

Linear Manmade Structures, Hydroscape Fragmentation, And Ecological Consequences

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Hydroscape (Dong 2009)

- Surface water dominates: patches and flux
- Spatially heterogeneity: presence, depth, and flow of water
- Dominant process: water movement--flow
- Spatial patterns: water related patches, boundaries, ecotones, matrix and connectivity
- Spatial-temporal patterns: *seasonally shifting mosaic and pulsing connectivity*

Outline

I. Introduction

II. Road

III. Levee

IV. Canal

V. Hydroscape fragmentation

VI. Conclusion and discussion



Road

I. general

- A. Thousands of studies
- B. Terrestrial and forest oriented
- C. Major agent of landscape fragmentation

Road

I. general

- A. Alter abiotic processes and conditions
- B. Alter biotic interactions, distribution and abundance
- C. Increase human domination over natural systems

I. Five general mechanisms

- i. create new habitats;
- ii. block the movement and dispersal of organisms;
- iii. provide travel lanes,
particularly for exotic species;
- iv. generate edge effects;
- v. fragment landscapes.

Road

II. Effects on hydroscape

- A. All major effects apply
- B. All major mechanisms operate
- C. Impose significant hydrologic effects
thus might generate more serious impacts at the
landscape scale

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Levee

1. alter the hydrology and other physical processes
2. thus degrade natural habitats and influences biotic interactions
3. create conditions for human activities



Levee: major hydrologic mechanisms

- i. obstruct the flow;
- ii. affect the spatial and temporal distribution of flow and depth:
 - a. reduce the regulatory capacity of watersheds and thus increase flow fluctuations of downstream water bodies,
 - b. create impoundments, and still and deep water conditions,
 - c. reduce or eliminate inundation in previously flood plains and wetlands, and thus create dry land;
- iii. alter the natural patterns of shifting mosaic and pulsed connectivity;
- iv. fragment rivers and flood plains, and interrupts the hydrologic continuity.

Levee: major physical-chemical mechanisms

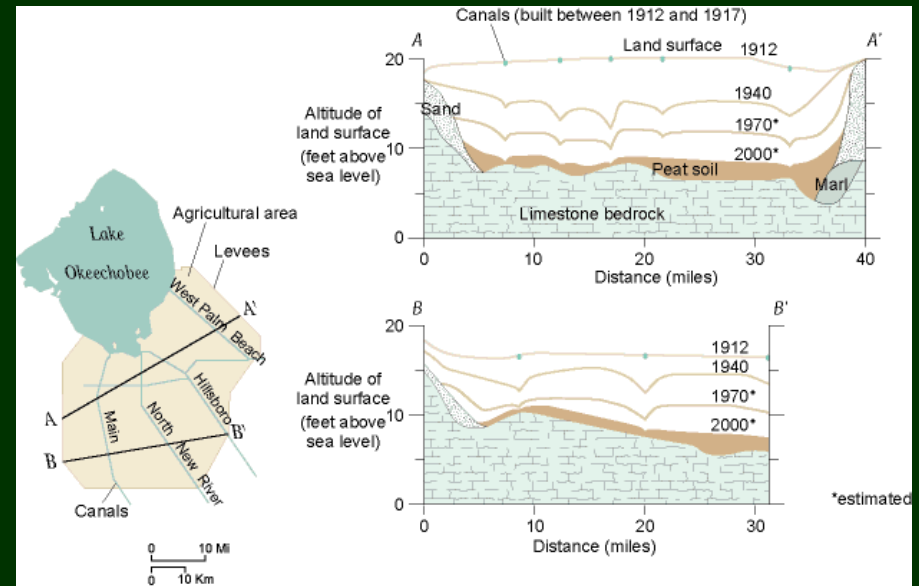
- i. block the movement of materials, including sediments, woody debris, and nutrients;
- ii. trap or screen out particles;
- iii. change turbidity levels;
- iv. alter sediment transport;
- v. change geomorphic features of the hydroscape;
- vi. modify the fate of contaminants;
- vii. change water quality.

