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A Proposal for the International Cooperation of Mangrove Ecosystem Studies in Guangxi of China

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Abstract In the present paper, the situations concerning mangroves in Guangxi, China were reviewed with focus on resources, scientific research and natural conservation. The urgent problems, related to coastal mangroves, were given out as some research projects for the considerations of foreign scientists and managers. On this basis, a favourable local study site of mangrove ecosystem was introduced in detail.

Key words mangroves, Guangxi, international cooperation

Since the UN Conference on Environment and Development (UNCED) held at Rio de Janeiro in June 1992, the biodiversity conservation and sustainable development have been the highlighted topic in the world. Mangrove ecosystem as a kind of marine coastal wetlands also draw more attentions today (Field, 1992). Cooperative studies, information exchanges, training and educations are being conducted world—wide, because human beings own only one earth, and globally, people in different countries share the same resources. In order to enhance the conservation, management and utilization of mangrove resources in Guangxi, some informations about the mangroves along Guangxi coast were briefly introduced, and international cooperations in any forms were attempted.

1 Background of Mangrove Resources, Scientific Research and Mangrove Conservation in Guangxi, China.

1.1 Natural resources

Being an autonomous region in south China adjacent to Vietnam, Guangxi abounds in mangrove resources due to its coastal climate of northern tropics , and its own coastline of as long as 1595 kilometers ranging from 20°54' 10" to 21°24' 20" N, 107°56' 30" to 109 ° 47' 00" E. There are 14 mangrove species belonging to 14 genera, in 10 families naturally growing along Guangxi coast (Table 1), of which *Avicennia marina*, *Aegiceras corniculatum*, *Kandelia candel*, *Rhizophora stylosa* , *Bruguiera gymnorrhiza and Excoecaria agallocha* are the main species . The present area occupied by mangroves counts up to 5645 hm^2 in this region. This area, determined by remote sensing technique of

satellite in 1989 and 1990, takes up more than one third of the total of China (14 853 hm^2) and exceeding any one of the other five mangrove provinces (Hainan, Guangdong, Fujian, Zhejiang and Taiwan). In addition, in this region there are vast exposed intertidal zones of 13 548 hm^2 remaining suitable for mangrove growth.

Table 1 Mangrove species found in Guangxi

Family	No.	Species
Rhizophoraceae	1	*Bruguiera gymnorrhiza* (L.) Lamk.
	2	*Ceriops tagal* (Perr.) C. B. Rob.
	3	*Kandelia candel* (L.) Druce
	4	*Rhizophora stylosa* Griff
Acanthaceae	5	*Acanthus ilicifolius* L.
Acrostichaceae	6	*Acrostichum aureum* L.
Mysinaceae	7	*Aegiceras corniculatum* Blanco.
Verbenaceae	8	*Avicennia marina* (Forsk) Vierh.
Apocynaceae	9	*Cerbera manghas* L.
Combretaceae	10	*Lumnitzera racemosa* Presl.
Euphorbiaceae	11	*Excoecari aagallocha* L.
Sterculiaceae	12	*Heritiera littoralis* (*Drgand.*) Ait.
Malvaceae	13	*Hibiscus tiliaceus* L.
	14	*Thespesia populnea* (L.) Soland ex Correa

Guangxi mangroves mainly fringe exposed coastline with high tidal amplitudes, and wide—spread and large continuous forests characterize the mangroves . In China, many typical cases are peculiar to this mangrove region , such as sandy mangroves and desertification of mangrove intertidal zones, rocky mangroves, pebbly mangroves, luxuriant *Rhizophora stylosa* community, best sheltered island—assembled mangroves with lovely views, significant contributions of mangroves to intertidal shell productions , and developed mariculture within mangrove forests and blackish waters. Mangroves have been best traditionally used by inhabitants. For example, in China it was first found in Guangxi that *Avicennia marina* leaves and fruits can be utilized as green manure and foods respectively. Thus merely a province, Guangxi offers so many interesting opportunities to scientists.

