The background of the entire cover is a photograph of Lake Victoria at sunset. The sky is filled with orange and yellow clouds, and the sun's reflection creates a bright, shimmering path across the water's surface. In the distance, the silhouettes of mountains and several small boats on the water are visible.

# LAKE VICTORIA

AFRICA'S INLAND SEA

by Kenneth Mallory and Mark Chandler  
NEW ENGLAND AQUARIUM





## Introduction

*Lake Victoria: Africa's Inland Sea* is a brief look at a remarkable lake in East Africa called Nam Lolwe by the Luo and Nalubale by the Luganda people. They are just some of the many people working together to assure the lake and its resources remain the life sustaining forces they have been for the earlier part of their history. The ideas expressed in this book are the collected wisdom of many individuals both from Africa and the international community of scientists. We would particularly like to thank Dr. Richard Ogutu-Ohwayo, S. B. Wandera, and Tim Twongo of the Uganda Fisheries Resource Research Institute in Jinja, Uganda; Dr. Helida Oyieke, James Maikweki, and Peter Nyamenya of the National Museums of Kenya; William Ojwang and James Ogari of Kenya Marine Fisheries Institute; Christina Kessler, author of *All the King's Animals! The Return of the Endangered Wildlife to Swaziland* and important contributor to this book with photos and interviews; Dr. Les Kaufman, Associate Professor of Marine Biology, Boston University for his guiding hand in the text for this book; and Margaret Thompson Mallory, who contributed many of the best photos. We owe special thanks to the Lowell Institute in Boston, Massachusetts, which made this book possible by supporting its production and distribution to a wide audience, and to the New England Aquarium for creating the traveling exhibit *Nyanja! Africa's Inland Sea* for audiences in the United States and Africa. Like the exhibit, this book was created in the spirit of international cooperation and education.



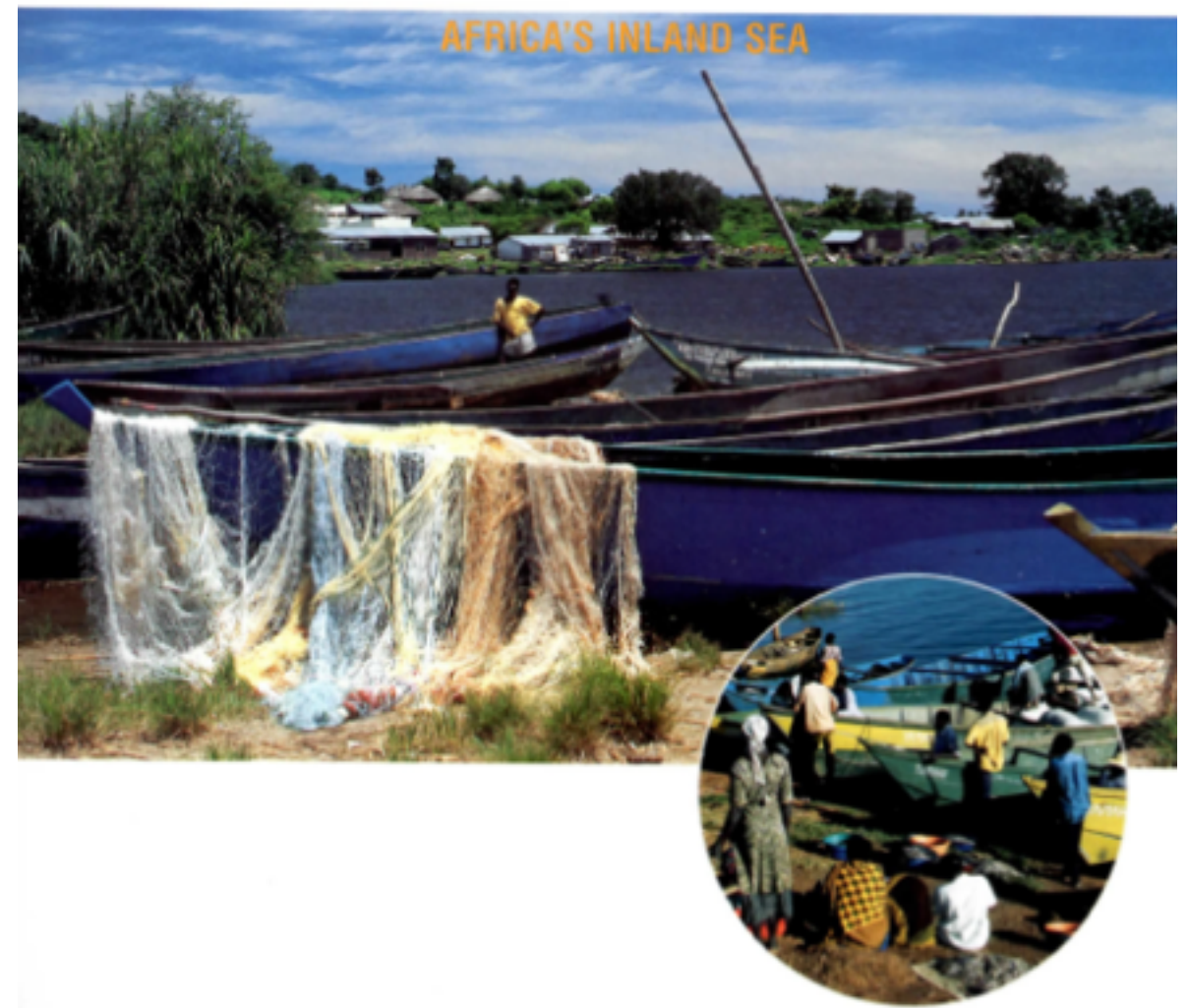
This material is based upon work supported by the National Science Foundation under Grant No. ESI-9705519.