Levee: major ecological mechanisms

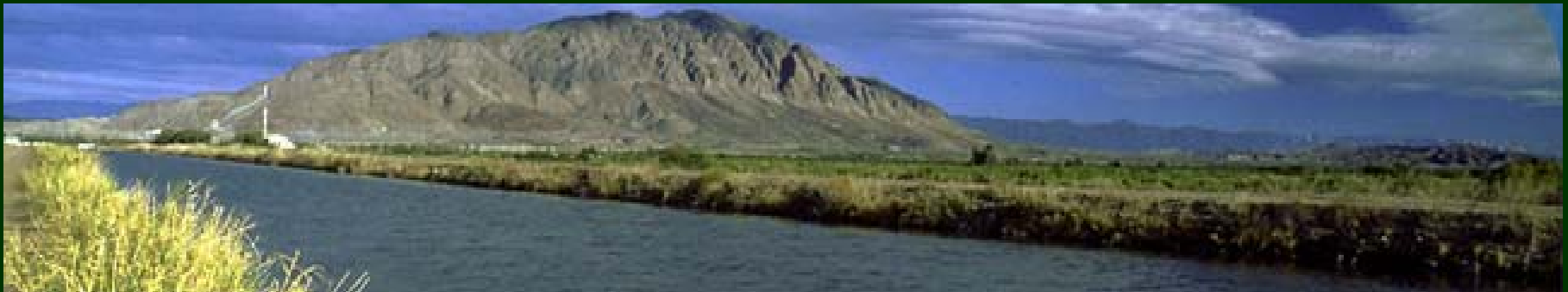
- i. Alter habitats:
 - a. create new habitats,
 - b. degrade habitats for previously adapted native species,
- ii. block the movement and dispersal of organisms,
- iii. provide travel lanes, particularly for exotic species,
- iv. generate edge effects,
- v. fragment hydroscapes, and alter the connectivity of populations, trophic structures, and ecosystem processes.

Levee: increase human activities

- i. Land conversions;
- ii. Ground subsidence;



- I. Introduction
- II. Road
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Canal

1. alter the hydrology and other physical processes,
2. thus degrade natural habitats and influences biotic interactions,
3. create conditions for human activities



Canal: major hydrologic mechanisms

- i. Convey water flow,
- ii. Affect the spatial and temporal distribution of flow and depth:
 - a. drain water, reduce or eliminate inundation in previously wet areas, and thus create dry land,
 - b. create deep and permanent water conditions;
 - c. irrigate dry areas;
- iii. alter the natural patterns of shifting mosaic and pulsed connectivity.
- iv. fragment wetlands, and alter the hydrologic continuity.



Canal: major physical-chemical mechanisms

- i. Transport materials;
- ii. Alter geomorphic features of the hydroscape;
- iii. Modify the fate of contaminants;
- iv. Change water quality.



Canal: major ecological mechanisms

- i. Alter habitats:
 - a. create new habitats,
 - b. reduce or degrade habitats for previously adapted native species;
- ii. Facilitate or block the movement and dispersal of organisms,
- iii. Provide travel lanes, particularly for exotic species,
- iv. Generate edge effects,
- v. Fragment hydroscapes.
- vi. Alter the connectivity of populations, trophic structures, and ecosystem processes



Canal: increase human activities

- i. Land conversions;
- ii. Navigation and recreational access to interior areas;
- iii. Others, oil pipe etc;



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Fragmentation

leads to:

- a. isolation of one fragment from other similar areas
- b. decrease in the interior areas,
- c. increase in edges,
- d. reduction in the total area of certain types of patches,
- e. increase in the number of fragments.

As a result, the average sizes of previously dominant patches decrease.

alters the physical environment and physical processes, and causes changes in the distribution and abundance of animals, plants and microbes.

Hydroscape Fragmentation

Key: Interrupt water flow,

leads to changes in:

- a. spatial-temporal distribution of physical-chemical processes,
- b. geomorphic configurations,
- c. previously continuous topographic, hydrologic, biogeochemical, and biological gradients, and generate punctuated distribution, discontinuity, and disconnectedness,
- d. the distribution and abundance of animals, plants and microbes.

1. Introduction
2. Road
3. Dam and levee
4. Canal
5. Hydroscape fragmentation
6. Conclusion and discussion

Hydroscape Ecology

significant contribution to landscape ecology

1. Clear demonstration of the linkage between processes and patterns
2. Clear illustration of the mechanic structures of a human-nature complex systems
3. Guidelines of ecological engineering at the hydroscape scales.

History and New Trend

- Construction of linear structures
- Removal for multiple services and diverse interests:
 - Road modification,
 - Canal backfill,
 - Levee removal;



Stone, R. 2006. The End of Angkor. Science



Critical Issues: movements!

- Water flow;
- Transport of materials: sediments, nutrients, and contaminants;
- Movement of organisms;

Right place, right time, right amount,

Seasonally shifting mosaic and pulsing connectivity

Questions

