Lecture 22, 08 November 2005
Conservation in Practice

Conservation Biology
ECOL 406R/506R
University of Arizona
Fall 2005

Kevin Bonine
Kathy Gerst

Conservation Biology 406R/506R
Conservation of Aquatic Ecosystems
(Van Dyke Chapter 9)

Exam two was returned on Thursday (one week)
Thank Bob Steidl
Role Playing on 15 November
Exam 3 on Thursday 17 November
(review sheet later this week)
Return 506 papers

Conservation of Terrestrial Ecosystems
(Van Dyke Chapter 10)

There will be a seminar on Wednesday, November 2.
1 pm in BSE 225.

The presenter will be:

Dr. William W. Shaw
School of Natural Resources
University of Arizona

His topic will be:


Did anyone see this?

Exam 2

3. Fst data and Slatkin’s Migration Estimates
9. Density-dependent population over time
10. Effective population size
18 Cryptic species
21. Alleles (haplotype)

Aquatic Conservation (VanDyke, Chapter 9)

• Marine vs. Freshwater
  (definition of limnology)

• Fisheries
• Mariculture
• Hydrothermal Vents (and other Benthic Examples)

Today:

• Wetlands
• Eutrophication

• Ramsar Treaty
  other legislation

• IBI

Shifting Baselines?
Linette Ancha
The Center for Limnology was established in July 1982 to plan, conduct, and facilitate inland freshwater research. The Center grew out of almost one hundred years of limnology at the University initiated by E.A. Birge and Chancey Juday, who founded limnology in North America through extensive descriptive and comparative studies. Our roots were further developed by Arthur D. Hasler, who led the way in experimental limnology and facilitated four decades of aquatic studies at Wisconsin. Our present program builds on these approaches and has expanded to include long-term studies, synthesis, modeling, Great Lakes research, and application to resource management and environmental issues.

The Center Today
Today’s Center for Limnology operates two field stations, the Lake Mendota Laboratory located on the University of Wisconsin-Madison campus and the Trout Lake Station in the Northern Highland Lake District at Boulder Junction. Although both facilities operate year round, Trout Lake Station is the most busy during the summer months.

Contact Information:
University of Wisconsin Center for Limnology
680 North Park Street
Madison WI 53706-1492
Phone 608-262-3014
Fax 608-265-2340

Importance of freshwater environments and wetlands

An acre of wetland can store 1.0 to 1.5 million gallons of floodwater.

Water storage (and release during dry periods) and erosion control

You can drink more than 4,000 glasses of tap water for the price of a packaged beverage (based on price of a six-pack of soda).

Water filtration (improves water quality)

75% of commercially harvested fish are wetland-dependent.
95% when shellfish species are added to this figure.

Up to one-half of North American bird species nest or feed in wetlands.

Biological productivity (plant and animal habitat)

What is a freshwater aquatic environment?

- **Lotic Systems:** flowing water environments such as streams and rivers.
- **Lentic Systems:** lake, pond environments.
- **Wetlands:** areas where the land transitions from aquatic to terrestrial, such as marshes, swamps, bogs and fens. Very difficult to define.

How is a wetland defined?

A wetland is defined by the EPA by the:

1. **Hydrology** – it is covered by water during part of the growing season or the soils are saturated.
2. **Vegetation** – it has at least 50% obligate and facultative plants.
3. **Hydric soils** – soils that are saturated long enough to have low oxygen levels.

Importance of freshwater environments and wetlands

<table>
<thead>
<tr>
<th>Regulation Functions</th>
<th>Carrier Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage and recycling of nutrients</td>
<td>Agriculture, irrigation</td>
</tr>
<tr>
<td>Storage and recycling of organic waste</td>
<td>Stock farming (grazing)</td>
</tr>
<tr>
<td>Groundwater recharge</td>
<td>Wildlife crop resources</td>
</tr>
<tr>
<td>Natural flood control and flow regulation</td>
<td>Transportation</td>
</tr>
<tr>
<td>Sediment control</td>
<td>Surface water treatment</td>
</tr>
<tr>
<td>Water treatment</td>
<td>Climate stabilization</td>
</tr>
<tr>
<td>Sediment stabilization</td>
<td>Carbon sequestration</td>
</tr>
<tr>
<td>Carbon sequestration</td>
<td>Maintenance of migration and nursery habitats</td>
</tr>
<tr>
<td>Maintenance of wetlands stability and productivity</td>
<td>Maintenance of ecosystem stability</td>
</tr>
<tr>
<td>Maintenance of wetlands stability</td>
<td>Maintenance of biological and genetic diversity</td>
</tr>
<tr>
<td>Maintenance of wetlands biodiversity</td>
<td>Maintenance of integrity of other ecosystems</td>
</tr>
<tr>
<td>Maintenance of ecosystem integrity</td>
<td>Maintenance of migratory and nursery habitats</td>
</tr>
<tr>
<td>Maintenance of migratory and nursery habitats</td>
<td>Maintenance of ecosystem integrity</td>
</tr>
<tr>
<td>Maintenance of biological and genetic diversity</td>
<td>Maintenance of migratory and nursery habitats</td>
</tr>
</tbody>
</table>

