being realised.  
Score:0

**Potential education and cultural value.** The great age of the mangrove at the site suggests it has both potential educational and cultural value.  
Score: 1

**Potential role for NGOs.** There is a clear role here for a conservation NGO to assist in management plan development.  
Score: 1

**Potential economic value.** Traditional extensive aquaculture is mainly practised at the site. Unfortunately, continued allocation of land for construction of aquacultural ponds remains a threat at the site and the mangrove forest is further threatened by cutting for fuel.  
Score: 1

**Total score: 31**  
**Site rank: 3 =**

### 5.13 Van Uc Estuary

**Area (size or extent).** The site covers 1,500 ha and was one of the smallest sites surveyed.  
Score: 4

**Diversity (habitat).** The site supports 12 habitats.  
Score: 2



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**Diversity (species).** Saunders's Gull and Black-faced Spoonbill are endemic to East Asia. Score: 2

**Rarity (habitat).** The site includes 100 ha of old-growth mangrove forest and saltmarsh. Score: 2

**Rarity (species).** Two threatened bird species, Black-faced Spoonbill (Critically Endangered) and Saunders's Gull (Endangered) were recorded at the site. Score: 7

**Abundance (species population concentration).** More than 1% of the world populations of Saunders's Gull and Black-faced Spoonbill were recorded at the site. Score: 2

**Naturalness.** The site contains 100 ha of old mangrove. One of only four such sites remaining in the Red River Delta. Score: 1

**Fragility.** The site supports three fragile habitats: dune, saltmarsh and mangrove. Score: 3

**Special role in maintaining biological diversity.** The site supports mangrove forest greater than 30 years old and two bird species listed by Collar *et al.* (1994). Score: 3

**Sustainability (traditional aquacultural management).** The traditional extensive method of aquaculture was mainly utilised. Score: 1

**Position as an ecological unit.** The site is contiguous with the Thai Binh estuary (Tien Lang district). Score: 1

**Potential conservation value.** The site is currently unprotected. Given the suite of threatened species occurring at the site and the extent of old-growth mangrove forest, it is of very high conservation value but its potential is not being realised. Score: 0

**Potential education and cultural value.** The age of the mangrove forest at the site renders it of potential education and cultural value. Score: 1

**Potential role for NGOs.** The high conservation importance of the site and lack of sustainable management suggests a role for a conservation NGO in management plan development. Score: 1

**Potential economic value.** The traditional extensive method in aquacultural management is the main method used in the area. The mangrove is used as a fuel source but the sustainability of this activity is unknown. It is not known if current levels of fishing and hunting are sustainable. Score: 1

**Total score: 31**  
**Site rank: 3 =**

### 5.14 Kien Thuy District

**Diversity (habitat).** The coastline of Kien Thuy district is bisected by the Do Son peninsula. The coastal area supports 11 habitats, including all the major habitats found in the Red River Delta.

Score: 2

**Fragility.** The district includes three fragile habitats: dune, saltmarsh and mangrove.

Score: 3

**Sustainability (traditional aquacultural management).** Semi-intensive and traditional extensive aquaculture is practised in the district.

Score: 0

**Position as an ecological unit.** The northern sector of the district is contiguous with mangroves in An Hai district.

Score: 1

**Potential role of NGOs.** Roles for NGOs exist in the fields of environment awareness, aquacultural extension and afforestation.

Score: 1

**Potential economic value.** Traditional extensive aquaculture is practised.

Score: 1

**Total score: 8**  
**District rank: 6**

### 5.15 Do Son District

**Diversity (habitat).** The Do Son peninsula is a small area with low habitat diversity: only three different habitats were recorded. This was the only district in the Red River Delta with a rocky coastline.

Score: 1

**Potential education and cultural value.** The Do Son peninsula is already a tourist resort.

Score: 1

**Total score: 2**  
**District rank: 11**

### 5.16 An Hai District

**Diversity (habitat).** Ten different habitats were recorded in the district.

Score: 2

**Diversity (species).** Black-faced Spoonbill and Saunders's Gull are endemic to East Asia.

Score: 2

**Rarity (habitat).** Sedge-beds were recorded in the district.

Score: 1



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**Rarity (species).** A total of 17 Saunders's Gulls (Endangered) and one Black-faced Spoonbill (Critically Endangered) were observed in the district.

Score: 7

**Abundance (species population concentration).** Less than 1% of the estimated world populations of Saunders's Gull and Black-faced Spoonbill were recorded from the district.

Score: 0

**Fragility.** The district supports three fragile habitats.

Score: 3

**Special role in maintaining biological diversity.** The district supports two species of birds listed by Collar *et al.* (1994)

Score: 2

**Sustainability (traditional aquacultural management).** The extensive traditional method of aquaculture is practised.

Score: 1

**Position as an ecological unit.** The district is contiguous with mangroves in Kien Thuy district.

Score: 1

**Potential role for NGOs.** The district is unprotected and there may be a need to raise local awareness of the need for sustainable use of natural resources.

Score: 1

**Potential economic value.** Traditional extensive aquaculture is practised.

Score: 1

**Total score: 21**  
**District rank: 2**

### 5.17 Thuy Nguyen District

**Diversity (habitat).** Six habitats were recorded in the district.

Score: 1

**Fragility.** The district supports one fragile vegetation type.

Score: 1

**Sustainability (traditional aquacultural management).** Traditional extensive and modified extensive aquaculture is practised in the district.

Score: 1

**Potential role of NGOs.** Roles for NGOs exist in the fields of environment awareness, aquacultural extension and afforestation.

Score: 1

**Potential economic value.** The main method used in aquaculture is the traditional extensive method.

Score: 1

**Total score: 5**  
**District rank: 7 =**



### 5.18 Southern Coast of Thuy Nguyen District

**Area (size or extent).** This was the smallest site surveyed and covered only 600 ha. Score: 3

**Diversity (habitat).** The site supports four habitats. Score: 1

**Rarity (habitat).** The site supports 100 ha of old-growth mangrove and is one of only four such sites in the Red River Delta. Score: 1

**Naturalness.** The mangrove forest is more than 30 years old and is not contained within aquaculture ponds. Score: 1

**Fragility.** The site supports mangrove. Score: 1

**Special role in maintaining biological diversity.** The site supports old-growth mangrove. Score: 1

**Sustainability (traditional aquacultural management).** The extensive traditional method is mainly followed. Score: 1

**Potential conservation value.** The site is already protected by the district people's committee. Score: 1

**Potential education and cultural value.** The age and extent of the old-growth mangrove and its proximity to Hai Phong suggests a high potential education value. Score: 1

**Potential role for NGOs.** Although the site is currently protected, nearby pond-owners do not cultivate mangrove in their ponds, despite extension advice to the contrary. There is a possible role here for an NGO in further attempting aquacultural extension to improve management of these areas. Score: 1

**Potential economic value.** The method of aquaculture used is the traditional extensive method. Score: 1

**Constraints on management.** Management of the site is constrained by the lack of a management plan and lack of financial resources.

**Total score: 13**  
**Site rank: 7**



## 6. Discussion

### 6.1 Coastal Zone Management Policy

The Ministry of Agriculture and Rural Development (MARD) has responsibility for the management and development of forests, including mangrove; much of the afforestation which has taken place in the coastal zone has been within the scope of programmes such as Programme 327. However, the remit of the Ministry of Fisheries (MoF) extends to the management of marine resources found in mangroves and the intertidal area. Clearly, there is some overlap, and, particularly with regard to the critical issue of aquacultural development, it is not clear where the limits of responsibility lie. At the moment, the protected area system is managed by MARD, whilst responsibility for administration of the Ramsar Convention rests with the Ministry of Science, Technology and the Environment (MOSTE). There is a clear need for these two ministries to collaborate more closely on the notification of sites. Attention to these two issues will assist the preparation and implementation of the national wetland strategy, a task which currently rests with MOSTE.

The entire coastal zone of the Red River Delta faces enormous development pressure, particularly from aquacultural development. Currently, the government of Vietnam has not developed a policy or directive relating to the aquacultural industry (Anon. 1996b). Individual provinces appear to implement their own *ad hoc* policies. However, in relation to this issue, there is a need for a balanced policy based on the principle of sustainable use and conservation. The government of Vietnam has already recognised that there is a need for a coastal zone management plan, since it was included as a priority project in the Biodiversity Action Plan for Vietnam (Anon. 1994a). It would be logical, therefore, to proceed with such a plan for the coastal zone of the Red River Delta.

**Afforestation Policy.** Almost all mangrove afforestation in the Red River Delta has been with *Kandelia candel*. Only a few areas have experimented with interplanting *Sonneratia caseolaris* and *K. candel*. The use of interplanting will not only reduce the problem of pest attack but will increase the biodiversity value of the mangrove and may result in increased productivity. In the Red River Delta, *K. candel* is planted at an interval of 0.3 to 0.7 m. This planting density is too high and results in poor growth rates and depressed productivity. In similar coastal areas of Bangladesh, mangrove trees are planted at intervals of 1.3 or 1.75 m; plantations planted at 1.3 m are thinned after five years (Saenger and Siddiqi 1993).

Since the principle justification for afforestation in the coastal zone of the Red River Delta is coastal protection and land reclamation, its impact on biodiversity and the local economy has traditionally been overlooked. Intertidal mudflats are not wasteland! They comprise a critically important habitat for birds such as the critically endangered Black-faced Spoonbill, 20% of the world population of which occurs in the Red River Delta during winter. Intertidal mudflats provide some of the poorest and most marginalised elements in society with a source of income. Unregulated mangrove afforestation destroys this valuable habitat. Mangrove afforestation programmes should be subject to an environmental impact assessment to avoid adverse effects on biodiversity and human communities.

*Casuarina equisetifolia* has been planted extensively along sandy beaches and on offshore islands, principally to assist land stabilisation. It was concluded that *C. equisetifolia* is failing to bind the sand adequately because leaf litter is collected for fuel (MacKinnon 1990). It is also possible that *C. equisetifolia* may suppress rates of natural plant growth in the herb layer. Naturally occurring shrubs and trees are likely to bind the sand more effectively than an alien species such as *C. equisetifolia*. Furthermore, the impact of an alien species such as *C. equisetifolia* on rare and sensitive dune and saltmarsh vegetation is unknown.



**Fisheries Policy.** Although numerous decrees and regulations exist in relation to the fishing industry, there is currently no ordinance relating to minimum mesh sizes, catch technique or minimum catch length. During a recent survey in early 1996, it was estimated that the inshore fishery was heavily over-exploited (Anon. 1996a). The collection of shellfish is a major activity, but there is a complete lack of data on its sustainability at current levels of exploitation.

**Hunting Law Policy.** No data currently exist on the sustainability of this activity at current rates of exploitation. Anecdotal evidence suggests that it is probably not sustainable at current levels. Since the use of mist-nets is indiscriminate, there is the very real danger that a significant proportion of the world population of Black-faced Spoonbill could be wiped out quite easily. Clearly this is an activity which requires legislation and the development and implementation of anti-hunting laws.

## 6.2 Evaluation of Sites and Districts

In order to assess which are the key coastal sites for conservation in the Red River Delta, the results of the evaluation of districts and sites are presented in Tables 9 and 10. The final row in both tables assigns a rank to each district or site. The four districts which include one or more sites (Xuan Thuy, Tien Hai, Thai Thuy and Thuy Nguyen) have disproportionately low scores. This indicates that the wealth of biodiversity in these districts is concentrated at specific sites. Despite the limited utility of this table, it does indicate that the entire coastline of Nghia Hung district is of particular importance and that the biodiversity of this district is not concentrated at any particular sites. This clearly has implications for the management of this area, since it would be impracticable to declare a nature reserve for the entire coastline of the district. What it does indicate is the need for a coastal zone management plan which fully reflects the need for sustainable use of biodiversity. What Table 9 does not indicate is the importance of Tien Lang district, the entire coastline of which is divided between two sites: the Thai Binh estuary (north side) and the Van Uc estuary. Table 10 indicates the importance of these two sites.

