THE EAST AFRICAN GREAT LAKES: LIMNOLOGY, PALAEOLIMNOLOGY AND BIODIVERSITY

ADVANCES IN GLOBAL CHANGE RESEARCH

VOLUME 12

The titles published in this series are listed at the end of this volume.

THE EAST AFICAN GREAT LAKES: LIMNOLOGY, PALAEOLIMNOLOGY AND BIODIVERSITY

Edited by

Eric O. Odada

and

Daniel O. Olago

Pan African START Secretariat,
Department of Geology,
University of Nairobi, Kenya

KLUWER ACADEMIC PUBLISHERS
NEW YORK, BOSTON, DORDRECHT, LONDON, MOSCOW

eBook ISBN: 0-306-48201-0
Print ISBN: 1-4020-0772-8

Created in the United States of America

Visit Kluwer Online at: http://kluweronline.com
and Kluwer's eBookstore at: http://ebooks.kluweronline.com

CONTENTS

Hydrology and Physical Limnology

Biodiversity, Food Webs and Fisheries

Sedimentary Processes, Paleoclimate and Paleoenvironment

INTRODUCTION

The Second International Symposium on the East African Lakes was held from 10-15 January 2000 at Club Makokola on the southern shore of Lake Malawi. The symposium was organized by the International Decade for the East African Lakes (IDEAL), a research consortium of African, European and North American scientists interested in promoting the investigations of African Great Lakes as archives of environmental and climatic dynamics. Over one hundred African, European and North American scientists with special expertise in the tropical lakes participated in the symposium which featured compelling presentations on the limnology, climatology, palaeoclimatology and biodiversity of the East African Lakes. It is their papers that comprise this book.

The large lakes of East Africa are important natural resources that are heavily utilized by their bordering countries for transportation, water supply, fisheries, waste disposal, recreation and tourism. The lakes are unique in many ways: they are sensitive to climatic change and their circulation dynamics, water-column chemistry and biological complexity differ significantly from large lakes at higher latitudes; they have long, continuous, high resolution records of past climatic change; and they have rich and diverse populations of endemic organisms. These unique properties and the significance of the palaeolimnological records demand and attract research interest from around the world.

IDEAL research is contributing to our understanding of basic limnological processes in the African Great Lakes and how physical dynamics drive their biogeochemistry and thus rendering them sensitive, compared to temperate great lakes, to climatic and anthropogenic change. Recent studies indicate that Lake Victoria has undergone dramatic shifts in the lake ecosystem caused by the introduction of the Nile Perch in 1950s and of the water hyacinth during the past five years. The lake also dried up completely prior to 12,400 years BP. Thus, the hundreds of species of fish in modern Lake Victoria may have evolved within the last 12,400 years; this is the fastest rate of vertebrate species evolution ever recorded.

Elsewhere in East Africa, high resolution studies of past climate change in Lake Naivasha, Kenya and in Lake Malawi have shown a distinct Little Ice Age in tropical Africa. Evidence for the Younger Dryas even in tropical Africa has also been documented in the sediment record of Lake Albert. More recent studies have demonstrated that Lake Malawi was at a low stand during the LGM like all the African lakes in the Northern Hemisphere. This lake was previously known to have

been low in the early Holocene and around 35ka but was believed to have been at a high stand during the LGM.