Thanks to the support of the Lowell Institute

Photographs and Illustrations by: Chris Augusta, Mark Chandler, Alistair Economakis, Paul Erickson, Alexander Goldowsky, Javene Jones, Christina Kessler, Paul Loiselle, Kenneth Mallory, Margaret Thompson Mallory and Joe Richardson

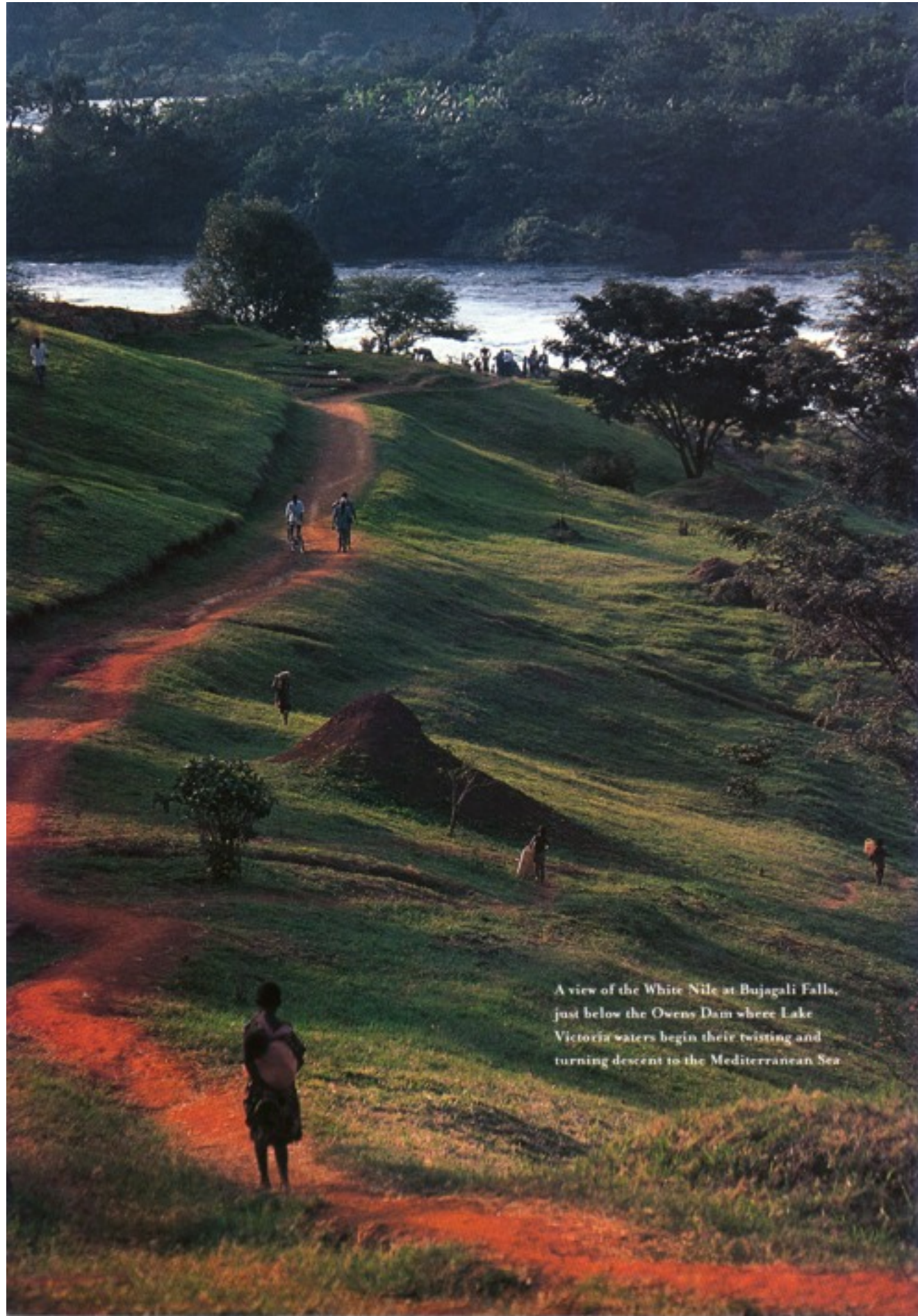
# LAKE VICTORIA

AFRICA'S INLAND SEA



by Kenneth Mallory and Mark Chandler  
NEW ENGLAND AQUARIUM





A view of the White Nile at Bujagali Falls, just below the Owens Dam where Lake Victoria waters begin their twisting and turning descent to the Mediterranean Sea



**Lake Victoria dhows**

## Origins

There is a lake high on a plateau in East Africa called Lake Victoria. It sits near the Equator like a giant saucer of water, its widest

dimension about 402 kilometers(250 miles), its average depth near 37 meters (120 feet). Lake Victoria is the largest tropical lake in the world, second in size to only one other giant freshwater lake, Lake Superior, located between Canada and the United States. Lake Victoria is so large it spills into three of Africa's



largest countries: Kenya, Uganda, and Tanzania. It is also a famous lake because its waters drop 6,400 kilometers (4,000 miles) to the Mediterranean Sea, down mountains and through valleys to create the river called the White Nile.





A papyrus swamp attracts dragonflies like this one (inset)



Colorful vegetation from Jinja, Uganda



Haplochromine cichlid species

## wildlife



Hippos share the shoreline with a variety of water birds.