Information Functions

- Research, education and monitoring
- Uniqueness, rarity or naturalness and role in cultural heritage

Wetlands alone have an economic value of $70 billion per year (World Conservation Union)

$4.8 trillion overall economic value (Costanza, et al.)
How Much Wetland Area Has Been Lost??
(since pre-settlement ~ 1600’s)?

- **Nationwide** – 53% (in lower 48)
- **Great Lakes Basin** – 70%
- **Michigan**
  - 50% of total wetlands lost
  - 70% of coastal wetlands
  - 75% of Michigan wetlands in private ownership.

(from Living With Michigan Wetlands: A Landowner’s Guide)

---

**Major Effects of Wetland Losses**

- loss of spawning grounds for fish
- loss of waterfowl habitat
- loss of flood control capability
- 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

---

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

Farming up to edge of stream.
Livestock corral adjacent to stream

Invader Species

- Major threat to wetland diversity
- Reduction in the abundance and species-richness of native macrophytes and associated invertebrate communities
- Alteration of nutrient cycles and biochemical processes
- Invasive exotic species tends to increase as ecosystems become degraded

Eutrophication – enrichment of aquatic ecosystems by inorganic nutrients (mostly P & N), causing increased primary productivity

- Cultural eutrophication - The usual suspects: sewage, agriculture, land clearance... fisheries mgmt. practices?
- Did reclamation pollute Black Pond? (Stager, 2001)
- Anabaena blooms: Rotenone fish kills and/or fish stocking?
- Sediment core evidence: diatoms and organic matter

“Natural” Eutrophication - a Paleo Perspective

- Forest fires, droughts, climate shifts
- Insect infestations? Hemlock Decline ~ 4,800 yrs. BP – van Nostrand Lake, Ontario (St. Jaques et al., 2,000).
- Die-off = nutrient inputs, erosion
- Sediment cores: pollen, diatoms, organic matter

Acidification

- H₂S & NO + atm. moisture = sulfuric and nitric acid precip.
- Mortality and fecundity: inverts., amphibians, fish
- Mobilization of heavy metals e.g. Al, Hg
- Watershed factors: buffering capacity, climate patterns, elevation, seasonal snow cover (key)
- Big Moose Lake, Herkimer Co., NY: vulnerable in all categories

Introduced weeds and non-native plants, i.e. purple loosestrife need to be controlled through biological, chemical and/or mechanical means or prevented by proper land management, i.e. minimize disturbance.
Are Eutrophication and Acidification “Good” or “Bad”?  

- Mid 1900s: “oligotrophic lakes are ‘wasted resources’ – fertilize them!”

- 1970s – 1980s: “eutrophic lakes are scummy and ‘polluted’ – ban phosphates!” (so acid precipitation must be good because it makes nice, clear oligotrophic lakes?!)  

- Human activity vs. non-human processes  

- Perspectives: human (many), organisms, ecosystems  

Approaches in Protecting Freshwater and Wetlands

<table>
<thead>
<tr>
<th>Conservation Issue</th>
<th>Remedial Management</th>
<th>Preventative Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetlands</td>
<td>Coordinated Management</td>
<td>Buffer strips</td>
</tr>
<tr>
<td>Acidification</td>
<td>Tening</td>
<td>Education</td>
</tr>
<tr>
<td>Sedimentation and Eutrophication</td>
<td>Removal of fertilizers, Overfishing, Chemical manipulation, Biomanipulation</td>
<td>Reduce the use of fertilizers, Reduce erosion on agricultural lands, Education</td>
</tr>
<tr>
<td>Invasive Species</td>
<td>Intervention (Manual Removal, Mechanical Control, Chemical Control, Biological Control, Environmental Manipulation, Direct use of invasive species)</td>
<td>Protection, Restoration, Education</td>
</tr>
<tr>
<td>Groundwater Depletion</td>
<td>Reclaimed water</td>
<td>Conservation, Regulation, Education</td>
</tr>
</tbody>
</table>
Freshwater Legislation

