






# WETLANDS

A **wetland** is any area of land where the water table is at or near the surface for some defined period leading to unique physical, chemical and biological processes and conditions of shallow flooded systems.





Rich and sophisticated civilizations grew on wetlands of the Niger, Nile, Tigris, Euphrates, Ganges etc. many centuries ago. The fertile valleys supported large populations and facilitated rapid development of the civilization.

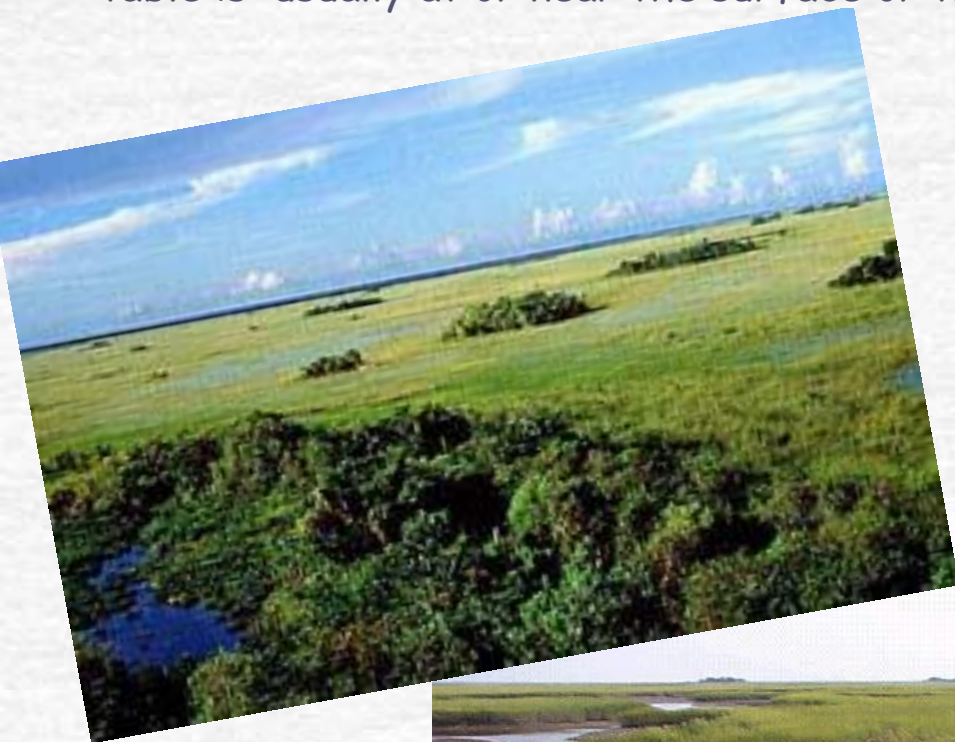




# What is a wetland?

Habitats that are not quite terrestrial and not quite aquatic

Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.



- Wetlands are usually inundated by water during some part of the year, are poorly drained, have low relief, and have high soil moisture.
- Wetlands may appear along coasts as swamps or marshes (i.e. salt marshes) or in the continental interior as marshes, wet meadows, or prairie potholes, or peat moss bogs







Dave Davis

## Wetland Function

reduce damage caused by floods by slowing and storing flood water

recharge groundwater supplies and moderate stream flow by providing water to streams

cleaning of polluted waters and improving water quality

habitat for plants and animals

# Benefits of Wetlands

- ✔ A unique wildlife habitat
- ✔ Support water based recreational activities
- ✔ Natural downstream flood control
- ✔ Natural treatment and filtering system for polluted water
- ✔ Potential source of ground water recharge



