Geo-ecological Rehabilitation of the Mangrove Forest in Can Gio district, Vietnam

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Introduction

Mangrove ecosystems Development is promoted by land and vegetation interaction processes under the controlled of the tidal action. The habitat only located on the upper half of the tidal range.

At the same time, mangroves change the forest structure largely depending on the environmental gradation caused by slight differences in the height of the ground. We could say that development of a mangrove forest is not only physiological and ecological development of a forest itself but is geo-ecological development including changes in the geomorphic and hydrological conditions. Can Gio district in Vietnam used to have rich mangrove forests before spraying of defoliants during the Vietnam War. Although the forests were destroyed massively because of the defoliants, the district has managed to regain mangrove forests steadily by the reforestation program after the war. In this report, we are going to clarify what kinds of changes were made through the process of the destruction and restoration in this district.

Outline of Research Area

Can Gio district where located about 30 km southeast from Ho Chi Minh City. The total area is 73,000ha, and the land area excluding the rivers and ponds is 51,100ha. Today, about 37,300ha has been covered with mangrove forests. The amount of 19000 ha was planted by local people but the rest was covered by natural expansion (Table 1,2). It means that the nearly 50 % of the total mangrove area was categorized into naturally established and the survived forest. The samples of the site developments are shown in Fig. 1.

Table 1 Forestation area of Rhizophora apiculata in Can Gio District (Miyagi et al. 2003)

Year	1966	1973	2001
Area Held by Mangroves in Analysis Area (ha)	36,386	20,779	37,311
Total Area in Analysis Area (ha)	66,157		
Percentage Mangroves Hold in Analysis Area	55%	31%	56%

Table 2　Plantation processes of mangroves at Can Gio district.

Year	Forestation Area (ha)	Year	Forestation Area (ha)
1973	8,4	1986-88	2,132.7
1978	1,557.7	1989	24.0
1979	1,321.0	1990	11.9
1980	3,135.0	1991	1,465.0
1981	1,787.0	1992	1,168.3
1982	1,842.9	1993	1,100
1983	553.1	1994	900
1984	983.5	Total	18,795
1985	803.9		

The data for the year 1973 was quoted from the Experimental Forestation in Than Ton Hiep Village. (after V.N.Nam, 1998m, Hong, 1996)

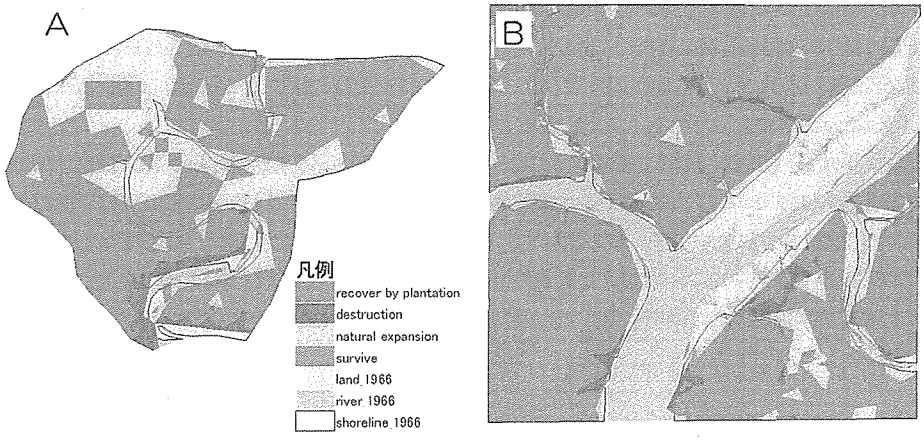

Fig.1　Mangrove habitat changes in the selected sites Can Gio district.
A: The habitat located at the core area of the Biosphere reserve. The plantation stared at the early stage and the small tidal creeks occupied by the new mangrove habitat. B: The habitat located at the north eastern part of the Can Gio mangrove area. A large amount of the shrub has been stocked at the slightly higher elevation part. The new habitat developed along thelarge canal.

The changing processes of the mangrove forests after the defoliation, there were atill large amounts of the forest survived at the higher location as the shrubs. The plantation area such as Rhizophora apiculata forest dominant in many sites. The naturally established mangrove forest such as Avicennia alba and A. officinaris also are remarkable at the near of the original mangrove habitat.

