

# Mangrove Resources, Human Disturbance and Rehabilitation Action in China

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## 1 Introduction

Mangrove forests in China did not receive much attention in the world because it is small in scale in comparison with the mangroves in the Southeast and East Asian countries, and was little known by oversea scientists. Even though mangroves have been widely used since the ancient time by the local Chinese people as timber, firewood, tannin, food, medicine, green manure and fisherine site, only about fourteen years ago did the government really start to realize the importance of mangroves in maintaining the coastal economic development. Since then, more and more programs pertaining to the conservation, plantation and research of the mangroves have been supported. However, when the conservation programs conflict with exploitation, some of the local government agencies and people tend to put their interests in economy, so the human disturbance of mangrove system is still serious, and social management is urgently needed today. This paper is a brief mangrove country report with the focus on current status of mangrove resources, the influences of human activity on mangroves, and some rehabilitation actions being performed in China.

## 2 Mangroves

Mangroves only occur along the coast of Southeastern China where the climate is subtropical or tropical. From south to north, mangroves distribute in the provinces of Hainan, Guangxi, Guangdong, Fujian, Taiwan and Zhejiang (Figure 1) with a total species number of 26 for mangrove plants and 11 for semi-mangrove plants (Table 1). Semi-mangrove plants are defined as woody plants with amphibious characteristics, i. e. they can occur both in sea water and on land where they are occasionally flooded by highest tides.

It is very difficult to exactly estimate the area of pristine mangrove forests in China. Even though the present data were investigated at different time with varied methods by different authors, it is a fact that mangroves were severely degraded from the 1950s to 1970s. For example, in the 1950s there were 10 000ha mangroves surrounding Hainan Island (Chen et al., 1986), but only 4836ha remained by the end of 1985 (Lin et al., 1985). In Fujian province 719ha forests existed in the 1960s (Lin et al., 1981), but no

more than 250ha are now still standing (Fan, 1990). In Guangxi province, there were more than 12 246ha mangroves, but only 5 654ha of them are left at the present (Fan, 1993). It is believed that the mangrove area in China keeps decreasing, thus the real area now is not more than 14 853ha (Table 2).

Table 1 Distribution of mangrove and semi-mangrove species in China (Lin, 1993).

Family	Species	Province <sup>a)</sup>						
		①	②	③	④	⑤	⑥	
<b>Mangrove</b>								
1. Rhizophoraceae	1. <i>Bruguiera cylindrica</i>	+						
	2. <i>B. gymnorrhiza</i>	+	+	+	+	+		
	3. <i>B. sexangula</i>	+						
	4. <i>B. s. var. rhynochopetala</i>	+						
	5. <i>Ceriops tagal</i>	+	+	+	+			
	6. <i>Kandelia candel</i>	+	+	+	+	+	+	
	7. <i>Rhizophora apiculata</i>	+						
	8. <i>R. stylosa</i>	+	+	+				
	9. <i>R. mucronata</i>				+			
	2. Acanthaceae	10. <i>Acanthus ebractearas</i>	+	+				
		11. <i>A. ilicifolius</i>	+	+	+	+	+	
		12. <i>A. xiamenensis</i>					+	
	3. Barringtoniaceae	13. <i>Barringtonia racemosa</i>	+					
	4. Combretaceae	14. <i>Lumnitzera littorea</i>	+					
		15. <i>L. racemosa</i>	+	+	+	+		
	5. Euphorbiaceae	16. <i>Excoecaria agallocha</i>	+	+	+	+	+	
	6. Meliaceae	17. <i>Xylocarpus granatum</i>	+					
	7. Myrsinaceae	18. <i>Aegiceras corniculatum</i>	+	+	+	+	+	
	8. Palmae	19. <i>Nypa fruticans</i>	+					
	9. Rubiaceae	20. <i>Scyphiphora hydrophyllacea</i>	+					
	10. Sonneratiaceae	21. <i>Sonneratia alba</i>	+					
		22. <i>S. caseolaris</i>	+					
		23. <i>S. hainanensis</i>	+					
		24. <i>S. ovata</i>	+					
		25. <i>Heritiera littoralis</i>	+		+			
	11. Sterculiaceae	26. <i>Avicennia marina</i>	+	+	+	+	+	
12. Verbenaceae	subtotal	24	10	10	9	7	1	
<b>Semi-mangrove</b>								
1. Acrostichaceae	1. <i>Acrostichum aureum</i>	+	+	+	+	+		
	2. <i>A. speciosum</i>	+	+					
2. Apocynaceae	3. <i>Cerbera manghas</i>	+		+	+			
3. Bignoniaceae	4. <i>Dolichandron spathacea</i>	+	+					
4. Compositae	5. <i>Pluchea indica</i>	+	+		+			
5. Hernandiaceae	6. <i>Hernandia sonora</i>	+						
6. Leguminosae	7. <i>Pongamia pinnata</i>	+	+	+	+			
7. Lythaceae	8. <i>Pemphis acidula</i>	+			+			
8. Malvaceae	9. <i>Hibiscus tiliscus</i>	+	+	+	+	+		
	10. <i>Thespesia populnea</i>	+	+	+	+			
9. Verbenaceae	11. <i>Premna obtusifolia</i>	+	+	+	+			
	subtotal	11	8	6	8	2		

a) ①Hainan, ②Guangdong, ③Guangxi, ④Taiwan, ⑤Fujian, ⑥Zhejiang

Table 2 The mangrove area in southeastern China.

