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OF THE FISHERIES ON LAKE
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SHORELINE CLASSIFICATION OF LAKE TANGANYIKA BASED ON
THE RESULTS OF AN AERIAL FRAME SURVEY
(29.09.92 - 03.10.92)

by

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PREFACE

The Research for the Management of the Fisheries on Lake Tanganyika project (Lake Tanganyika Research) became fully operational in January 1992. It is executed by the Food and Agriculture Organization of the United Nations (FAO) and funded by the Finnish International Development Agency (FINNIDA) and the Arab Gulf Programme for United Nations Development Organizations (AGFUND).

This project aims at the determination of the biological basis for fish production on Lake Tanganyika, in order to permit the formulation of a coherent lake-wide fisheries management policy for the four riparian States (Burundi, Tanzania, Zaïre and Zambia).

Particular attention will be also given to the reinforcement of the skills and physical facilities of the fisheries research units in all four beneficiary countries as well as to the buildup of effective coordination mechanisms to ensure full collaboration between the Governments concerned.

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1. INTRODUCTION

During the first ever aerial frame survey of Lake Tanganyika (29.10-03.11.1992), carried out with a single engine 6-seater plane (PA-32-300 Cherokee), almost the entire shoreline of the Lake, with a total length between 1500 (Corsi, 1988, Mikkola & Lindqvist, 1989; Roest, 1987; Vanden Bossche & Bernacsec, 1990) and 2500 km (Brichard, 1989), was filmed on videotape using a Sony CCD-V880E Handycam Hi8 Camcorder (Hanek & Coenen, 1993). The aerial frame survey methodology and results were described in another Project Technical Document (Hanek, Coenen & Kotilainen, 1993) while this report, also based on the results of the analysis of the above aerial frame survey videofilm, presents the results of the shoreline classification according to type of substrate observed.

2. METHODOLOGY

The shores of Lake Tanganyika belong, with a total length estimated to be about 1850 km (Hanek, Coenen & Kotilainen, 1993) belong to various types of substrates, but as it is impossible to describe them all, our classification only took into account the following major substrates: marsh, sand, rock and mixed rock/sand.

Our definition of shoreline used is "the narrow strip of land along the edge of the lake". So, for example, if there is a narrow strip (a couple of meters) of sandy beach along the edge of the lake and behind the beach a huge, steep rocky mountain, our classification of the shoreline will be sand and not rock.

For the determination of the shoreline characteristics the videorecording of the Lake Tanganyika Frame Survey was reviewed. With the help of detailed maps (scale 1: 50,000) , except for Zaïre where only old 1: 200, 000 scale maps were available (see Table 1) , the different shoreline types were marked on the maps (R: rock; S/R: sand-rock; S: sand; M: marsh) and also the exact location of all fishing villages was determined as exactly as possible.

Table 1 : Characteristics of the maps used for the execution and analysis of the aerial census/frame survey.

COUNTRY	MAP CHARACTERISTICS
Burundi	Institut Géographique du Burundi (IGEBU), 1982-83, 1:50,000
Tanzania	surveys and Mapping Division, Ministry of Lands, Housing and Urban Development, 1974-84, 1:50,000
Zambia	Surveyor-General, Ministry of Lands and Natural Resources, 1966-70, 1:50,000
Zaïre	Institut Géographique du Congo Belge, 1957-58, 1:200,000

3. RESULTS AND DISCUSSION

3.1 Review of earlier classifications

Earlier classifications (or incomplete descriptions) of the shoreline of Lake Tanganyika were given by several authors, as follows:

- Van Meel (1952; 1954), based on his observations during the Hydrobiological Exploration of Lake Tanganyika (1946-47), while describing respectively the 'milieu végétal' and the phytoplankton of the Lake, discerned the following major types of shoreline: estuaries, sandy beaches with or without sandy shelf, rocky zones, mixed beaches, and rocky massifs with or without a mass of fallen rock at the foot of the rock. Major estuaries cited by Van Meel are the Ruzizi delta (border of Burundi and Zaïre); the Lugufu (or Rugufu), the Ifume near Karema, and the Malagarasi between Karago and Kigoma (Tanzania); and the Lovu on the westcoast of the Lake (Zambia). Typical sandy beaches observed were the one of Moni (north of Kalemie or ex-Albertville), the one of Kalemie (from the Kalemie river southwards up to Kalengela village), those of Tembwe, Moba and Zongwe (all in Zaïre); the one of Nsumbu (Zambia); those - from south to north - of Kala, Kirando ' Karema, Kibwesa, Kasoje and Ujiji (Tanzania) ; and Nyanza Lac, Rumonge and Lubindi in Burundi. Major rocky zones or beaches were observed in Kolobo, M'Toa Bay north of Moba (Zaïre); and the beach of Kibweza, Edith Bay and Utinta in Tanzania. Mixed beaches were very common and comprised a variety of sandy beaches with small or big rocks scattered on it. Rocky massifs were observed to be common, like the Ubwari peninsula (Zaïre) and several other stretches of steep rocky massifs diving abruptly into the Lake.

- Leloup (1952), while describing the invertebrates observed during the Hydrobiological Exploration of Lake Tanganyika in 1946-47, discerned the following main types of supralittoral or supratidal zones: in decreasing order of importance they are rocks, beaches composed of pebbles and gravel, sandy beaches, and muddy or marshy zones around estuaries. Main examples given of zones with pebbles and gravel are Tembwe, M'toto, Vua (Zaïre), Utinta (Tanzania) and the extreme inner ends of the south of Cape Tembwe (Zaïre) , and the ones of Lagosa (Tanzania) , Moliro (Zaïre) and Mpulungu (Zambia) . Sandy beaches cited, covered or not with vegetation, comprise the ones of Nyanza Lac and Lubindi (Burundi), Kigoma and Edith Bay (Tanzania) and Kalemie (Zaïre); the sandy strips of Kasoje (Kasole, Tanzania), the shores south of Tembwe (Zaïre) and the Malagarasi (Tanzania) , of Kasenga, Ujiji, Ulumbolo (Tanzania), Rumonge, Bujumbura (Burundi), Nsumbu and Lovu (Zambia). Muddy or marshy zones were observed around estuaries of rivers such as Ruzizi (Burundi) , Malagarasi and Kafumbwe (Tanzania), Lovu (Zambia), Sumbwa and Lugumba (Zaïre).

- Brichard (1989), having explored by means of scuba diving about one third of the total underwater shoreline, gives a map of the underwater rock biotopes and sandy/swampy ecological barriers for Lake Tanganyika with an indication of the approximate boundary between the northern and southern biotopes by an expansive ecological barrier in their middle, cutting the lake virtually into two separate parts and therefore responsible for an isolation of the Lake fishes into two major stocks with a high percentage of local species living north or south of this barrier. The rocky underwater zones presented in his map do not quite correspond with the rocky zones of the shoreline inventoried above water level. Indeed, extensive sand beaches can have a rocky belt underlining them in a few feet of water, sometimes for miles along the coast.

- Maes *et al.* (1991), during a census of the fishing units in the north-western zairian part (about 250 km) of Lake Tanganyika (Zaire border with Burundi southwards up to Kazimia), characterized and mapped the shoreline according to the following types of substrates: weed, sandy shore, rock, marsh, papyrus and small sandy beaches covered with pebbles. They also tried to find a correlation between the type of shoreline and the type of fishing practised.

- Michel *et al.* (1992) presented a map of Lake Tanganyika showing, without much detail, the major dominant substrates (rock, sand, mixed rock and sand, marsh) for the coastline of Burundi, the major part of the coastlines of Tanzania and Zambia, but only for a small stretch of the north-east region around Uvira for Zaire. Comparing the distribution of the endemic gastropod fauna of the Lake with the distribution of dominant substrates as possible barriers to dispersal, the authors concluded that the habitat fragmentation hypothesis more likely explains the current distribution of gastropod morphospecies than the changing lake level hypothesis.

3.2 Results of the present shoreline classification

Based on the results of the analysis of the aerial remote survey video-tapes, the general shoreline types for the whole of Lake Tanganyika were mapped in Figure 1. More details are given in three other maps (see Figures 2, 3 and 4) showing each one third of the Lake. The four substrate types considered are indicated on the maps in patterns, for all areas video-taped. Indeed, some areas were not filmed (9.7% of the shoreline) because of changing the battery/video-cassette, bad weather conditions (turbulences, storm), technical problems, etc.