Lake Victoria is a hauntingly beautiful lake whose shallow inlets and bays are home to giant hippopotamuses, which bathe along its shores.





**Pied kingfisher**



**Flower from Jinja, Uganda**



**Black-headed weaver bird**

**Crocodile**



thick-skinned crocodiles, which lurk in the shallows, home to weaver birds, which live in cities of drooping nests, kingfishers, which make acrobatic dives to the water to snatch tiny surface-feeding fish, and a host of hundreds of different kinds of fishes, many of which are found nowhere else in the world.



**The shores of Napoleon Gulf (circa 1960s). Today the forest and elephants are gone.**





**Bamboo sticks provide a platform to support night-fishing lights, which, in turn, attract omena fish.**

Besides the animals that have made the lake their home, native peoples have long depended on the lake for travel, for transport, and for the life-sustaining properties of water, especially its wealth of protein-rich fishes.



**A local fisherman displays his catch of Nile perch**



**A village woman casts omena out on the ground to dry.**



**Night fishing for small omena fish, also called mukene or dagaa fishes**



In past years, a fishing banquet of colorful cichlids, sweet tasting tilapia, whiskery catfish, elephant-nose fishes with curved snouts, and even the ancient lungfish, a relic of hundreds of millions of years of evolution, was always available to feed the people who lived around the lake.



Catch of the day, lungfish, tilapia, and catfish



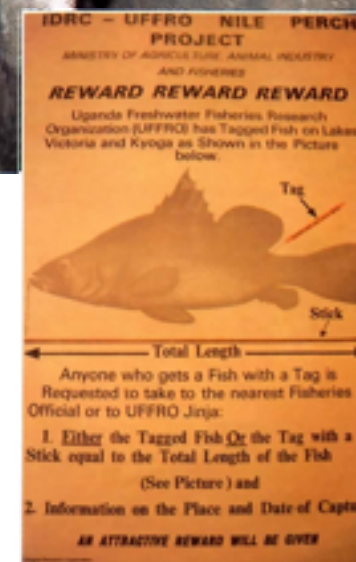
Lungfish



Fishermen cast nets for tilapia and other lake fishes.