Lake Malawi and Lake Tanganyika are aquatic island systems of elevated endemic biodiversity providing extraordinary conditions to study evolutionary biology. In these lakes we have the unique opportunity to investigate the dynamics of evolutionary and ecological change. Patterns of speciation, the origin of major morphological evolution, and the origin of major reorganizations in community structures can all be investigated in a comparative setting in these two lakes. The sedimentary record of these lakes offers us an opportunity to resolve both evolutionary and ecological changes in their biota at time scales of decades, centuries, millennia, to millions of years. Despite their long histories and geological similarities, the patterns of diversity and genetic differentiation of the biota differ dramatically between Lakes Malawi and Tanganyika. Both lakes were colonized by cichlid fishes, thiarid gastropods and ostracode crustaceans, but these exemplar taxa currently have contrasting aspects in the two lakes. Approximately 1000 fish species are estimated to have evolved within the cradle of Lake Malawi, which is approximately 10 per cent of all freshwater fish species in the world. Despite their astonishing multitude, these species encompass a rather modest degree of molecular genetic and morphological change. The fishes in Lake Tanganyika are genetically and morphologically much more diverse than those in Lake Malawi, yet total only 300 species. In Lake Tanganyika about 240 out of 250 species of prosobranch gastropods and ostracode crustaceans are unique to that lake, and like the cichlid fish, form numerous distinct, divergent lineages. The living prosobranch gastropod fauna of Lake Malawi has undergone only limited differentiation and few if any endemic ostracodes are reported from this lake.

The papers presented in this book provide a comprehensive coverage of the large lakes of East African Rift Valley, touching on climate, limnology, palaeoclimatology, sedimentation processes, biodiversity and management issues of these lakes. The papers show that high quality, globally relevant research can be, and is being done in Africa. The call from African researchers is for their international colleagues and the science funding agencies to move from a position where they see their interactions in Africa essentially as “capacity building” to one of partnership and “capacity recognition” with capacitating where necessary and effective. African and developed world science administrators must work together to sustain the scientific capacity which has been built in Africa, instead of tacitly allowing it to migrate to Europe and North America. The world needs it to stay home.

Eric O Odada.

ACKNOWLEDGEMENTS

The Second International Symposium on the East African Lakes on the limnology, climatology and palaeoclimatology of the East African Lakes was held in Malawi at Club Makokola on the palm-fringed southern shore of Lake Malawi. The symposium was sponsored by the John D. and Catherine T. MacArthur Foundation, The International START Secretariat through NORAD funding for global environmental change research and capacity building in sub-Saharan Africa, and the PAGES International Project Office. We are grateful for the generous support that made the symposium and the publication of this volume possible.

The symposium was organized by IDEAL in collaboration with the University of Malawi, the Large Lakes Observatory, University of Minnesota, USA and the Pan-African START Secretariat, University of Nairobi, Kenya. We are particularly grateful to the Department of Geology at Bunda College University of Malawi for providing all the logistical support for the symposium. We are also very grateful to the management of the Club Makokola for providing excellent conference facilities at this picturesque resort on the southern shore of Lake Malawi.

Tom Johnson of the Large Lakes observatory, University of Minnesota spent much of him time providing valuable advice to the organizing committee for the symposium. We also benefited considerably from the advice provided by the IDEAL Steering Committee. The authors of the articles in this volume are to be commended for their commitment to research on the African Great Lakes, despite the logistic challenges that accompany such efforts. We greatly appreciate the efforts of all the following reviewers, who substantially improved the quality of the papers published in this book.

Eddie Allison, P. Anadon, Daniel Ariztegui, Mamboudou Ba, Richard Back, Michael Biryabarema, Gary Bowen, Don Branstrator, Arthur S. Brooks, John Bullister, Peter Casper, Tesfaye Cherinet, Steven Dadzie, Jean-Pierre Descy, Cynthia Ebinger, Hubert Gallee, A.T. Grove, Paul Hamblin, Robert Hecky, Karin Holmgren, Andrew Hudson, Ken Irvine, Emi Ito, Thomas C. Johnson, G. Khroda, Seth Kisia, Koen Martens, Henry Lamb, Suzanne Levine, Stephen McCord, Sarah Metcalf, Joseph Mworia-Maitima, Isaac Nyambok, S. Odingo, R. Okoola, Anne-Marie Oldewage, A.O. Opere, Adrian G. Parker, Ingemar Renberg, Louis Scott, F. Semazzi, William Smethie Jr., J. Sutcliffe, David Swayne, Michael Talbot, Jean-Jacques Tiercelin, Dirk Verschuren, Martin Vollmer.