For the 90.3% of Lake shoreline filmed, rocky shorelines were most abundant (43%), followed by sandy shorelines (31% mixed rock/sand shorelines (21%) and marshy shorelines (5%). Burundi has mostly sandy shorelines (78%), while in the other three countries rocky shorelines are most abundant (see Table 2). The density of sandy shorelines - and probably also of sandy areas below the water surface - in the northern, shallow basin of the Lake might

indicate the presence of numerous, shallow (not deeper than 130 m) and sandy spawning grounds for *Limnothrissa miodon* (Matthes, 1967).

The results of our classification are completing, in much more detail, those of the few authors who described, classified and/or mapped, as part of their respective studies, the different types of shoreline for part or whole of Lake Tanganyika (see 3.1).

Table 2 Abundance (in %) of the different types of shoreline substrate per country and for the 90.3 % of Lake Tanganyika's shoreline video-taped.

TYPE OF SHORELINE SUBSTRATE				
COUNTRY	SAND	ROCK/SAND	ROCK	MARSH
BURUNDI	78%	8%	4%	10%
TANZANIA	21%	15%	57%	7%
ZAMBIA	20%	21%	57%	2%
ZAIRE	30%	27%	39%	4%
TOTAL	31%	21%	43%	5%

3.3 Discussion

In general, our classification of the shoreline corresponds with those already given by other authors (see 3.2 above) and completes the classification for almost the entire coastline. The variation in shoreline substrates is so divers and changing so rapidly, that the easiest way of having a good idea of this variation and the distribution/succession of the different types of shoreline substrates is to look at the different maps presented.

The shoreline classification presented in this report will be checked, corrected - if necessary - and completed (for the few missing parts) during our next aerial frame survey(s).

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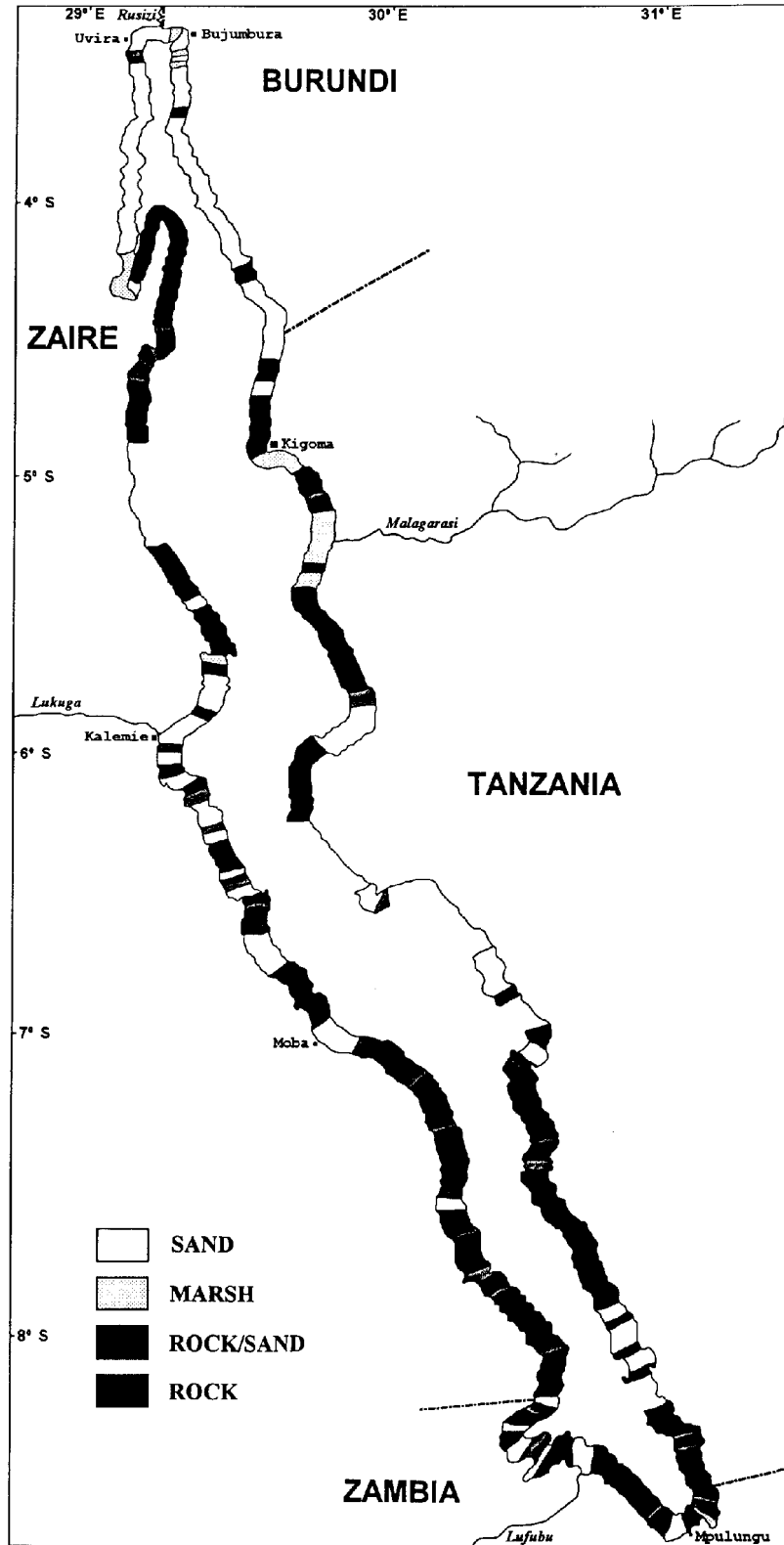


