

*Pedder Lake, Australia  
(Tasmania)*



*Quake Lake, Montana*



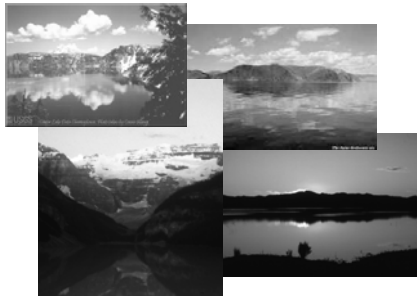
*New York City Drinks Lake Water*



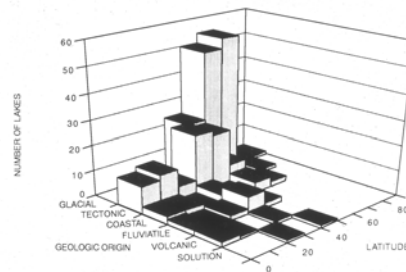
*So Does Northern New Jersey*



*Lentic Ecosystems*

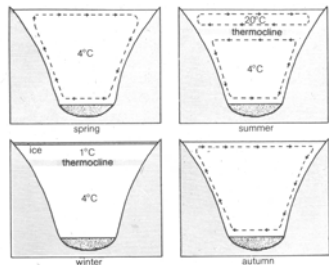


*Classification Of Large Lakes*

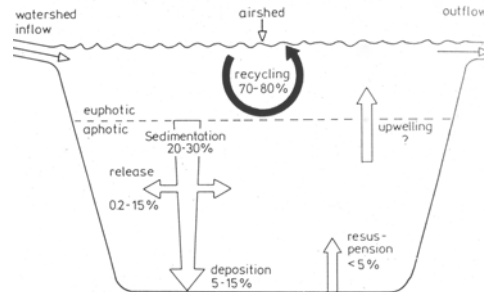




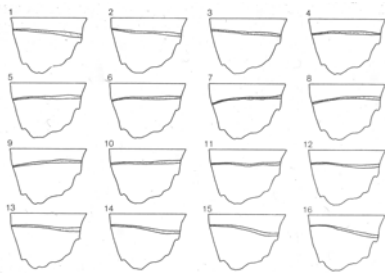
*Temperature Profiles Throughout The Seasons In An Oligotrophic Lake*



*Circulation Patterns*



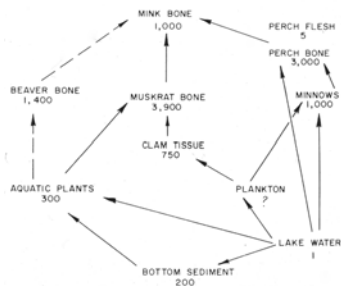
*Thermal Profiles Of An Oligotrophic Lake Over A 12 Hour Period*



*Energy Flow In An Oligotrophic Lake*



*Accumulation Of Strontium<sup>90</sup> In A Lake*



*Langmuir Circulation*

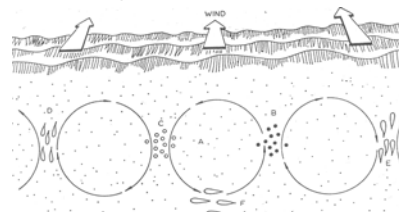
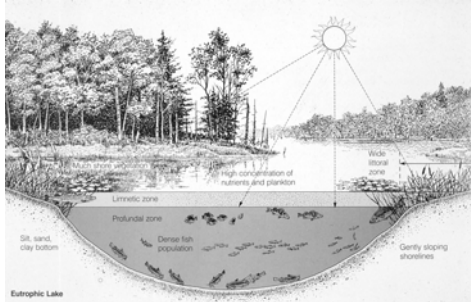


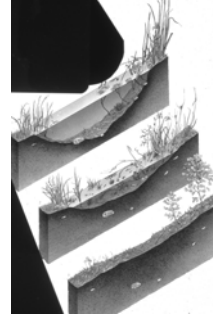
Figure 3.18 Langmuir circulation and plankton distribution: A, randomly distributed neutrally buoyant particles; B, sinking particles aggregated in upwelling zone; C, floating particles concentrated in downwelling zone; D, E, and F, zooplankton aggregation positions determined by the velocity field in the cell. Redrawn from Stavn (1971) by Ledbetter (1979).

## *Eutrophic Lakes*



From: Miller, *Living In The Environment*

*All Lake Undergo Eutrophication And Eventually Fill In With Detritus And Dry Up*



*Pitcher Plant Bog*

## *Unusual Lakes*

### *Lake Baikal From Space*



The Earth - From Space  
A Satellite View of The World

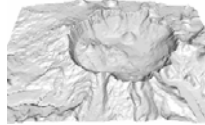
Courtesy NASA

### *Lake Baikal From Space*





## Crater Lake, Oregon



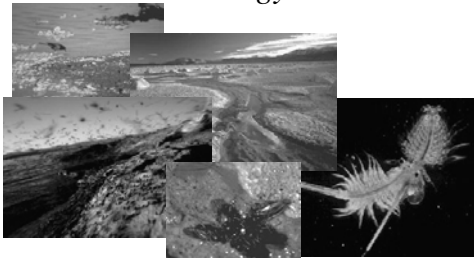
Biological studies include the discovery of bacterial colonies associated with hydrothermal fluids. These yellow-orange mats consist of thousands of *Gallionella* and *Leptothrix* bacteria. Golden-colored bacteria were found surrounding Liao's Bath. A thick band of moss, *Drepanocladus aduncus*, encircles the lake at depths from 26-140 m (85-460 ft). It hangs like icicles on vertical cliffs and forms thick, lush fields on the gentler slopes around Wizard Island. A fascinating discovery is the animals living in the deepest basin of Crater Lake (589 m, or 1,932 ft). These animals which withstand such high water pressure include flatworms, nematodes, earthworms, copepods, ostracods, and the midge fly *Heterotrissocladius*.

## Mono Lake, California



## Mono Lake, California: Ecology

Birds feeding on shrimp and flies



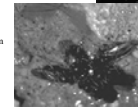
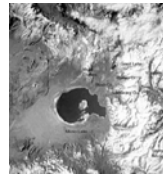
Alkali Flies

Brine Shrimp

## Mono Lake, California: Ecology

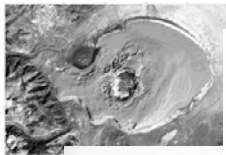
Pluvial lake (no outlet)  
Carbonates (CaCO<sub>3</sub>), chlorides, sulfates  
pH - 9.8  
Salinity - 70-90g/L

*Desulfonatronum thiasimutans* - alkali-loving bacterium  
*Spirochaeta americana* - haloalkaliphilic anaerobe  
*Bacillus arsenicoselenatis* - arsenate-loving benthic bacterium

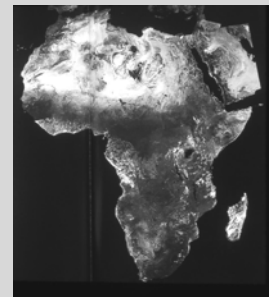


Halophilic green algae:  
*Nannochloris* sp. dominates  
Primary productivity: 340-540g C/m<sup>2</sup>/yr

## Mono Lake, California: Remediation



## Tropical Lakes Of Africa



## Tropical Lakes Of Africa: Lake Nakuru

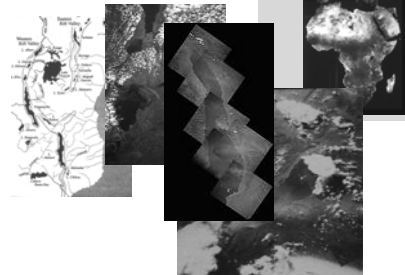


Surface area [km2] 40  
 Volume [km3] 0.092  
 Maximum depth [m] 2.8  
 Mean depth [m] 2.3  
 Water level Unregulated  
 Length of shoreline [km] 27  
 Catchment area [km2] 1,800\*\* Including the lake area.

