

GIS ANALYSIS OF MORPHOLOGICAL CHANGES ON THE COAST NEAR GENKA RIVER, OKINAWA

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1. Introduction

Geographic Information System (GIS) is an important tool for spatial analysis. Examination of morphological changes on the coast through time give an important perspective of what can be influencing changes on the environment. Genka River, situated at the northwest part of Okinawa Island (Fig.1), has been focused by many studies regarding sweet and brackish water fishes, benthos, water quality, water flux and river ecosystem. The upstream part of the river has been subjected to construction works mainly focusing on water storage and flood control. Because of species loss and habitat depletion, researchers started to give more attention to what could be the causes of environmental degradation. As an example, Genka River was known to be the southernmost habitat for the Ryukyu-ayu fish. In 1978 it was noticed that this species could no longer be found on the Okinawan rivers, so as Genka. Since it is an endangered species, efforts are being made to replace individuals, and emphasis has been given to try to understand the causes for habitat change and to find out focuses for restoration (Tachihara, 2003). The effects of the construction works upstream have been discussed by environmentalists as causes for habitat degradation, but it seems that few focus was given to changes due to constructions near the river mouth and the coastline.

2. Objective

The objective of this work was to create a GIS Database with images from several different years focusing on Genka River and its surrounding coastline, in order to analyze changes in the shoreline and the riverbed through space and time.

3. Methodology

Orthophotos' digital files from the year 1977 already georeferenced in Universal Transverse Mercator (UTM) coordinate system were obtained from the website of the Ministry of Land, Infrastructure, Transport and Tourism of Japan (http://orthophoto.mlit.go.jp/ortho_map.html). They were imported to the GIS software SuperMap Deskpro, to a data source set in the Japanese 2000 geographical projection system zone XV. From this several files, a mosaic of aerial photographs was turned into one single raster image, already georeferenced. This image was used from then on as the spatial reference for registering of all the other data sets into this database. Original orthophotos covering the region - taken in the years of 1946, 1962, 1970, 1977, 1993 and 2003 - and their respective scanned files were granted from the archives of the Okinawa Prefecture Research Institute for Subtropics. These files were registered and used to create one single mosaic image for each year. From each

year's mosaic, the interest area was cut and saved as one sample image for each available year. Throw overlay and transparency tools, changes on the river mouth and coastline were analyzed through time. The limits of riverbed and coastline were traced for each year and put together in one layer in order to create a map of variations on the coast. Figure 2 shows a diagram of the process of GIS analysis.

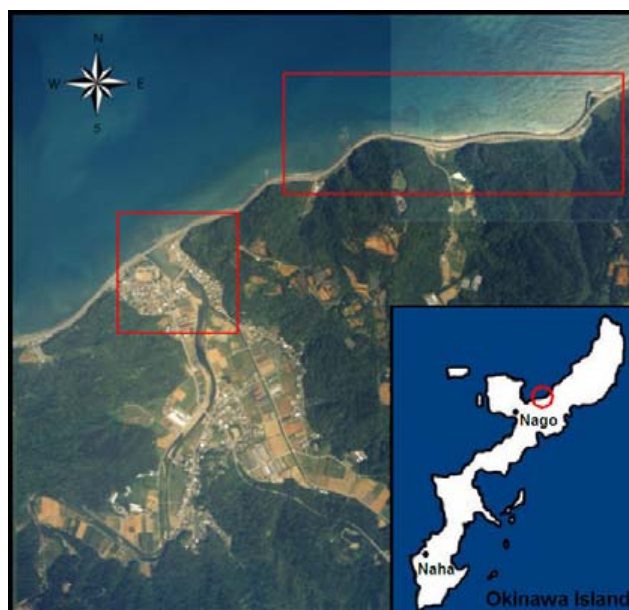


Figure 1. Study area. Polygons show areas discussed on the results.