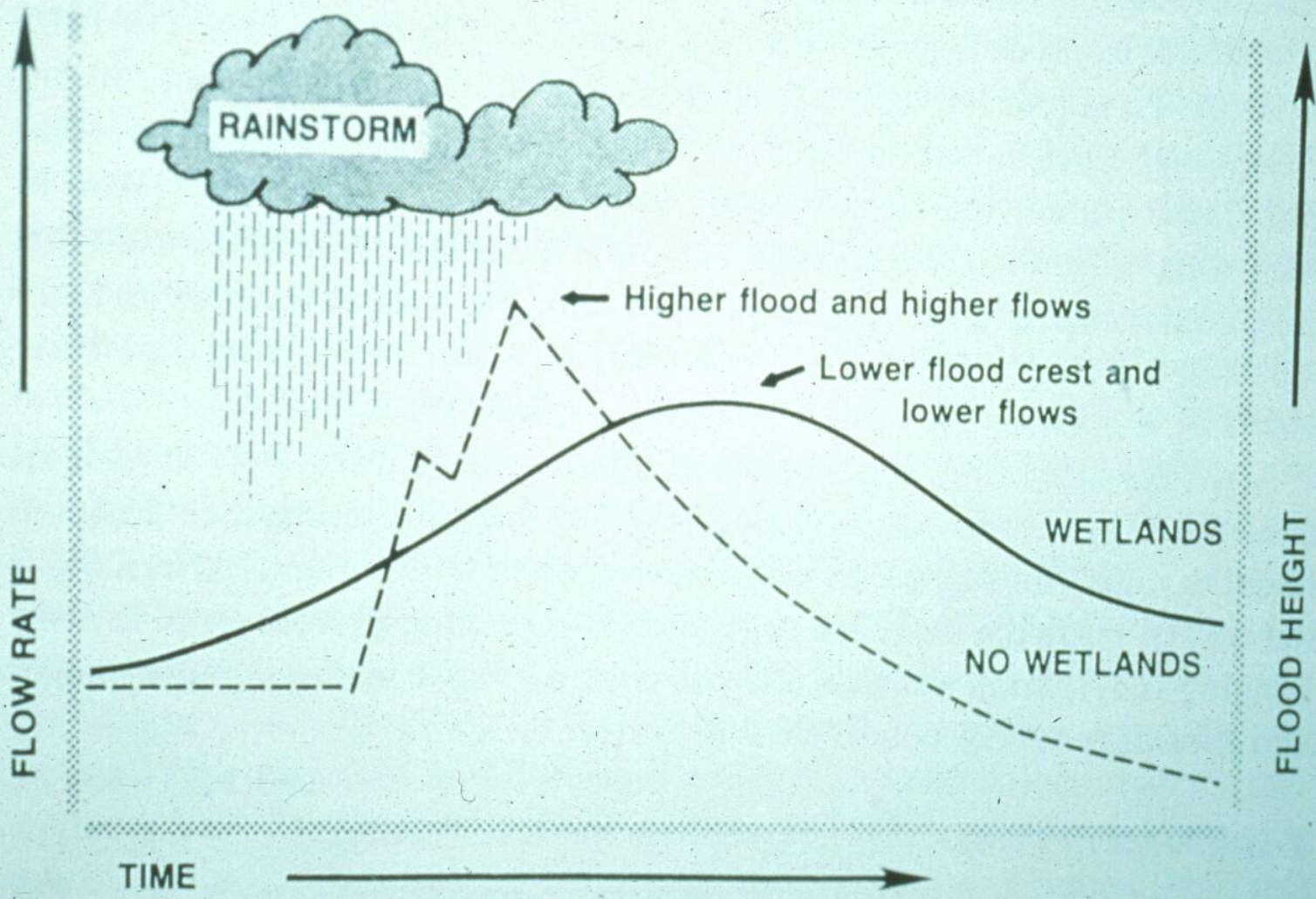


FIGURE 1. Wetland value in reducing flood crests and flow rates (Tiner 1984).



# Flooding in the mid-South, Nov., 2001



























Natural wetlands have distinct ecosystem functions to which society can assign a “value.”

- **nutrient storage** → removal of fertilizing nutrients helping farmers to attain compliance with water quality targets
- **accumulation of organic material for fuel or agriculture** → storage of carbon, source of peat
- **filtering of solids from waters** → wastewater and sewage treatment, trapping sediment



Natural wetlands have distinct ecosystem functions to which society can assign a “value.”

- **animal habitats** → fishing, wildfowl hunting and fish and shrimp hatcheries. In addition, Wetlands are a home to threatened and endangered species.
- **plant habitats** → forestry, agriculture
- **regulating water outflow** → flood and erosion protection
- **all functions** → recreation, research, and education