1. 2 Scientific research

Although Guangxi shares the largest mangrove forests in scale in China , not many scientific studies concerned had been carried out before 1991 . In the past few years, the remote sensing technique of satellite was applied to determine the numerical distribution of mangroves along Guangxi coastal zone . Form 1984 to 1986, a field survey was sponsored for mangroves by government, and the relationship between forests and the chemical characteristics of *in situ* soil was explored. Planting practices have been keeping for many years in this region, but the mortality of seedlings is found to be high. Whatever, these practices provide accumulating acquaintance vailable to improve planting

techiques. It has been a long time in China that most of the scientific studies on mangroves were performed by individuals who work in isolated special agencies, generally remote from the major mangrove area. Thus , any disciplinary and synchronous research on mangrove ecosystems used to be impossible. In consideration of this reason and the exuberant mangroves in Guangxi,an unique research center in the nation, Guangxi Mangrove Reseach Center (GMRC), was established by government in December 1991 to design and implement integral studies with a focus on northern tropical coastal mangroves.

1. 3 Conservation situations

From the 1960s to early 1980s, Guangxi mangroves suffered a severe destruction as a major result of reclaimation on the purposes of salt ponds, agriculture and mariculture. It is estimated that more than one third of the pristine forests have been completely removed from this region, and many of the survivors have been degraded to stunted secondary communities. This critical situations received much attention from decision—makers. In order to protect such an important natural resource and provide sites for scientific research, two mangrove natural reserve areas were set up in Guangxi (Table 2). Situated in the two ends of Guangxi coastline from east to west , Shankou reserve area is in the east , towards the west coast of Guangdong; another, Beilun reserve area is in the west, at the juncture of Vietnam and China. Now the resource areas are under protection and management, and many scientific studies are being conducted in both of the reserve areas. Apart from the two extant natural reserve areas, the local government is going to create "green sea dyke" with mangrove and marsh plants along the possible coast of Guangxi so as to improve the ecological environment and permanently maintain the development of coastal economy.

Table 2 Mangrove Natural Reserves in Guangxi, China before 1993

Name	Shankou	Beilun
Locality	21°28' N	21°30' N
	109°43' E	108°09' E
Established time	1990	1990
Protected area (ha)	8000	2680
Mangrove area (ha)	730	1207
Sponsor	nation	province
No. of mangrove species	13	12

2 The Works Done by Guangxi Mangrove Research Center

Closely associated with Guangxi Oceanology Institute, the center—members and specialities have included botany, marine biology , marine chemistry , sedimentology , meteorology and mariculture. The ongoing project of the center, with a budget of RMB¥350 000 and duration from 1991 to 1993,

was supported by National Science and Technology Commission of China and Guangxi local government. For this project, the works done have included:

——Distribution of forests, species composition, structure of plant community, growing situations, successional sequences.

—— Standing conditions of substratum, ecological stress to seedlings and afforestation strategies. Biodiversity of mangrove ecosystems.

——Productivity and biomass of the major mangrove communuties.

—— Relative abundance, dominance, biomass of the major benthic invertebrates, diatoms and plankton.

—— Connections betweeen the mangroves and near — shore waters and benthos, with particular attention to the importance of mangrove forests to fisheries in the coastal zone.

—— The role of mangroves in protecting coastal lands, dykes and public facilities from seawater erosion.

——Legal protection and public education.

During the studies, the typical sandy mangroves and the phenomenon of light—growth inhibition on rooting of *Kandelia candel* viviparous seedlings were found out by the center' s staff.

From 1994 several projects are about to be performed by the centre, including the application of biotechniques to fast produce mangrove seedlings, introduction of new mangrove species to enhance the local biodiversity, survey of the trophical structure of associated flora and fauna. Most of the items will be carried out in Shankou reserve area.

GMRC is situated in Beihai city, which is located at the southern tip of Guangxi, on the border of the Beibu Gulf. The city of Beihai is well regarded as "Chinese Miami" because it offers people 20km long seabeach that is covered by fine and white sands. Various kinds of mangrove communities also shelter the seashore of the city , sandy *Avicennia marina* forest for instance. As one of the earlist 14 open coastal cities in the nation, Beihai is served by a modern airport, harbour and bus station, and is today a fast growing city of not only tourism but also diversified industry and commerce.