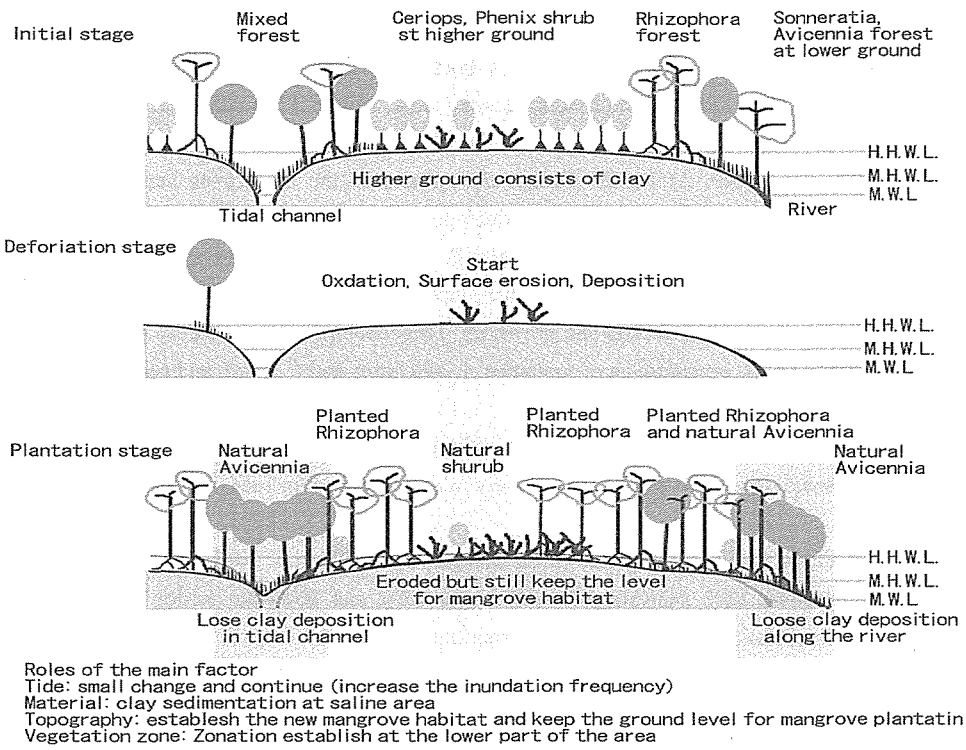

Fig. 2 Geo-ecological rehabilitation process of the Can Gio deltaic mangrove habitat

Here, we would like to see how the aforementioned change process of the mangrove forests and land in Can Gio district have worked as interaction of geomorphic processes and biological processes. The Fig. 2 shows the change processes made by now (Hayashi et al, 2006).

The mangrove forests in this area are typical deltaic mangrove forests. The delta which is the foundation of the forests was generally formed by the transgresion maximum of the middle Holocene. Afterwards, the tip of the delta and inter distributary basis were eroded under the influence of the small changes in the sea level, and finally the landform we see today was formed. A mangrove forest develops on the upper half of the tidal zone, and we assure that a change of the distribution was repeated during the process of the filling. Soil and sand carried from the upper reaches of the river accumulated in the delta, and the ground level reached around the highest high water level from the mean high water level. We assume that the stability of the type of the sea level after about 1000 A.D. and the existence of the forests have caused these changes.

Before the spraying of the defoliants, the most of the forests were on the upper part of the tidal zone. The soil consists of loose clay and mangrove organic materials was exposed to the sun directly, oxidized, dried up, and the biomass seemed to be broken down after the forests was destroyed all at once. At the same time, squalls during the rainy season caused the bare land severe erosion on its surface. The soil spread around the forests and finally formed the land on the upper half of the tidal area after accumulation. The mangrove species which grow up around the level of the middle tidal level became to form forests here. Forests of *Sonneratia alba* used to be here before the spraying of the defoliants. However, later *Avicennia*

alba dominated here because its seeds spread and sprout effectively, and it also prefers the same ground level to grow up.

The local residents conducted forestation on this land too. They planted affordable *Rhizophora mucronata*. However, they were too much exposed to running water around the middle tidal level of the big river, and most of the trees died a few years after being planted. As the forests of *A. alba* became larger, the ground level also became higher. At MEET Center, the species of the mangroves have been mixed complicatedly because *R. apiculata* and *A. officinalis* which come from the seeds produced by the forested trees have come in. Affordable Rhizophora species such as *R. apiculata* and *R. mucronata* were planted on the land bared by the defoliants. But after forestation, there have been various changes of the landform, and seeds carried by tide have reached the forests and grown up. These factors have caused the forest structure to be complex. The forests of *R. apiculata* have contained *A. officinalis* and *C. tagal*, and such forests have become larger and lager.

The differences in ground level create a variety of effects in formation of landform affected by ebb tide and rivers. At the same time, they also create a variety of opportunities for seeds to flow into new land on ebb tide.

In spite of the dynamic changing processes of the mangrove rehabilitation, we have no accurate field evidences of the mechanism base analysis. We will reveal what and how the erosion sedimentation processes carried after the defoliation operation at the permanent plot.