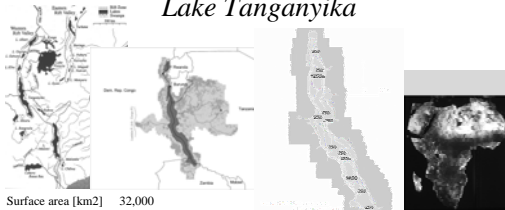
World Lakes Database

<http://www.ilec.or.jp/database/afr/af-07.html>

## Tropical Lakes Of Africa: Lake Malawi



## Tropical Lakes Of Africa: Lake Tanganyika



Surface area [km2] 32,000  
 Volume [km3] 17,800  
 Maximum depth [m] 1,471  
 Mean depth [m] 572  
 Water level - Unregulated  
 Length of shoreline [km] 1,900  
 Catchment area [km2] 263,000

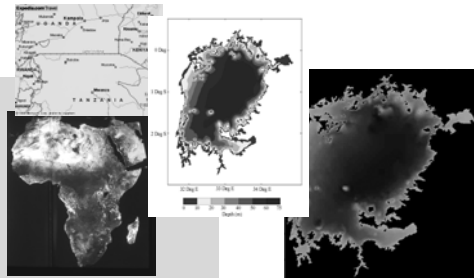
### PRIMARY PRODUCTION RATE

[mg C m<sup>-2</sup> day<sup>-1</sup>](L, 4)

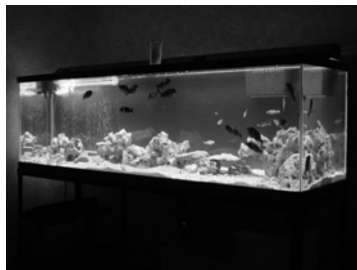
April-May 600  
 October-November 1,400  
 Annual 1,000

Fig. 10/11/12. Primary production rate in Lake Tanganyika. Data from 1988-1990. Source: World Lakes Database.

## Lake Victoria, East Africa



## Tropical Lakes Of New York City



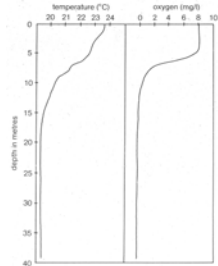
Cichlids Unlimited

## Some Attributes Of Three African Lakes

Lake	World Rank in Size	Area km <sup>2</sup> (miles <sup>2</sup> )	Depth m (feet)	Clarity m (feet)	Age in Years	Cichlid Species
Tanganyika	7th	34,000 (13,100)	1,470 (4,823)	22 (72)	6 million	300
Malawi	9th	31,600 (12,200)	700 (2,310)	17 (56)	1-2 million	500
Victoria	3rd	68,600 (26,500)	95 (305)	1-8 (3-25)	12,400	400



*Temperature And Oxygen Profiles Of A Tropical Lake*



Vertical profiles for temperature and oxygen in a stratified lake - Lake Banyoni in Uganda (after Deane, 1973)

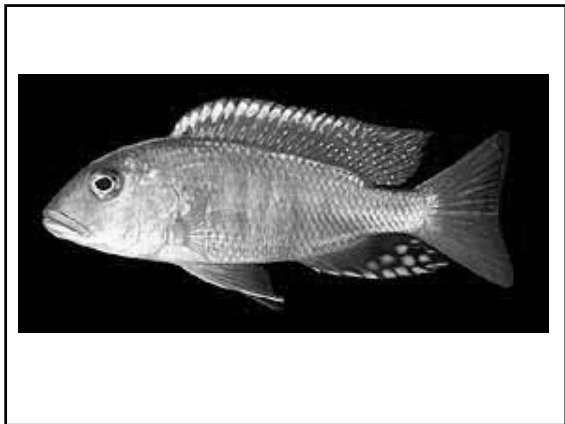
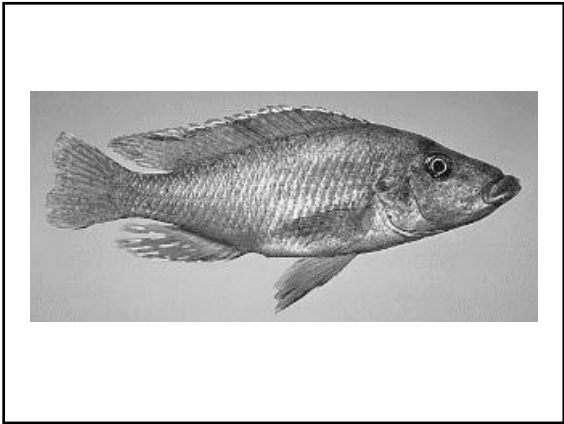
*Lakes Malawi And Tanganyika: Speciation Of Cichlids*

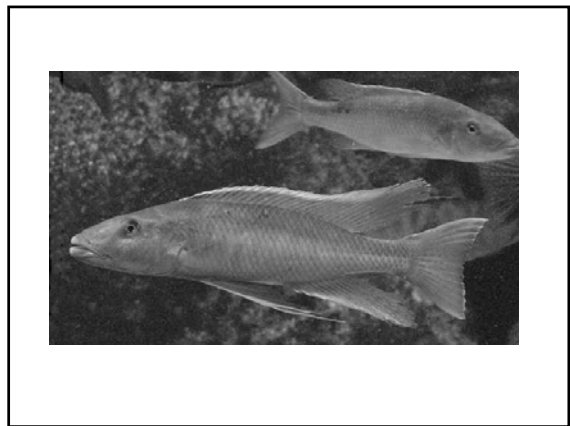
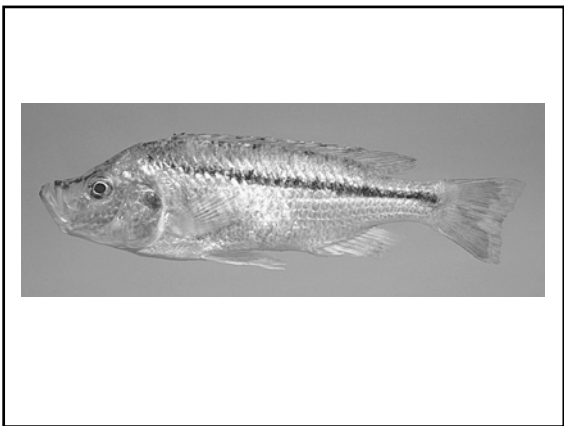
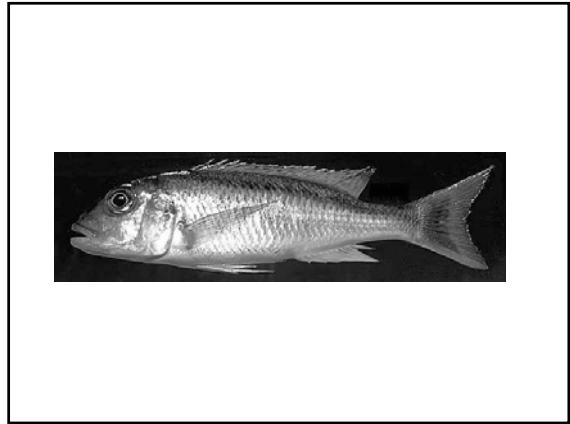
**Speciation of Cichlids**

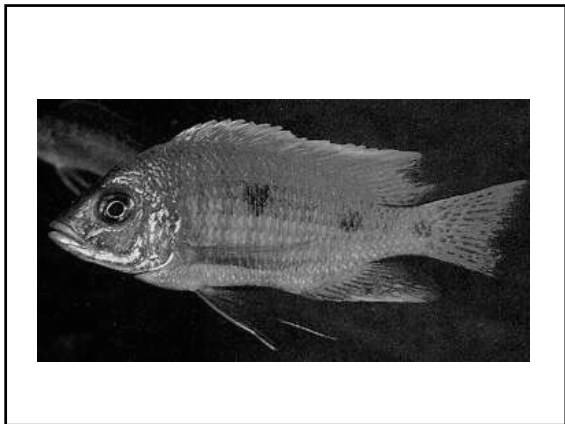
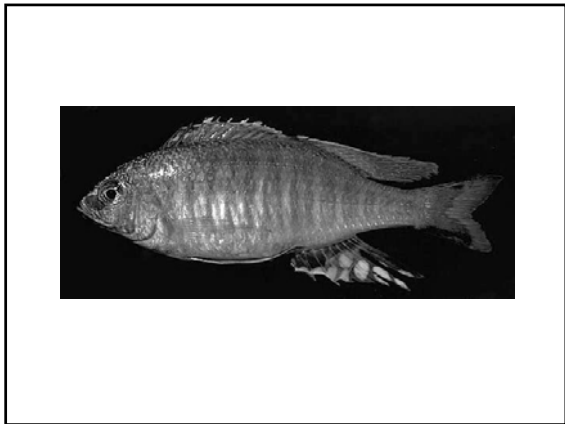
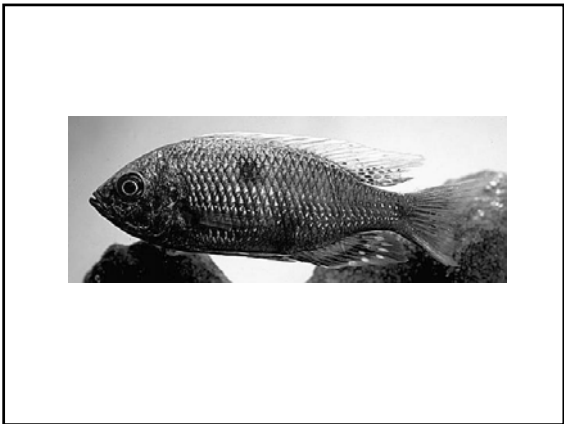
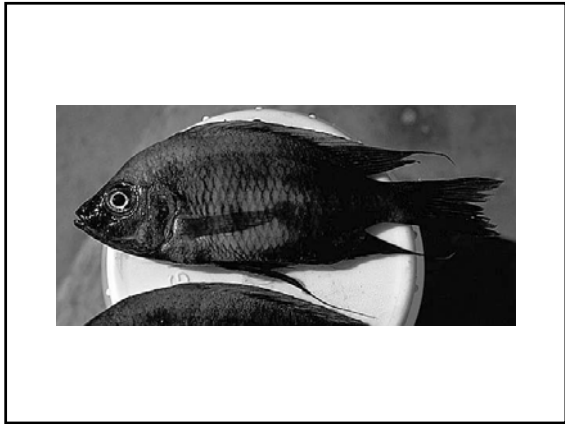
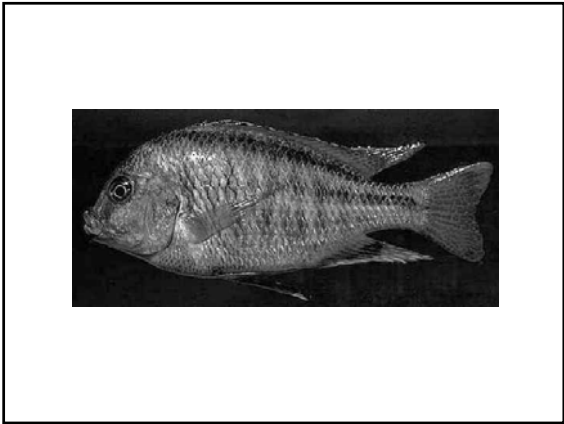