Wild & Scenic Rivers Act (1968, USA)
- “Stream or section thereof designated as wild or scenic river is protected from any action by any federal agency that would adversely affect its water quality.”
- Sections of rivers can also be designated

Clean Water Act & Amendments (1972, USA)
- “restore & maintain integrity”
- “enhance aquatic life”

Wetlands Legislation

1971 Ramsar Convention (international)
- Protection of ecosystem instead of species
- Canada
- United States – Table 9.3, p.246
- United States – Wetlands Reserve Program

1982 Commission on Conservation of Antarctic Marine Living Resources (CCAMLR)
- Established marine life conservation; allows for “rational use” of resources
- Regulated harvesting - may not cause population to diminish below number that allows stable recruitment

Problems Associated with Marine Environmental Law and Policy
- “Present management of marine ecosystem is based on a series of regimes that are directed at the various parts rather than the whole and that are… ineffectual” (W.M. von Zharen)
- National jurisdiction does not usually coincide with the movement of fish populations
- Pollution from one country often affects waters and marine ecosystems of other countries
- Discharged waters may introduce non-native species to coastal waters that destroy local species
- International and national laws conflict with the conservation of marine resources

IBI

<table>
<thead>
<tr>
<th>Category</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species richness and composition</td>
<td>1. Total number of fish species</td>
</tr>
<tr>
<td></td>
<td>2. Number and identity of native species</td>
</tr>
<tr>
<td></td>
<td>3. Number and identity of resident species</td>
</tr>
<tr>
<td></td>
<td>4. Number and identity of non-native species</td>
</tr>
<tr>
<td>Trophic composition</td>
<td>5. Proportion of individuals as prey fish</td>
</tr>
<tr>
<td></td>
<td>6. Proportion of individuals as omnivores</td>
</tr>
<tr>
<td></td>
<td>7. Proportion of individuals as carnivores</td>
</tr>
<tr>
<td>Fish abundance and condition</td>
<td>8. Proportion of individuals as top consumers</td>
</tr>
<tr>
<td></td>
<td>9. Number of individuals in sample</td>
</tr>
<tr>
<td></td>
<td>10. Proportion of individuals as hybrids</td>
</tr>
<tr>
<td></td>
<td>11. Proportion of individuals as hybrids</td>
</tr>
<tr>
<td></td>
<td>12. Proportion of individuals with diseases, tumors, fish damage, or damaged spines</td>
</tr>
</tbody>
</table>
Biolologist Zeb Hogan, Monk Gantulga and Fishing Outfitter, Dan Vermillion partner to save taimen

The University of Wisconsin-Madison, the University of Nevada-Reno, and the University of California-Davis, and the Mongolian Institute of Geocology have partnered as a research team in a conservation effort to sustainably protect Mongolia's giant salmon, Hucho taimen, through operation of fishing concessions. This 5-year program will be the most extensive study of Hucho taimen ever conducted. The study will assess population status, migrations, and threats to healthy populations of taimen, and the role of taimen as a part of the broader ecosystem. Information produced by the science team will be used to develop a natural resource management plan for the region.

Mongolia’s environment undermined by gold fever

Traditional cultures are coming into direct conflict with modern mining, which also threatens local ecology.

Ecosystem Management

Ch10 Van Dyke text

"...land management system that seeks protect viable populations of all native species, perpetuates natural disturbance regimes on the regional scale, adopts a planning timeline of centuries, and allows human use at levels that do not result in long-term ecological degradation"

Ecosystem:
-energy and nutrient processing system with physical structure and function that circulates matter and energy.

Definitions are debatable...
Ecosystem Management (Ch10 Van Dyke text)

Why?
- erosion, pollution, waste disposal, sedimentation
- small or uncharismatic species, recreation, intrinsic value
- single species approach very expensive
  (SDCP model)

- driven by CAPACITY to deliver goods, services, functions;
  NOT Demand for them
  (forest as an ecosystem, not just a tree farm)

- management experimental and adaptive (SDCP)
  - monitoring

- cooperation, stakeholders

"Managers recognize the need for human communities to utilize some ecosystem resources" (VanDyke p.272)

- Define “some”
- Where do we draw the line?
- Human population increase?

Unit of ecosystem management?
- watershed?
- make sure include important components (Everglades and Lake Okeechobee)

Ecosystem Processes: Necessary vs. Sufficient
- Hawaii missing 90% native vertebrates
- fire, water, herbivory, predation