## Nile Perch



Today this same wealth and diversity of fishes is threatened and changing. Early in the 1960s a new kind of fish was introduced to the lake, the giant Nile perch (*Lates niloticus*), capable of growing to a length of 2 meters (six to seven feet) and





140 kilograms (300 pounds). Nile perch were introduced by fisheries officials who wanted a new source of protein that could feed the people of the lake, make money for commercial fishermen, and provide large fish for sports fishing.

At first the giant Nile perch did everything the officials wanted it to do. The giant fish spread far and wide throughout Lake Victoria. It could be found off the shores of Uganda, Kenya, and Tanzania, in deep water and in shallow bays.



But in time, the promise of perch as food for the people of the lake was increasingly replaced by profits for businessmen selling their fish products around the world. The best parts of the perch, the tenderest, juiciest fillets, were sent out of Africa to the markets in Europe and the Middle East. They would pay high prices for such choice meat.







The perch's sandpaper hide (above) made shoes, belts, and purses that were sold in far-away locations. Nile perch swim bladders (right), the internal organ that helps fish rise and sink in the water, were sent to England for filtering beer and wine and to the Far East for thickening soup. Only the smallest Nile perch and leftover tails and fish heads of the larger Nile perch remained for many people of the lake.



**Small Nile perch are offered for sale at market.**





Painting © Chris Augusta

*Astatotilapia* “thickskin” haplochromine cichlid

## Haplochromine Cichlids

And worst of all for the small village fishermen, the Nile perch ate most of the other kinds of fishes they had traditionally caught, including lungfish, catfish, tilapia and the little fishes called haplochromine (hap-low-crow-means) cichlids.

The loss of so many haplochromine cichlids had an especially devastating effect. Known as “furu,” “fulu,” and “nkeje,” depending on whether you are from Tanzania, Kenya, or



A zooplankton-eating haplochromine  
(*Pundamilia nyererei*)



Haplochromines hang as displays in the market.

Uganda, they are also called haplochromines by the scientists who study them. Their disappearance because of the Nile perch not only removed an important ingredient in the medicines and culture of lake people; it also destroyed a living laboratory of cichlid evolution.



Haplochromine packaged for market.





## Darwin's Dreampond

Before the arrival of the Nile perch, there were over 500 different haplochromine species in a myriad of shapes, colors, and lifestyles. There were insect eaters, algae scrapers, mud biters, leaf choppers, snail crushers, shrimp eaters, baby eaters, fish eaters, scale scrapers, and snail shellers, all of which found a way to live in one giant lake by finding a different source of food.



**Snail-shelling haplochromine (*Macropodus bicolor*) with curved teeth.**

To the scientists, this variety of diet and habitat was simply astounding. Samples of earth taken from the bottom of the lake suggest the lake may have temporarily but completely dried up 12,000 to 14,000 years ago. If this is true, these hundreds of cichlid species must have evolved from a handful of ancestral species in this same relatively short span of time.