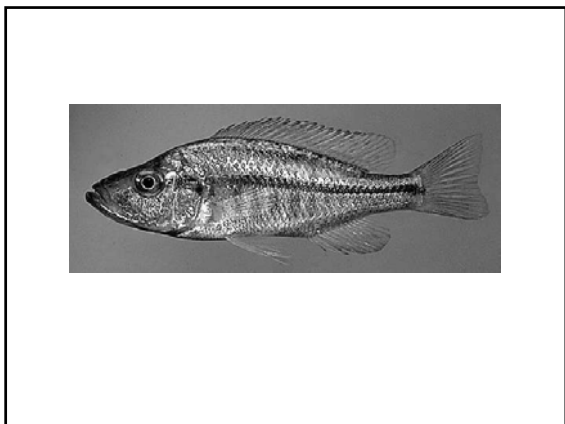
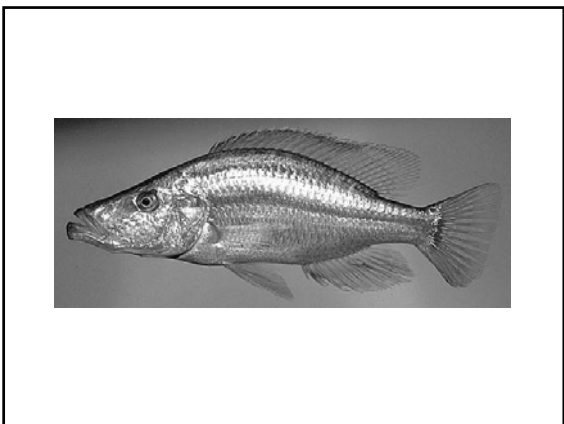
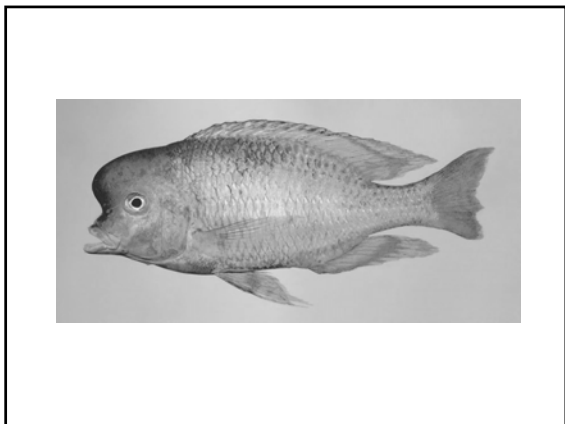
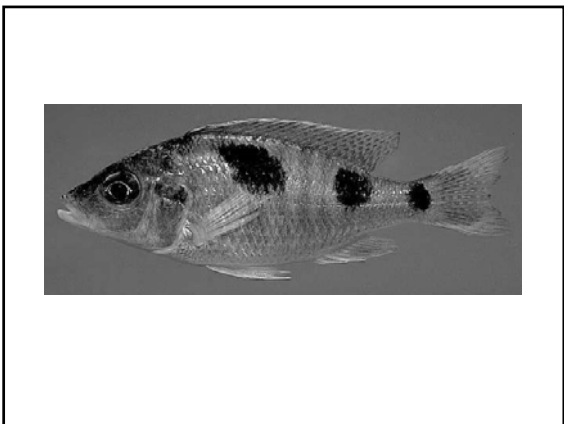
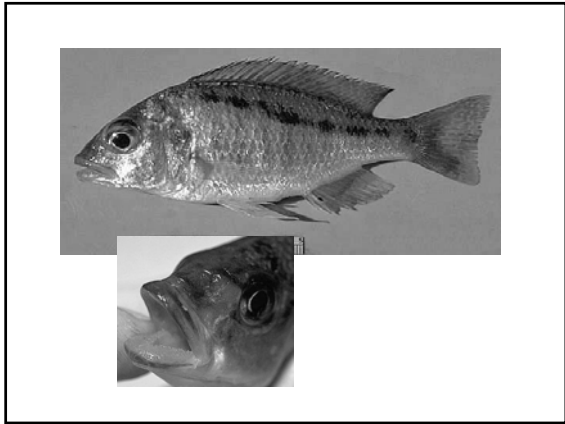
Photography by Stephen Boulet © 1996

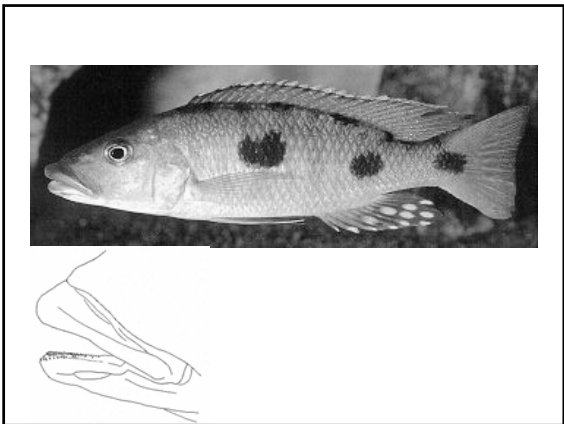
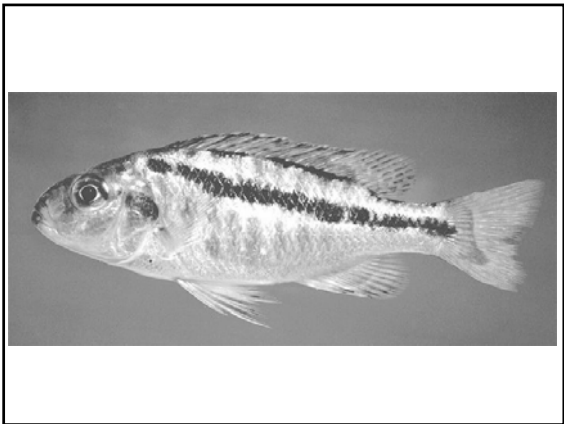
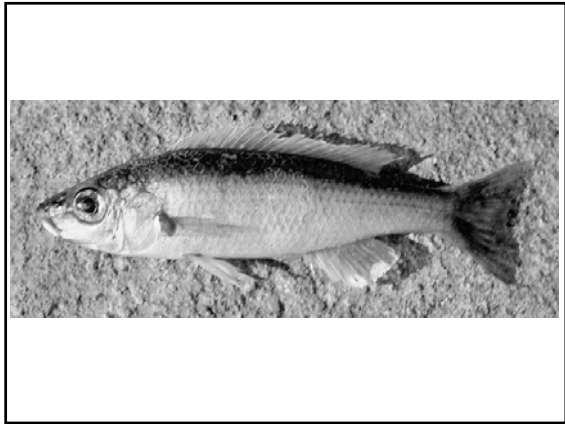
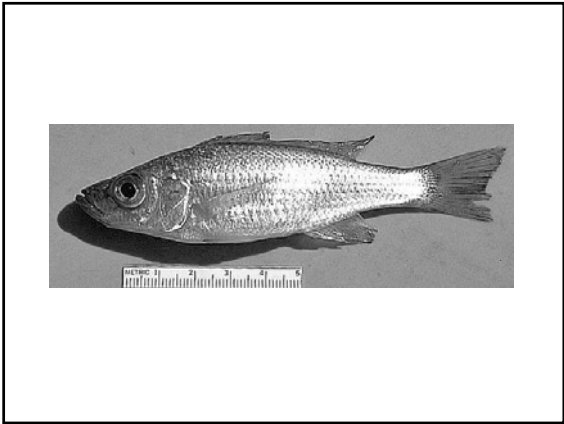