3 Research Projects Proposed for Cooperation

Combining the natural characteristics of mangroves, science values and the needs from social economy , following aspects to Guangxi mangroves are urgent for studies.

A. Better methods to build up the green belts with salt marsh and mangroves along Guangxi coast.

B. Niche of mangrove associated fauna, and the ecological mariculture of those species that have great commercial importances.

C. Physio—ecology, primary productivity, nutrient cycling and ecosystems of sandy mangroves, with particular reference to the relationship between sandy mangroves and shell production in the sandy beach.

D. Ecological biochemical materials from mangroves and their roles in controlling micro — organism interactions.

F. Application of mangroves to protect coastal water environments.

G. Introduction of new mangrove species to Guangxi region to increase local biodiversity.

H. Relationship between traditional culture and human utilization of mangroves, improving protection policies and methods of management.

I. Comparative studies on ecological economy values between artificial coastal zones and mangrove coastal zones.

4 The Study Site Opened for International Cooperation in Guangxi

Although there are not great many of mangroves in China, China is the northern border of the natural distribution of mangroves, thus mangroves in China seems to be of a particular importance from a global view because there are doubtlessly many special interesting problems about the subtropical and northern tropical mangroves. Considering the mangrove natural resources, conservation situations and the previous scientific experiences, we are right here proposing National Shankou Mangrove Natural Reserve Area for the major study site. Five mangrove natural reserve area in China were reviewed by Fan (1990), Lin and Fan (1992). Followings are the more detail informations about Shankou Mangrove Reserve Area.

Location: Situated in Yinglou Bay, southeast of Guangxi coast towards the west coast of Guangdong, 109°43' E, 21°28' N. No typical estuary

Mean annual air temperature: 22.4℃, 37.4℃ Max., −0.8℃ Min.

Mean annual RH: 82%.

Mean annual rainfall: 1816.5 mm.

No. of rainy days: 144 with 80% to 85% in the period from April to September.

Mean tidal amplitude: 2.53 m, 6.25 m Max.

Mean sea water salinity: 28 ppt.

Sea water pH: 7.5～7.8

Soil conditions: Softmud bottom, valcanic ash original.

pH of the forest top soil: 4.6

Salinity of forest top soil: 20.2 ppt.

Organic matter of soil: 3.99%

Total available area: 8 000 hectares of protected region, 730 hectares of mangrove forests.

No. of manager: 16

Ownership: One of the first five marine—type natural reserve areas ratified in Sept. 1990 by the State Council of China, and became the member of China Biosphere Reserve Networks in July 12, 1993.

All of the thirteen local mangrove species mentioned above were observed in the site where *Rhizophora stylosa*, rare in China, is the dominant species that even formed the large luxuriant communities in 5 to 7m height with a mean tree age of 70 years old. Other species are also common. The standing crop of this *R. stylosa* community was 29.16kg/m^2; yearly net productivity was 1.54kg/m^2, in which the total litter production was 0.63kg/m^2 (Lin et al., 1992). By field investigations in 1992, we found that there were 111 species of benthic macrofauna in this reserve area, of which 49

species were mollusca, 44 crustacea, 11 fishes and 7 other species. The mean fresh biomass of these fauna was 147.09g/m^2. In the land direction, about 160 hm^2 rice lands are protected by the *R. stylosa* community and in the sea direction, there are an extensive exposed sandbeach where the traditional aquaculture of pearls (*Meretrix meretrix*) is developed outside the mangrove community. Well developed waterways, about 2.5m deep at hightides, run through the forests with very rich associated fauna and flora. Birds are an important part in this system.

This reserve area offers the convenient accommodations, transportation and easy access into the forests. There is not any heavy industry around, and the anthropologic interferences are little, therefore, the forests remain pristine, being the best one along the coast of chinese mainland. It is about one hundred kilometers or two hours by bus from this site to Guangxi Mangrove Research Ceneter, situated in Beihai city.

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