Volume 2

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Asian and Pacific Coasts

Editors

Soon Keat TAN

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World Scientific

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Soon Keat TAN & Zhenhua HUANG

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PREFACE

The coastal zone has always been an important frontier – for trade, food and foundation for modern civilization. This same zone has also been exploited in one way or another and sometimes without regards to the nature's balance and scheme of things. It is only when somethings go terribly wrong that we begin to react and attempt to undo the mistakes of the past. At times we have succeeded, but at a high price. At times, we have to retreat and concede defeat as the technology of man is no match to the force of nature. Overtimes we learn to work with nature and leverage on science of nature to protect the coastal zone and hold our frontier between the sea and land.

We are now in the exciting and challenging era of climate change. The immediate future foretells higher seawater level, stronger winds, waves and currents. Globally we see increasing frequency of storm surges, increase intensity of rainfall and flood. We need to work together to advance the science and knowledge of the coastal zone. Scientists, engineers, and professionals need to work together to deal with coastal zone issues and challenges.

This set of four-volume proceedings collects all the papers presented at the 5th International Conference on Asian and Pacific Coasts and covers a wide range of topics, including coastal and harbor structures, sediment processes and shoreline changes, coastal environmental problems and marine ecology, coastal zone management and planning, tsunami, ocean energy, global environmental problems, laboratory and field measurement techniques, numerical simulations of coastal problems, and basic research in ocean waves, currents, and tides. The proceedings will be a valuable reference book for researchers, engineers, professionals, and postgraduate students working on the coastal engineering problems.

Tan Soon Keat
Zhenhua Huang
Nanyang Technological University, Singapore
October 2009

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CONTENTS

APPLICABILITY OF SEDIMENTS EXCAVATED IN RIVER CHANNEL TO BEACH NOURISHMENT CONSIDERING IMPACT ON HABITAT

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Nesting population of Loggerhead Turtles on Miyazaki Coast has been decreasing due to beach erosions and construction of seawalls. In order to restore the suitable coastal environment and retreated shoreline, a beach nourishment project had been carried out on this coast. The project experimentally utilized a large volume of nourishment materials excavated from an adjacent river to confirm an applicability of those materials to the beach nourishment. This study clears the applicability of excavated sediments to the beach nourishment through some soil tests, surveys of beach evolution, and monitoring of nesting population of Loggerhead Turtles.

1 Introduction

Beach nourishment can restore the habitats in the area where it has been degraded by erosion. Miyazaki Coast is one of the famous nesting fields of Loggerhead Turtles in Japan. The nesting population on this coast has been decreasing due to beach erosion as well as construction of seawalls. In order to restore the suitable coastal environment and retreated shoreline, a beach nourishment project was carried out experimentally on this coast. In this project, nourishment materials excavated from Oyodo River, which flows into Miyazaki Coast, were utilized experimentally to confirm an applicability of those materials to the beach nourishment. River excavation for the purpose of flood control usually produces a large volume of sediments. For coastal engineers, it is attractive to utilize those sediments for beach nourishment because of the shortage of nourishment materials. To confirm the applicability of excavated sediments to the beach nourishment, it is important to monitor influences of nourishment materials on coastal habitats. Moreover, a method of beach nourishment works and the management of beach after the nourishment are also important. This study clears the applicability of excavated sediments to the beach nourishment through some soil tests, surveys of beach evolutions, and monitoring of nesting population of Loggerhead Turtles.

2 Background of beach erosion along Miyazaki Coast

Figure-1 shows the location of Miyazaki Coast. The coast faces the Pacific Ocean, and it locates between Oyodo River and Hitotsuse River. Yoshitaka(1978) had reported

that both rivers provide coastal sediments mainly on this coast, and the predominant direction of sediment transport on this cast is estimated southward.