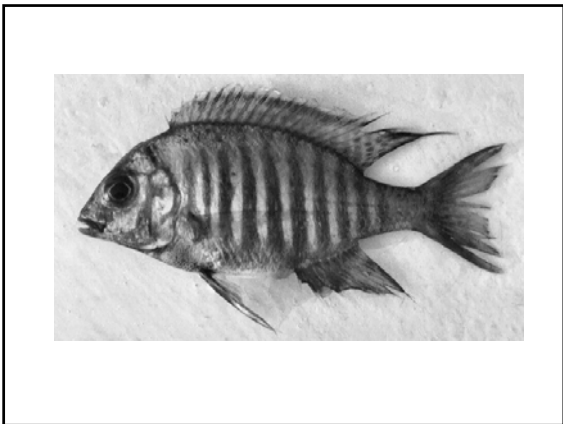
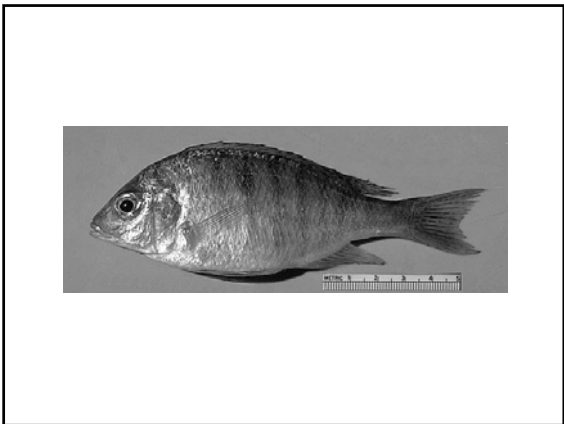
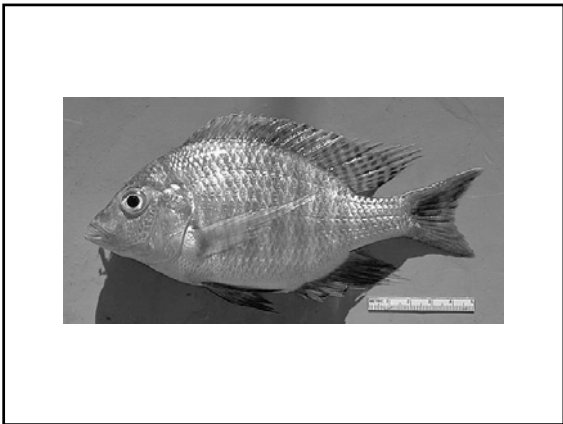
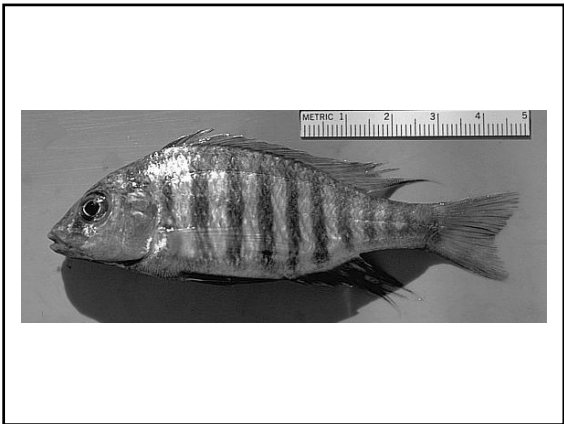
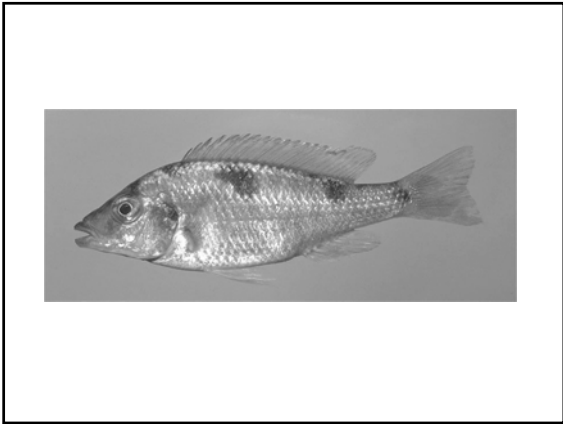
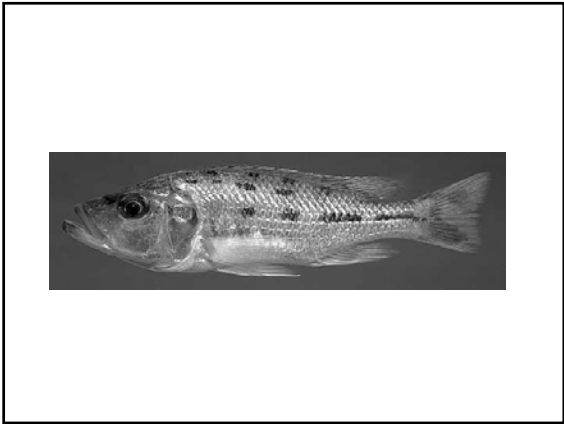


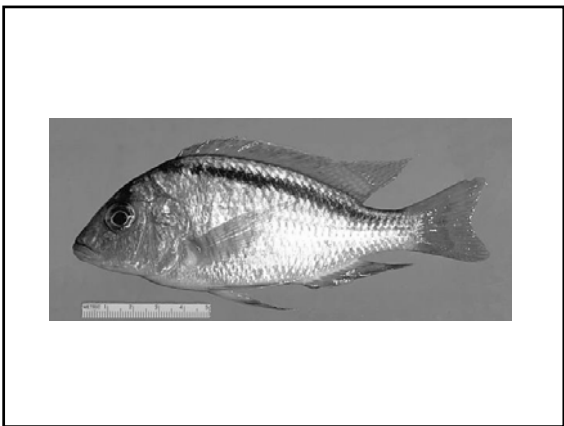
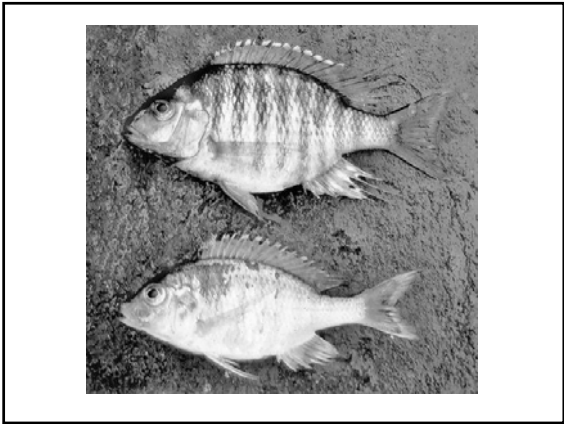




