Wetland Management

Categories of wetland benefits to human society

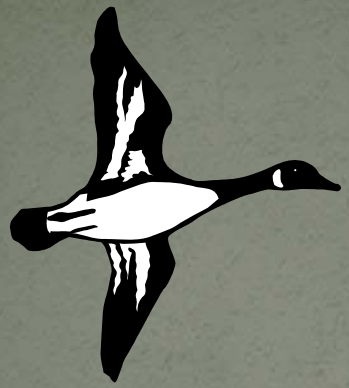
Services

- Flood control
- Prevention of saline intrusion
- Storm protection / windbreak
- Sediment removal
- Toxicant removal
- Nutrient removal
- Groundwater recharge
- Erosion control
- Wildlife habitat
- Fish habitat
- Toxicant export
- Shoreline stabilization
- Macroclimate stabilization
- Microclimate stabilization
- Biological diversity provision
- Wilderness value provision
- Aesthetic value provision
- Cultural value provision
- Historic value provision
- Existence value provision
- Carbon transformation

Goods

- Water abstraction
- Forest resources
- Agricultural resources
- Wildlife resources
- Forage resources
- Fisheries
- Mineral resources
- Water transport
- Tourism/ recreation
- Aquaculture
- Research sites
- Education sites
- Fertilizer production
- Energy production

From Williams, 2006, pg 249



Wetland Functions

- "Since wetlands do perform multiple functions, one of the thorniest problems of management is ensuring that management for one function or goal does not cause loss of other equally important functions." Keddy (2002)

Not just biodiversity; **functions**

What are functions?

1. Wetlands functions are interdependent.
   - E.g., wetland area & shrimp production
   - Biomass and biodiversity

2. Functions are produced by species, and species can be used as indicators of those functions.

Threats to Wetlands

- Wetland loss
- Wetland degradation
  - Fragmentation; loss of connectivity; watershed alteration
- Hydrologic modification (dehydration; inundation)
- Pollution
  - Nutrient/Contaminant loading
  - Salinization
  - Organic loading / reduce DO
  - Thermal alteration
- Vegetation removal
- Non-indigenous invasive species
- Mosquito control

" Both community and functional perspectives are needed to understand the multiple consequences of different management actions." Keddy, 2002.

Why do humans manage wetlands?

- Maintain water quality
- Reduce erosion
- Provide flood protection
- Process airborne pollutants
- Buffer urban systems to ameliorate climate and noise
- Maintain gene pool of marsh plants, wildlife
- Provide aesthetic environment
- Produce wildlife
- Control insect populations
- Provide critical habitat for fish, waterfowl, etc.
- Produce fuel, fiber, fodder
- Support scientific inquiry