# Contributions to poverty alleviation

→ Products

↓ Natural

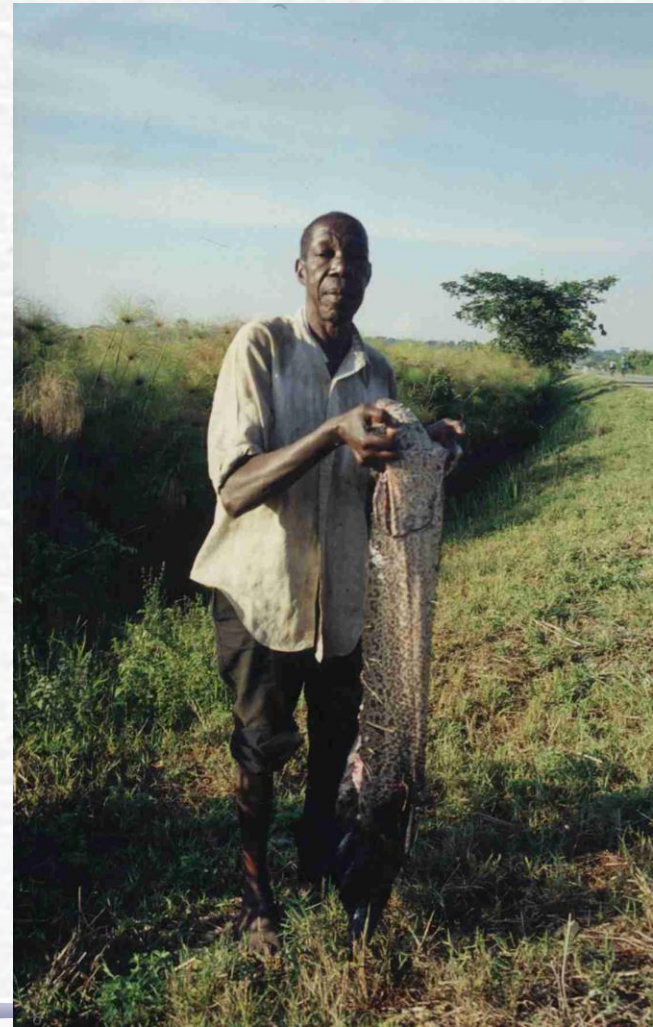


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# The Truth- and nothing but the truth!

**.. Is that wetlands contribute immensely to poverty alleviation and to the health of the environment**



# Contributions to poverty alleviation

## Hydrological services

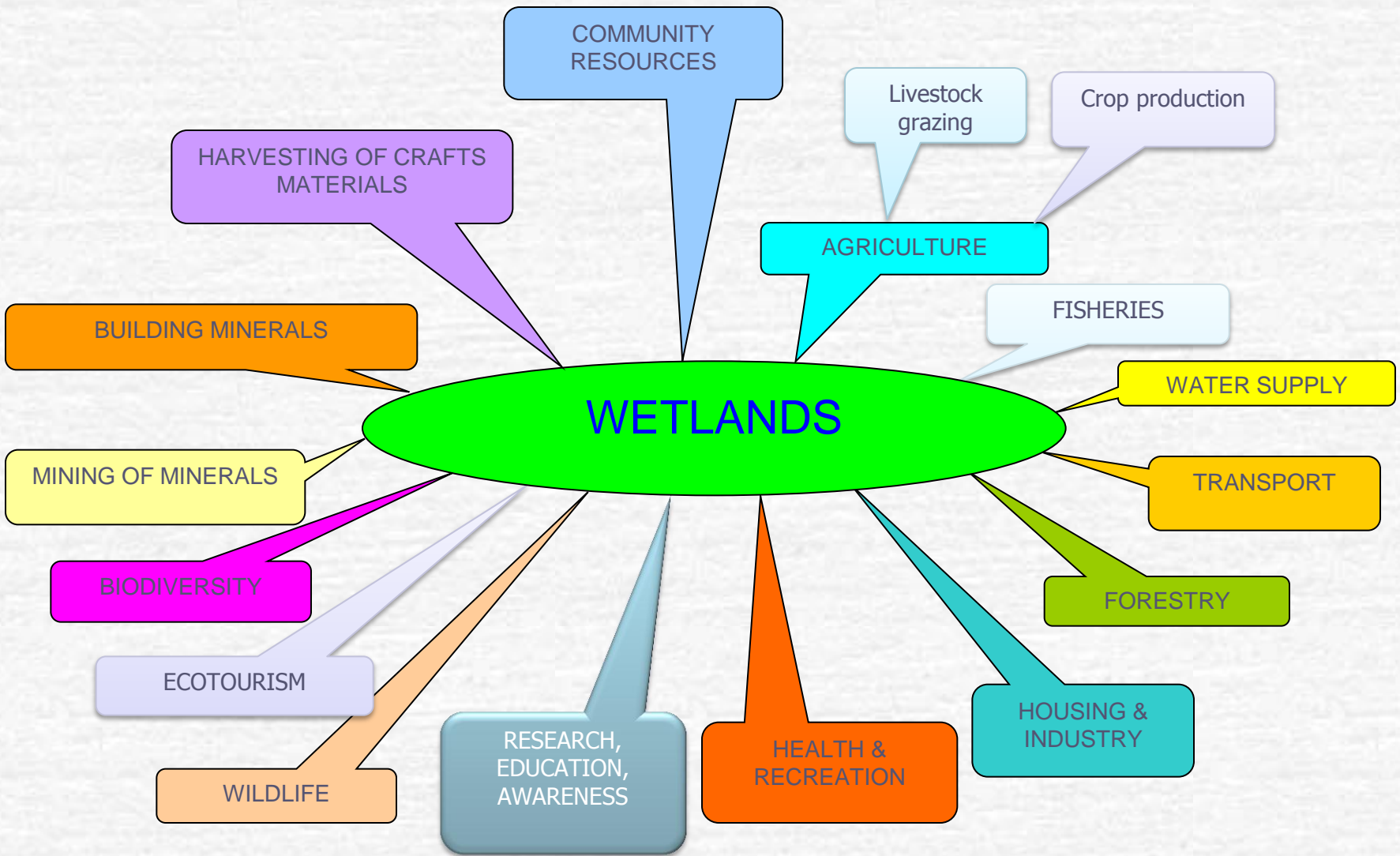
- water storage and distribution in space and time
- water filtration and purification