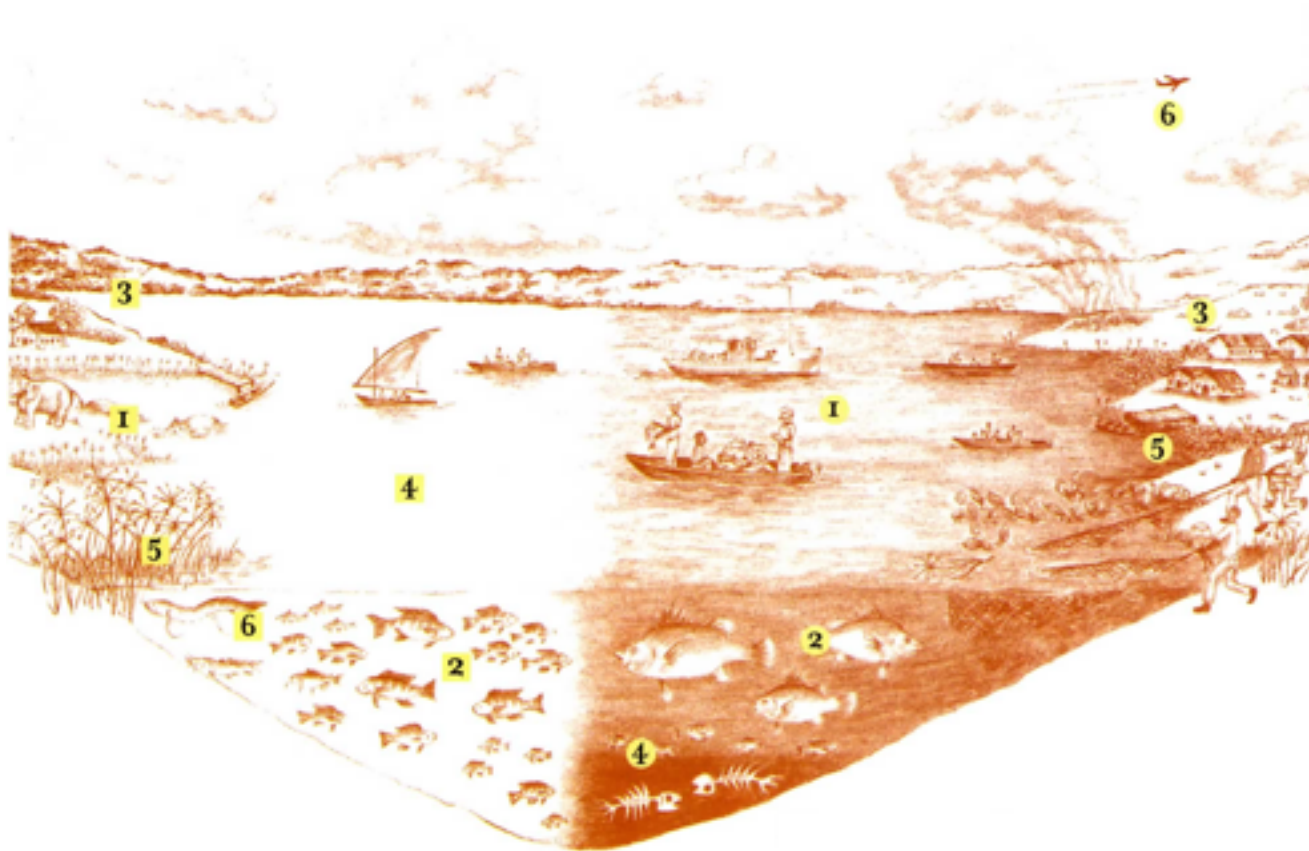
So apparently changeable are the cichlids as a species that, if introduced into a new part of the lake, they could become, for example, specialized feeders on entirely new types of food. The cichlids showed that adaptation and evolution could occur much more quickly than anybody had thought.



**Fish-eating haplochromine (*Prognathochromis venator*) with pointed teeth.**



# Lake Victoria / Then and Now



## 1900

- I** A diversity of human cultures, animals, and plants were found around the lake.
- 2** Protein was available from diverse fish fauna of more than 500 different species.
- 3** Fewer people lived around a forested lake edge.
- 4** The water was clear, and rich in oxygen.
- 5** Vast papyrus wetlands and shorelines of waterlilies provided valuable habitat to hundreds of animal species.
- 6** Local villages feasted on a wide variety of prized fish species such as lungfish and tilapia.

## Today

- I** Large animals have disappeared. Increased fishing efforts and new fishing technologies have reduced fish populations.
- 2** Popular native fishes are now rare; introduced Nile perch is the major source of protein taken from the lake.
- 3** Deforestation and farming have increased erosion and nutrients pouring into the lake.
- 4** In turn, these land-based changes have decreased water clarity and oxygen in the lake, triggering massive fish die-offs.
- 5** The introduced water hyacinths choke shorelines.
- 6** Today, most high quality fish is exported.



The practice of making charcoal to cook fish and make bricks has led to cutting down the forest, which in turn allows the soil and fertilizer to flow into the lake.