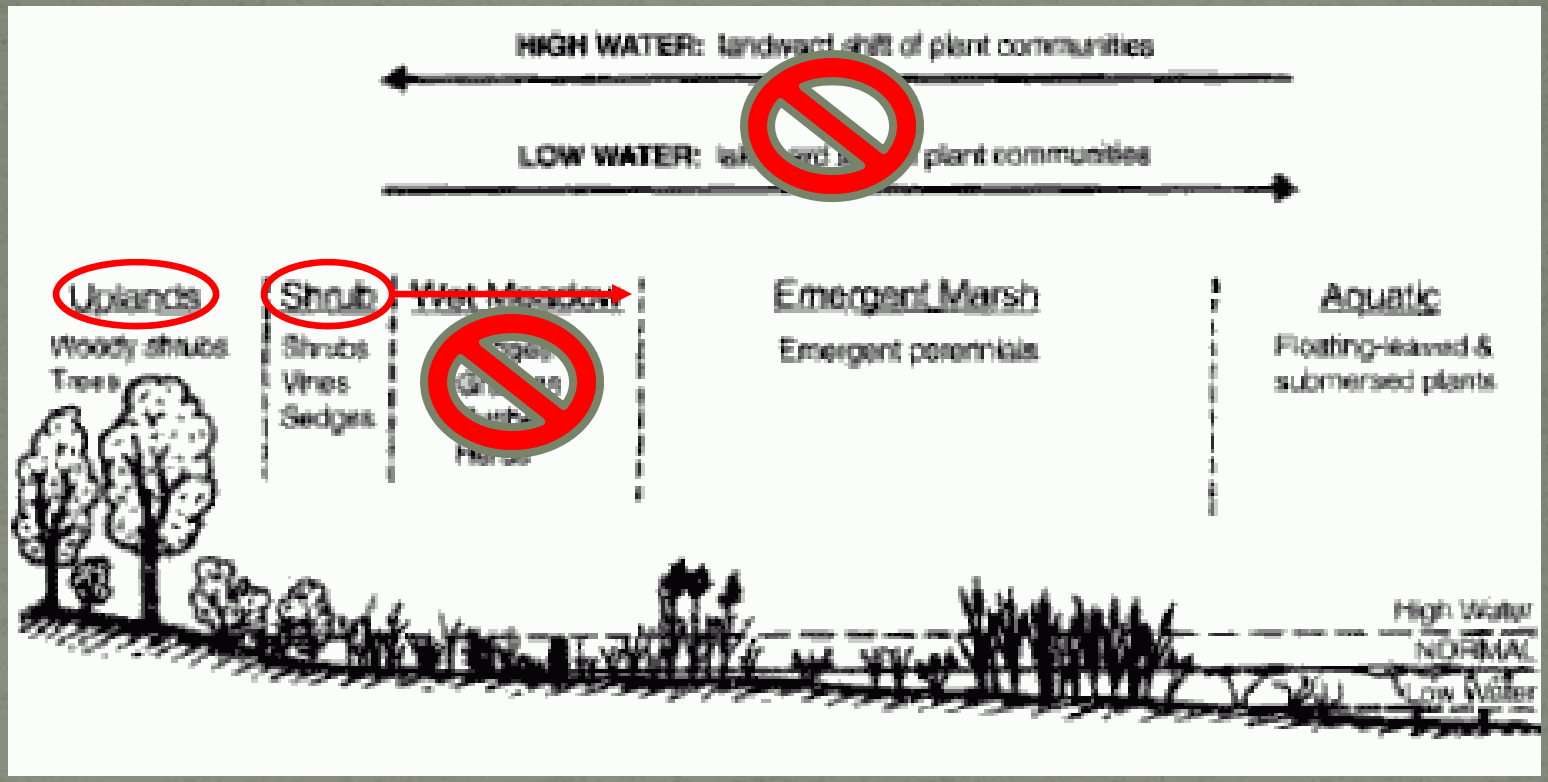
Wetland Management: Hydrology

- Stabilize water levels:
  - Ditching, draining = decrease water levels;
  - Levees and dams = increase water levels
- Alters vegetation, animals, water quality
- Reasons:
  - Navigation and transportation
  - Flood control
  - Industrial/urban activity

Problems with water level stabilization

- Vulnerable to invasives
- Colonizable by woody plants
- Increase in biomass (more fertile)= loss of specialists
  - Evergreen; carnivorous plants; other infertile site specialists.
  - Leads to loss of specialist animal species (require specialist plants; feed on mud flats; tolerate low fertility; use unvegetated areas)