18 5 2002



COMMUNITY RESOURCES

Livestock grazing

Crop production

AGRICULTURE

FISHERIES

WATER SUPPLY

TRANSPORT

FORESTRY

HOUSING & INDUSTRY

HEALTH & RECREATION

RESEARCH, EDUCATION, AWARENESS

WILDLIFE

ECOTOURISM

BIODIVERSITY

MINING OF MINERALS

BUILDING MINERALS

HARVESTING OF CRAFTS MATERIALS

WETLANDS



# WETLAND THREATS

- ✓ Drainage
- ✓ Dredging- process of excavating materials underwater. It is used to deepen waterways, harbors, and docks and for mining alluvial mineral deposits, including tin, gold, and diamonds
- ✓ Stream channelization
- ✓ Logging
- ✓ Mining
- ✓ Pollution
- ✓ increased nutrient levels
- ✓ Nonnative species

# Wetland threats cont'd

- Diking- a bank of earth formed of material being excavated.
- damming
- Tilling
- Levees- (or dyke), embankment, flood bank or stop bank is a natural or artificial slope or wall, usually earthen and often parallel to the course of a river.



# Value of Wetlands: Hydrology

- ☞ Extremely important as a mechanism for hydrological control of stream flow.
- ☞ Increased lateral flow
- ☞ Increased retention time
- ☞ Increased infiltration
- ☞ Groundwater recharge
- ☞ Wetlands have high water storage capacities
- ☞ Wetlands are often the fundamental source of dry season base flow.

# Value of Wetlands: Soil Stabilisation

Dense vegetation is highly effective at binding the soil and protecting the soil surface.




# Value of Wetlands: Water Purification

- Increased deposition of silts, organic substances and inorganic substances.
- Allows the settling out of toxins.
- Absorption of nutrients and trace elements by vegetative biomass.



# Value of Wetlands:

## Very high levels of production

- High levels of nutrients
  - Abundant water
  - In many cases, a stable environment
- 



# High Biodiversity

## Why?

- Stability?
- Productivity?
- Crucial role in life cycles?

## What drives diversity?

- stability and productivity, or low productivity and stress, or instability, or spatial and temporal variability?

**hydrophytes** - plants typically found in wet habitats



Purple loosestrife  
*Lythrum salicaria*



cattail  
*Typha sp.*

**hydric soil** - soils which are usually wet and where there is little or no free oxygen

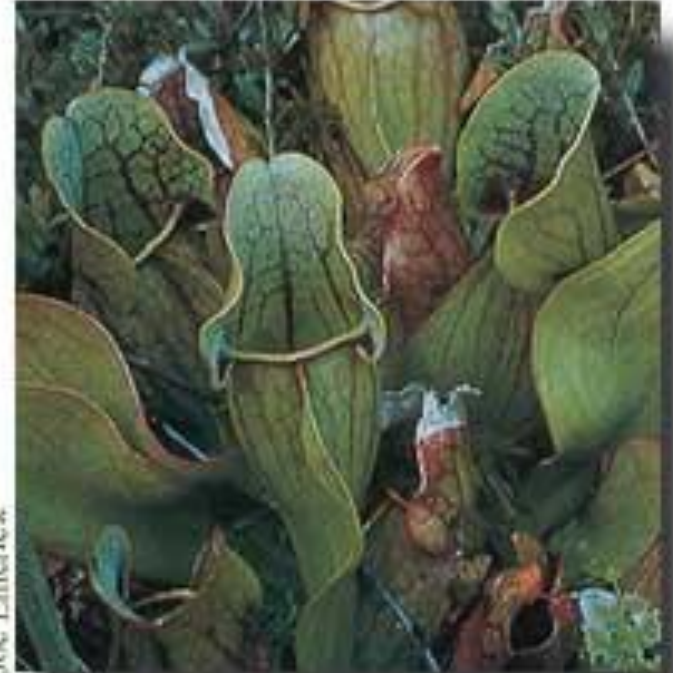


**Bog** - characterized by spongy peat deposits, acidic waters, and a floor covered by sphagnum moss.



John Neelher ton

Eastern mud salamander (*Pseudotriton montanus*) on *sphagnum* moss



Joe Emerick

Northern pitcher plant  
*Sarracenia purpurea*

Bogs receive all or most of their water from precipitation rather than from runoff, groundwater or streams.