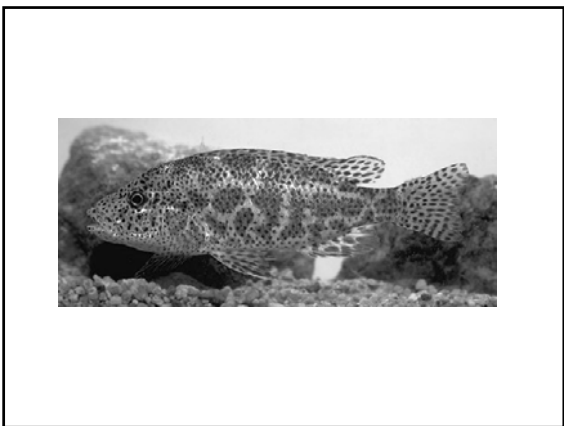


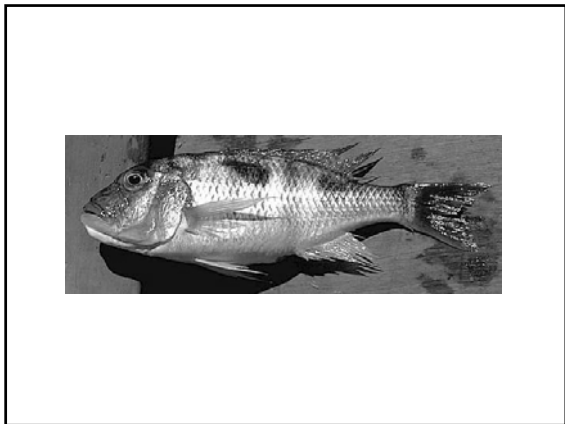
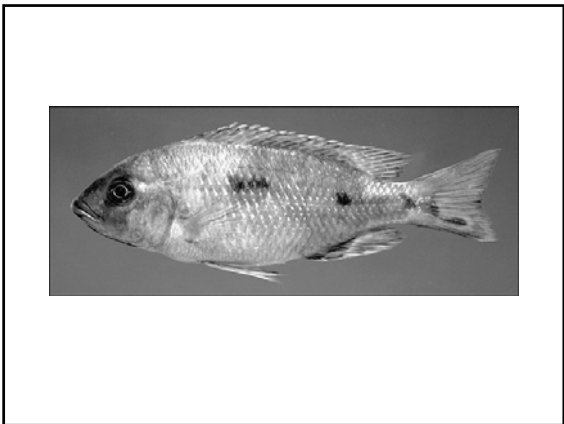
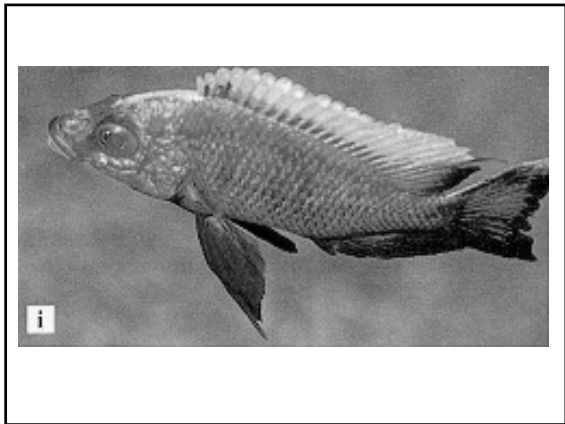
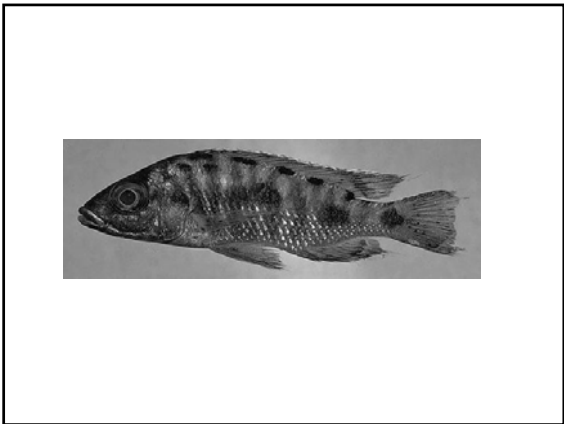
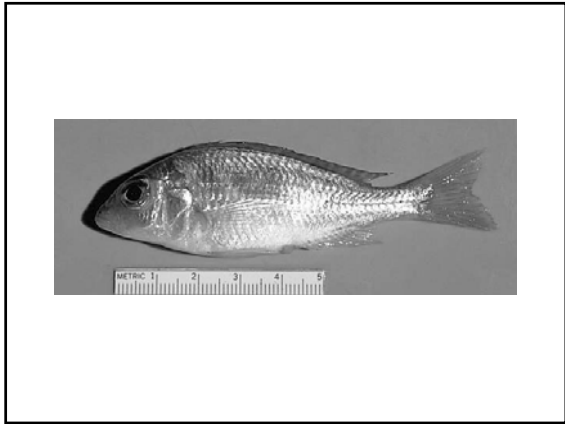
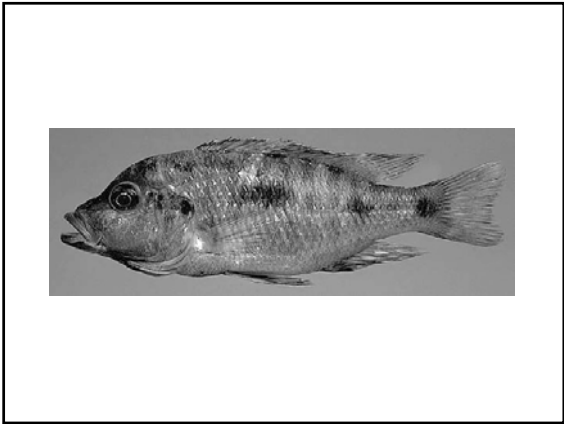


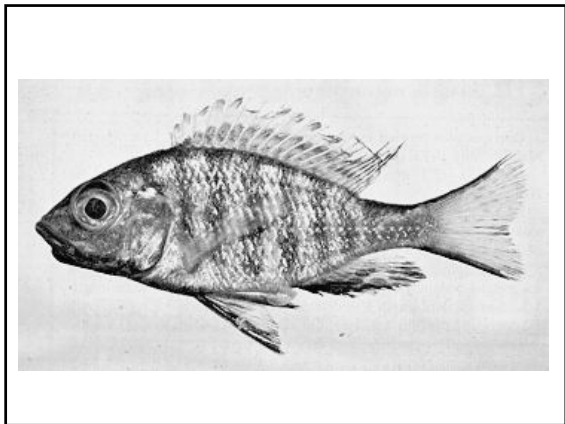
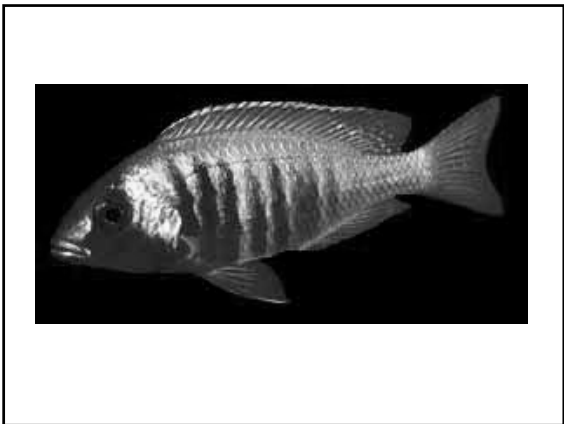
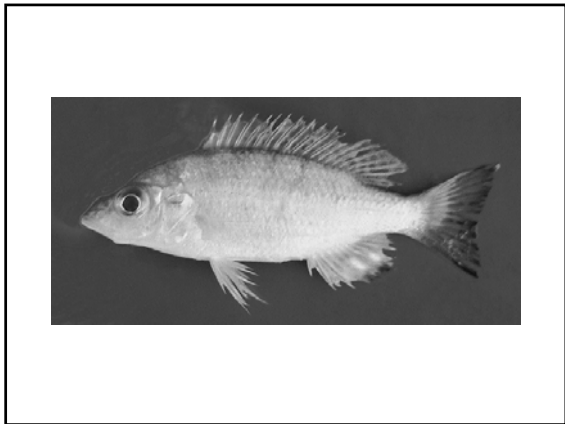
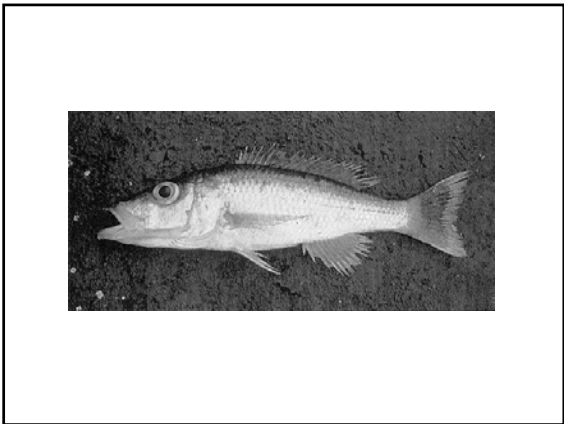
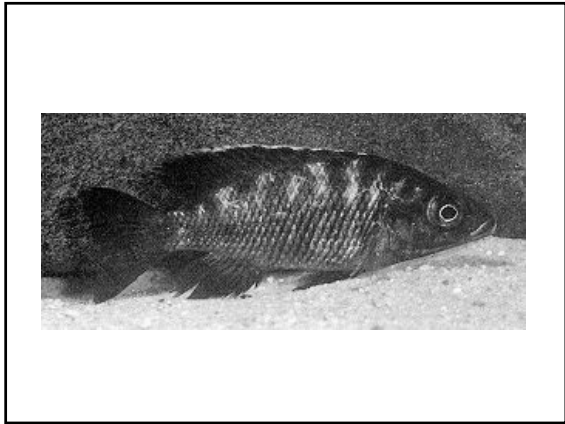
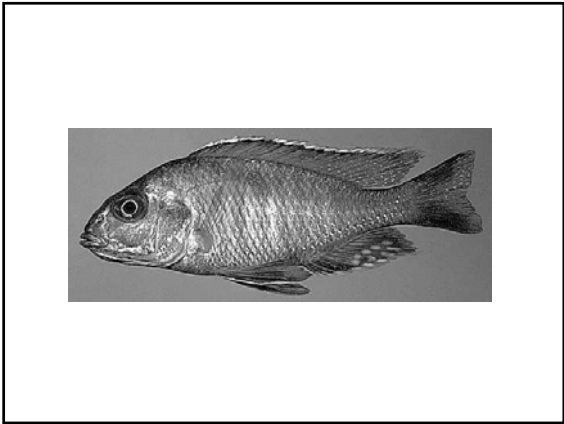