Table 10 brings together the results of the evaluation for Nghia Hung district, together with six sites from within Xuan Thuy, Tien Hai, Thai Thuy and Thuy Nguyen districts. These seven sites should be considered the key coastal wetlands in the Red River Delta. When ranked, the pre-eminent position of Xuan Thuy Nature Reserve can clearly be seen. Ranked second is the coastline of Nghia Hung district. Third position is shared by the two Thai Binh estuary sites and the Van Uc estuary. Although presented and described as two sites, the Thai Binh estuary, divided between Thai Thuy and Tien Lang districts, comprises one ecological unit. Furthermore, the site is only narrowly separated from the Van Uc estuary. All of these sites contain important areas of old-growth mangrove. If these three sites had been considered as a single site, they would have scored higher. What is interesting is the relatively low score of Tien Hai Nature Reserve, which ranks only sixth. Despite being contiguous with Xuan Thuy Nature Reserve, it has low scores for biological importance. Before the Forest Protection Department proceeds further with the development of this site, the four other sites of greater conservation importance should receive priority attention for conservation action. In the case of the two Thai Binh estuary sites and the Van Uc estuary, there is a convincing case for the establishment of small nature reserves.

Although Xuan Thuy Nature Reserve and the coastline of Nghia Hung district are ranked first and second, neither site supports old-growth mangrove. Complimentarity, therefore, exists between these and the four sites supporting old-growth mangrove. This is another element in the argument for protecting a range of sites through a system of small protected areas in the coastal zone of the Red River Delta, rather than just concentrating on the two established nature reserves.

What became clear during this project was the low level of knowledge and awareness of the biological value and importance of coastal habitats at all levels, from householder to local government. Nature

**Table 9: Conservation Evaluation of Coastal Districts in the Red River Delta**

Criterion	NS	KS	NH	HH	XT	TH	TT	KT	DS	AH	TN
Diversity (habitat)	1	1	3	1	2	2	3	2	1	2	1
Diversity (species)	1		5			1				2	
Rarity (habitat)	1		1	1						1	
Rarity (species)	3		19			3				7	
Abundance (species population conc.)	1		2								
Abundance (20,000 waterbirds)			1								
Abundance (5,000 shorebirds)			1								
Naturalness											
Fragility	3	3	5	2	3	3	4	3		3	1
Special role	1		8			1				2	
Sustainability	1	1	1				1			1	1
Position in an ecological unit	1	1						1		1	
Potential conservation value											
Potential education and cultural value	1			1					1		
Potential role for NGOs	1	1	1		1	1	1	1		1	1
Potential economic value	-1	-2	1		-2	1	1	1		1	1
Total score	14	5	48	5	4	12	10	8	2	21	5
<b>District Rank</b>	<b>3</b>	<b>7 =</b>	<b>1</b>	<b>7 =</b>	<b>10</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>11</b>	<b>2</b>	<b>7 =</b>

Districts: NS=Nga Son, KS=Kim Son, NH=Nghia Hung, HH=Hai Hau, XT=Xuan Thuy, TH=Tien Hai, TT=Thai Thuy, KT=Kien Thuy, DS=Do Son, AH=An Hai and TN=Thuy Nguyen. Data for Tien Lang district are presented in Table 10.

reserve development and other conservation activities are only likely to be accorded priority, to be allocated the resources they require, to be valued, and to enjoy a moderate degree of success, once awareness has been raised amongst all members of society. Awareness campaigns focusing on the vital roles coastal habitats play in maintaining the economic well-being of local communities should be developed together with protected area plans whenever possible.



Table 10: Key Coastal Wetland Sites in the Red River Delta

Criterion	Nghia Hung Dist.	Xuan Thuy Nature Reserve	Tien Hai Nature Reserve	Thai Binh Estuary TT Dist.	Thai Binh Estuary TL Dist.	Van Uc Estuary	Coast of Thuy Nguyen Dist.
Area (size or extent)	4	4	4	4	4	4	3
Diversity (habitat)	3	3	2	2	2	2	1
Diversity (species)	5	5	1	2	2	2	
Rarity (habitat)	1	1		1	1	2	
Rarity (species)	19	20	4	8	8	7	1
Abundance (species pop. conc.)	2	2	1	2	2	2	
Abundance (20,000 waterbirds)	1	1					
Abundance (5,000 shorebirds)	1	1					
Naturalness				1	1	1	1
Fragility	5	4	3	2	2	3	1
Special role	8	9	1	4	4	3	1
Sustainability	1	1	1	1	1	1	1
Position in an ecological unit		1	1	1	1	1	
Potential conservation value		1	1				1
Potential education and cultural value	1	1		1	1	1	1
Potential role for NGOs	1	1	1	1	1	1	1
Potential economic value	1	3	1	1	1	1	1
Total score	52	58	21	31	31	31	13
Site Rank	2	1	6	3 =	3 =	3 =	7

## 7. Management Recommendations

This section is divided into two parts: firstly, overall recommendations for coastal zone management are presented. These recommendations are applicable to the coastal zone throughout the Red River Delta. Wherever possible, the agency responsible for implementation is named. This is followed by specific recommendations for the key coastal wetland sites for conservation in the Red River Delta. It is hoped that these recommendations will be considered and taken into account at the central and provincial levels when elaborating land-use management strategies for the coastal districts. These common-sense recommendations are based on principles of sustainability of resource-use. As such, it is hoped that some will already have been incorporated into land-use plans and projects currently under discussion or awaiting implementation.

The management recommendations for the key coastal wetland sites for conservation in the Red River Delta *de facto* comprise the basis for a biodiversity conservation strategy for the area. These key sites, if not already afforded adequate protection, will require management planning and enhanced levels of protection if they are to be conserved. It is intended that these recommendations form a basis for project elaboration and development between provincial authorities, conservation NGOs and bilateral funding sources to ensure the conservation of these sites.

### 7.1 Recommendations for Coastal Zone Management

**Policy.** The current remit of MARD includes the management of forest lands, including mangrove. The mandate of MoF includes aquacultural development, which necessitates management of mangrove. To avoid any conflict or duplication of effort in the area of responsibility for mangrove management, it is recommended that the central government:

- Clarify the situation to ensure that one ministry or body has clear and overall responsibility for mangrove management, or that clear guidelines be developed which unambiguously allocate areas of management responsibility.

**Notification of Ramsar Sites.** Currently MOSTE has responsibility for the notification of Ramsar Sites. However, the Forest Inventory and Planning Institute (FIPI) is mandated to recommend the establishment of new protected areas. It is recommended that the central government ensure that in the future:

- MOSTE consult closely with FIPI regarding the future submission of candidate sites to the Ramsar Convention Bureau.

**Coastal zone management planning.** There is currently insufficient emphasis on the role of natural and semi-natural ecosystems and their critical role in maintaining basic ecosystem functions and their pivotal role in contributing to sustainable development. Therefore, given that a coastal zone management plan was also a recommendation under the Biodiversity Action Plan, it is recommended that central and provincial government collaborate to ensure that:

- Provincial coastal land-use management plans be developed for the Red River Delta.

Given that there is currently no government policy directive or guidelines relating to aquacultural development, it is recommended that:

- The government consult with informed and interested parties to elaborate an ecologically sustainable aquacultural policy and development guidelines for the Red River Delta.
- Through an aquacultural extension service, the government ensure that emphasis is placed on promoting aquacultural models, such as the *Gei Wai* method.
- The government ensure that the construction of aquaculture ponds always be subject to an environmental impact assessment and not be permitted in areas supporting mangrove greater than 30 years old.

Since construction of banks, enclosing mangrove forest either depresses the forest's productivity or kills it and, in recognition of the role mangrove forest plays as a nursery area for shrimp, crab and fish, it is recommended that:

- Throughout the Red River Delta, 80% of the mangrove forest remain outside aquacultural ponds.

**Mangrove afforestation.** The justification for mangrove afforestation in the Red River Delta has principally been for coastal stabilisation and protection. As a result, virtually all mangrove afforestation in the Red River Delta has involved planting a monoculture of *Kandelia candel* with a tree interval of 0.3 to 0.7 m. These two factors render the plantations vulnerable to insect attack and result in poor tree growth-rates. In addition, the high planting density reduces sunlight penetration of the seawater, depressing the rate of fallen leaf decomposition, thereby reducing primary productivity within the ecosystem. This reduces the overall ecosystem biomass, especially of economically important species like shrimp, crab and fish, and reduces overall species diversity. It is recommended to MARD and MoF that:

- The planting of monocultures of *K. candel* cease.
- Future afforestation be with more than one mangrove species that occurs naturally in the Red River Delta.
- The planting interval between trees be at least 1.3 m and up to 1.75 m (trees planted at 1.3 m will require thinning after five years).

As a signatory to the Ramsar Convention and the Convention on Biodiversity, Vietnam has an international responsibility to ensure the conservation of sites and habitats supporting endangered species. The intertidal mudflats in the Red River Delta represent the winter habitat for 20% of the world population of Black-faced Spoonbill. This is also the feeding habitat for thousands of migratory shorebirds. Afforestation with mangrove reduces this habitat. The conservation importance of mudflats must be recognised in land-use planning. It is recommended to provincial people's committees that:

- Environmental impact assessments be conducted at all sites where mangrove afforestation is proposed.
- There be no afforestation at sites supporting Black-faced Spoonbill or Saunders's Gull, or where there are concentrations of feeding shorebirds.

## Section 7 - Recommendations

- Afforestation within nature reserves ceases.
- Provincial Forest Protection Departments seek information on the toxicity of all pesticides and cease using Diperex, Padan, *Sat Trung Linh* and any other controlled pesticide forthwith.
- Provincial Forest Protection Departments comply with the law as specified and cease planting *Casuarina equisetifolia* in the core zones of nature reserves.
- In forest management plans, FIPI cease recommending afforestation with *C. equisetifolia* in nature reserve core zones and, where possible, outside of nature reserves; and that native species be identified to stabilise sandy coasts and dunes.

In recognition of the need to provide fuelwood to local communities but given the ecological shortcomings of *C. equisetifolia*, it is recommended that:

- The government ensure incentives be introduced to encourage planting of wood lots and shelterbelts, preferably of native species, along roads and paddyfield bunds.
- The revival of the traditional *Tet Trong Cay* tree-planting festival to encourage such afforestation be considered.

Bee-keeping is recognised as a sustainable agricultural activity and it is recommended that:

- The government, through agricultural extension services, promote bee-keeping in mangrove areas of the Red River Delta.

**Fisheries.** Given that there is no baseline data available on the sustainability of current levels of fishing and marine product collection, it is recommended that MoF:

- Undertake a detailed assessment of the inshore fishery and the collection of marine products and that this form the basis for developing fisheries management guidelines to guarantee sustainable use.

**Bird hunting.** Given that there is no baseline data available on the sustainability of current levels of bird catching and hunting, it is recommended that MARD:

- Undertake a detailed assessment of bird catching and hunting and that management guidelines be developed and introduced to guarantee sustainable use.
- Reduce disturbance of shorebird roosts by inclusion of these sites in nature reserves.

**Awareness.** Given the low levels of awareness among all resource-user groups of the importance of coastal wetlands, it is recommended that:

- The government authorities and NGOs develop and introduce information which will increase awareness of the role that coastal ecosystems play in contributing to the economic well-being of people.