Province	Area (ha)	Reference
Hainan	4836	Lin and Lu 1985
Guangxi	5654	Fan 1993
Guangdong	3813	Su 1989
Fujian	250	Lin and Fan 1992
Taiwan	300	Fan 1993
Zhejiang	a few	Fan 1990
Total	14 853	

### 3 Human disturbance

The major causes, including direct and indirect, of mangrove degradation are summarized in Table 3. In China, a great part of disappeared mangroves were resulted from building seabund, and the reclaimed mangrove area was converted to agriculture and salt production. It is reasonable to believe that more than two third of the original mangroves in China were depleted on these purposes. These kinds of degradation mainly took place during the period from the later 1950s to the early 1970s. For instance, in Guangxi province there are now 5683ha salt land, and at least 10 000ha reclaimed farm land, about 80% of the lands used to be mangrove swamps. With the development of coastal economy, the reclamation practices do not stop basically, not for agriculture and salt production, but for construction of shrimp pond, city settlement, harbour and industry. It can be estimated that more than 1000ha mangroves are right now under the cutting danger.

Table 3 The change tendency of human disturbance to mangrove forest in China.

Disturbance	Past	Present	Future
Direct			
Building seabund	+++	++	+
Salt production	+++	++	+
Agricultural land	+++	++	+
Shrimp pond	+	++	+++
City settlement	+	++	+++
Harbour construction	+	++	+++
Industrial land	+	++	+++
Repair of seabund	++	++	++
Timber	+++	++	+
Firewood	+++	++	+
Green manure	+++	++	+
Plant Food	++	++	++
Animal Food	++	++	+++
Feed	+++	+++	+++
Medicine	+	+	++
Indirect			
Pollution	+	++	+++
Tourism	+	++	+++
Land soil loss	+	++	+++

Note: Damage degree: Heavy+++ , medial++ , light+

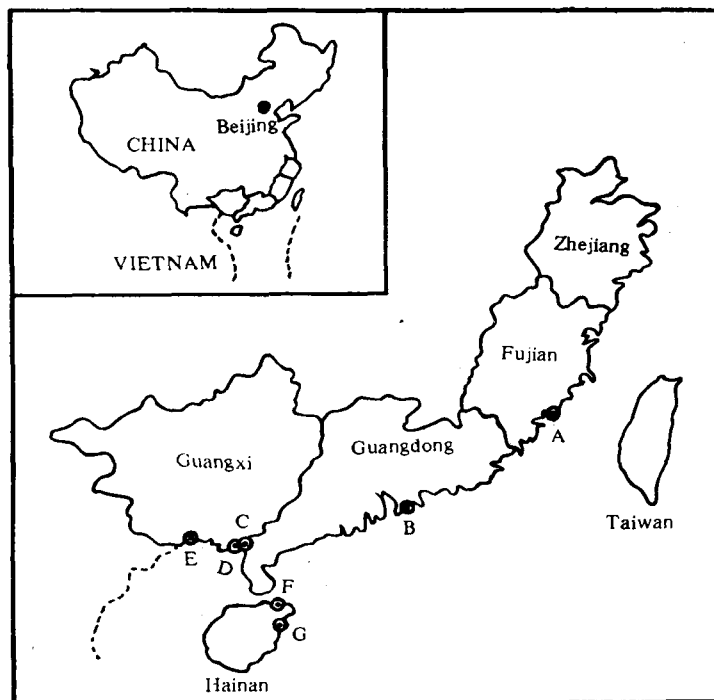


Fig. 1 Distribution of mangrove forests and mangrove nature reserves along coastal provinces in southeast China.

Seabund and mangroves banding together are widely used to protect the coast from erosion in China. The seabund is usually made of rock and mudsoil, sometimes of stems and branches of mangrove trees. During typhoon season, the dangerous seabund needs repaired or enhanced to resist sea waves. For convenient transportation of rock, the landward mangrove trees, such as *Bruguiera gymnorhiza*, are cut to form an artificial water way parallel to the bund, so that the boat can anchor everywhere along the bund. This is a major cause for the decline of luxuriant *B. gymnorhiza* forests in China.