Figure I. Lake Tanganyika shoreline classification

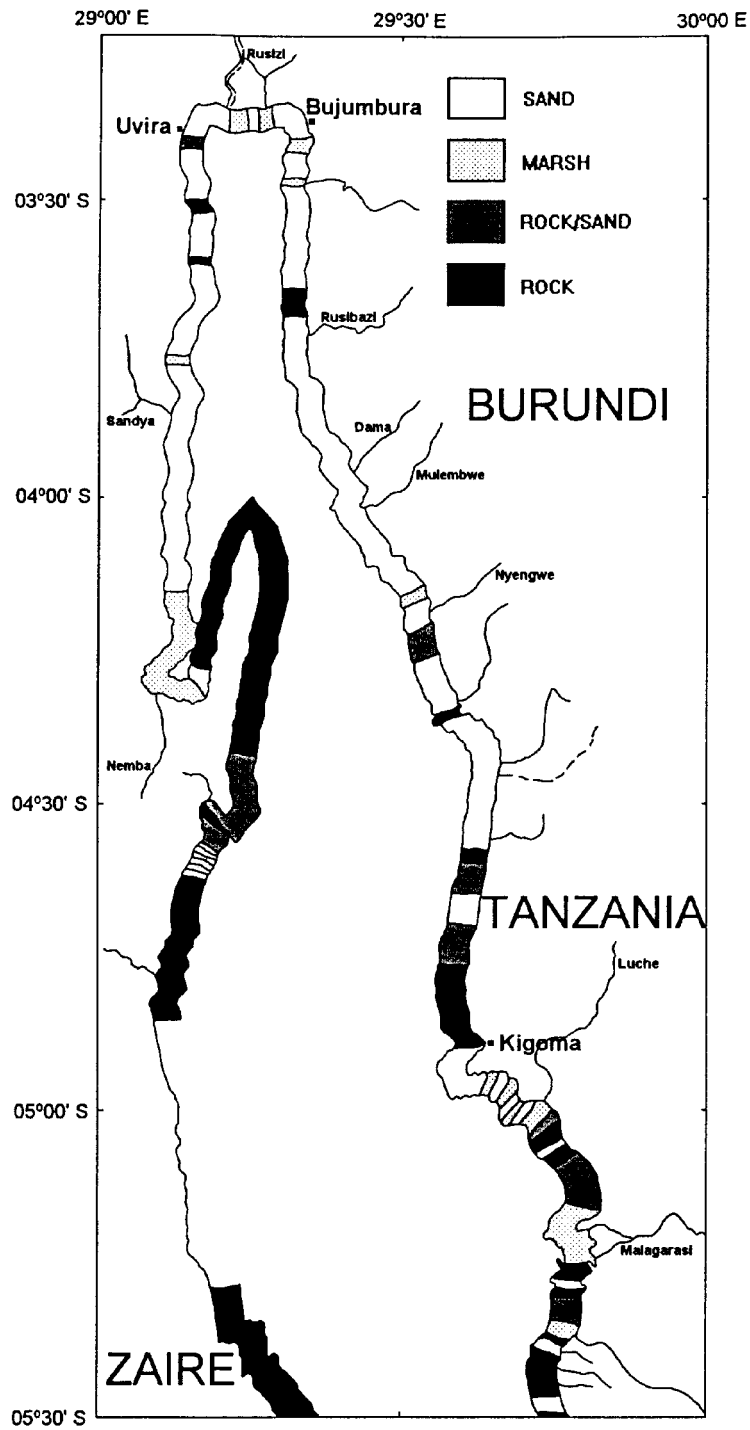


Figure II. Lake Tanganyika shoreline classification (northern part)

