

MANGROVE HABITAT RESTORATION AND MANAGEMENT IN RANONG COASTAL ENVIRONMENTS, THAILAND

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Introduction

Coastal environmental issues are becoming a crucial concern due to various types of coastal habitats such as barrier islands, coastal wetlands, coral reefs and mangroves becoming fragmented worldwide (Field 1996; Macintosh et al. 2002; Ashton et al. 2003) especially in Southeast Asian countries including Thailand. This study focused on mangrove habitat; tropical inshore communities dominated by several species of trees, shrub and herbs and capable of growth and reproduction in areas inundated daily by seawater (Aksornkoae et al. 1992; Smith and Smith 2004).

Mangroves play an important role in habitat complexity and diversity of the associated fauna of the ecosystem (Tri et al. 1998; Lee 1998). They also provide shelters and breeding ground for terrestrial and marine organisms such as shrimp, crabs and fish (Sasekumar et al. 1992; Barbier and Strand 1998). Moreover, they provide important indirect services such as shoreline stability and water quality (Buot 1994; Janssen and Padilla 1999). There are many species in need of corridors to move between mangrove patches (Smith and Smith 2004).

The Ranong mangrove ecosystem is fragmented due to population growth, conversion to aquaculture, agriculture and coastal urban and industrial development (Ong 1995; Macintosh 1996). On 26 December 2004, the Sumatra tsunami hit the Andaman Sea Coast of Ranong, Thailand causing severe damage to lives and properties.

A healthy mangrove ecosystem can mitigate the negative impact of tsunamis. In the Ranong province many villages were saved from tsunami because of the dense growth of mangroves along the coastline (Chotthong and Aksornkoae 2007). It has been generally proved that mangroves can decrease the wave energy and coastal erosion rate (Harakunarak and Aksornkoae 2005; Kathiresan and Rajendran 2005; Hashim et al. 2010).

Mangrove habitat restoration in the fragmented areas could be the best option to enhance the ecology and socio-economic aspects of the coastal zone (Waters et al. 2008; Doydee 2009; Hashim et al. 2010). The objectives of this study were to determine mangrove dominant species using vegetation analysis and to identify the suitable areas for mangrove restoration through satellite image and to recommend appropriate species to be planted in the mangrove ecosystem of Ranong, Thailand.

Methods

Study area

This study was conducted in Ranong, Thailand [$9^{\circ}43'$ N to $9^{\circ}57'$ N and $98^{\circ}29'$ E to $98^{\circ}39'$ E]. It is a UNESCO-MAB biosphere reserve located on the Andaman Seacoast, about 568 km south of Bangkok. Ranong encompasses an area of 3,298 sq km. Ranong is geographically characterized with long expanses of sandy beaches, unspoiled upland and mangrove forests, waterfalls, parks, and a biodiversity sanctuary zone (Doydee et al. 2008).

Three districts and 2 sites of each district were selected based on accessibility, size of mangrove patches and associated elements such as channels and distance. These districts were Mueng (Ngaw [1] and Rachakrud [2]), Kapoe (Bangben [3] and Banghin [4]) and Suk Samran (Talaynog [5] and Hadsaykaow [6]) (Figure 1).