## 7.2 Recommendations for the Conservation of Key Coastal Wetlands in the Red River Delta

**Nghia Hung district.** It is recommended that:

- A management plan be developed for the entire coastal zone of Nghia Hung district. This plan should seek to promote the sustainable exploitation of marine resources, fully taking into account the importance of mudflats as feeding areas for threatened species and offshore islands as roosting areas for migratory shorebirds.

**Xuan Thuy Nature Reserve.** It is recommended that:

- The management plan for Xuan Thuy Nature Reserve be fully revised to ensure that national protected area management legislation and international guidelines are closely followed. In particular that:
  - (i) there be no further afforestation with *Kandelia candel* in the core zone of the nature reserve;
  - (ii) a mangrove thinning regime be developed and introduced;
  - (iii) there be no further afforestation with *Casuarina equisetifolia* in the core zone of the nature reserve;
  - (iv) a new nature reserve finance scheme be developed and introduced to guarantee funding from profits derived from aquaculture in the nature reserve, Ramsar Site and buffer zone;
  - (v) no further aquaculture development be permitted in the nature reserve and that the aquacultural ponds on Con Lu island be dismantled;
  - (vi) intensive aquacultural practices not be permitted in the nature reserve and buffer zone;
  - (vii) a review of the nature reserve's boundaries be undertaken to ensure adequate representation of habitats;
  - (viii) the eastern and south-east boundaries of the nature reserve be marked;
  - (ix) no further human habitation be permitted in the nature reserve, especially on Con Lu island;
  - (x) grazing of domestic animals be controlled;
  - (xi) research be undertaken to determine the sustainability of human activities in the nature reserve and buffer zone;
  - (xii) measures be introduced to prevent bird hunting and disturbance of shorebirds at roosts;
  - (xiii) a research programme be developed to monitor the status of threatened bird species and the impact of resource-use by humans on these species. This should include sampling of invertebrates and substrates to determine possible pesticide, toxic waste and heavy metal contamination which may cause death or reduced breeding success of the species in question;
  - (xiv) nature reserve infrastructure and equipment needs be reviewed; and
  - (xv) staffing levels be reviewed and intensive training be introduced for all staff.



**Tien Hai Nature Reserve.** It is recommended that:

- The management plan for Tien Hai Nature Reserve be fully revised to ensure that national protected area management legislation and international guidelines are closely followed. In particular that:
  - (i) there be no further afforestation with *Kandelia candel* in the core zone of the nature reserve;
  - (ii) a mangrove thinning regime be developed and introduced;
  - (iii) there be no further afforestation with *Casuarina equisetifolia* in the core zone of the nature reserve;
  - (iv) a new nature reserve finance scheme be developed and introduced to guarantee funding of the nature reserve from profits derived from aquaculture;
  - (v) no further aquaculture development be permitted in the nature reserve;
  - (vi) intensive aquacultural practices not be permitted in the nature reserve and buffer zone;
  - (vii) a review of the nature reserve's boundaries be undertaken to ensure adequate representation of habitats;
  - (viii) no further human habitation be permitted in the nature reserve;
  - (ix) research be undertaken to determine the sustainability of human activities in the nature reserve and buffer zone;
  - (x) measures be introduced to prevent bird hunting and disturbance of shorebirds at roosts;
  - (xi) nature reserve infrastructure and equipment requirements be reviewed; and
  - (xii) staffing levels be reviewed and intensive staff training be introduced for all staff levels.

**Thai Binh estuary (Thai Thuy district).** Given the conservation importance of this unprotected site, it is recommended that all reasonable measures be taken to establish a nature reserve at the site. It is especially recommended that:

- Funds be sought for the development of a management plan for the establishment of Thai Binh Estuary Nature Reserve.
- Until such time as this is realised, Thai Binh Provincial People's Committee and Thai Thuy District People's Committee take all steps within their power to:
  - (i) prevent logging of the old-growth mangrove trees at the site;
  - (ii) prevent further aquacultural pond development at the site; and
  - (iii) seek expert guidance and rapidly implement emergency measures to prevent further mangrove die-back at the site.

**Thai Binh estuary (Tien Lang district) and Van Uc estuary.** Given the conservation importance of these unprotected sites, it is recommended that all reasonable measures be taken to establish a nature reserve covering both sites. It is especially recommended that:

- Funds be sought for the development of a management plan for the establishment of Thai Binh and Van Uc Estuary Nature Reserve, which should include the coastal areas from the Diem Dien River, Thai Thuy district to the Van Uc River, Tien Lang district.

- Until such time as this can be realised, Thai Binh and Hai Phong Provincial People's Committees, and Thai Thuy and Tien Lang District People's Committee take all steps within their power to:
  - (i) prevent logging of the old-growth mangrove trees at the site;
  - (ii) prevent further aquacultural pond development at the site; and
  - (iii) seek expert guidance and rapidly implement emergency measures to prevent further mangrove die-back at the site.

**The southern coast of Thuy Nguyen district.** It is recommended that:

- Thuy Nguyen District People's Committee be offered financial and material assistance to assist their current management of the site.
- A management plan be developed for the site.

## 8. Conclusions

The most important sites for conservation in the coastal zone of the Red River Delta are Xuan Thuy Nature Reserve, the coastal zone of Nghia Hung district, the Thai Binh estuary (Thai Thuy district), the Thai Binh estuary (Tien Lang district) and the Van Uc estuary. A nature reserve has wisely been established at Xuan Thuy but the four other sites are currently unprotected and threatened by aquacultural development and unsustainable exploitation of marine products.

These four additional sites are all worthy of designation under the Ramsar Convention and the establishment of nature reserves at three of these sites should be considered an urgent priority. An environmentally sensitive coastal zone management plan should be developed for Nghia Hung district. This will not only help secure the conservation of biodiversity but will assist the sustainable management of natural resources for human communities in this district.



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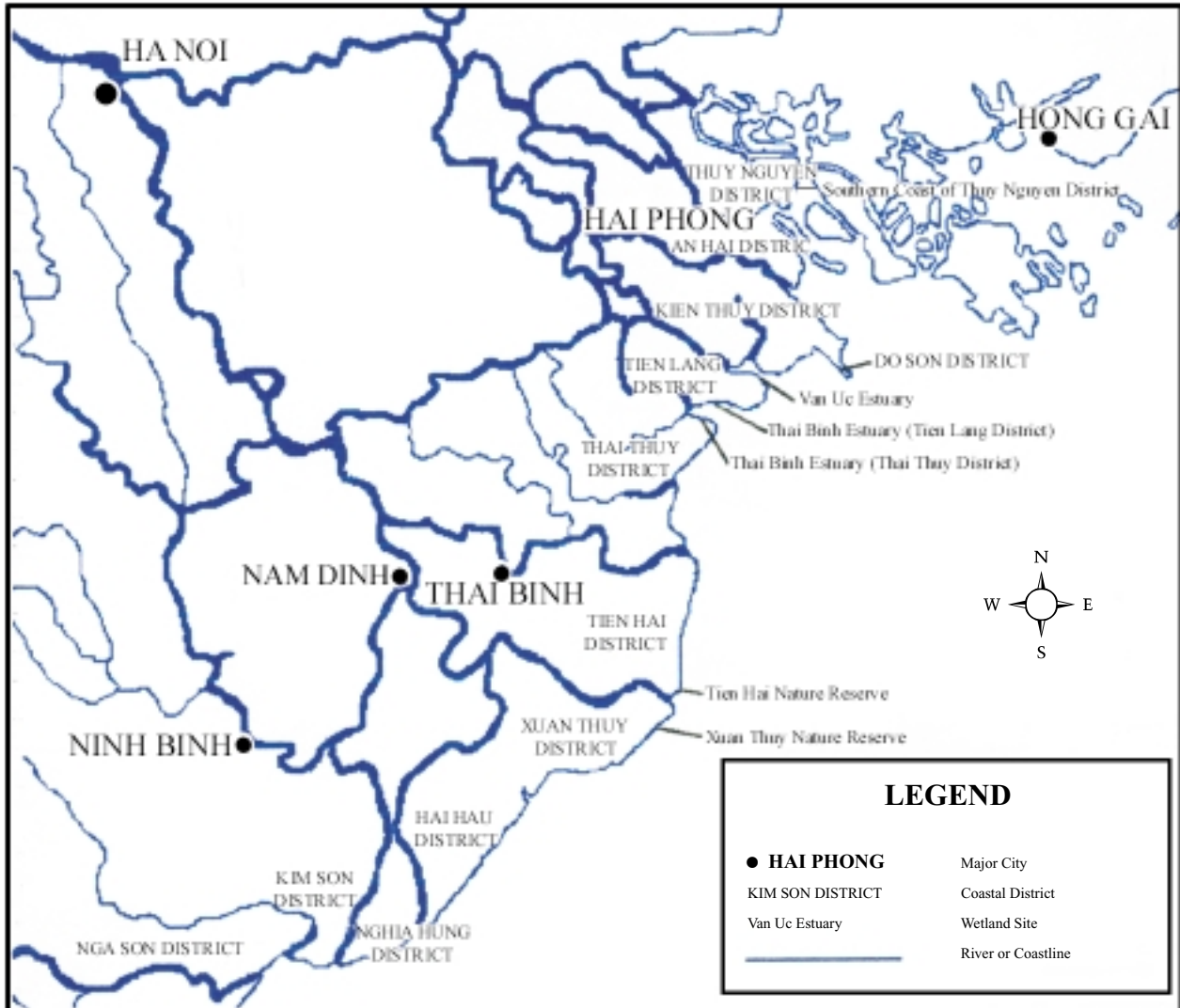
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**Map 1: The Red River Delta**

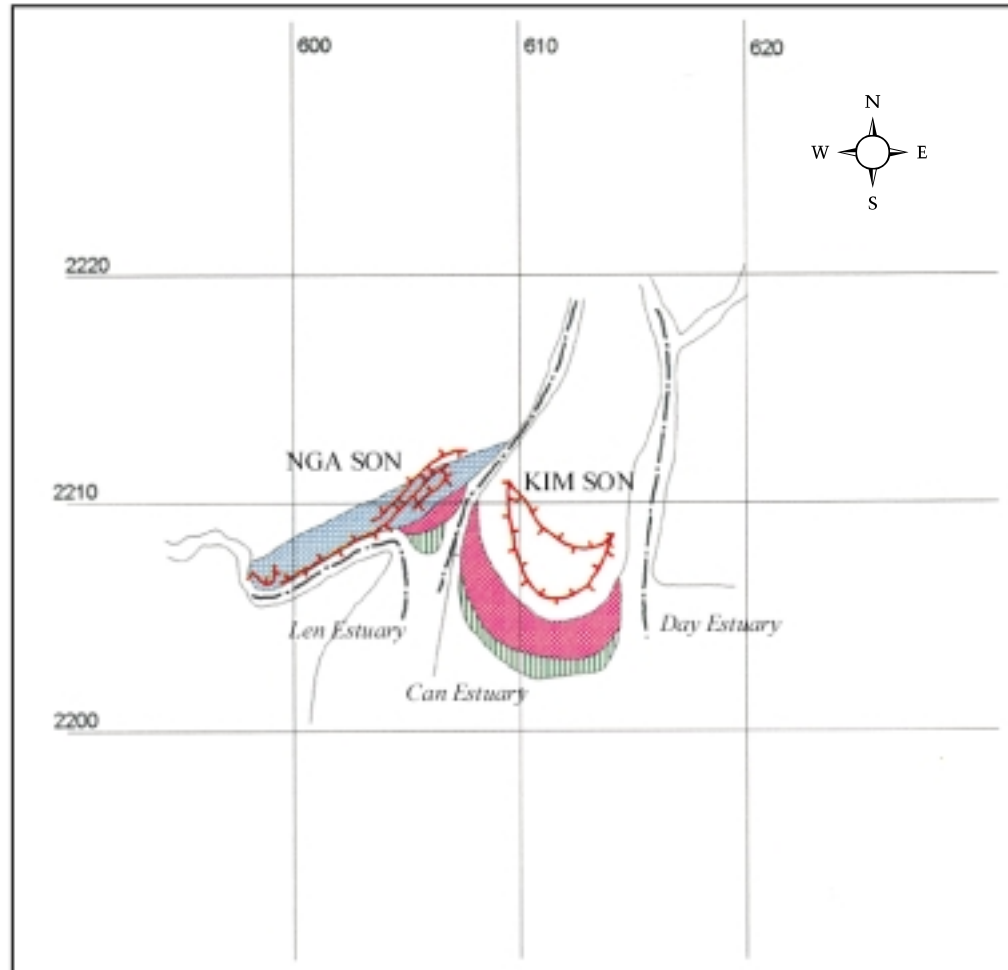
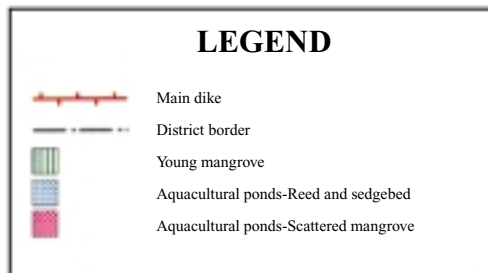