Water level stabilization effects



Problems with water level stabilization

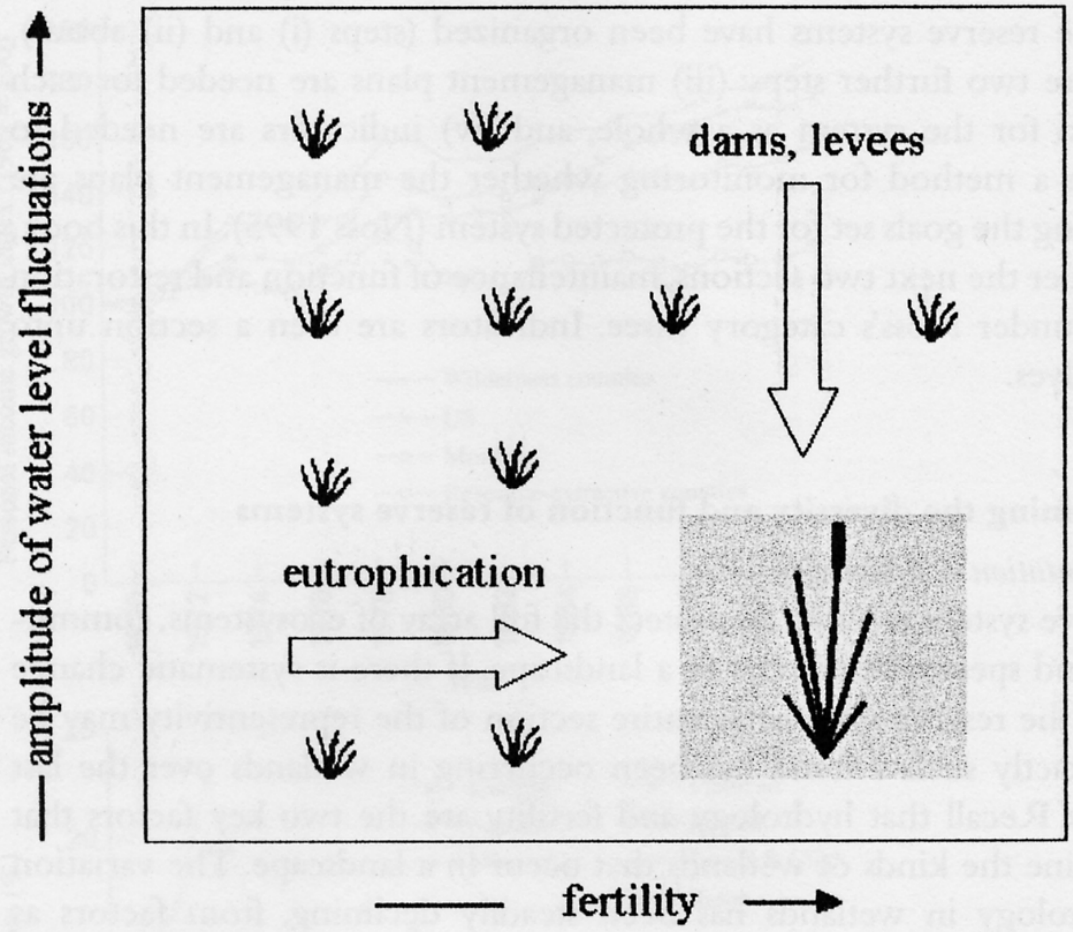


Figure 12.10 Human activities have compressed wetlands onto an increasingly narrow array of flooding and fertility regimes, leading to a loss of many wetland types.

Keddy, 2002, pg 504.

Managing for Specific Functions: Amphibians

- Mitigation wetlands aren't the same as natural. Problems for amphibians:
  - Low hydrologic variability
  - Steeper bank slopes
- Water permanency means more predators (fish, bugs)
- Less littoral zone reduces breeding success, reduces foraging habitat and refugia.