## A Century of Change

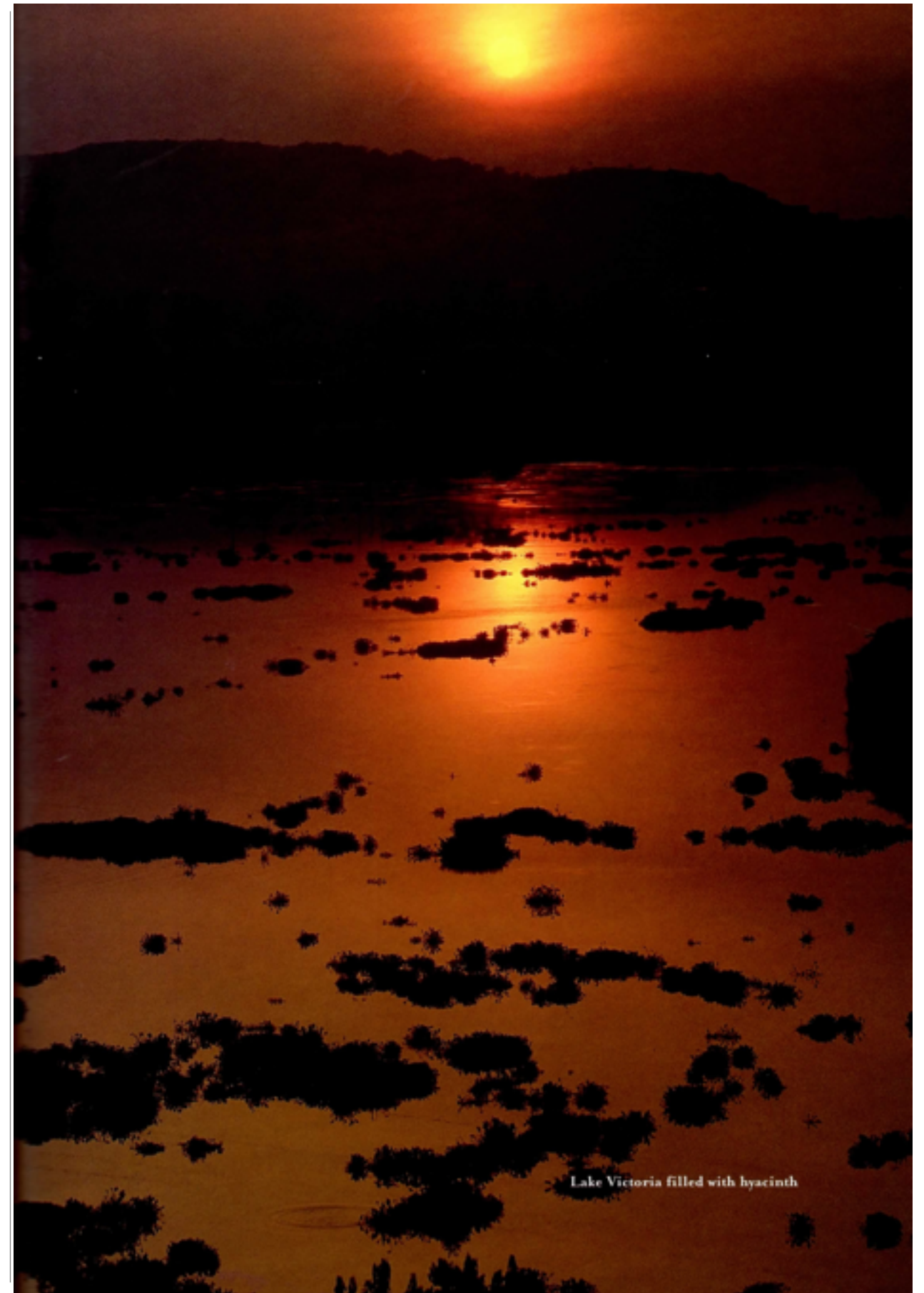
The loss of an evolutionary marvel wasn't the only consequence from the collapse of the haplochromine population of fishes. The development of farms as well as deforestation of shoreline trees and other vegetation began to allow more and more soil and sewage to run into the lake, overfertilizing the water. This quickly led to an overabundance of microscopic algae. As long as the algae-eating cichlids were alive, they had kept much of this plant life under control.





**In some shorelines along the lake, the water hyacinth is so thick that workers are hired to push the mass of plants into deeper water (above). Without these efforts, the bays become blocked with plants (below)**

With the cichlid disappearance, the runoff soils caused such an explosion of plant life that it threatened to choke the lake, leading to fish kills and impassible fields of a green plant called water hyacinth introduced as an ornamental from South America in 1988. In some places, workers were hired just to push floating islands of hyacinth away from the shore and back into deeper water.



**Lake Victoria filled with hyacinth**





Fisheries Resource Research Institute scientist, Rose Muggide, filters lake water.



Fisheries Resource Research Institute, Jinja, Uganda



Fisheries Resource Research Institute scientist



Fisheries Resource Research Institute workers inspect water hyacinths.