SCALE 1:1,000,000

N.B. Nghia Hung District is also a wetland site

## Map 2: Coastal Habitats of Ninh Binh Province and Nga Son District, Thanh Hoa Province

SCALE 1:320,000
















Grid: UTM, zone 48  
Horizontal Datum: India 1960

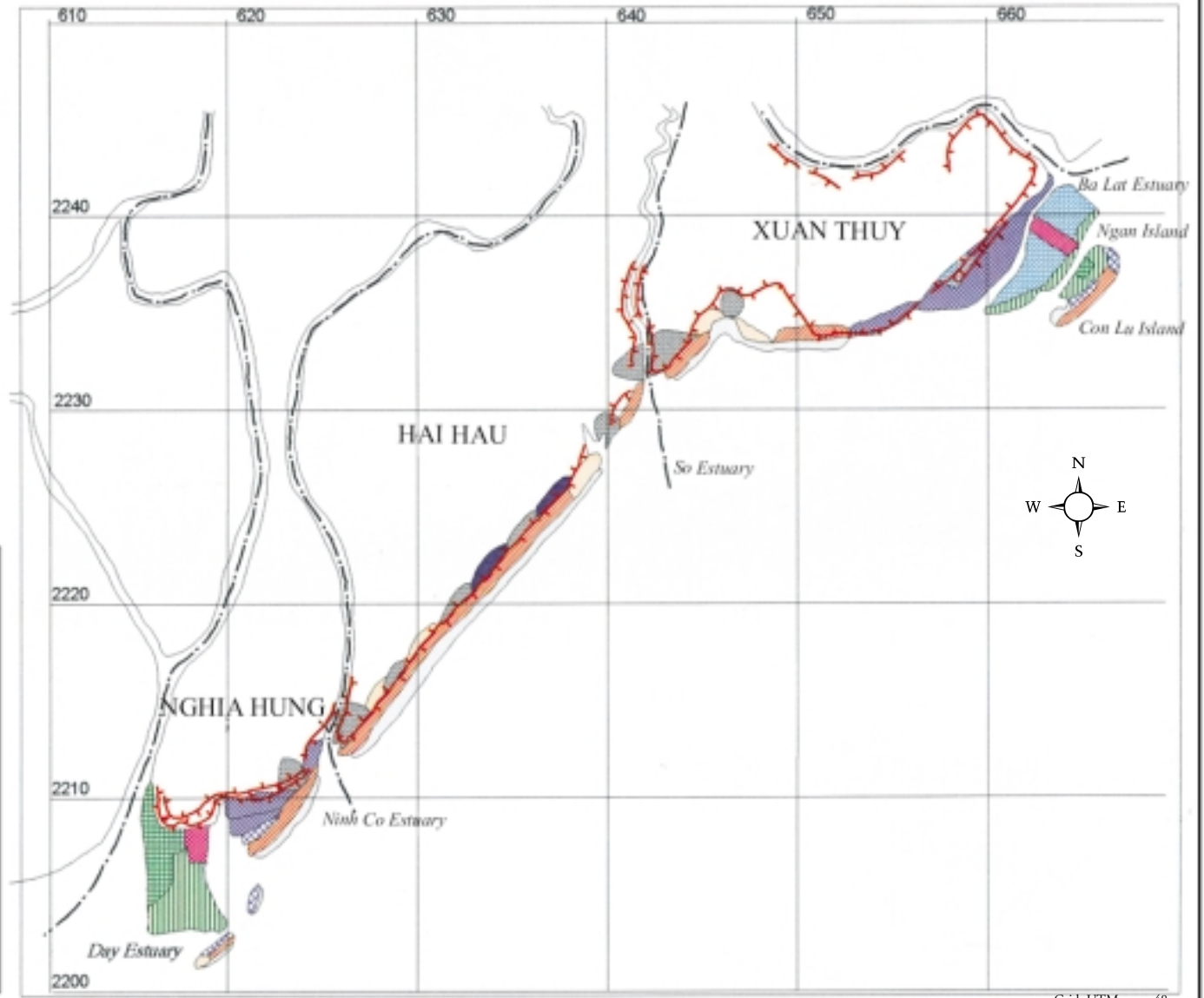


# Map 3: Coastal Habitats of Nam Ha Province

SCALE 1:320,000

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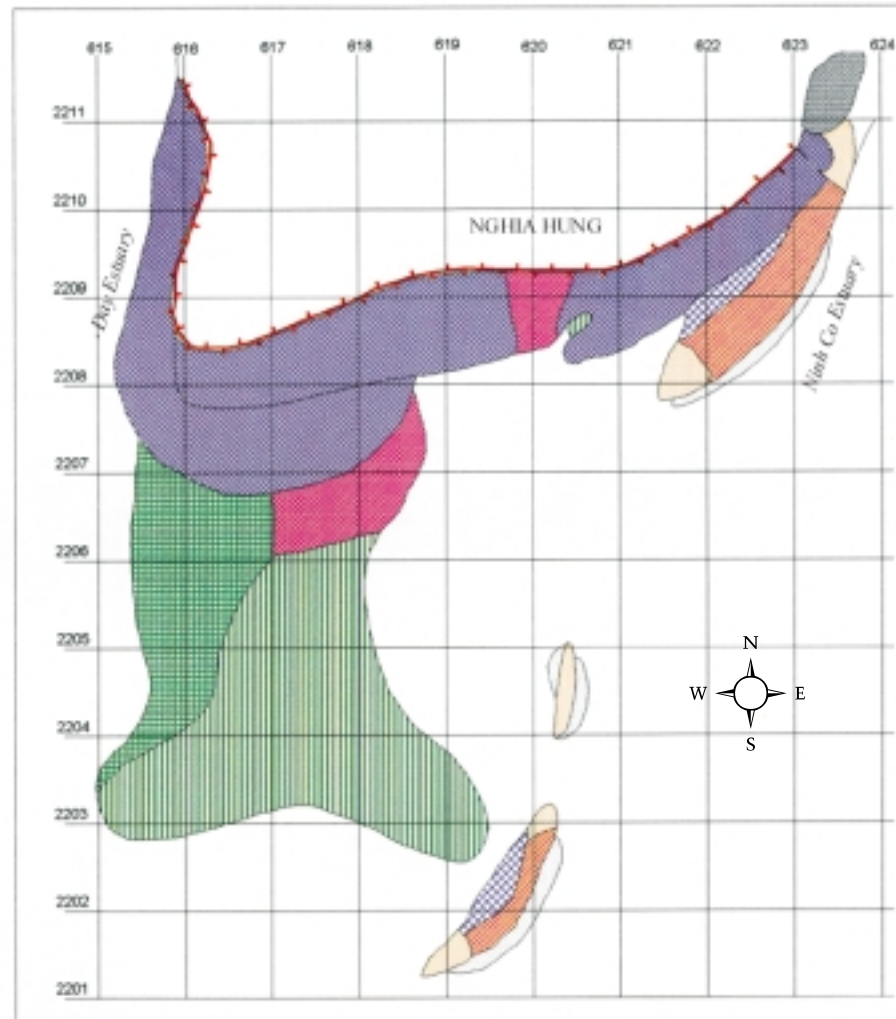
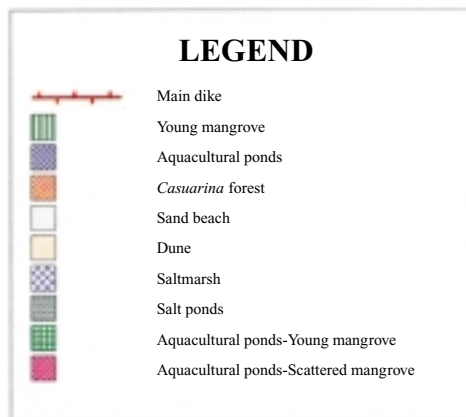
-  Main dike
-  District border
-  Young mangrove
-  Aquacultural ponds
-  *Casuarina* forest
-  Sand beach
-  Dune
-  Saltmarsh
-  Salt ponds
-  Aquacultural ponds-Young mangrove
-  Aquacultural ponds-Reed and sedgebed
-  Saltmarsh-Sand dune
-  Aquacultural ponds-Scattered mangrove



Grid: UTM, zone 48  
Horizontal Datum: India 1960

# Map 4: Coastal Habitats of Nghia Hung District

SCALE 1:80,000















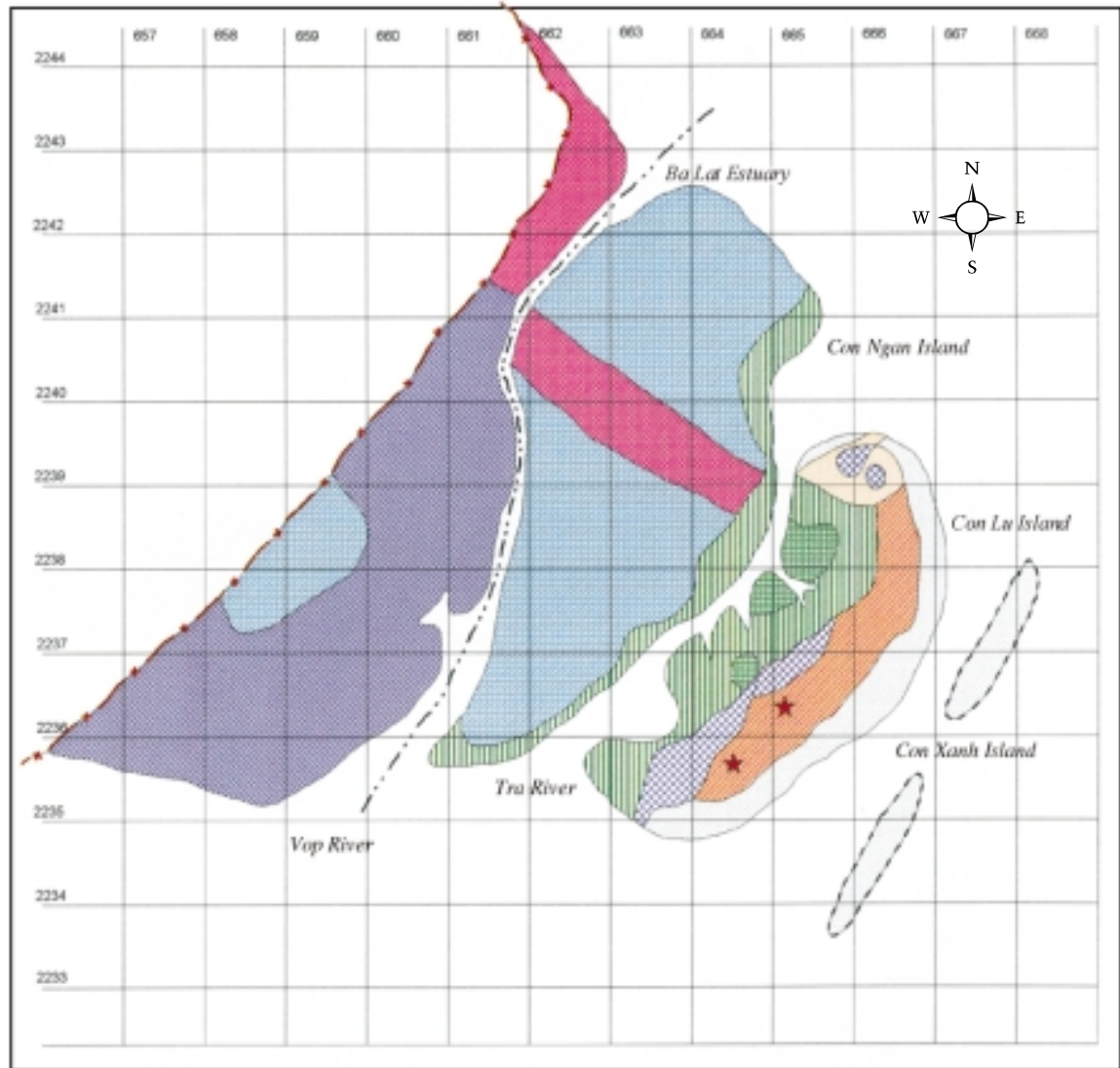
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# Map 5: Xuan Thuy Nature Reserve