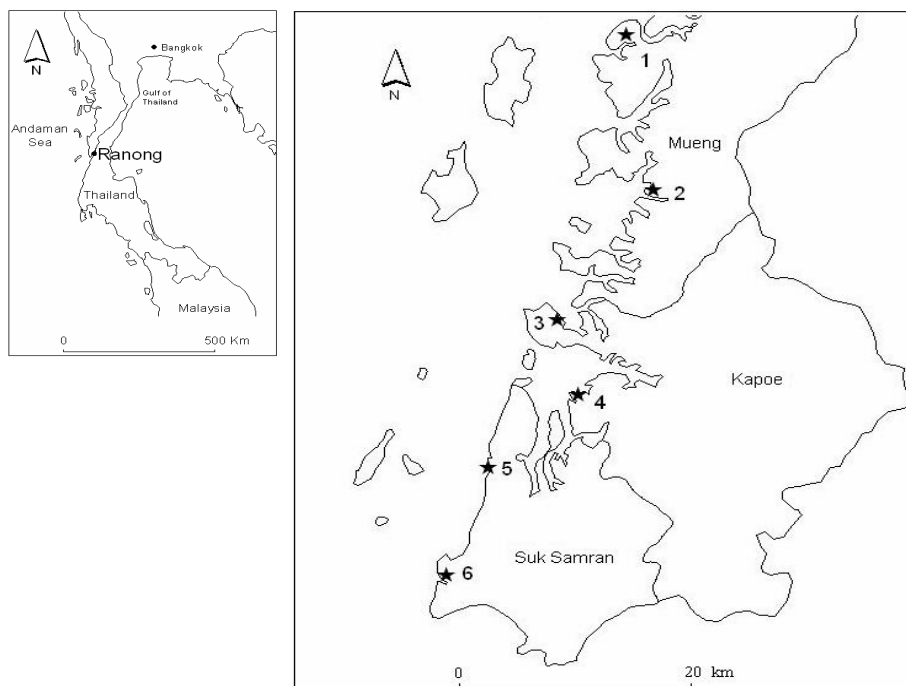


Figure 1 Six study sites in the mangrove landscape along the Andaman Seacoast in Ranong, Thailand: Mueng (Ngaw [1] and Rachakrud [2]), Kapoe (Bangben [3] and Banghin [4]) and Suk Samran (Talaynog [5] and Hadsaykaow [6])

Data Collection

The coordinate data of each sampling site were determined using a Global Positioning System (GPS) receiver with estimated accuracy of 10 m or better. Their values were validated and the localities were checked using georeferencing technique (Bantayan 2006; Anongponyoskun and Doydee 2009). The Point Centered Quarter (PCQ) method of Mueller-Dombois and Ellenberg (1974) was used to inventory the mangrove species in the study area. Vegetation analysis using Important Value Index (IVI) was applied to examine mangrove dominant species in the collection sites. Remotely sensed data (Landsat-5 TM) was employed to assess the attributes of the mangrove patches. The geospatial method was used to create the biodiversity corridor.

Results and Discussion

The mangrove forest areas are presented along the Andaman Seacoast of Ranong as shown in Figure 2. There are mangrove forests in every district, but more mangrove forests are concentrated with long connection found in Mueng. In Suk Samran district the mangrove patches are isolated (Figure 2).

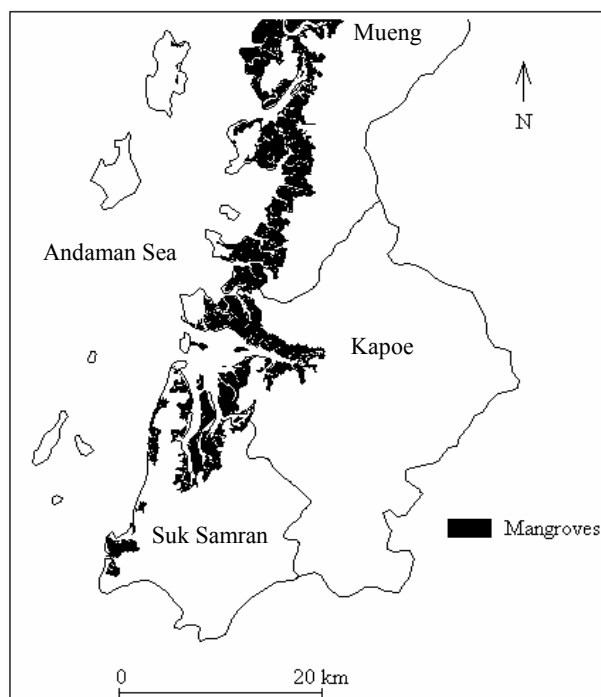


Figure 2 Distribution of mangrove forest areas in Ranong, Thailand

Among the districts studied, Mueng had greatest number of patches (17) while Kapoe had the least (5). There were a total of 34 mangrove patches in the study area (Table 1). Most of the patches were clumped, elongated, medium and large in size and were located along the shore.

