Does the Everglades Still Exist?

Restoring an Iconic Ecosystem or Intervening in a Novel One?

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The discussion on restoration goals is often focused on extremely degraded systems; using the concept of alternative stable states, many have pointed out that it may not be possible to ‘restore’ past ecosystem structure or function; some have suggested replacing ‘restoration’ with terms like ‘rehabilitation’ to describe management of ‘novel’ ecosystems; also, the dynamic nature of ecosystems challenges our ability to divine the future state of systems if no human intervention occurred.
Targets at Regional Scales

• Goals for restoration should be linked to the level of degradation at the start (strip mine versus over-dried wetland);

• Regional ecosystems (large area that includes multiple systems) may include areas with a diversity of levels of degradation and possibly areas with a diversity of human uses;

• Thus, some portions may be amenable to a restoration ethic while others are better described by rehabilitation
Iconic Ecosystems
Management and Restoration

- Society has identified some ecosystems for special protection based on their character, uniqueness, or aesthetics and placed them in the public trust;
- In the US, the 1964 Wilderness Act is a powerful law providing the highest level of protection for such lands;
- The public has determined that management should strive to sustain the character that led to their protection… even though definitions of characteristics such as ‘wilderness’ are problematic.
Targets Practical and Ideal

- Humans dominate most ecosystems world-wide, few examples of un-impacted systems exist.
- Even when restoration of historical ecosystem functions or structure may be feasible, may but not practical (cost) or desirable (alternative uses for land).
- Multiple targets may be desirable:
  - ‘natural system’ target illustrates what has been lost and what is possible
  - ‘alternative futures’ illustrate what is attainable under different levels of investment and constraint
Restoration of Regional Ecosystems
The Everglades: A Novel Ecosystem?

- Is the Everglades a ‘novel ecosystem’?

- How do we set targets for Everglades restoration?
What makes the Everglades an iconic ecosystem?

Marjory Stoneman Douglas is famous for starting her book, River of Grass, with the claim that there is ‘no other Everglades’ in the world.
Everglades National Park

- Created in 1947, over 1,500,000 acres in size
- Over 90% is Federally designated Wilderness
- International Biosphere Reserve, World Heritage Site and a Wetland of International Importance
- Includes over 50% of remaining Everglades
What makes the Everglades an iconic ecosystem?

• From the perspective of aquatic ecology:
  – History of ecosystem, biogeography
  – Large size
  – Wet-dry season hydrology
  – Oligotrophic

• These factors come together to explain why this ecosystem historically sustained large populations of wading birds and all are under threat
What makes the Everglades an Iconic Ecosystem

- Oligotrophic
  - The key limiting nutrient is low relative to requirements
  - Limestone basement rock binds with P, tends to be associated with oligotrophic ecosystems...

Everglades is predictably oligotrophic, similar to other Caribbean systems
The Everglades has an Unusual Pattern of Biomass

This figure from a common textbook (Kalf, J. 2002. Limnology. Prentice Hall, NY) illustrates that our results from the Everglades stand out. Also, reporting biomass is a standard ecological technique for making comparisons.
Oligotrophy - Eutrophy

• Adding nutrients to Everglades triggers a sequence of events:
  • P in system accumulates;
  • Periphyton mats disappear;
  • Vascular plant communities change;
  • Aquatic animal communities initially increase in abundance;
  • Ultimately get cattail monoculture, usually following a fire;
  • Eutrophication leads to low DO, loss of animal productivity;
  • Takes very long time to eliminate P once it is added.
What makes the Everglades a Iconic Ecosystem?

• Historically sustained large populations of wading birds
• How can an oligotrophic ecosystem do this?
• Answer brings together all of the distinguishing features
How can the Everglades sustain large populations of wading birds?

- The Everglades dries from the edges toward the center over the dry season.
- Ridge and Slough relief runs roughly perpendicular to the direction of drying;
- Water recession strands aquatic animals in short-lived drying pools.
Remnant Pool

February

WATER FLOW

DENSE SAWGRASS

SPARSE SAWGRASS, SPIKERUSH

SHORT

LONG

HYDROPERIOD
April

Remnant Pool
How does the Everglades sustain large populations of wading birds?

- Everglades fishes move across to sustain populations and locate dry-season refuges, but many fail and are stranded in drying pools.
- Drying pools hold 2 to 5 times higher density of small fish and crayfish than wet-season sloughs.
- Ridge-slough topography and hydrology create opportunity of wading birds.
**Flow as Important as Size**

- Sustains ‘landscape’ scale hydrological and biogeochemical processes
  - Flowing system
    - Physical process shapes and sustains ridge-and-slough topography; tree islands;
    - Moves flocculent material (POM);
    - Movement (flushing) of POM shapes landscape via biogeochemical processes

- Habitat Connectivity
  - Aquatic animals move across landscape during periods of high water (wet season) to locate refuges during low water (dry season)… or become stranded in places where available for consumption
  - May also contribute to nutrient distribution through animal movement and death
Human Interactions with Ecosystem

- Ecosystem size reduction and loss of habitats;
- Local drying and general changes in timing and delivery of water at regional scales;
- Nutrient enrichment;
- Flow and connectivity;
- Non-native species;
- Mercury pollution
Four Factors Necessary for Restoration to be Successful

Water is the key to reviving a dying ecosystem.

1. **Quantity**: Increase the total spatial extent of natural areas

2. **Quality**: The quality of the water must be healthy for the environment.

3. **Timing**: The timing of water held and released into the ecosystem will be modified to mimic natural flow patterns.

4. **Distribution**: Water will be captured to distribute to the ecosystem, as well as urban and agricultural users in the future.
Restoring or Intervening?

- Hobbs has suggested that restoration is limited to systems with limited alteration to biotic and abiotic components.
What Remains to Restore?

- Habitats under EAA are lost
  - Pond apple marsh
  - Sawgrass plain
Prospects and Conclusions

• Some areas are already treated as ‘novel’ systems: EAA, and much of WCA 2A
• Southern WCA 3A, Shark River Slough and Taylor Slough (ENP) remain in a restorable state if definitions are based on NSM
• Loxahatchee NWR and WCA 3B are debatable and depend on political will.
Prospects and Conclusions

• The Everglades is a national treasure and an internationally important ecosystem.

• Though its size is reduced and it has experienced many changes because of human activity, it still supports wading birds and a unique ecological system.

• Restoration efforts are ongoing that seek to maintain these ecological values and recover at least some that have been lost.
Conclusions

• Conversion of an Iconic Ecosystem to a Novel One is a Tragedy
• Identification as a ‘novel system’ is semantic in many cases, no single threshold for ecosystem character – novel vs not novel
• Focus should be on ecosystem functions and societal values that led to identification as an Iconic Ecosystem
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