The local Chinese people used to gather timber, firewood, green manure from mangroves, but nowadays there is not enough large mangrove trees available for timber, and chemical fertilizer takes the place of mangrove green manure, such as the nitrogen-rich leaves of *Avicennia marina*. Cutting of mangroves for firewood is not common at the present, but for comprehensive utilization. Frequently, the removed trees usually grew along the waterway with more barnacles and oysters on their stems and branches. These trees are first thrown into crab pond where the fouling macrofauna are fed off by crabs, *Scylla serrata* for instance. After then, the immersed trees are put out of the pond to be dried for firewood. Generally, mangrove plant is not good firewood because of a lot of tannin that will produce heavy smoke during burning. This immersion processing not only supplies feed for mariculture, but also makes better firewood by leaching tannin. However, this kind of use doubtlessly accelerates the degradation of mangrove forests.

In the past time, the long propagules of *Kandelia candel* were occasionally eaten

during the year of great famine in Fujian province. Eating *Nypa fruticans* is peculiar to Hainan Island. The fruits of *Avicennia marina* is for routine dishes especially in Guangxi province where the pretreated fruits can be found on many vegetable markets from July to October. This collection of fruits breaks the twigs, and shorten the community. Walking within forest destroys a great number of seedlings and young trees, resulting in sparsity of species in the community.

The crab of *Scylla serrata*, the worms of *Sipunculus nudus*, *Phascolosoma esculenta*, and the fishes of *Periophthalmus cantonensis*, *Boleophthalmus chinensis* have a high commercial value in China, which are abundant in mangrove areas. Many mangrove mudflats were completely re-dug once a month. The activity of diggers for these animals usually damages the roots and proves fatal to seedlings and adult trees.

In China, farmers often raise poultry and livestock in mangrove area. Duck and goose go around the forest to search for benthos. Cattle and sheep generally act along the inland mangrove forests to feed on the leaves or young twigs of *Avicennia marina* and *Kandelia candel*. Their movement on mudflat frequently buries the artificially planted seedlings, consequently hinders the rehabilitation of the forest.

Traditional use of mangrove plants of *Acrostichum aureum*, *Acanthus ilicifolius*, *Bruguiera exangula*, etc. as medicine has a long history, but a few mangroves has been removed on this purpose. Some possible medicinal uses of mangrove plants are expected to be discovered in the future for cancer, AIDS in particular.

Damage to the mangrove system may be caused indirectly and originate in distant areas. Since several years ago, more and more large factories and harbours have been set up along the coastal area. The drainage of polluted water will destroy the wildlife of mangrove ecosystem. The noise of tourists and boats expels the birds such as egret. In estuarine area, the loss of land soil has made some mudflats too hard for *Rhizophora stylosa* prop roots to grow, and led to the death of the tree.

#### 4 Rehabilitation action

The rapid degradation and impasse of mangroves have received a great attention of government decision makers. From 1980 to 1990, seven mangrove nature reserves were set up in Jiulongjiang (Fujian province), Futian (Guangdong), Zhanjiang (Guangdong), Shankou (Guangxi), Beilun (Guangxi), Dongzhai (Hainan) and Touwan (Hainan). About 46% of the total mangrove forests, i. e. 6781ha, are under protection in China. The location and some information about these reserves are showed in Figure 1 and Table 4. Reserves of Shankou and Beilun are under the control of local and central oceanic administration, other five under the control of forestry administration. In these reserves, scientific research, plantation, introduction of new species and public education are conducted. In 1991, the unique institute specialized in mangrove ecosystem studies in China, Guangxi Mangrove Research Center (GMRC), was set up in Beihai city of Guangxi (Fan, 1992), and published papers in a special issue of the Journal of the Guangxi Academy of Sciences. In 1992, The National Academic Commission for Mangrove Ecological Research was established. On November 15~19, 1993, the First Chinese Symposium on Mangrove Ecosystems was held in Beihai of Guangxi. Approximately 90 participants including researchers, managers and officials attended the symposium.

sium. Today, an influential program named the Actions of Mangrove Biodiversity Conservation in China is under the consideration of the governmental agencies.

Table 4 Mangrove nature reserves in China.

Order <sup>a)</sup>	A	B	C	D	E	F	G
Name of reserve	Jiulongjiang	Futian	Zhanjiang	Shankou	Beilun	Dongzhai	Touwan
Situated province	Fujian	Guangdong	Guangdong	Guangxi	Guangxi	Hainan	Hainan
Location	24°29'N 117°55'E	22°32'N 114°05'E	21°29'N 109°44'E	21°28'N 109°43'E	21°30'N 108°09'E	19°54'N 110°20'E	19°34'N 110°45'E
Setting time	1988	1984	1990	1990	1990	1980	1981
Protected area (ha)	200	405	2000	8000	2680	5200	3333
Mangrove area (ha)	67	111	933	730	1027	1733	2000
No. of mangrove species <sup>b)</sup>	4	7	12	12	11	20	26
Sponsor of government	local	central	local	central	local	central	local

a) The locations of reserves from A to G are shown in Figure 1.

b) The species include mangrove and semi-mangrove plants.

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