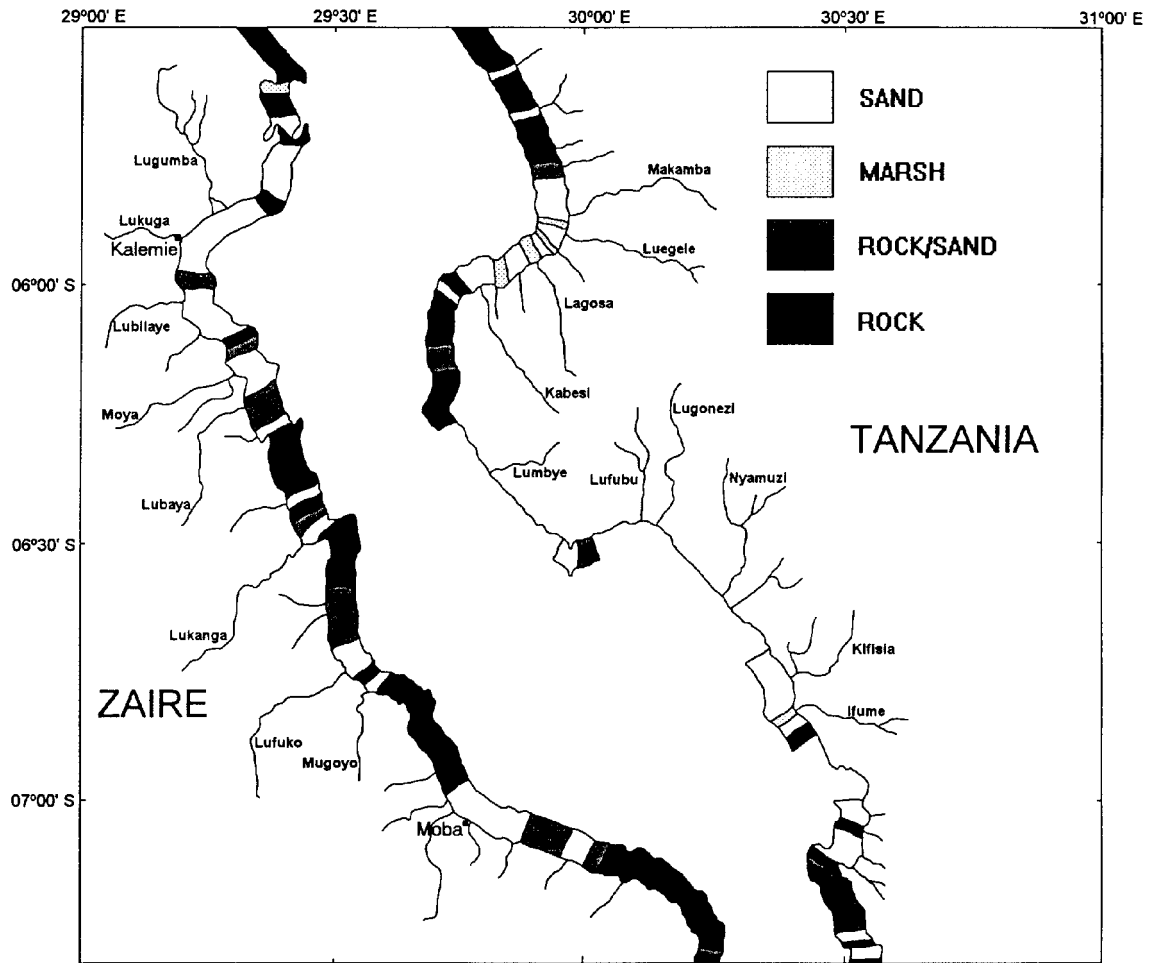


Figure III. Lake Tanganyika shoreline classification (middle part)