Table 1 Attributes of mangrove patches in three districts of Ranong, Thailand

Districts	Attributes of Mangrove Patches			
	No. of Patches	Size	Shape	Arrangement
Mueng	17	Large	Elongate	Clumped
Kapoe	5	Large	Polygon	Clumped
Suk Samran	12	Medium	Elongate	Clumped
Total	34			

Table 2 presents IVI of mangrove vegetation in 6 study sites. There were 9 families with 19 mangrove species. The highest species richness of the mangrove trees was in Rachakrud site (14 species) while the lowest species richness of the mangrove trees was in Banghin and Talaynog sites (7 species).

Table 2 Importance Value Index (IVI) of mangrove species in 6 coastal sites in Ranong, Thailand

Name of species (Family)	Mangrove Forest Sites											
	Ngaw		Rachakrud		Bangben		Banghin		Talaynog		Hadsaykaow	
	A	B	A	B	A	B	A	B	A	B	A	B
<i>Aegiceras corniculatum</i> (Myrsinaceae)	5.12			9.15								
<i>Avicennia alba</i> (Avicenniaceae)	11.91	3.74	102.14	23.98	3.82	31.90						
<i>Avicennia marina</i> (Avicenniaceae)			87.55									
<i>Avicennia officinalis</i> (Avicenniaceae)	18.44	46.95	8.38				23.43	15.87	17.22	14.31		
<i>Bruguiera cylindrica</i> (Rhizophoraceae)	17.51	8.42	8.87	6.33	4.02	4.19				8.21		
<i>Bruguiera gymnorhiza</i> (Rhizophoraceae)			3.69									
<i>Bruguiera parviflora</i> (Rhizophoraceae)	30.97	56.76	43.85	26.03	13.51	77.35	4.07	103.13	67.59	37.80	18.31	
<i>Ceriops decandra</i> (Rhizophoraceae)	8.74	20.67			98.53	104.82			4.11	4.54		
<i>Ceriops tagal</i> (Rhizophoraceae)	4.64	11.45					75.00	29.31	22.36	18.39	3.56	
<i>Excoecaria agallocha</i> (Euphorbiaceae)			3.45	10.65	4.33							
<i>Heritiera littoralis</i> (Sterculiaceae)				3.92								
<i>Lumnitzera littorea</i> (Combretaceae)			5.30	16.97								
<i>Lumnitzera racemosa</i> (Combretaceae)				26.85								
<i>Rhizophora apiculata</i> (Rhizophoraceae)	190.18	111.59	61.75	19.01	80.47	102.41	64.16	107.05	72.83	78.52	119.81	176.51
<i>Rhizophora mucronata</i> (Rhizophoraceae)		18.23	4.84			13.59	4.87	44.97	66.85	119.63	106.46	74.14
<i>Scyphiphora hydrophyllacea</i> (Rubiaceae)				27.55								
<i>Sonneratia alba</i> (Sommeratiaceae)			21.92	43.07			5.70	44.24				
<i>Xylocarpus granatum</i> (Meliaceae)	24.40		10.32	15.53	31.25	25.43	68.73	70.36	4.61			3.97
<i>Xylocarpus moluccensis</i> (Meliaceae)		14.03	30.51				6.79				11.05	

Note: A = PCQ perpendicular to the channel and B = PCQ parallel with the channel

The Avicenniaceae and Rhizophoraceae were mangrove dominant families. There were 6 mangrove dominant species namely: *Avicennia marina*, *A. officinalis*, *Bruguiera parviflora*, *Ceriops decandra*, *Rhizophora apiculata* and *R. mucronata* in the study area (Figure 3). *Rhizophora apiculata* was the most dominant compared with other mangrove trees species due to the highest value of IVI (190.18) found in Ngaw A (Table 2).