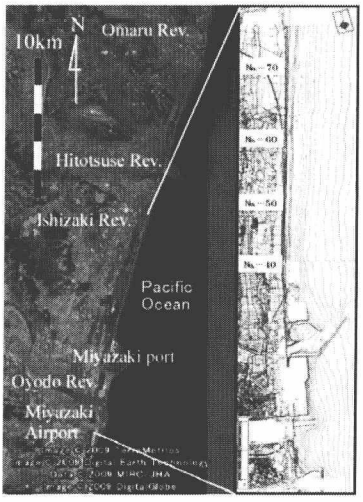

Figure-1 Location of Miyazaki Coast

Along the upstream of each river, many dams had been constructed for irrigations and hydropower. A rate of sedimentation in Hitotsuse River watershed is estimated about 0.8 millions m^3/yr, and also about 0.3 millions m^3/yr in Oyodo River watershed (Miyazaki Office of River and National Highway, The Ministry of Land, Infrastructure and Transport, 2007). A large volume of sedimentation in both watershed areas is considered one of the main causes of severe beach erosion on this coast. Moreover, construction of Miyazaki port is assumed the other main factor of beach erosion. The port has been constructed just beside the north of Oyodo River since 1983, and its offshore breakwater had changed the direction of sediment transport on adjacent beach. It is estimated that the rate of sediment transport into this port is about 0.2 millions m^3/yr.

Figure-2 shows the change of shoreline measured from 1982. The traverse numbers on lateral axis corresponds to the numbers shown in Figure-1. In 1988, the shoreline advanced on the range from No.46 to No.50, and it also retreated on other traverse positions. The shoreline recession spread gradually along Miyazaki Coast. In 2004, more than 40m recessions can be seen on the wide range along this coast. Photo-1 shows a snapshot of recent beach at No.67. In order to protect the coastal line, a gentle slope-type seawall has been constructed since 1983. Now, the seawall is extended from No.43 to No.57. Furthermore, many detached breakwaters have been constructed since 1988 along the beach on the north side of Miyazaki Port.

Figure-3 shows the landing population and the rate of laying eggs of Loggerhead Turtles on Miyazaki Coast (Society of Wild Animals Research in Miyazaki, 1977-2007). Myojinyama beach in this figure is a natural beach that locates on the north side of Ishizaki River. Sumiyoshi beach locates between No.60 to Ishizaki River, and the beach

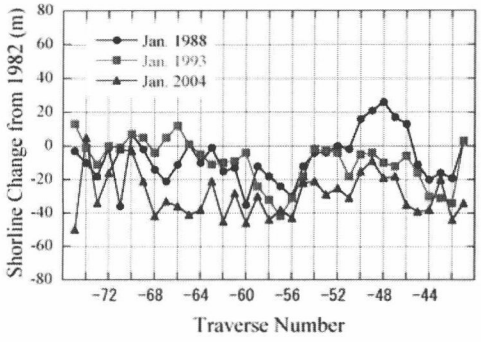

Figure-2 Change of Shoreline from 1982

Photo-1 Snapshot of recent beach configuration (July 18th, 2007, Murakami)

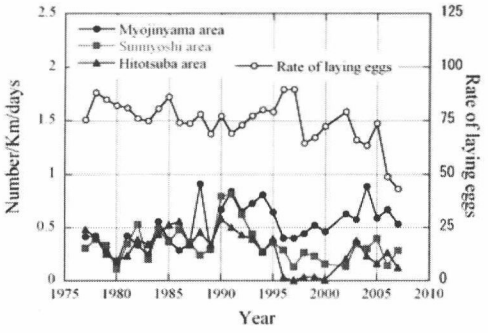

Figure-3 Landing population and the rate of laying eggs on the Miyazaki Coast (Society of wild animals research in Miyazaki; 1977-2007.)

is partially protected by seawalls. Also, Hitotsuba beach locates on the south side of Sumiyoshi beach, and the beach is fully protected by seawalls and detached breakwaters.

In Figure-3, the rate of laying eggs fluctuates around 75% until 1997. Afterward, the rate shows downward trend. The landing population also shows decreasing tendency on Hitotsuba beach and Sumiyoshi beach respectively from 1990. This tendency coincides with the form of significant erosion and the construction of shore protection facilities. On the other hand, the landing population on Myojinyama beach shows increasing tendency.

3 Beach nourishment project and soil tests on Miyazaki Coast

From December 2006 to March 2007, the beach nourishment project had carried out experimentally along the beach on the south side of Ishizaki River. Figure-4 shows the project area and the locations of soil tests carried out in this research. The project had been executed at two sections. Each section is referred as the south section and the north section respectively in following discussions. Nourished embankment at each section has a different profile as shown in Figure-5. About 25,000m^3 nourishment materials were installed on the south section, and about 5,000m^3 on the north section.