SCALE 1:80,000

**LEGEND**

-  Main dike - Border of Xuan Thuy Ramsar Area
-  Border of Xuan Thuy Nature Reserve
-  Police and army station
-  Young mangrove
-  Aquacultural ponds
-  Casuarina forest
-  Sand beach
-  Dune
-  Saltmarsh
-  Aquacultural ponds-Young mangrove
-  Aquacultural ponds-Reed and sedgebed
-  Aquacultural ponds-Scattered mangrove

















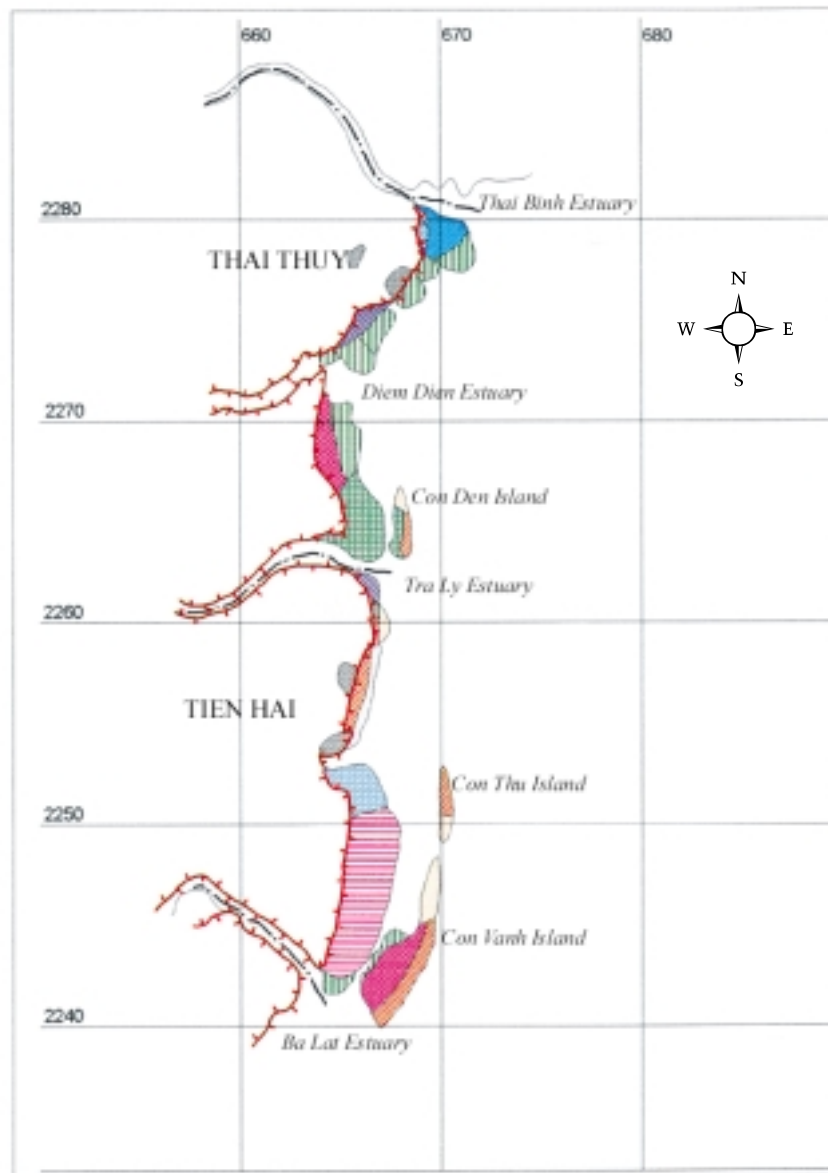
Grid: UTM, zone 48  
Horizontal Datum: India 1960

# Map 6: Coastal Habitats of Thai Binh Province

SCALE 1 : 320,000

**LEGEND**

	Main dike
	District border
	Young mangrove
	Aquacultural ponds
	Casuarina forest
	Sand beach
	Dune
	Saltmarsh
	Salt ponds
	Aquacultural ponds-Young mangrove
	Aquacultural ponds-Reed and sedgebed
	Aquacultural ponds-Old mangrove
	Aquacultural ponds-Scattered mangrove
	Aquacultural ponds-Reed and sedgebed-Scattered mangrove














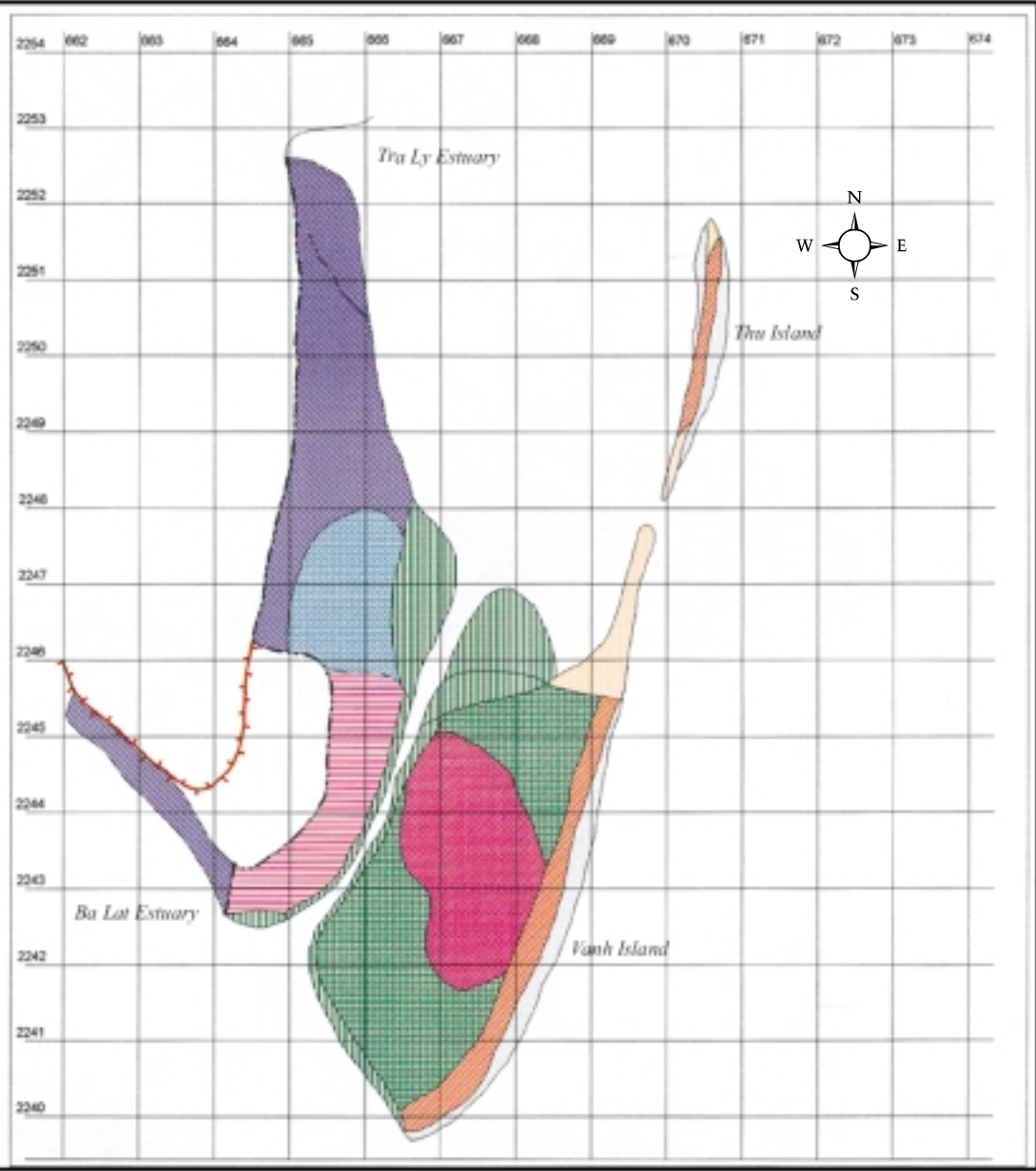
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# Map 7: Tien Hai Nature Reserve