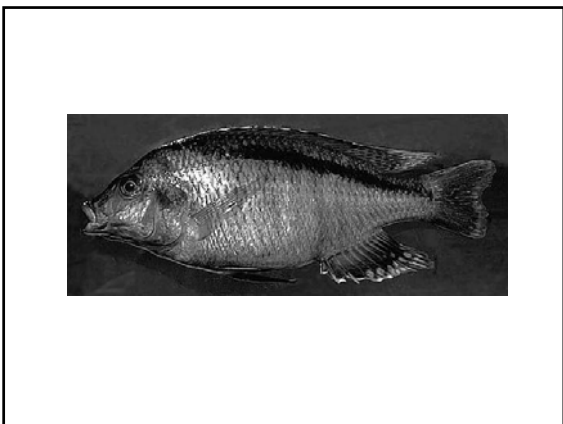
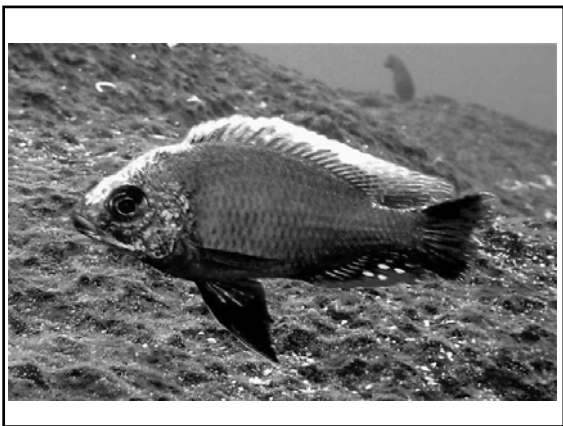
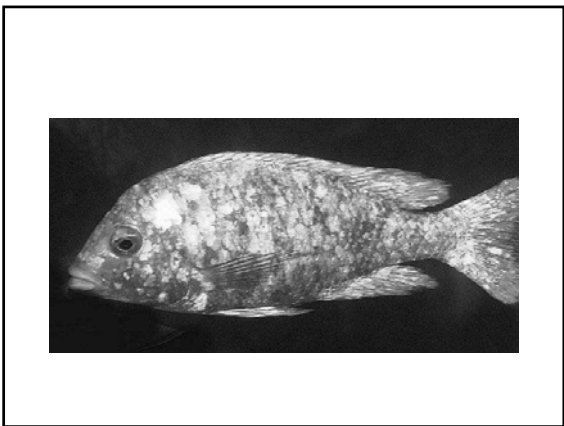
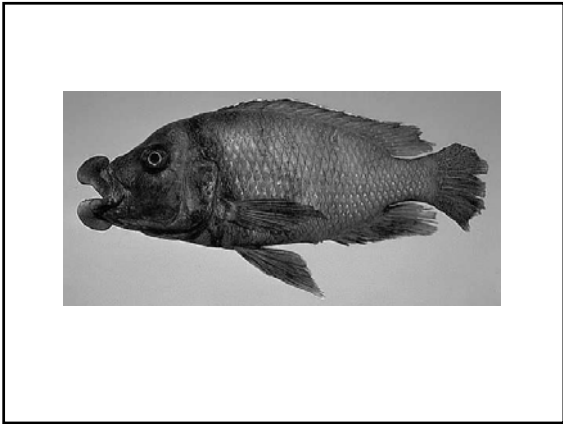
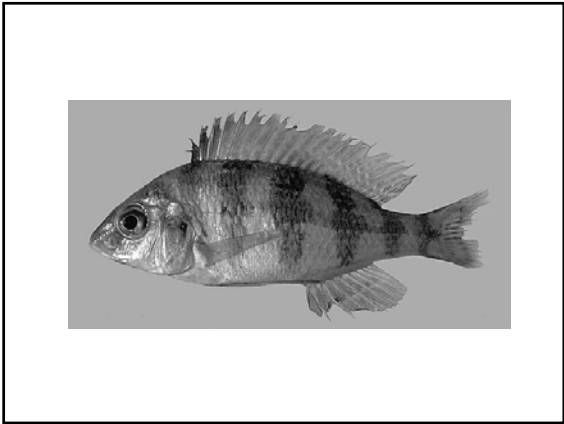


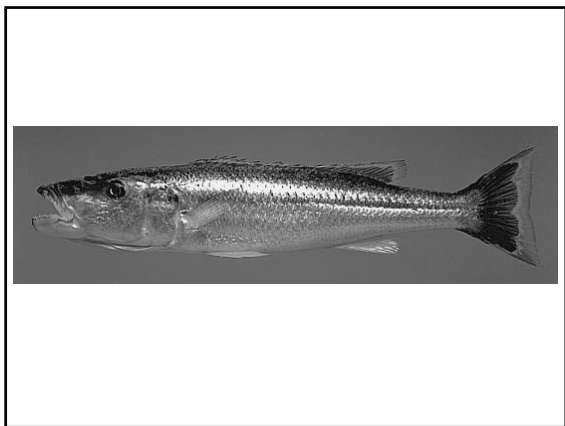
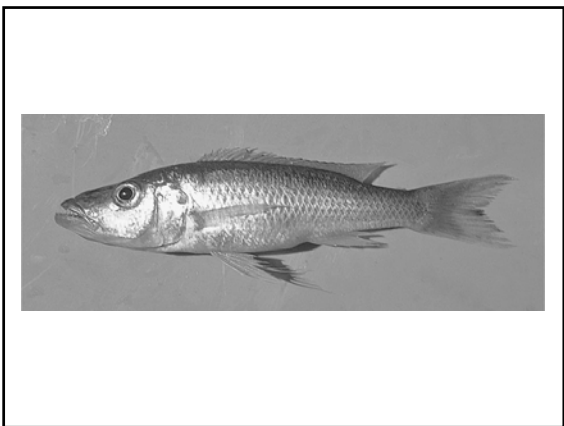
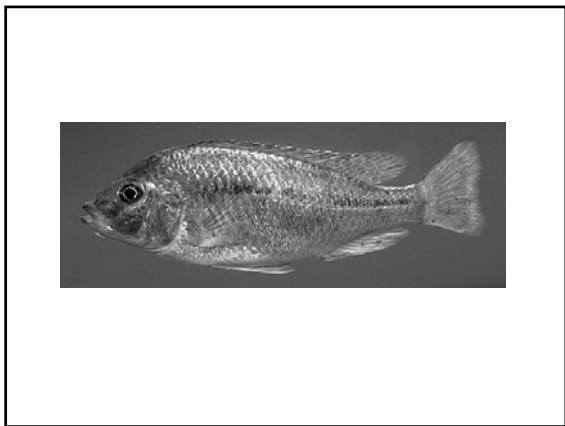
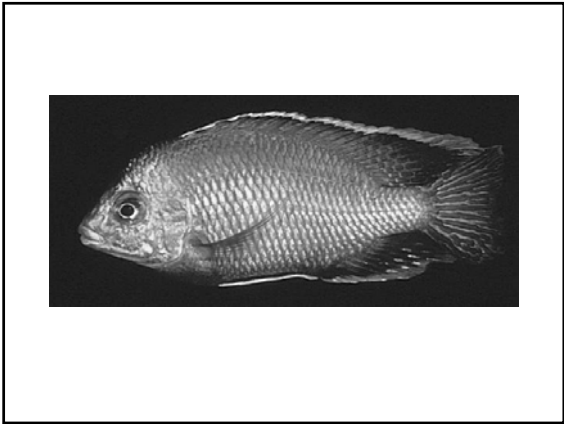


