Fish Habitat and the Riverscape:

Exploring Concepts and Approaches for Aquatic Habitat Management

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DEPARTMENT OF NATURAL RESOURCES

Today: Managing Fish Habitat

Landscape
Process Concepts

Habitat
Management

Sport Fish
Applications

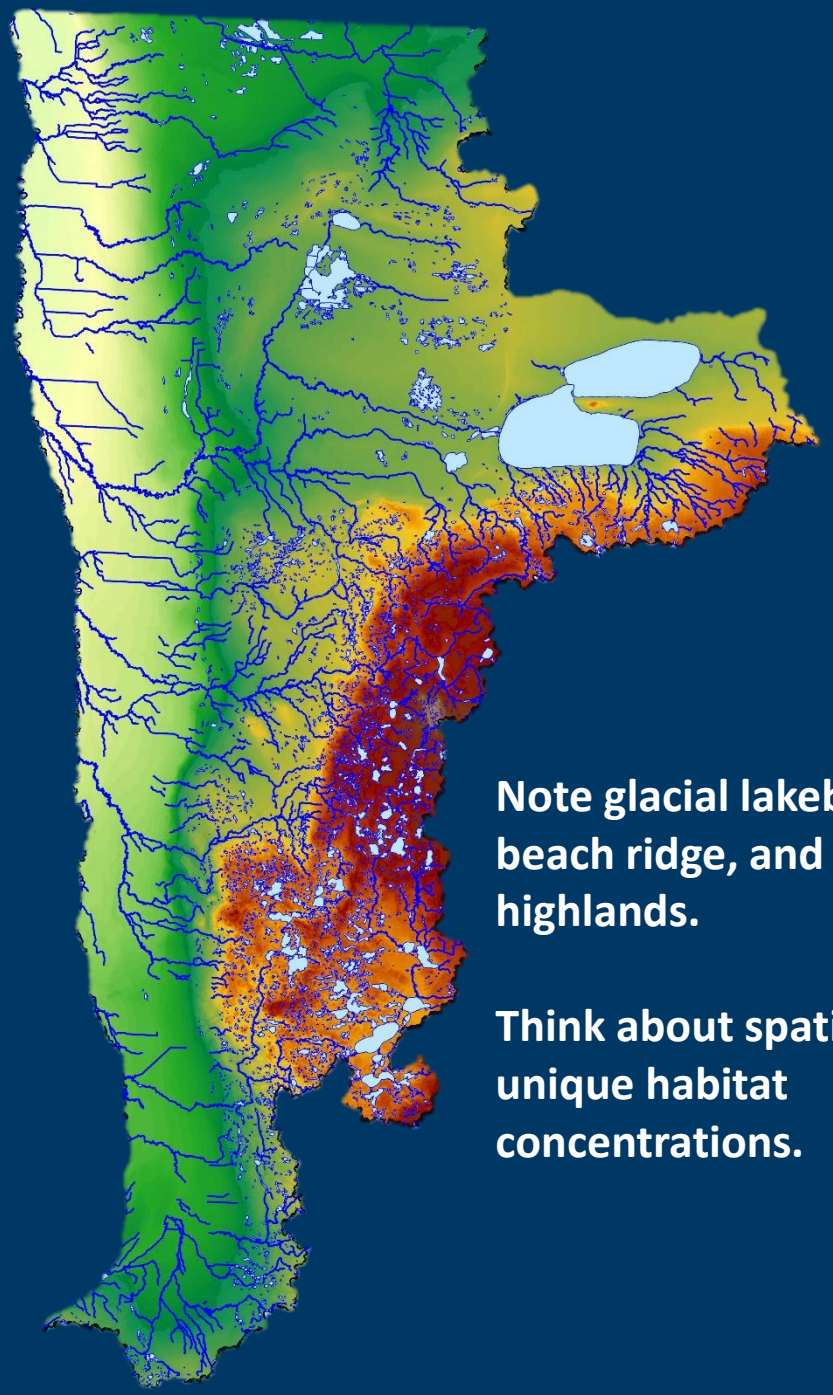
Red River Basin Examples

Themes

- Landscapes and Fish Habitat
- Riverscape Management
- Applications

Landscape Perspective

- Resource Context
  - Landscape history informs habitat distribution, gradients, and limits
- Red River Basin
  - Landscape shaped by glacial forces
    - Topography & geology
- ★ "Riverscapes" – *Big Idea*
  - Habitat and process context of a fishery system