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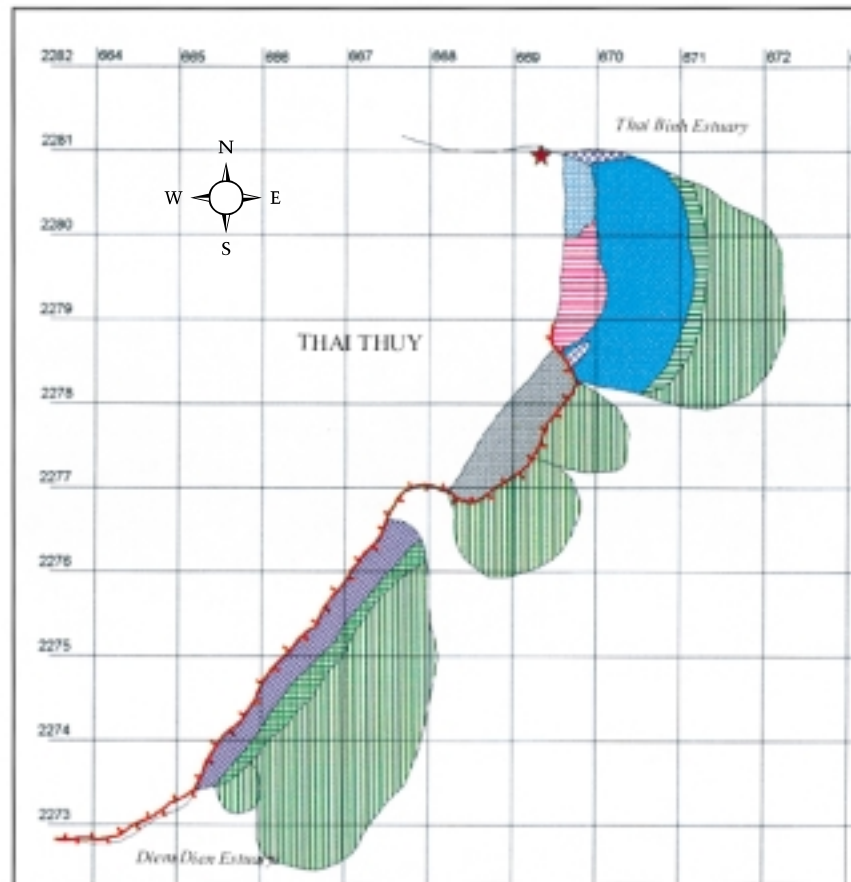
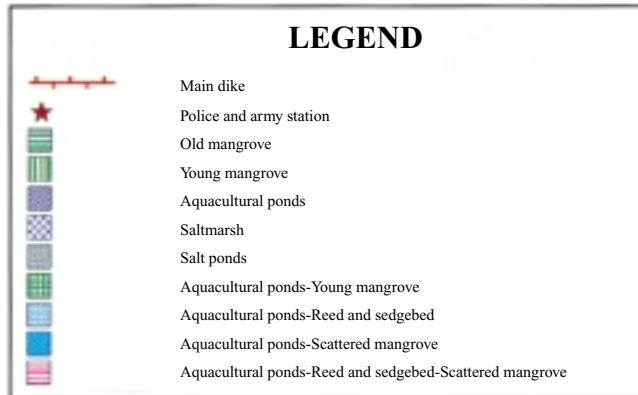
-  Main dike
-  Border of Tien Hai Nature Reserve
-  Young mangrove
-  Aquacultural ponds
-  Casuarina forest
-  Sand beach
-  Dune
-  Aquacultural ponds-Young mangrove
-  Aquacultural ponds-Reed and sedgebed
-  Aquacultural ponds-Scattered mangrove
-  Aquacultural ponds-Reed and sedgebed-Scattered mangrove



Grid: UTM, zone 48  
Horizontal Datum: India 1960

# Map 8: Coastal Habitats of Thai Binh Estuary, Thai Thuy District

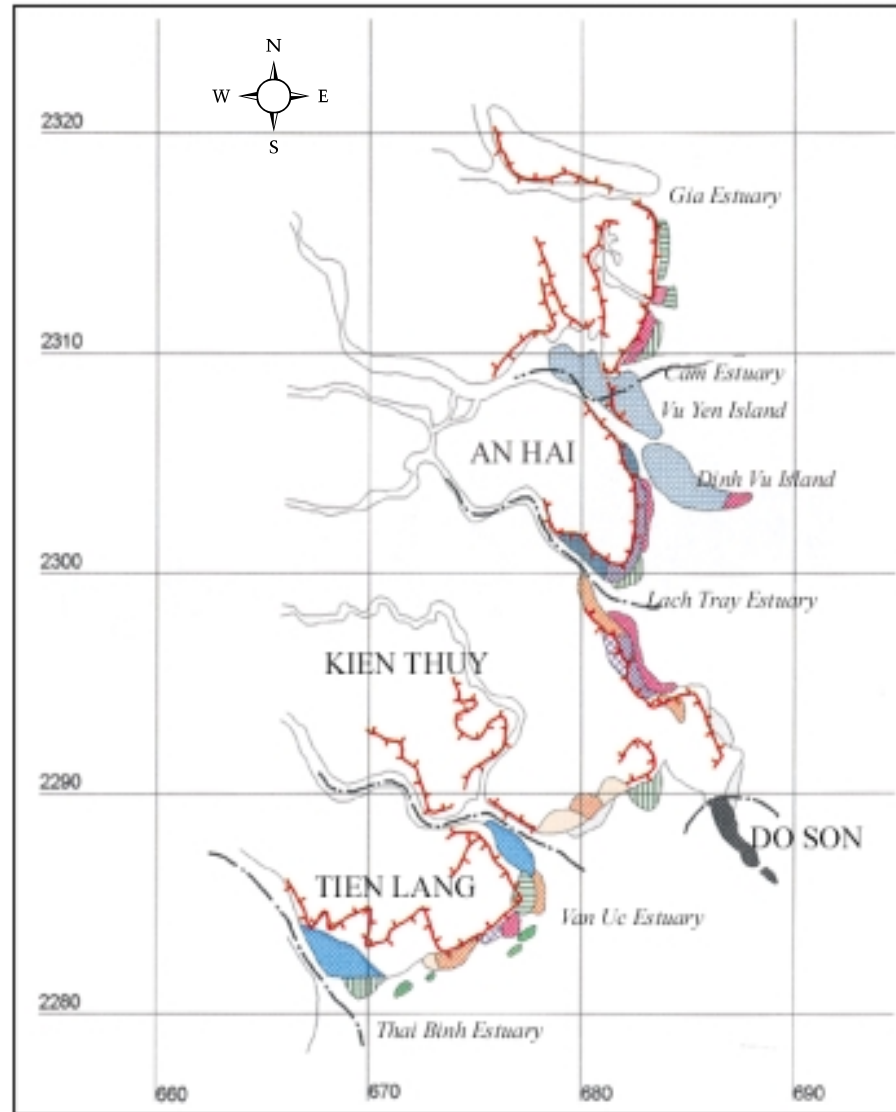
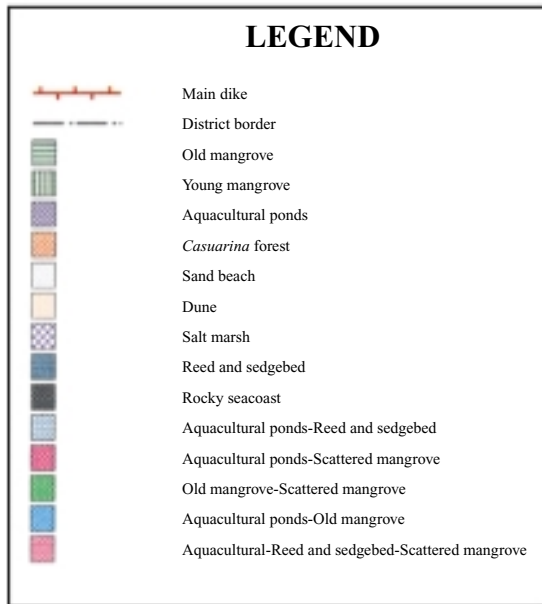
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Grid: UTM, zone 48  
Horizontal Datum: India 1960

# Map 9: Coastal Habitats of Hai Phong Province

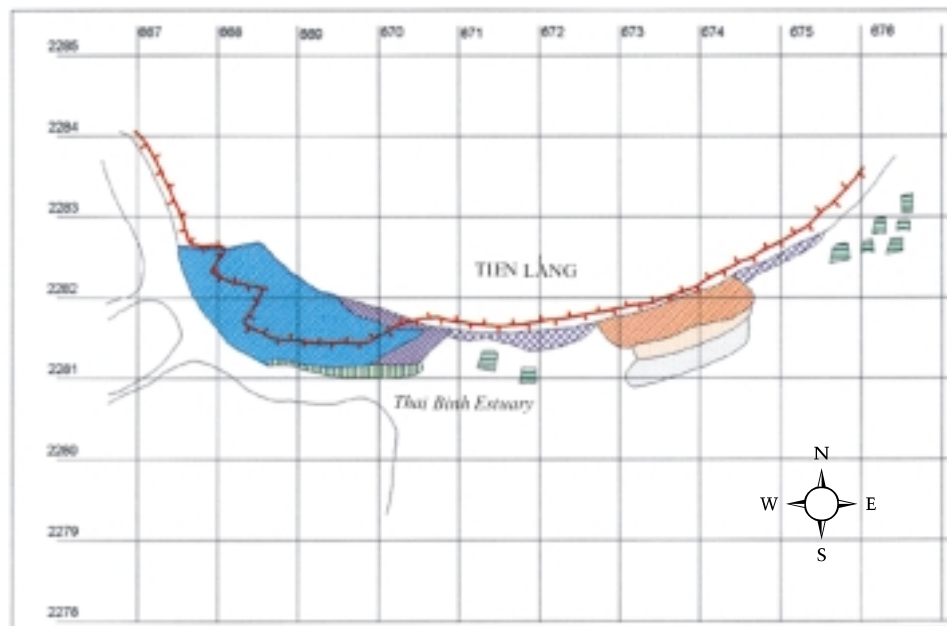
SCALE 1:320,000



Grid: UTM, zone 48. Horizontal Datum: India 1960

# Map 10: Coastal Habitats of Hai Phong Province

SCALE 1:320,000

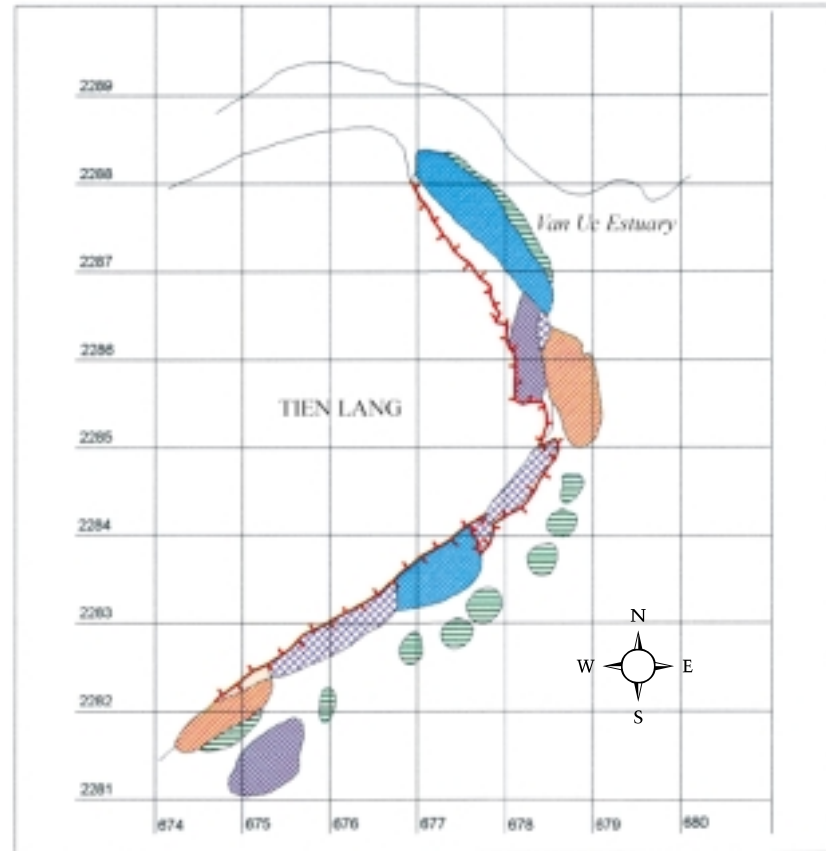
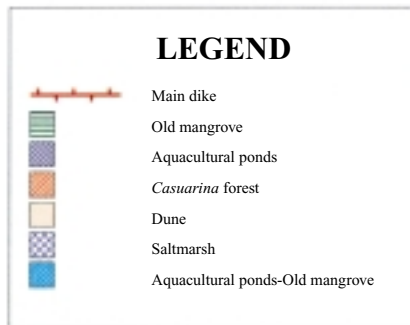