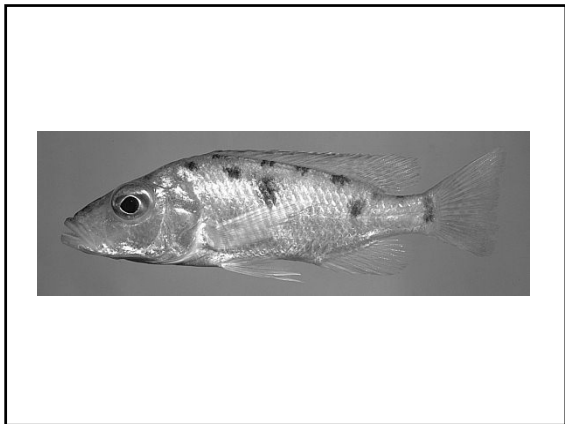
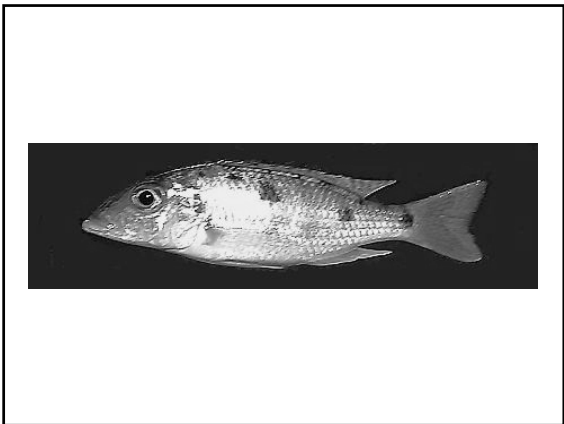
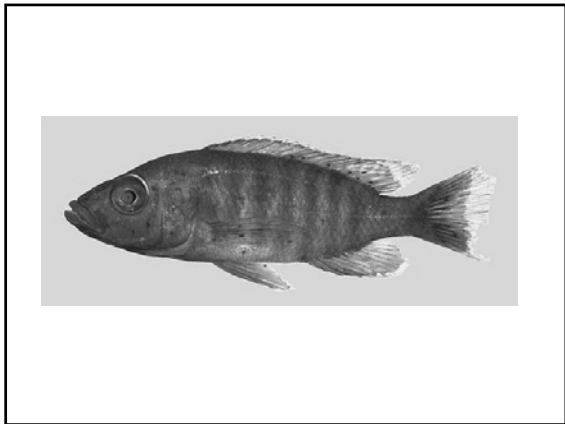
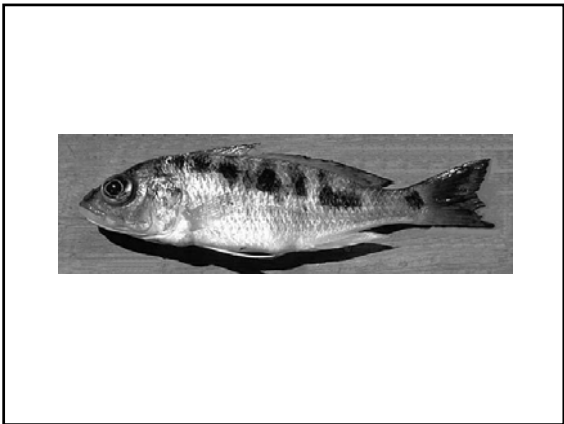
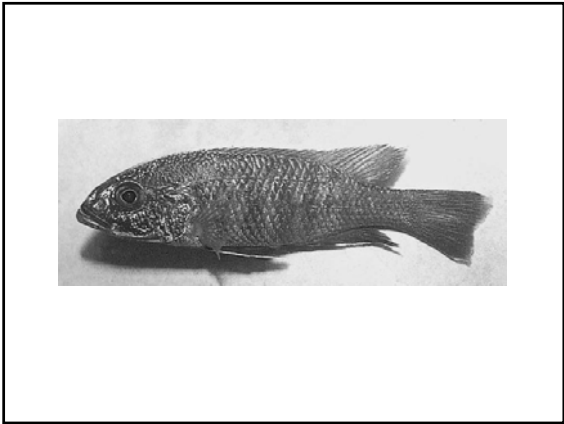


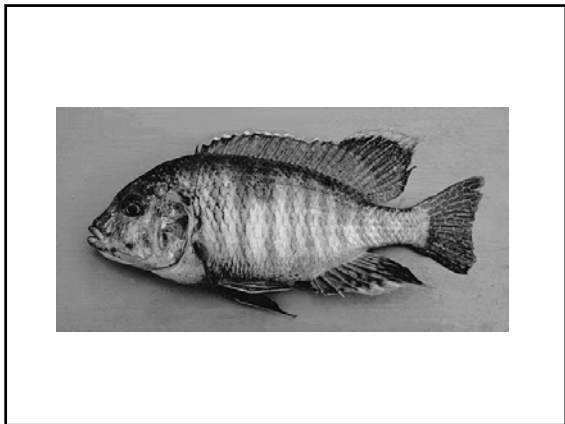
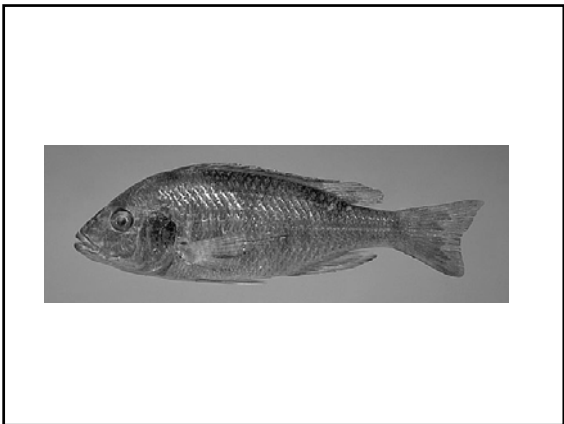
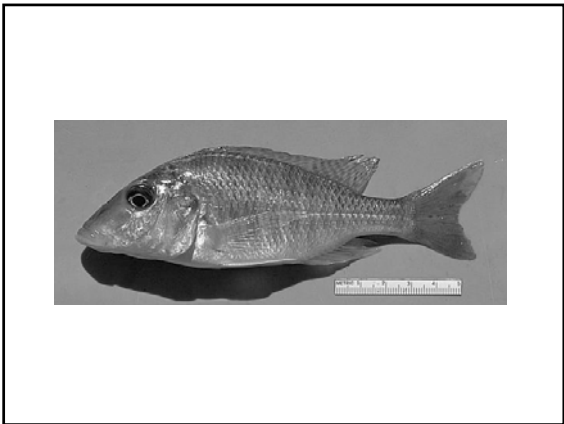
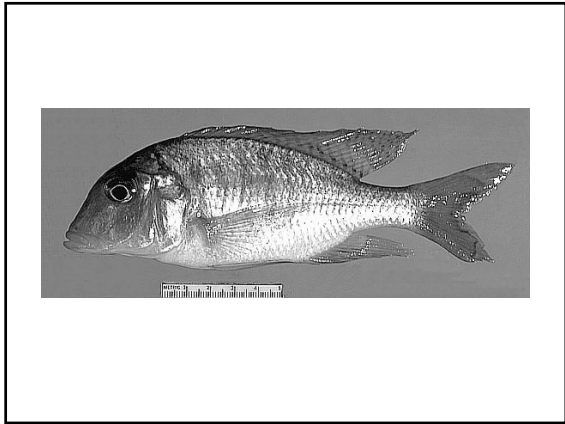
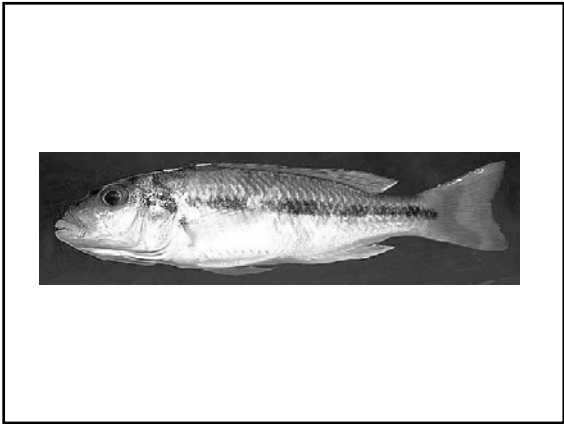


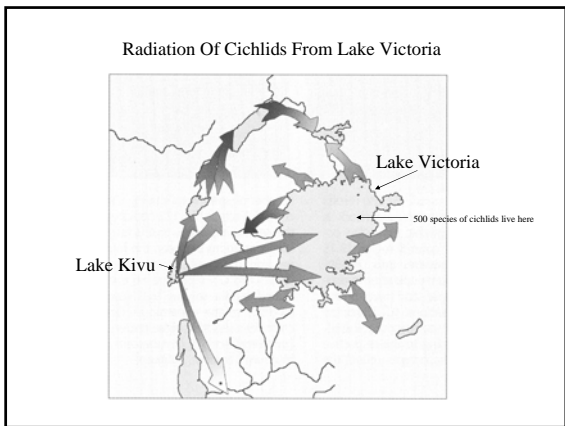
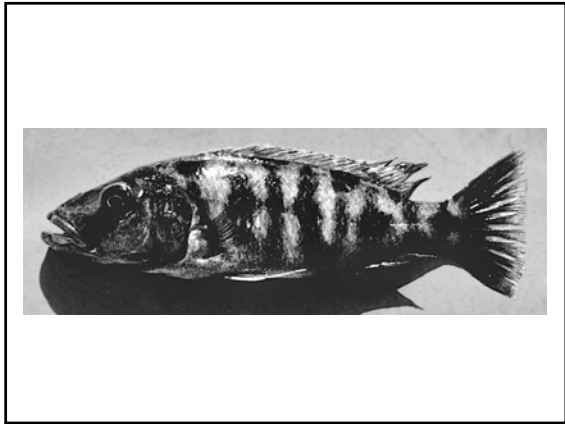
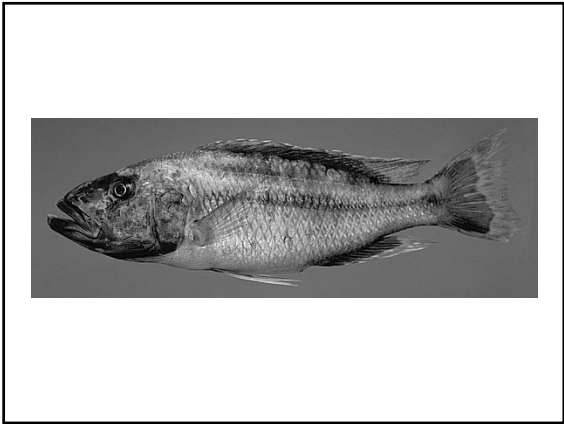