Those dominant species were recommended for mangrove reforestation and habitat rehabilitation. *Rhizophora apiculata* is suitable species for mangrove habitat restoration in and nearby Ngaw while *Avicennia marina* or *A. officinalis* should be planted in and nearby Rachakrud site. *Ceriops decandra* is recommended species in Bangben. *Bruguiera parviflora* and *R. apiculata* will be planted in the coastal rehabilitation project in Banghin. *Bruguiera parviflora* and *R. mucronata* are appropriated choices for planting in Talaynog while *R. apiculata* is species option for Hadsaykaow as they are more adapted to the environmental conditions in the area.

Mangrove habitat fragmentation from time to time in Ranong, Thailand resulted in smaller-sized patched and increase distance between patches. It affects ecological processes and species composition as observed in Banten Bay, West Java Island, Indonesia (Doydee and Siregar 2006). Therefore, mangrove restoration is necessary for coastal landscape management.

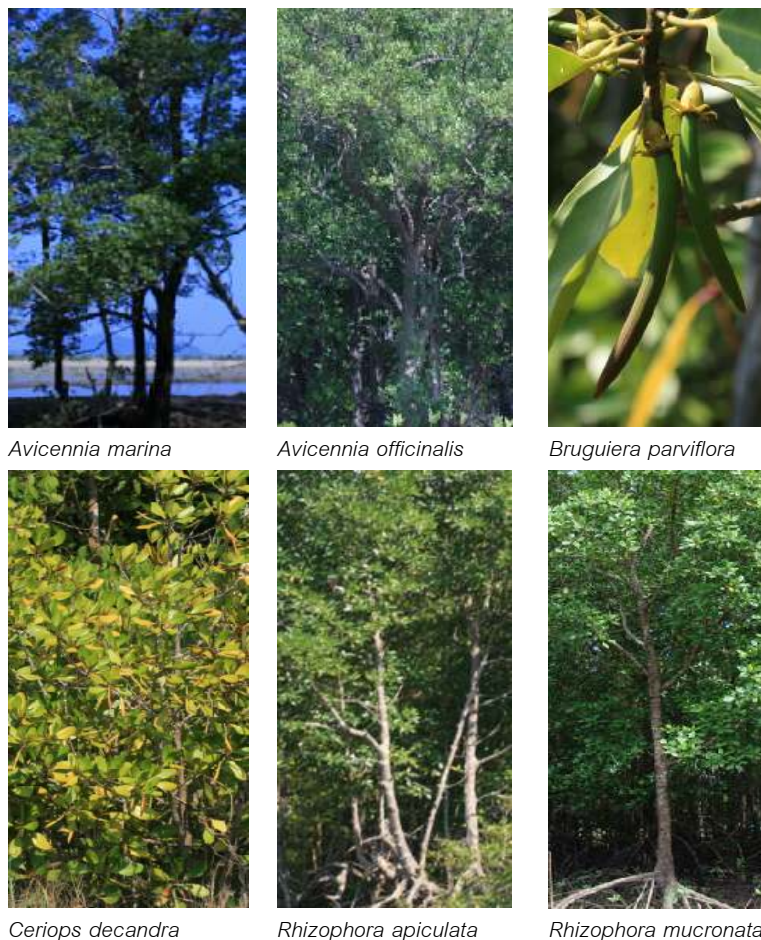


Figure 3 Mangrove dominant species in the study area

The failure to adequately regulate coastal development and rush to transform coastal areas into economic zones without considering their nature are major factors contributing endangered or imperiled lives and properties. This is fact in the tragedy of Sumatra tsunami attacked Andaman coastal area on 26 December 2004 including Ranong. While there is no guarantee that mangrove habitat restoration will prevent another natural disaster, local communities who dwelling in this coastal area need more mangroves to mitigate the energy of strong winds and tidal waves and for their livelihood during ordinary phenomena.