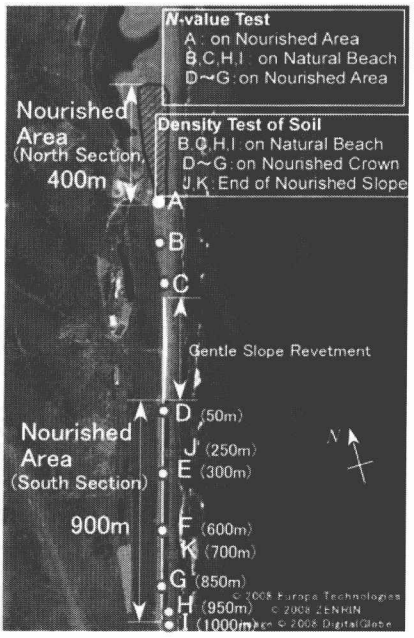

Figure-4 Location of the project areas

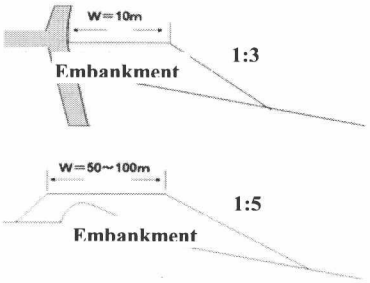

Figure-5 Profiles of nourished embankment

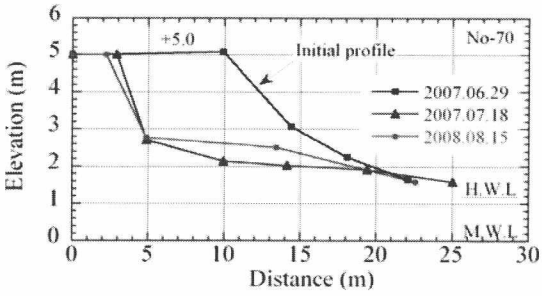

Figure-6 Embankment profile (No.-70)

On both sections, the nourished embankments were scarped by high waves from July to August in 2007. Figure-6 shows the change of embankment profile at No.-70 on the south section. After the erosion of embankment, an improvement of the cross section was carried out only on the north section from December 2007 to March 2008. At first, the embankment slope was smoothed with 1:10. Furthermore, the improvement was executed carefully not to compact the embankment crown by heavy machine works.

Beach hardness greatly influences the nesting behavior of Loggerhead Turtles (i.e. Robert G. Dean, 2002; Mary J. Steinits, et al, 1998; Richard A. Davis, et al., 1999). In this study, the soil density test by the sand replacement method was executed at some points on the south section. On the north section, the soil density test using core cutter was also executed at some locations. The portable dynamic cone penetration test was also carried out on both beaches.

4 Beach hardness and its influences on nesting of Loggerhead Turtles

4.1 *Results of soil test on nourished embankment*

Figure-7 shows the grain size distribution of the nourishment materials and native sand. The native sand was well sorted by waves, and the median diameters were ranged from 0.3mm to 0.6mm. On the other hand, the median diameter of the nourishment materials on the south section was slightly smaller than the diameter of native sand. The