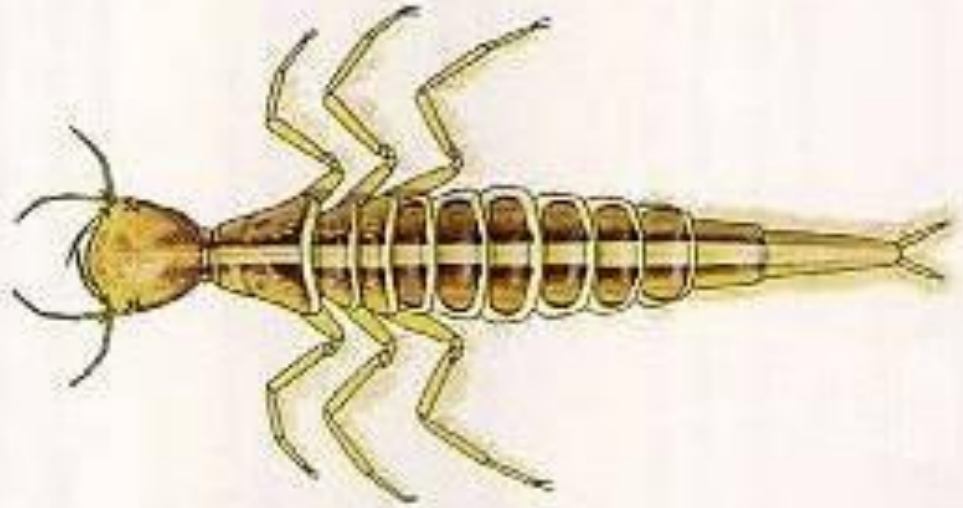


# Insects are often major predators in temporary ponds

*Notonecta*--backswimmer



Dyticid beetle larva



Dragonflies



Some insects get through the dry phase in dormancy, other just fly away and re-colonize the pond once it refills

# Many amphibians breed in temporary ponds

[http://www.nwf.org/frogwatchUSA/frogs\\_state.cfm](http://www.nwf.org/frogwatchUSA/frogs_state.cfm)



American Toad  
*Bufo americanus*



Chorus frog  
*Pseudacris triseriata*






## Definition Reminder



Thus areas of land that are permanently, seasonally or occasionally water logged with fresh, saline, brackish (slightly salty) or marine waters including both natural and man made areas that support characteristic biota qualify as wetlands.

# Wetlands in Kenya

- Wetlands cover about 14,000 km<sup>2</sup> of Kenya's land surface and are diverse in type and distribution.
- They include:



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- **The lake Victoria wetlands** i.e. the edges of shore and the islands in the lake and **Lakes Kanyaboli, Jipe and Challa.**
  - **The Rift valley lakes** of Magadi, Naivasha, Elementaita, Nakuru, Bogoria, Baringo and Turkana.
  - **Extensive swamps** e.g. Ewaso Nyiro, Yala-Nzoia delta, Suswa etc.
- The Flooded plains** of Shompole in the south and Lokitipi in the north west.
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- **The Coastal wetlands** in the Tana delta and the north of Sabaki river. **These include mangroves, coral reefs, sea grass beds, and back reef lagoons.**
- 








**In Kenya, wetlands are important since they provide people with an enormous range of goods and services ranging from staple food plants, grazing grounds, coastal and inland fisheries and breeding grounds for birds.**







Wetlands also are vital life support systems which play a significant role in controlling the hydrological cycle and they help clean the environment.

Major water sources for industrial and domestic uses are found in wetlands.



# TYPES OF KENYAN WETLANDS

1 **RIVERINE WETLANDS**: these are wetlands, which are found along river courses. They are most obvious in the lower river courses where flood plains and **ox-bow lakes** may be found. E.g lakes Shakababo, Asso etc. Swamps may develop on both sides of the river as the river meanders. Deposited sediments on the channel may raise the level of the river above the flood plain.



# Riverine wetlands




Photo by R. Grippo



2. **LACUSTRINE WETLANDS**: this type of wetlands are associated with lakes, i.e. the sources of water are lakes.


a) **Crater lakes**: these are circular and steep sided lakes that may have fringing vegetation. Examples are lakes Simbi and Chala. Others occur on Mt.Kenya and Mt.Marsabit.






Lacustrine wetlands in Pine Barrens, southern NJ







b) **Rift valley lakes**: these occur on the floor of the Rift valley. They are usually small and shallow. Examples are Bogoria, Nakuru and Magadi. Lake Ol Bolossat lies on the back tilted Kinangop Plateau at the base of Satima escarpment. It is the highest lake within the Kenyan Rift valley.