The ideal area to carry out mangrove habitat restoration is between patches through biodiversity corridors that link mangrove area together (Figure 4). They should also link core areas and must be surrounded by buffer zones (Forman 1995; Mumby et al. 2004). They provide habitat and pathways for animal movement and also plant dispersal. It has been suggested that the width of mangrove forest should not be less than 100 m to effectively provide protection against waves (Chotthong and Aksornkoae 2007).

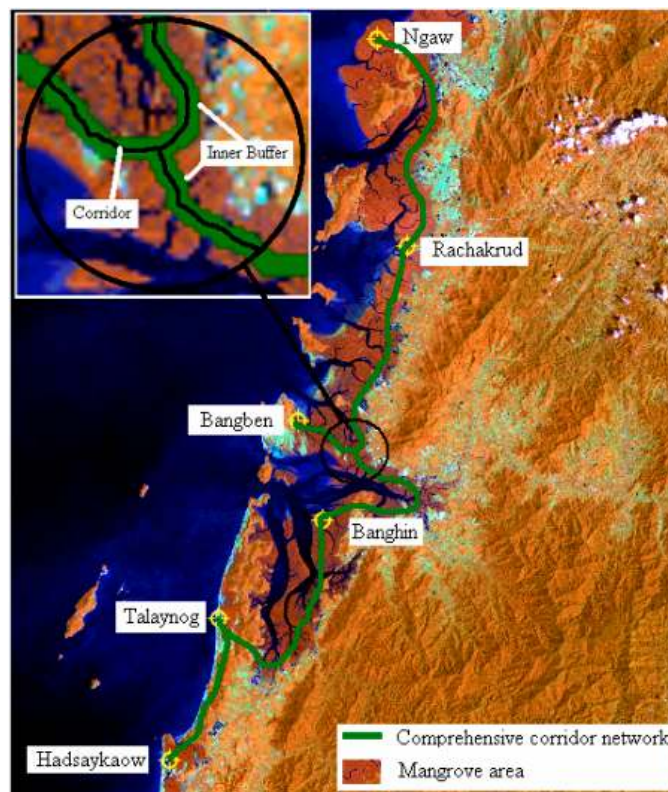


Figure 4 The Landsat-5 TM image showing comprehensive corridor network

In this study the biodiversity corridor will link 6 study sites. The establishment will be based on the satellite image (Landsat-5 TM) which provides the synoptic view of mangrove patches, their distribution, distance between each patches and other land cover types (Figure 4). However, for a successful biodiversity corridor in mangrove habitat restoration project, special attention must also be paid to environmental conditions (e.g. hydrology, wave energy, salinity regime, soil and water pH, soil texture, nutrient concentration, elevation and slope) required by existing natural mangrove species in an adjacent reference site (Gilman and Ellison 2007; Hashim 2010).

Until recently, mangrove forests have been recognized by local people mainly for direct use values. This misconception coupled with the consideration of mangrove resources as being “open access” easily led to their exploitation. The national and local government unit regulations and enforcement are crucial to ensure the protection of mangroves. Any effort in mangrove habitat restoration and management project in the coastal landscape will not be successful without cooperation from the locals. This is similar to the study by Chotthong and Aksornkoae (2007) who reported that the success of the mangrove forest rehabilitation mainly depends on the participation of local people.

If the communities can fully understand the important of mangroves, then they are willing to take part in the conservation efforts. This will lead to a successful of mangrove habitat restoration in Ranong. Thus, the local people need to be better informed about the mangrove ecosystem, its resources, ecological and economic benefits (Macintosh et al. 2002; Doydee and Rebanco 2008).

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