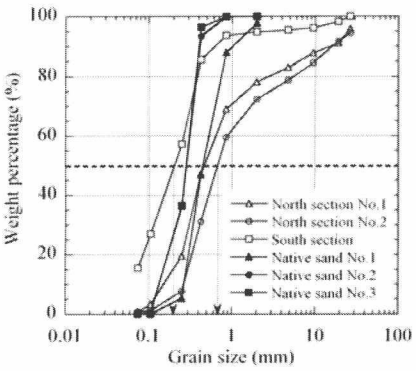

Figure-7 Grain size distributions

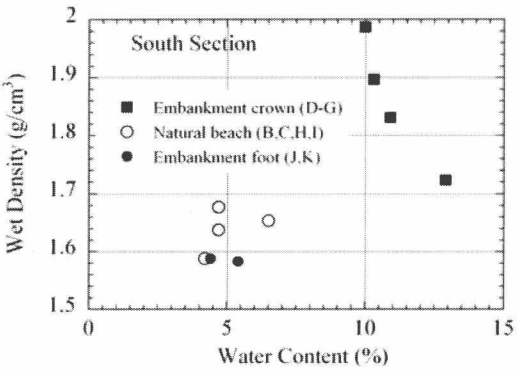

Figure-8 Wet density and water content

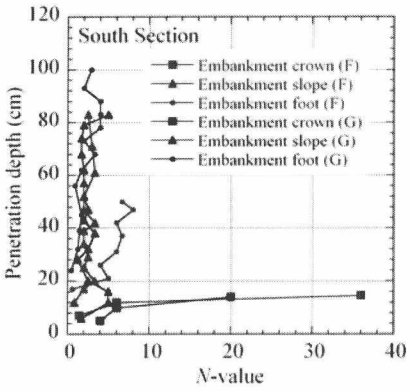

Figure-9 *N*-value on the crown of nourished embankment on South section

nourishment materials on the south section included finer sand such as the silt fraction. On the north section, the nourishment materials included coarser fraction contrary to the south section, though the median diameter was nearly the same as the native sand.

Figure-8 shows the wet density and the water content of native sand and nourishment materials on the south section. The wet density on the nourished embankment took higher than the density at the embankment foot and on natural beach. The fine fraction included in the nourishment materials causes the higher density on the embankment crown (Robert G. Dean, 2002). Also, the nourishment works with using heavy machines make the embankment crown harder. Figure-9 shows the distribution of *N*-value on the south section. It is clear that the *N*-value on the embankment crown shows extremely higher value, and the crown becomes a very hard condition.

Above results show that the crown of the nourished embankment becomes very hard when the nourishment materials include a certain quantity of fine materials even in the case of having nearly the same median diameter as the native sand. Moreover, it is

important to execute a beach nourishment works carefully not to compact the embankment crown by heavy machine works.

4.2 *Influences of beach hardness on nesting behavior of Loggerhead Turtles*

Beach hardness affects the nesting behaviors of Loggerhead Turtles (Robert G. Dean, 2002; R. Nishi, 1996). Figure-10 shows the landing population and the rate of laying eggs of Loggerhead Turtles from 2006 to 2007 on each section. The beach length of the north section and south section is 0.6km and 0.86km, respectively. The section of gentle slope revetment locates between the north and south section, and its length is about 0.4km. Also, the natural beach section in this figure is the south side of the south section.

Differences of landing population on each section are very small. On the other hand, large differences can be seen in the rate of laying eggs. The south section shows quite lower rate in 2007 and 2008. The reason of this lower rate was assumed the increase of turtle's return behavior, where turtles went back to the sea without laying eggs. The deeply scarped embankment on the south section was remained without any improvement of the profile, and it might check the landing and the nesting of turtles.

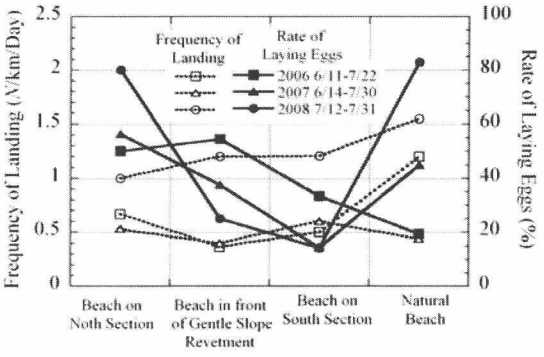

Figure-10 Rate of landing population and laying eggs on each section

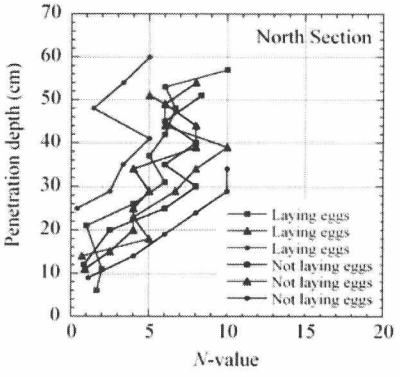

Figure-11 *N*-value distributions on the nesting and body pit position

On the north section, the rate of laying eggs shows nearly the same as the natural beach in 2007 and 2008, and also higher than the gentle slope revetment section. The nourished embankment on this section initially had a gentler slope, and the slope was improved gentler than the initial slope after the deformation by high waves. It was assumed that both factors preserved the landing and nesting of turtles.

Figure-11 shows the result of *N*-value test just beside the nesting location and on the location of body-pit without laying eggs in 2008. Some nesting locations could be found on the nourished embankment of the north section, and the maximum *N*-values at those locations were ten. On the other hand, the same *N*-value could be also observed at locations without laying eggs. From these results, it is confirmed that Loggerhead Turtles