C) **Glacial lakes**: are also called **tarns** and are found on rocky eroded basins of upper slopes of Mt. Kenya. Due to low temperatures they do not support large wetland ecosystems.






d.) **Lake Victoria:** formed in a large down warped basin, the lake is fed by many rivers and has an outlet in Jinja. The shoreline is irregular with many headlands, inlets and islands. The nature of land creates a suitable environment for the accumulation of sediments and development of swamps along the shorelines.










e) **Plateau wetlands**: on the plateau, one finds depressions on which shallow lakes are found. These lakes are fed by springs and surface run off. They vary in surface area and volume. They may dry out completely during prolonged drought. Examples are **Amboseli** and the **Suguta Marmar**.

**Deltaic** wetlands are found on river mouths entering lakes or oceans.






3. **PALUSTRINE WETLANDS**: these are associated with **marshes**, **swamps** and **bogs**. Swamps are wetlands with H<sub>2</sub>O above ground with emergent vegetation reaching at least one metre above the water surface. Marshes have shorter emergent vegetation and may have water above, at, or below, ground level. A bog is usually round to oval in area and covered by **sphagnum moss** that is saturated because of high water table.












A bog is characterized by having no obvious channels leading into it and therefore lacks any appreciable surface inflow or outflow of water. It obtains its water and nutrients through precipitation and ground water. Bogs occur in areas where precipitation exceeds evaporation. An example is **Ondiri swamp**.








There are extensive swamps in Yala-Nzoia Delta, Shompole in the south and Ligitipi in the northwest.




## 4. ESTUARINE WETLANDS


Estuaries are inlets where rivers enter the ocean. Sources of moisture are partly **oceanic** and partly **fresh water (Brackish)**. Estuaries are found along the Kenyan coast around the islands of Lamu, Manda, and Pate, also Kilifi, Turtle Bay, Shimo la Tewa and Mombasa. Estuaries are sheltered from high-energy waves and get fine-grained sediments from inflowing streams. Their shores are colonized by mangroves and associated plants.





Mangroves grow in sheltered tidal waters below the high water level of spring tide. They are trees and shrubs that are adapted to the inter tidal environment and have developed **aerial roots** that absorb atmospheric oxygen. The roots provide anchorage in unstable substratum and have ability of **salt excretion**.






Mangroves in Kenya grow along the coast, around islands (Mombasa and Lamu) and along the banks of coastal creeks e.g. Mida, Kilifi and Mtwapa.

## **5. MARINE WETLANDS**


The marine wetlands include sea grasses and coral reefs.






## a) Coral reefs

- The coral reefs run parallel to the coast at a distance of 0.5 to 2.0 km. from the shoreline. This type of coral is the **fringing reef**.
- Coral reefs are found in Kisite, Malindi coral gardens and the Lamu archipelago. **140 different species** of hard and soft coral have been identified. Corals are organisms that grow slowly and require clear, well-oxygenated water.



Coral reefs are used as source of building materials, jewellery, ornamental objects and medicinal products (antibiotic drops). Half of the fish caught along the coast by artisan fishermen are associated with the coral reefs.









b) **Sea grasses**

Between intertidal zones to depths greater than the reefs are sea grass meadows. These are marine angiosperms that grow and flower underwater on shallow soft sediments. The families of these sea grasses include *Hydrocharitaceae*, *Cymodoceae* and *Zosteraceae*.






In Kenya sea grass beds are found in patches along the coastline often extending into the creeks. **Factors that determine the zonation and distribution of sea grasses are substrate type, salinity and the duration of emersion during the low tide.**

Animals that graze on the sea grass are sea turtles, dugoung, mollusks and a variety of fish.








Sea grass beds form nursery, breeding and feeding grounds for marine species that inhabit mangroves and the coral reefs.

## **6. Agricultural and artificial wetlands**

These include man made wetlands, irrigated lands, fishponds, dams, salt evaporation ponds, road impoundments and waste water treatment facilities.



Wetlands converted into agricultural land





# THREATS TO WETLANDS

- ☞ **a)** Cutting of aquatic plants for fuel, housing and commercial activities.
- ☞ **b)** Drainage-excluding water.
- ☞ **c)** Overgrazing
- ☞ **d)** Illegal and improper fishing practices
- ☞ **e)** Pollution by domestic sewage and industrial effluent, Dam building, mining and quarrying as well as coastal development.





- ✓ **f)** Eutrophication
- ✓ **g)** Human settlement and brick making
- ✓ **h)** Poaching of vegetation and animals
- ✓ **i)** Introduction of exotic species such as water hyacinth and Nile perch




# WETLANDS CONSERVATION

The concept of Wetlands as an ecosystem was propelled onto the world stage by the convention and wetlands of international importance, especially as waterfall habitat. This convention also known as the **Ramsar convention** was developed at a meeting held in Ramsar, Iran in 1971.