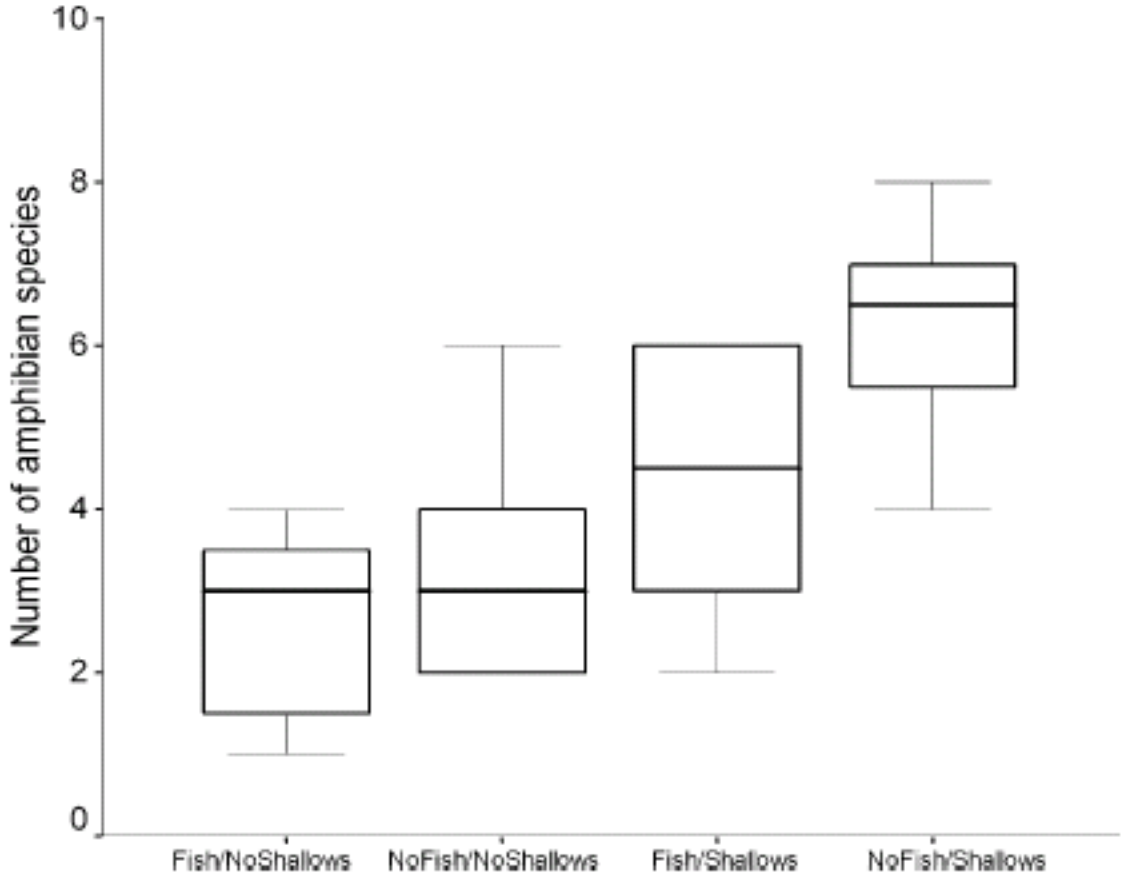


Figure 1. Box-and-whiskers plots (means, quartiles and extreme values within a category) of local amphibian species richness in 42 replacement wetlands differing in the presence of a shallow littoral zone (SHALLOWS) and presence of predatory fish (FISH) in central Ohio.

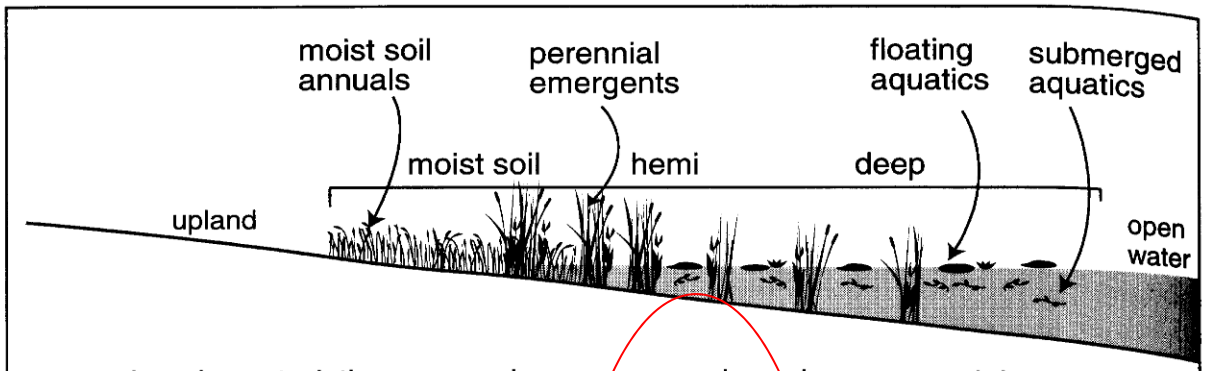
From: Porej and Hetherington, 2005. Wetlands Ecology and Management. 13:445-455.