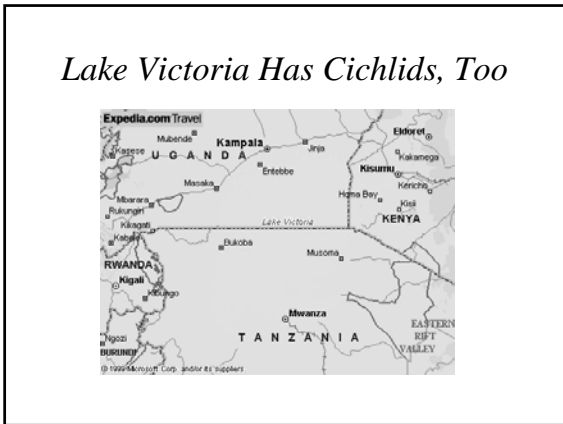
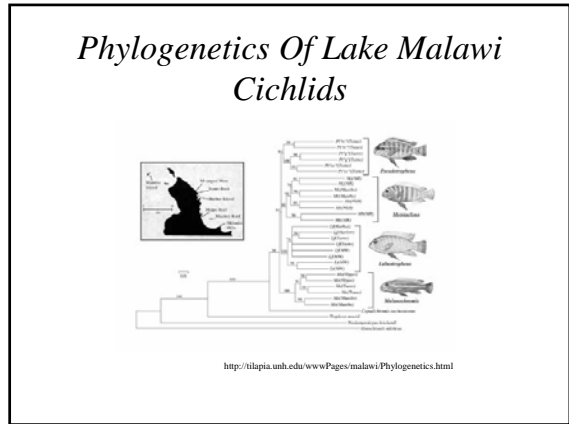
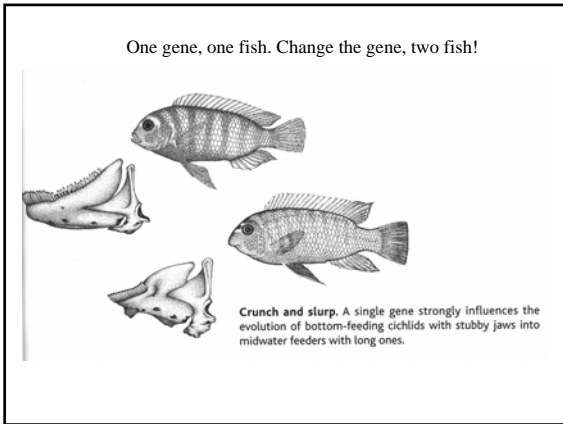
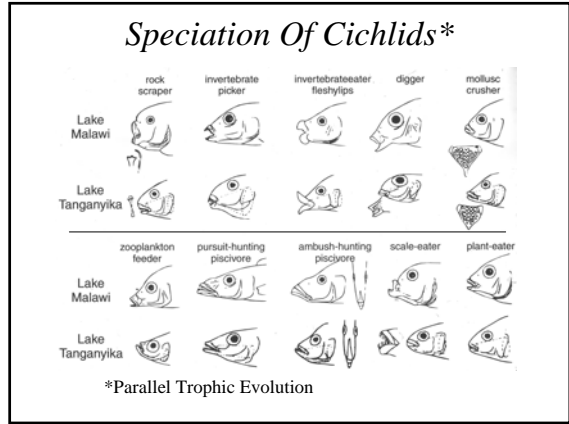
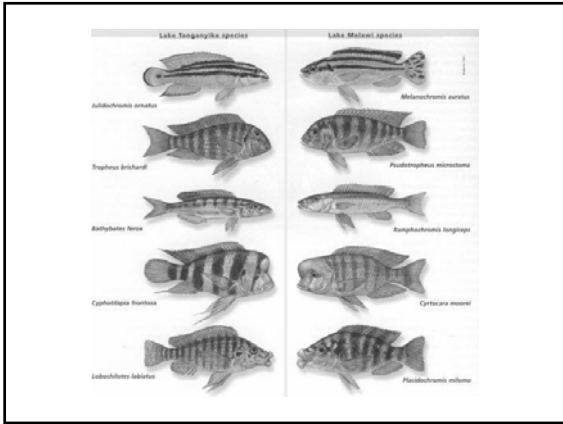












*That Is Until Someone Stocked It With Nile Perch!*

*Nile Perch And Foe*



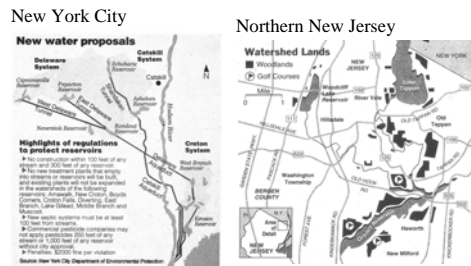
*New York City Drinks Lake Water*



*So Does Northern New Jersey*



*Two Approaches To Watershed Management\**



\*Which water would you rather drink?

*Beavers Alter The Landscape  
In favor Of Wetlands*

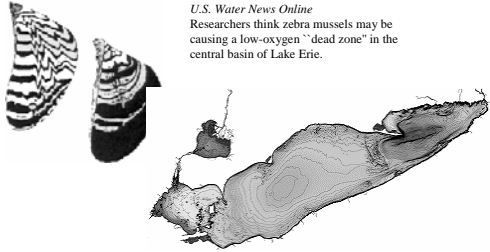


*Most Significant Cause Of Pollution  
World-wide: Agricultural Runoff*



## Zebra Mussels and Lake Erie

Lake Erie dead zone may be due to zebra mussels  
 September 2003  
*U.S. Water News Online*  
 Researchers think zebra mussels may be causing a low-oxygen "dead zone" in the central basin of Lake Erie.

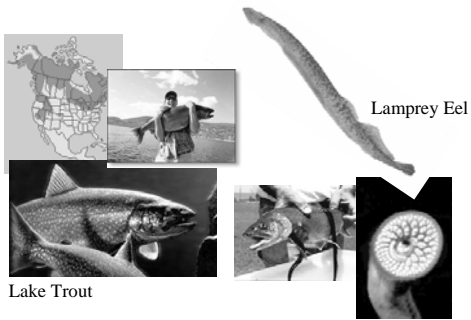


## St. Lawrence Seaway

The seaway was officially opened on June 26th 1959 and cost 470 million US dollars



## Host, Predators, And Parasites



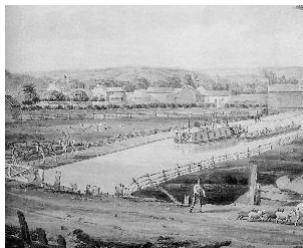
Lamprey Eel

Lake Trout

## Lake Trout With Wounds Inflicted By Lamprey Eels



## How The Lamprey Eel Got Into The Great Lakes



The Erie Canal, circa 1825

## How The Lamprey Eel Gained Entrance Into The Great Lakes: The Welland Canal



Today

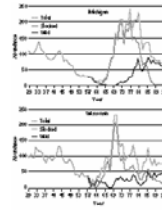
1829

## Controlling Lamprey Populations

1. Lampricides - TMF (3-trifluoromethy-4-nitrophenol)
2. Adult lamprey trapping



## The Lamprey Eel And Lake Trout: Remediation (of sorts)



### Lake Trout in the Great Lakes

by  
**Michael J. Hansen**  
National Biological Service  
**James W. Peck**  
Michigan Department of Natural Resources

Lake trout (*Salvelinus namaycush*) populations in the Great Lakes collapsed catastrophically during the 1940's and 1950's because of excessive predation by the sea lamprey (*Petromyzon marinus*) and exploitation by fisheries.

<http://biology.usgs.gov/iv-4/ho/frame/in2130.htm>