It is an intergovernmental treaty, which provides the framework for international co-operation for the conservation and wise use of wetland habitats. UNESCO serves as the depository for the convention and its secretariat, the Ramsar Bureau, shares headquarters with IUCN, the world conservation union in Gland, Switzerland.









By March 1995 there were 85 contracting parties and 726 listed sites. The convention has established itself firmly as a vital instrument for leadership in the conservation and wise use of wetland resources.






Ramsar convention collaborates with other relevant conventions such as convention on Biodiversity, convention on the Conservation of Migratory species of wild animals and the World Heritage Convention to ensure a concerted effort towards conservation and management of natural resources.






Ramsar sites in Kenya include lakes Naivasha and Nakuru.

Kenya Wildlife Service is the custodian of the Ramsar Convention in Kenya. It manages 26 National parks and 28 National reserves ranging from the coastal and marine habitats to the inland savannah, water bodies, forest and mountain regions.











A wide range of wetland types are found within protected areas. Wetlands are under the jurisdiction of several institutions including forest department, county, city and municipal councils as well as private individuals and firms. It is here that guidelines for their management are required.





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- A wetland policy is being prompted to address management and conservation concerns in Kenya. This is being done by the National Wetlands standing committee whose secretariat is the National Environment Secretariat (NES) now under The National Environment Management Authority (NEMA).
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The Ramsar Bureau provides guidelines for the development of this policy. The wise use of wetlands was defined at the third meeting of contracting parties held in Regina Canada in 1987 as **“their sustainable utilization for the benefit of human kind in a way compatible with the maintenance of the natural properties of the ecosystem”**.






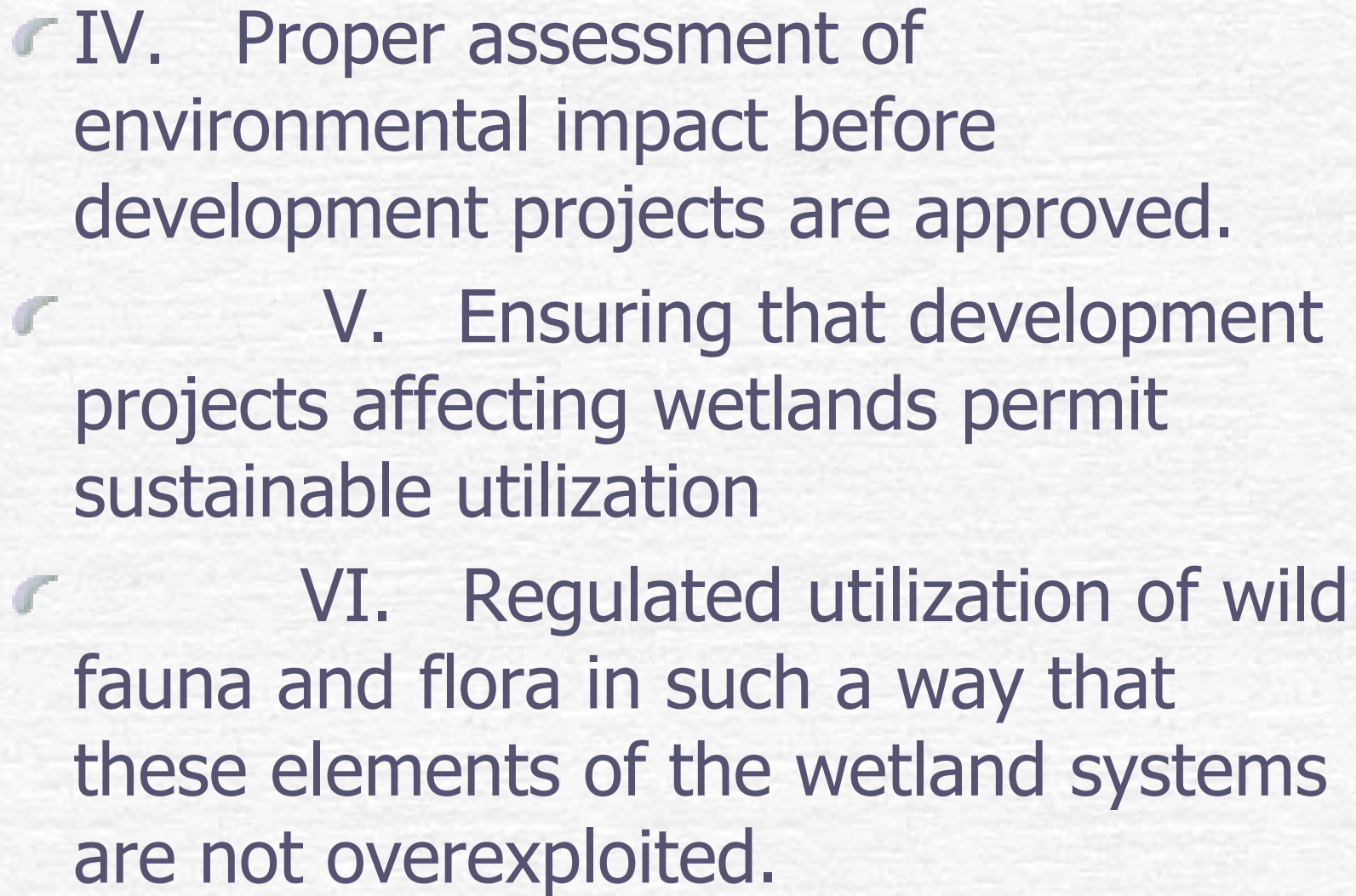
“Sustainable utilization is the human use of a wetland so that it may yield the greatest continuous benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations”.