Grid: UTM, zone 48  
Horizontal Datum: India 1960



# Map 11: Coastal Habitats of Van Uc Estuary Thien Lang District

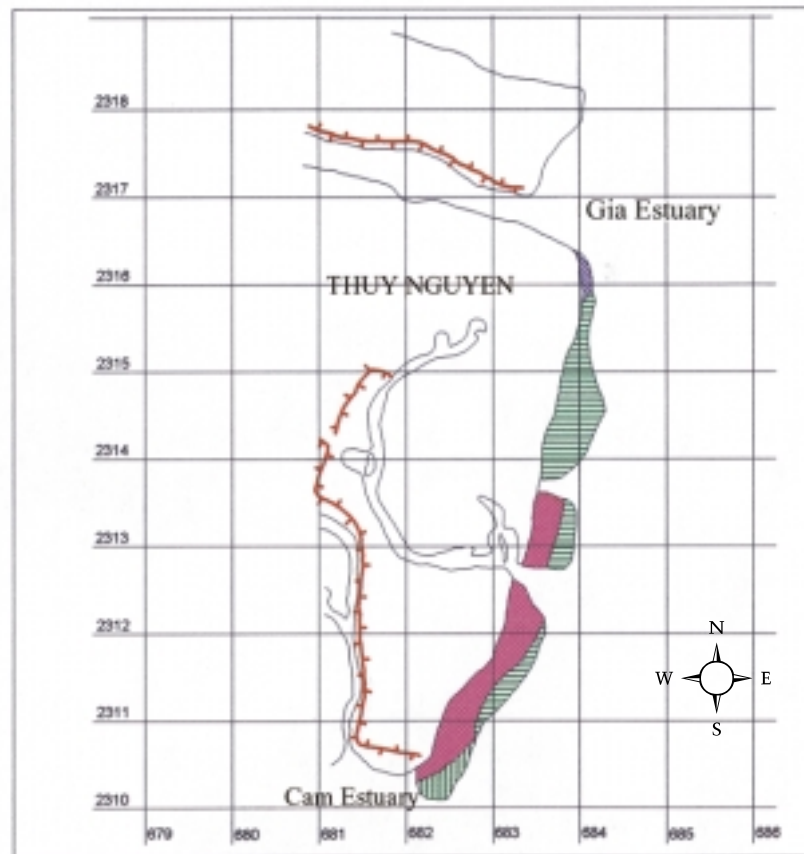
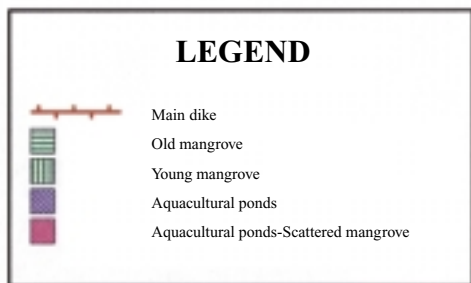
SCALE 1:320,000



Grid: UTM, zone 48. Horizontal Datum: India 1960

# Map 12: Coastal Habitats of the Southern Coast of Thuy Nguyen District

SCALE 1:320,000



Grid: UTM, zone 48. Horizontal Datum: India 1960

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## Appendix 2: Hypothetical List of Flora from the Key Coastal Wetland Sites in the Red River Delta

Family, Genus and Species	Distribution		Site						
	Intertidal	Dike	1	2	3	4	5	6	7
<b>Acanthaceae</b>									
<i>Acanthus ilicifolius</i>	+	+	+	+	+	+	+	+	+
<i>Ruellia tuberosa</i>		+		+		+			
<b>Aizoaceae</b>									
<i>Sesuvium portulacastrum</i>		+				+	+	+	+
<b>Amaranthaceae</b>									
<i>Achyranthes aspera</i>		+	+	+	+	+	+	+	+
<i>Althernanthera sessilis</i>		+	+	+	+	+	+	+	+
<i>Amaranthus spinosa</i>		+	+	+	+	+	+	+	+
<b>Amaryllidaceae</b>									
<i>Crinum asiaticum</i>		+	+	+	+	+	+	+	
<b>Annonaceae</b>									
<i>Annona glabra</i>		+	+	+	+	+	+		
<b>Asclepiadiaceae</b>									
<i>Hoya gigantea</i>		+	+	+	+				
<b>Avicenniaceae</b>									
<i>Avicennia marina</i>	+		+	+	+	+	+	+	
<b>Boraginaceae</b>									
<i>Heliotropium indicum</i>		+	+	+	+		+	+	
<b>Casuarinaceae</b>									
<i>Casuarina equisetifolia</i>		+		+	+	+	+	+	+
<b>Chenopodiaceae</b>									
<i>Chenopodium album</i>		+	+	+	+	+	+	+	+
<i>Suaeda maritima</i>		+			+				
<b>Compositae</b>									
<i>Bidens pilosa</i>		+	+	+	+	+	+	+	+
<i>Ageratum conyzoides</i>		+				+	+	+	+
<i>Blumea balsamifera</i>		+		+	+				
<i>Eclipta alba</i>		+	+	+	+	+	+	+	+
<i>Eupatorium odoratum</i>		+	+	+	+		+	+	
<i>Melanthera bicolor</i>		+	+	+	+				
<i>Parthenoxylon hysterophorus</i>		+				+	+	+	+
<i>Pluchea pteropoda</i>		+	+	+	+	+	+	+	+
<i>Wedelia calendulacea</i>		+			+	+	+	+	
<b>Convolvulaceae</b>									
<i>Ipomea pes-carpae</i>		+	+	+	+	+	+	+	+
<b>Cyperaceae</b>									
<i>Cyperus malaccensis</i>	+	+	+	+	+	+	+	+	+
<i>C. tegetiformis</i>	+		+	+	+	+	+	+	+
<i>C. stoloniferus</i>	+		+	+	+	+	+	+	+
<i>Fimbristylis ferruginea</i>	+			+					
<i>Scirpus</i> sp. nov.	+				+			+	+
<b>Euphorbiaceae</b>									
<i>Excoecaria agallocha</i>		+	+	+	+	+	+	+	+



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Family, Genus and Species	Distribution		Site						
	Intertidal	Dike	1	2	3	4	5	6	7
<b>Fabaceae</b>									
<i>Derris trifoliata</i>		+	+	+	+	+	+	+	+
<i>Sesbania</i> sp.		+			+				
<b>Flagellariaceae</b>									
<i>Flagellaria indica</i>	+							+	
<b>Goodeniaceae</b>									
<i>Scaveola hainamensis</i>		+	+	+	+	+	+	+	+
<i>S. taccada</i>		+	+	+	+	+	+	+	+
<b>Malvaceae</b>									
<i>Hibiscus tiliaceus</i>		+	+	+	+	+	+	+	+
<i>Thespesia populnea</i>		+	+	+	+	+	+	+	+
<i>Sida rhombifolia</i>		+	+	+	+	+	+	+	+
<b>Moraceae</b>									
<i>Ficus racemosa</i>		+		+					
<b>Myrsinaceae</b>									
<i>Aegiceras corniculatum</i>	+		+	+	+	+	+	+	+
<b>Poaceae</b>									
<i>Phragmites</i> sp.	+		+	+	+	+	+	+	+
<i>Cynodon dactylon</i>		+	+	+	+	+	+	+	+
<i>Sporolobus virginicus</i>		+	+	+	+	+	+	+	+
<i>Paspalum</i> sp.		+	+	+	+				
<b>Pteridaceae</b>									
<i>Acrostichum aureum</i>		+	+	+	+	+	+	+	+
<b>Rhizophoraceae</b>									
<i>Bruguiera gymnorrhiza</i>	+				+				
<i>Kandelia candel</i>	+		+	+	+	+	+	+	+
<b>Solanaceae</b>									
<i>Datura fastuosa</i>		+			+	+	+		
<b>Sonneratiaceae</b>									
<i>Sonneratia caseolaris</i>	+		+	+	+	+	+	+	
<b>Verbenaceae</b>									
<i>Clerodendron inerme</i>		+	+	+	+	+	+	+	+
<i>C. intermedia</i>		+	+	+	+				

Key: 1 = Southern coast of Thuy Nguyen district; 2 = Van Uc estuary; 3 = Thai Binh estuary (Tien Lang district); 4 = Thai Binh estuary (Thai Thuy district); 5 = Tien Hai Nature Reserve; 6 = Xuan Thuy Nature Reserve; 7 = Coastal zone of Nghia Hung district

## Appendix 3: List of Birds Recorded in the Coastal Zone of the Red River Delta

Order, Family, Genus and Species	Site/District																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<b>Anseriformes</b>																		
<b>Anatidae</b>																		
<i>Anser anser</i>			+			+												
<i>Anas penelope</i>			+			+	+		+									
<i>A. poecilorhyncha</i>						+			+		+							
<i>A. clypeata</i>	+				+	+	+	+										
<i>A. querquedula</i>						+	+											
<i>A. crecca</i>	+		+		+	+	+	+	+	+	+		+				+	+
<b>Turniciformes</b>																		
<b>Turnicidae</b>																		
<i>Turnix tanki</i>									+									+
<b>Piciformes</b>																		
<b>Picidae</b>																		
<i>Jynx torquilla</i>										+		+	+					
<b>Upupiformes</b>																		
<b>Upupidae</b>																		
<i>Upupa epops</i>									+									
<b>Coraciiformes</b>																		
<b>Coraciidae</b>																		
<i>Eurystomus orientalis</i>																		+
<b>Alcedinidae</b>																		
<i>Alcedo atthis</i>	+	+	+	+		+	+	+	+	+	+	+	+	+		+	+	+
<b>Halcyonidae</b>																		
<i>Halcyon smyrnensis</i>	+			+		+	+	+	+		+	+	+				+	+
<i>H. pileata</i>			+	+	+	+		+	+	+	+	+	+				+	+
<b>Cerylidae</b>																		
<i>Ceryle rudis</i>	+					+		+		+			+	+			+	+
<b>Meropidae</b>																		
<i>Merops viridis</i>			+					+		+								
<i>M. philippinus</i>								+			+	+						+
<b>Cuculiformes</b>																		
<b>Cuculidae</b>																		
<i>Cacomantis merulinus</i>	+	+	+	+		+												
<b>Centropodidae</b>																		
<i>Centropus bengalensis</i>			+			+				+		+	+		+		+	+
<b>Apodiformes</b>																		
<b>Apodidae</b>																		
<i>Hirundapus</i> sp.													+					
<i>Apus pacificus</i>	+								+				+					+
<b>Strigiformes</b>																		
<b>Tytonidae</b>																		
<i>Tyto alba</i>								+										
<b>Columbiformes</b>																		
<b>Columbidae</b>																		
<i>Streptopelia orientalis</i>										+		+	+					