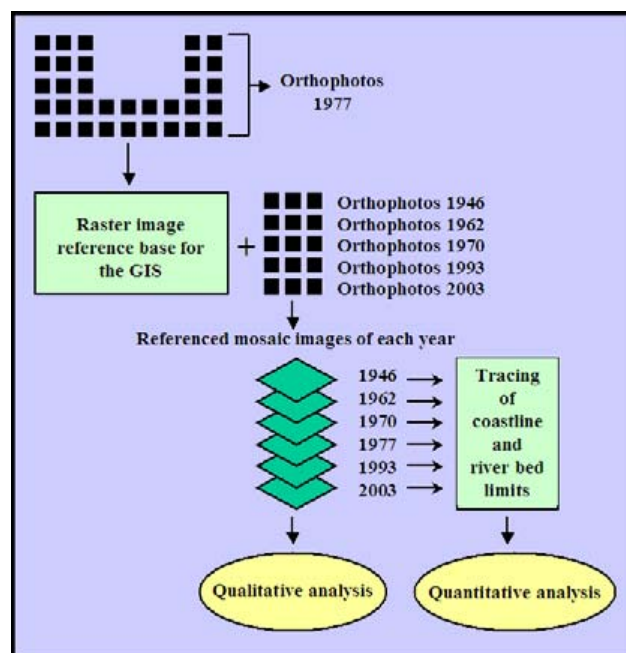


Figure 2. GIS methodology flowchart

Keyword: GIS, Genka River, Coastline variation, Ryukyu-ayu, Okinawa

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3. Results and Discussion

Tracing and overlay showed that changes happened all along the limits of the coastline and the riverbed through time. Regarding the coastline, major changes can be seen between 1977 and 1993, and account for an accretion of 30-40m seaward. Figures 3 and 4 show an example of this change, at an area northeast of the river mouth (see Figure 1 for location). Figure 4 shows that this change on the position of the coastline was due to the construction made for improvement of the seaside road, and that this was responsible for the depletion of the sandy beaches along the coast. On the riverbed, major changes are seen near the river mouth. Regarding the position of the riverbanks and the width of the streambed, major differences can be seen among 1946, 1962 and 1970 (Figure 5). From 1946 to 1962 there was a considerable decrease in width on both sides of the river, which together account for about 100m narrowing of the streambed. From 1962 to 1970 there was a change in the position of the riverbanks, but the streambed width remained about the same. Analyzing the images from the photographs (Figure 6) it is possible to notice that in 1946 the highlighted area was at least flooded, forming a lagoon-type structure. In 1970 though, this area was completely stabilized as part of the terrace surrounding the riverbank ground, and the lagoon disappeared. As the channel is perfectly defined, it shows that constructions were made in order to stabilize the river borders. Also in 1970 it is possible to see a new bridge constructed between the river mouth and the ocean, and the small circle highlights a process of sedimentation taking place. In 1993 this same area was incorporated to the terrace ground that surrounds the river, being stabilized by construction. Regarding urban development, clear changes can be seen on the amount of constructions surrounding the river, since 1946 until 2003.

5. Conclusions

The changes found on both the shoreline and the river mouth are all due to artificial constructions. While approaching the anthropogenic causes of impacts and changes in the environment, researchers and stakeholders have been emphasizing changes made upstream of the rivers or in the mountains. However, this study reveals that direct impact and depletion of ecosystem is also being caused by the artificial constructions near the coastline. Since environmental restoration has been a point of discussion and researchers are trying to find alternatives to improve the quality of the environment, impacts of these constructions made directly on the coast, such as the depletion of sandy beaches and the lagoon on the river mouth, should also be considered.

Reference

TACHIYARA, Katsunori. 2003. River characteristics and fish life of Okinawa – Past, present and future prospects for Okinawan rivers. 18th Takara Harmonist Fund. Activity Report. (In Japanese).

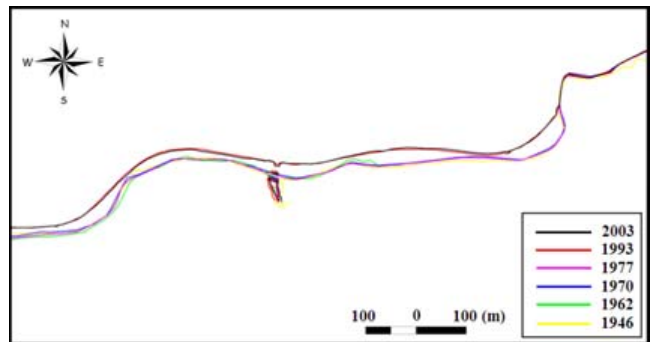


Figure 3. Variations on the coastline from 1946 to 2003



Figure 4. Depletion of sandy beaches due to improvement of the seaside road

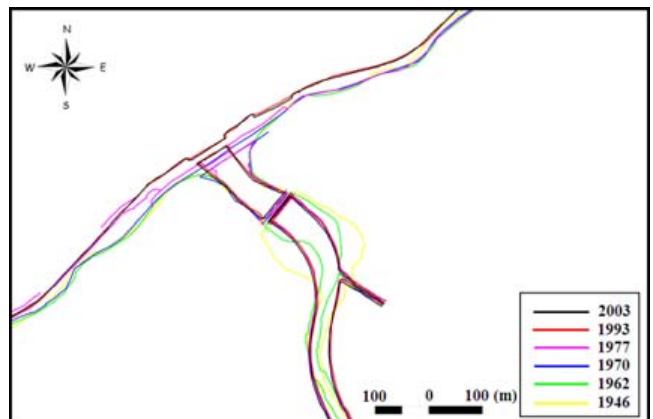


Figure 5. Variations on the riverbed limits from 1946 to 2003

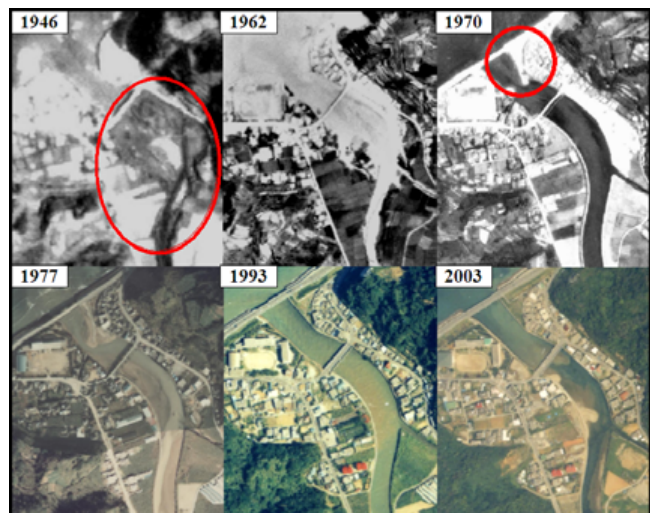


Figure 6. Changes on the river mouth due to channelization