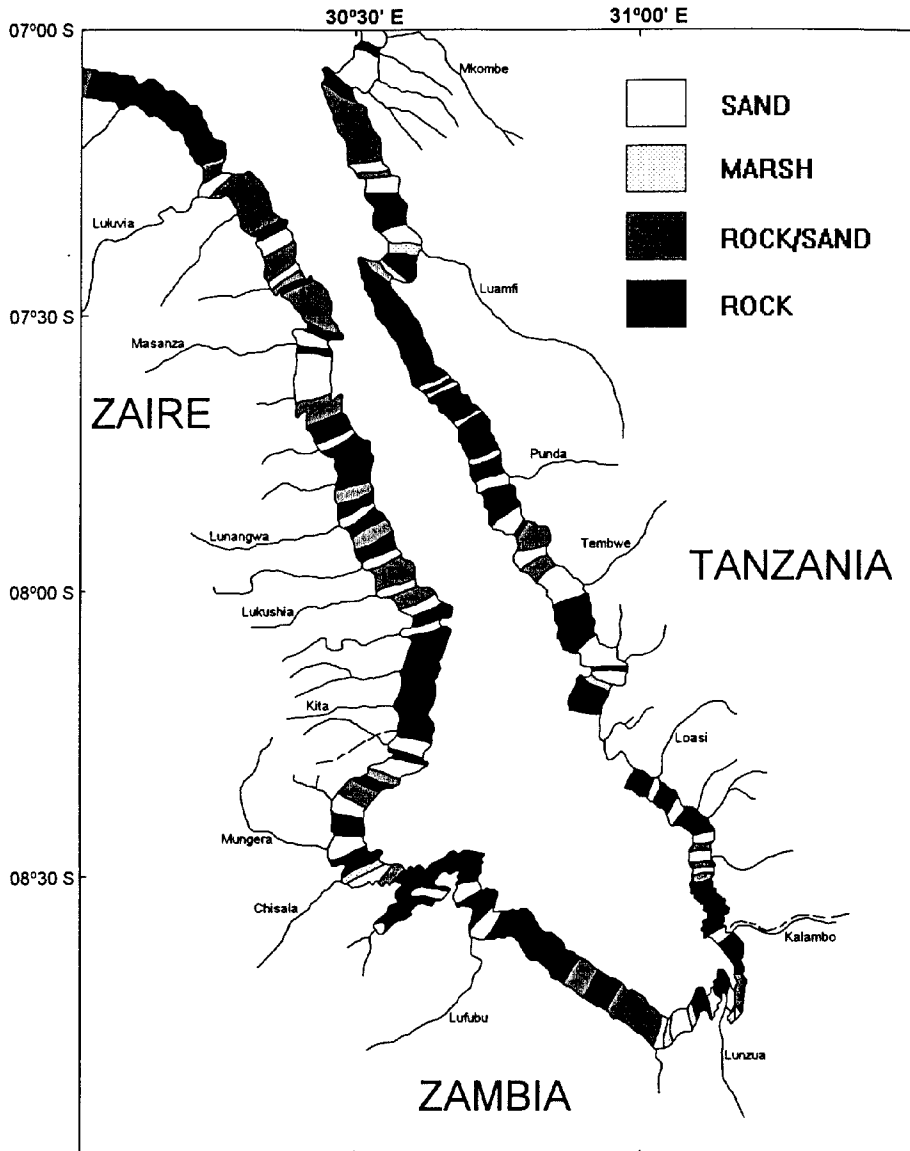


Figure IV. Lake Tanganyika shoreline classification (southern part)