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Order, Family, Genus and Species	Site/District																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<i>S. chinensis</i>	+		+	+		+	+	+		+			+					
<i>Treron</i> sp.																		+
<b>Gruiformes</b>																		
<b>Rallidae</b>																		
<i>Gallirallus striatus</i>			+			+				+	+							+
<i>Amaurornis phoenicurus</i>			+					+		+			+					
<i>Porzana pusilla</i>										+								
<i>P. fusca</i>										+								
<i>Gallinula chloropus</i>										+								
<b>Ciconiiformes</b>																		
<b>Scolopacidae</b>																		
<i>Gallinago gallinago</i>			+		+	+	+	+		+		+	+				+	+
<i>Limosa limosa</i>			+			+	+	+				+						
<i>L. lapponica</i>						+		+			+							
<i>Numenius phaeopus</i>	+					+	+				+							
<i>N. arquata</i>						+	+	+			+		+				+	
<i>Tringa erythropus</i>			+	+		+	+		+	+	+	+	+				+	+
<i>T. totanus</i>			+	+	+	+	+	+	+	+	+	+	+	+		+		+
<i>T. stagnatilis</i>			+			+	+				+	+	+					
<i>T. nebularia</i>	+		+	+	+	+	+	+	+	+	+	+	+	+		+		+
<i>T. guttifer</i>			+			+												
<i>T. ochropus</i>										+								
<i>T. glareola</i>			+			+					+		+					
<i>Xenus cinereus</i>						+		+			+	+	+					
<i>Actitis hypoleucos</i>			+		+	+			+	+		+	+					+
<i>Heteroscelus brevipes</i>						+	+											
<i>Arenaria interpres</i>			+			+												
<i>Limnodromus scolopaceus</i>						+												
<i>L. semipalmatus</i>						+												
<i>Calidris tenuirostris</i>						+		+			+							
<i>C. canutus</i>						+												
<i>C. alba</i>	+					+	+	+										
<i>C. pygmeus</i>						+												
<i>C. ruficollis</i>			+			+	+	+			+		+					
<i>C. alpina</i>			+			+	+	+			+			+				
<i>C. ferruginea</i>			+		+	+		+			+	+	+					
<i>Limicola falcinellus</i>						+		+										
<i>Philomachus pugnax</i>						+												
<i>Phalaropus lobatus</i>						+												
<b>Jacaniidae</b>																		
<i>Hydrophasianus chirurgus</i>						+												
<b>Charadriidae</b>																		
<i>Himantopus himantopus</i>			+			+	+											
<i>Phuivialis fulva</i>					+	+	+				+							
<i>P. squatarola</i>			+			+		+			+	+						
<i>Charadrius dubius</i>						+	+	+	+		+							
<i>C. alexandrinus</i>			+		+	+	+	+			+		+	+				
<i>C. mongolus</i>			+	+	+	+	+	+	+		+		+	+		+		



Order, Family, Genus and Species	Site/District																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
<i>C. leschenaultii</i>					+	+	+	+	+		+		+						
<i>Vanellus cinereus</i>														+					
<b>Glareolidae</b>																			
<i>Glareola maldivarus</i>			+			+													
<b>Laridae</b>																			
<i>Larus crassirostris</i>						+													
<i>L. heuglini/vegae</i>	+		+		+	+	+		+	+	+	+		+	+	+			
<i>L. ichthyaetus</i>			+			+													
<i>L. brunnicephalus</i>	+																		
<i>L. ridibundus</i>	+		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>L. saundersi</i>	+		+			+	+		+				+			+			
<i>Gelochelidon nilotica</i>			+			+	+	+	+		+	+	+						
<i>Sterna caspia</i>						+		+			+								
<i>S. hirundo</i>					+	+					+								
<i>S. albifrons</i>						+		+											
<i>Chlidonias hybridus</i>					+	+	+	+				+	+						
<i>C. leucopterus</i>						+													
<b>Accipitridae</b>																			
<i>Pandion haliaetus</i>													+						
<i>Aviceda leuphotes</i>						+							+						
<i>Milvus migrans</i>											+	+	+	+	+			+	+
<i>Circus aeruginosus</i>	+		+		+	+	+	+	+	+	+	+	+						
<i>C. melanoleucos</i>						+		+	+	+									
<i>Accipiter gularis</i>				+						+	+	+	+					+	+
<i>Butastur indicus</i>								+											
<i>Buteo buteo</i>						+					+								
<b>Falconidae</b>																			
<i>Falco tinnunculus</i>	+		+		+	+													
<i>F. columbarius</i>			+			+													
<i>F. peregrinus</i>						+				+									
<b>Podicipedidae</b>																			
<i>Tachybaptus ruficollis</i>	+			+	+	+		+		+		+		+				+	+
<b>Ardeidae</b>																			
<i>Egretta garzetta</i>	+		+	+	+	+	+	+	+	+	+	+	+	+				+	+
<i>E. eulophotes</i>						+													
<i>Ardea cinerea</i>			+	+	+	+	+		+	+	+	+	+	+		+	+	+	
<i>A. purpurea</i>	+					+	+	+	+	+	+	+							+
<i>Casmerodius albus</i>	+		+	+	+	+	+		+	+		+							
<i>Bubulcus ibis</i>	+				+	+		+	+	+		+	+						+
<i>Ardeola bacchus</i>	+		+	+	+	+		+	+	+	+	+	+	+		+	+	+	
<i>Butorides striatus</i>						+		+		+	+	+						+	+
<i>Nycticorax nycticorax</i>	+					+		+		+		+	+						
<i>Ixobrychus sinensis</i>										+								+	
<i>I. cinnamomeus</i>								+											+
<b>Threskiornithidae</b>																			
<i>Threskiornis melanocephalus</i>									+	+									
<i>Platalea leucorodia</i>						+				+									
<i>P. minor</i>						+		+	+	+		+				+			

Appendices

Order, Family, Genus and Species	Site/District																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<b>Passeriformes</b>																		
<b>Laniidae</b>																		
<i>Lanius cristatus</i>	+	+				+		+		+								
<i>L. colluriooides</i>								+		+			+					
<i>L. schach</i>				+		+	+	+		+	+		+					
<b>Corvidae</b>																		
<i>Crypsirina temia</i>																		+
<i>Oriolus chinensis</i>										+								+
<i>Pericrocotus divaricatus</i>																	+	+
<i>Rhipidura albicollis</i>						+			+			+	+				+	
<i>Dicrurus macrocercus</i>	+		+	+		+	+	+	+	+	+	+	+					+
<i>D. hottentottus</i>						+				+								
<b>Muscicapidae</b>																		
<i>Monticola solitarius</i>									+	+								
<i>Muscicapa dauurica</i>								+										
<i>Ficedula parva</i>						+		+				+						
<i>Luscinia calliope</i>						+		+		+								
<i>Copsychus saularis</i>	+	+		+	+	+		+	+	+	+	+	+	+	+		+	+
<i>Saxicola torquata</i>	+	+	+		+	+	+	+	+	+	+	+	+	+		+	+	+
<i>S. ferrea</i>															+		+	
<b>Sturnidae</b>																		
<i>Sturnus sinensis</i>									+	+	+	+	+				+	+
<i>S. roseus</i>										+								
<i>S. vulgaris</i>												+						
<i>Acridotheres tristis</i>										+								
<i>A. cinereus</i>	+	+				+			+	+		+	+				+	
<b>Paridae</b>																		
<i>Parus major</i>				+		+	+		+	+	+	+	+				+	+
<b>Hirundinidae</b>																		
<i>Riparia riparia</i>						+	+			+	+							
<i>Hirundo rustica</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>H. daurica</i>													+					+
<b>Pycnonotidae</b>																		
<i>Pycnonotus jocosus</i>						+												
<i>P. sinensis</i>				+		+		+					+					+
<i>P. aurigaster</i>	+			+		+	+	+			+		+		+			
<b>Cisticolidae</b>																		
<i>Prinia flaviventris</i>			+															+
<i>P. inornata</i>		+	+	+	+	+		+		+		+	+				+	+
<b>Zosteropidae</b>																		
<i>Zosterops japonicus</i>	+		+	+		+	+		+			+	+		+		+	
<b>Sylviidae</b>																		
<i>Locustella certhiola</i>						+				+								
<i>Acrocephalus bistrigiceps</i>						+		+										
<i>A. orientalis</i>						+				+								
<i>A. aedon</i>						+		+										
<i>Orthotomus sutorius</i>	+			+			+	+	+	+								
<i>Phylloscopus fuscatus</i>		+				+		+		+		+	+					+

Order, Family, Genus and Species	Site/District																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<b>Alaudidae</b>																		
<i>Mirafra javanica</i>			+			+				+	+	+				+	+	+
<i>Alauda gulgula</i>		+	+			+				+	+		+					+
<b>Passeridae</b>																		
<i>Passer montanus</i>	+	+	+	+	+	+		+	+	+	+		+	+		+	+	
<i>Motacilla alba</i>			+			+					+	+	+				+	+
<i>M. flava</i>	+	+	+			+	+	+		+	+	+	+	+			+	
<i>Anthus richardi</i>	+		+		+	+		+	+	+				+				
<i>A. hodgsoni</i>								+										
<i>A. cervinus</i>	+		+			+		+			+							
<i>Lonchura punctulata</i>						+		+		+					+		+	+
<b>Frigillidae</b>																		
<i>Emberiza spodocephala</i>						+		+	+		+		+					+

Follows Inskipp *et al.* (1996).

Key:

- |                              |   |
|------------------------------|---|
| 1 = Nga Son district         | 10 = Thai Binh estuary (Thai Thuy district) |
| 2 = Kim Son district         | 11 = Tien Lang district                     |
| 3 = Nghia Hung district      | 12 = Thai Binh estuary (Tien Lang district) |
| 4 = Hai Hau district         | 13 = Van Uc estuary                         |
| 5 = Xuan Thuy district       | 14 = Kien Thuy district                     |
| 6 = Xuan Thuy Nature Reserve | 15 = Do Son district                        |
| 7 = Tien Hai district        | 16 = An Hai district                        |
| 8 = Tien Hai Nature Reserve  | 17 = Thuy Nguyen district                   |
| 9 = Thai Thuy district       | 18 = Southern coast of Thuy Nguyen district |



## Appendix 4: Marine Products of Economic Importance in the Red River Delta

### Phylum: ARTHROPODA

#### Class: Crustacea

Order Decapoda

Grapsidae

*Sesarma bidens*

Ocypodidae

*Macrophthalmus simdentatus*

*M. japonicus*

Leucosidae

*Pseudophilyra olivacea*

Portunidae

*Scylla serrata*

*Portunus* sp.

*Charybdis cruceata*

*Orithya mammillaris*

Lysiosquillidae

*Acanthosquilla* sp.

*Stegophiura* sp.

Penaeidae

*Penaeus merguensis*

*Exopalaemon carinicauda*

*Metapennaeus ensis*

Carditidae

*Cardita variegata*

Eneridae

*Venerapis philippinarum*

*Gomphina aequilatera*

*Cultellus scalpellum*

*Pholas orientalis*

*Siliqua albida*

### Phylum: BRACHIOPODA

#### Class: Inarticulata

*Lingula* sp.

### Phylum: MOLLUSCA

#### Class: Gastropoda

Neritidae

*Neritina violacea*

Potamididae

*Cerithidea* sp.

Muricidae

*Murex trapa*

Turritellidae

*Turritella terebra*

#### Class: Bivalvia

Arcidae

*Arca subcrenata*

*A. granosa*

Anomiidae

*Placuna placenta*

Ostracidae

*Ostrea rivularis*

*O. densemenlosa*

Eneridae

*Meretrix meretrix*

*M. liisoria*

*M. lyrata*

*Cyclina sinensis*

Mactridae

*Mactra quadrangularis*

Psammobiidae

*Sanguinolaria diphos*

*Hitula diphos*

Semelidae

*Abrina* cf. *declivis*

Glaucomyidae

*Glauconome chinensis*

Solenidae

*Solen guoldi*

*S. grandis*



**Phylum: CHORDATA**

**Class: Actinopterygii**

Engraulidae

*Setipinna taty*

*Engraulis baelama*

Mugillidae

*Mugil kelaarti*

Ophichthyidae

*Pisoodonopsis boro*

Signidae

*Siganus oramin*

Apogonidae

*Apogon monochrous*

Lutjanidae

*Pristipomoides typus*

Leiognathidae

*Leiognathus dussumieri*

*L. brevirostris*

Eleotridae

*Borrichthys sinensis*

*Eleotris fusca*

Gobioididae

*Taenioides anguillaris*

Apocrypteidae

*Parapocryptes serperaster*

*Pseudopocryptes lanceolatus*

Periophthalmidae

*Boleophthalmus chinensis*

Bothidae

*Tephrinectes sinensis*

Cynoglossidae

*Cynoglossus trigramus*

Balanidae

*Balanus amphitrite*