Major items to be considered in the development of a national wetland policy are:



- 
- I. A national inventory of wetlands
  - II. Identification of the benefit and value of these wetlands.
  - III. Definition of the priorities for each site in accordance with the social, and economic conditions.



- 
- IV. Proper assessment of environmental impact before development projects are approved.
  - V. Ensuring that development projects affecting wetlands permit sustainable utilization
  - VI. Regulated utilization of wild fauna and flora in such a way that these elements of the wetland systems are not overexploited.

## SUCCESSION

1). As a lake fills with silt, it changes gradually from a deep to a shallow lake or pond Then to a marsh, and beyond this in some cases to a dry land forest.



2) When in an area of forests, a farm field is abandoned, a series of plant communities grow up and replace one another-


- First annual weeds
- Then perennial weeds and grasses
- Then shrubs and trees
- Until a forest ends the development




3) if a landslide exposes a surface of rock in the mountains, the surface can be successfully occupied by a sparse cover of:

- Lichens
- A spreading moss mat
- Grasses that enter and become a meadow
- A shrub thicket that overtops and suppresses the grasses

- 
- A first forest stage of smaller trees that seed into the shrub thicket, grow through it and replace it and a final stage of larger trees that take dominance from the first trees and may form a larger and potentially permanent forest community.
- 



Such processes of community development are called **successions**. This may be brought about by a physical process (as in 1) or it may be the growth of plants on soil as in (2), or it could be an interplay between organisms and the environment as in (3) **one dominant species modified** the soil in ways that made possible the entry of a second species then a third, fourth etc.





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# **Wetland Threats**

# Major Effects of Wetland Losses

- 50% loss of spawning grounds for fish
- 50% loss of waterfowl habitat
- 50% loss of flood control capability
- 50% loss of erosion control and sediment-trapping capability

## Why So Much Wetland Loss?

- Perception of wetlands as “wastelands” and “swamps” (= ignorance)
- Economic incentives for development and urban sprawl



# **Major Causes of Wetland Loss & Degradation**

- A) Biological Alterations
- B) Chemical Alterations
- C) Physical Destruction or Degradation

## **A) Biological Alterations**

1. Removal of wetland or riparian vegetation
2. Introduction of non-native/exotic species





Removal of riparian vegetation next to stream due to residential development.





Farming up to edge of stream.





Livestock corral adjacent to stream



Introduced weeds  
and non-native plants,  
E.g. water hyacinth


need to be controlled  
through biological,  
chemical and/or  
mechanical means

or prevented by proper  
land management, i.e.  
minimize disturbance.





# **Chemical Alterations**

1. Release of pollutants & toxic chemicals
  2. Change in nutrient levels
- 



Agricultural runoff carries pesticides, fertilizers and manure.





Livestock corral on streams allows manure (nutrients) to enter stream unfiltered by vegetation.





Sediment plume discharging into river  
and then entering lake.

# Physical Destruction or Degradation

1. Filling
2. Draining
3. Dredging & Stream Channelization
4. Peat Mining
5. Flooding & Changes in Sediment Deposition Patterns due to Dam Construction.
6. ATV/Recreational Uses



Stream channelization = straightening of rivers & streams for railroad and highways.





Flooding (and flood damage) is much greater when streams are straightened and riparian vegetation has been removed.







## Disappearing wetlands

Wetlands are disappearing rapidly, at about the rate of 300,000 acres (120,000 hectares) annually in the U.S. alone. Some legislators have tried to introduce a “no-net-loss” plan for wetlands. This states that for every acre of natural wetlands lost, a new acre of “wetlands” should be created.





Creating artificial bodies of water that act, in some ways, like wetlands is becoming a popular way to deal with loss of original wetlands.

However, man-made wetlands are usually not successful and lack the functionality of natural wetlands