Scientists examine the day's catch.

## Nations Take Charge

Beginning in the late 1980s, a group of concerned scientists from Africa and around the world decided to take charge. If they could help businessmen, government agencies, and others to an understanding of what had happened to the lake, they could take steps toward recovery. It is from these efforts that today a new plan of action has been born. It brings hope for the recovery of a "biodiversity" that will once again make the lake a sustaining force in the lives of all the people living in and around the lake.





**Scientists examine haplochromine cichlids in holding ponds.**



**A plankton net captures small plants and animals for examination**



**Preserved specimens of fish help scientists identify new animals**

# Fisheries

Today, Africa's leaders are pursuing a balanced approach to protecting the lake. Dr. Richard Ogutu-Ohwayo is an ichthyologist and the director of the Fisheries Resource Research Institute in Jinja, Uganda. His words carry the wisdom of a nation that sees a changed lake but one that will again serve all of the people well.

"I think the lake has a future. Adults used to view it as an endless resource but not so much anymore. Now people think about what they do on land that has an effect on the lake. If they make changes now in slash and burn farming, and industrial and municipal waste disposal or treatment, then there is a chance for their children to use the lake in the future."



**Dr. Richard Ogutu-Ohwayo**



**Cliffside soil erosion like that shown in the photo here is one of the primary causes of the lake's explosion of choking algae.**



Dr. Timothy Twongo is also from the Fisheries Resource Research Institute in Jinja, Uganda. He faces one of the most serious problems on Lake Victoria today. In 1988, the first water hyacinth showed up in the lake. Introduced by someone as an ornamental, the plant has reproduced in phenomenal quantities since 1988. Some beds are more than 2,471 acres (1,000 hectares) large.

The prevalence of the “water weed” affects transport, fishing, water cleanliness, outflow for water supplies, and electricity. Dr. Twongo does not expect to eradicate the weed, but hopes to figure out how to control it.

“The rapid spread of water hyacinth has taken people by surprise. I tried to warn the fishermen that one day they would fail to get out of their landings, but they just laughed. I tried to warn the government, but they just ignored me also. Now the water weed problem is tremendous.



**Dr. Timothy Twongo**

“There are three approaches to controlling the weed - chemical, mechanical, and biological. Chemical is not really an option because there is no telling what side-effects will be. A machine called the Swamp Devil barge-grinder is the mechanical device of choice.

“It churns and slices it way through the hyacinth but it is expensive. Biological control means introducing beetles to eat the hyacinth. It is a natural control, and although slow, it may be the best solution after all.”



**The water hyacinth grows so thick in front of this market-place that transport boats can barely reach the shore and workers must struggle through the weed and mud.**



**Scientists from around the world have helped to make sense of what has happened in Lake Victoria and have suggested ways to bring the lake back into greater balance with more biodiversity.**





# Education



**Peter Nyamenya**

Peter Nyamenya is Fish and Reptile Curator at the National Museums of Kenya in Kisumu. “Nam Lolwe is the Luo name for the lake. It means wide and endless. It still has the same size today, but it’s not the same lake.” Peter’s job is to maintain exhibits that display the original Lake Victoria. His exhibit tanks contain indigenous fishes, so kids can see what the lake looked like when their parents were kids. He also gives talks on the lake and its problems.

“Living exhibits are changing constantly as the fish grow. Kids love this because they can see the fish they catch today are not the same ones their fathers caught. We talk about pollution and over-fishing and there are always good questions. I think the lake has a future because kids today see the problems building and want to know what they can do to help.”



**Classroom computers teach what is known about Lake Victoria**

Dr. Helida A. Oyieke is Associate Director at the Center for Biodiversity at the National Museums of Kenya. “Our main concern is to sustain the lake’s biodiversity to protect it for future generations. I am concerned about the loss, and hope to stop the process,” says Dr. Oyieke. “Biodiversity means that the world is made up of the variation and variability, within living organisms.”

“Life is based on the biodiversity of natural resources. It’s the difference between one plant and another, one animal and another, that keep nature in balance.”

Dr. Oyieke is concerned because, since the introduction of Nile perch, over 200 species of the haplochromines have disappeared. With the invasion of water hyacinth the quality, clarity, and taste of the lake’s waters have changed.

“The infestation of the water weed is economically and environmentally a disaster. But there is some hope. Lake Naivasha was covered by water fern (*Salvinia molesta*) in the mid-to-late 80s. The beetles were introduced, and now the surface is clear. The same may happen with Lake Victoria.”