Wetland Management: Wildlife

- Waterfowl management means water level regulation.
  - Dykes, weirs, control gates, pumps.

Wetland Management: Wildlife

- In Great Lakes coastal wetlands:
  - Low water levels → aquatic plant invasion
  - High water levels → carp invasion



vegetation characteristics	annuals	annuals and perennials	perennials
summer water level	mudflat by mid-June	15 cm	>30 cm
seed production (annuals)	maximum	fair	low
plant species diversity	fair	maximum	fair
plant density	maximum	good	low
resident wildlife use	fair	maximum	good
aquatic invertebrate and fish abundance	fair	maximum	good
migratory wildlife use	maximum	good	fair
invasion potential of undesirable plants	high	low	low
muskrat production	low	good	good

from R.W. Kroll

Figure 17-10 **Generalizations of water-level management for vegetation, wildlife use, and other characteristics as practiced on impounded marshes near Lake Erie in northern Ohio. (*From Roy Kroll, Winous Point Shooting Club, Port Clinton, Ohio*)**

(M&G)

Wetland Management: Agriculture

- Rice production
- Aquaculture
  - Big head carp & silver carp- accidentally released during Mississippi River flooding;
  - Have invaded the Missouri, Mississippi, Ohio and Illinois Rivers
  - Feeding habit may threaten native species in the Great Lakes

Functional Assessment

- Wetland Evaluation Technique (Adamus et al. 1990)
  - Assesses 11 functions and values
    - GW recharge;
    - GW discharge;
    - floodflow alteration;
    - sediment stabilization;
    - sediment/toxicant retention;
    - nutrient removal/transformation;
    - production export;
    - wildlife diversity/abundance;
    - recreation; uniqueness/heritage.
- Hydrogeomorphic approach (Brinson, et al. 1994; Smith 1994).

What is HGM?

- Measures the capacity of a wetland to perform functions.
- Differs from other assessment methods:
  - Classifies wetlands based on their differences in functioning
  - Defines functions that each class of wetlands perform
  - Uses “reference” to establish the range of functioning of the wetland

Factors Influencing Function

- Position in the landscape - geomorphic setting
  - Landform, geologic evolution, topographic position
- Water source (hydrology)
- Flow and fluctuation of water once in the wetland (hydrodynamics)
  - Energy flow of moving water, direction of surface and near-surface flow in wetland

Functions

- Reflect the wetland characteristics and landscape and assessment objectives.
- Functions related to hydrologic processes: e.g.,
  - Short-term storage of surface water
  - Groundwater recharge, etc
- Benefits, products, and services of function:
  - Onsite: Replenish soil moisture, import/export materials, conduit for organisms
  - Offsite: Reduce downstream peak flow and volume; help maintain and improve water quality.

Assessment Model

- Define relationships between surrounding ecosystem / landscape and capacity of wetland to perform a function.
- Functional index (0-1) estimating the capacity to perform function, relative to the regional reference wetland.

Functional Capacity

- Degree to which an area of wetland performs a specific function
  - Quantitative or qualitative
- Example:
  - Function: Store floodwater.
    - Depends on ecosystem characteristics, e.g., elevation relative to stream, microtopography, slope, vegetation density.
    - Landscape characteristics: watershed size, runoff coefficients, location of control points, factors influencing frequency, duration, magnitude, seasonality of floods.
- Get HGM score

Wetland management: Summary

- Difficult to balance competing management desires
- How "natural' should the managed system be? Or do we sacrifice "naturalness" for a human need/desire?
- Can we even get the management right? (hydrology, etc.)?
- Evaluate functions using the HGM method
  - Can evaluate created/mitigated/restored wetlands this way, too.
  - Moves away from just richness/biodiversity/favorite species evaluations


27/03/2007