**Dr. Helida A. Oyieke**



**So dense is the population of water hyacinth in Lake Victoria that boat traffic is seriously compromised and even buried under an avalanche of water weed.**



# Resource Renewal

William Ojwang is a Research Scientist at the Kenya Marine Fisheries Research Institute. He works at a research station for endemic fishes on the Kenyan side of Lake Victoria. His task is gigantic - to increase the populations of the endangered local fish species.

So far, the breeding of catfish (*Clarias gariepinus*) has been successful. His project has three parts - to capture, mature, and breed the fish they catch in the remnant populations. William and a group of fishermen catch fish in the rivers feeding into the lake. These are places where Nile perch haven't arrived, and water hyacinth hasn't taken over, so endemic species still live.



**William Ojwang**



**Specimens of different cichlids in the laboratory help scientists understand the process of evolution.**



**Lakes adjacent to Lake Victoria without Nile perch or water hyacinth are refuges for native endangered species such as haplochromine fishes.**

At the Sangoro Research Station they carefully transfer captured fish to tanks and pools where they hope to reproduce the fishes and release the offspring into areas protected or free from Nile perch. "This is an exciting project because haplochromines evolve and adapt quickly to new environments. This means we can actually watch the evolution process."

William is now studying the role of zooplankton-eating haplochromines in the ecology of Lake Victoria.



**A zooplankton feeder (*Yssichromis argens*)**





## A Look to the Future



**Omena fishermen**



**Boy with tilapia**



Lake Victoria will never be the same again. But the people who are helping to protect the lake have the resources and a better understanding to sustain it. They can draw on the strength of the original lake system. They can re-create some of the previously existing lake from the small, untouched parts of the lake that still exist. They can set up a monitoring system to make sure abuses don't take place all over again. They can understand that biodiversity leads to a sustainable and well-functioning ecosystem that is good for wildlife, good for the people, and good for the economy. If they do all these things. Lake Victoria may once again be the vital resource it was in the past.





# Addendum



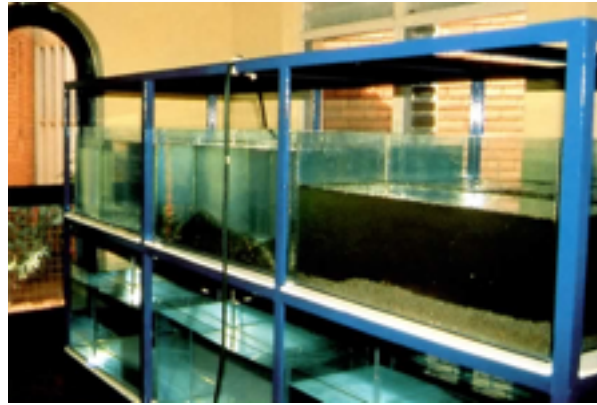
**Members of the VSSP set up a classroom aquarium in Kisumu, Kenya.**

The work to-date has relied on the good work of African and international scientists, as well as the Victoria Species Survival Plan (VSSP), an aquarium and zoo initiative to conserve the native fishes of Lake Victoria.



Haplochromine species-selected to represent most of the different feeding strategies that evolved in the lake-as well as the native ngege (tilapia) are held in captive breeding programs at 30 aquariums in the United States under VSSP, and in Europe under a similar program.

Perhaps more important than the captive breeding program, the VSSP has started a major education and research effort to insure biodiversity is maintained in the lake.



**Holding tanks provide a house for endangered species in Jinja, Uganda.**

In addition, a major cooperative effort among all three lakeside countries - Uganda, Kenya, and Tanzania - has been launched. It is called the Lake Victoria Environmental Management Program. It focuses on water quality, land-use management, restoration of indigenous food fish, control of Nile perch and water hyacinth, and community-based management.

There are other ecosystem revival success stories from around the world that serve as inspiration. They include the return of the striped bass to a challenged ecosystem in the Chesapeake Bay, the rebounding populations of corals in Kareole Bay, Hawaii, and the codfish in the North Sea.



**"There is always something new out of Africa."  
- Greek Proverb**

There is a Native American proverb that says,  
"Tell me, and I'll listen;  
show me, and I'll watch;  
Get me involved, and I'll learn."



**New England  
Aquarium**

Central Wharf • Boston, Massachusetts, USA - 02110-3399