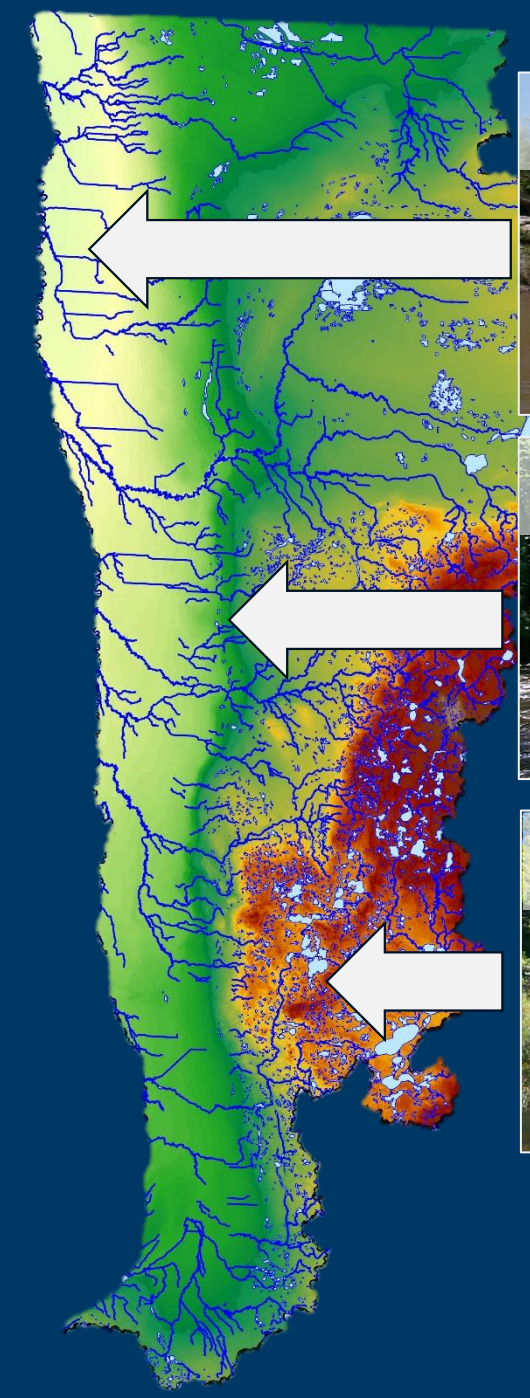


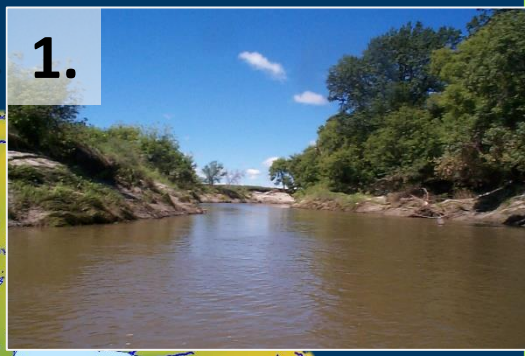
Note glacial lakebed, beach ridge, and highlands.

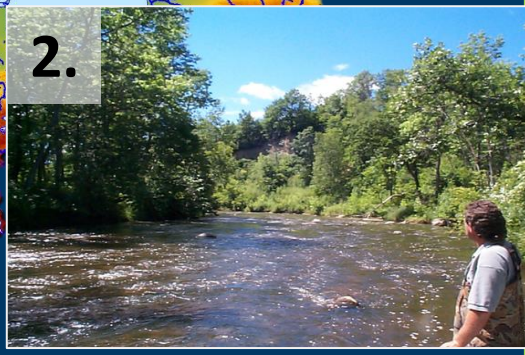
Think about spatially unique habitat concentrations.

Riverscape Components

- Glacially-influenced river network
  - Spatially diverse
    1. Lakebed streams
       - Low gradient, large channel habitat
    2. Beach ridge streams
       - Higher gradient, rocky substrate habitat
    3. Glacial moraine, outwash streams
       - Highly diverse habitat

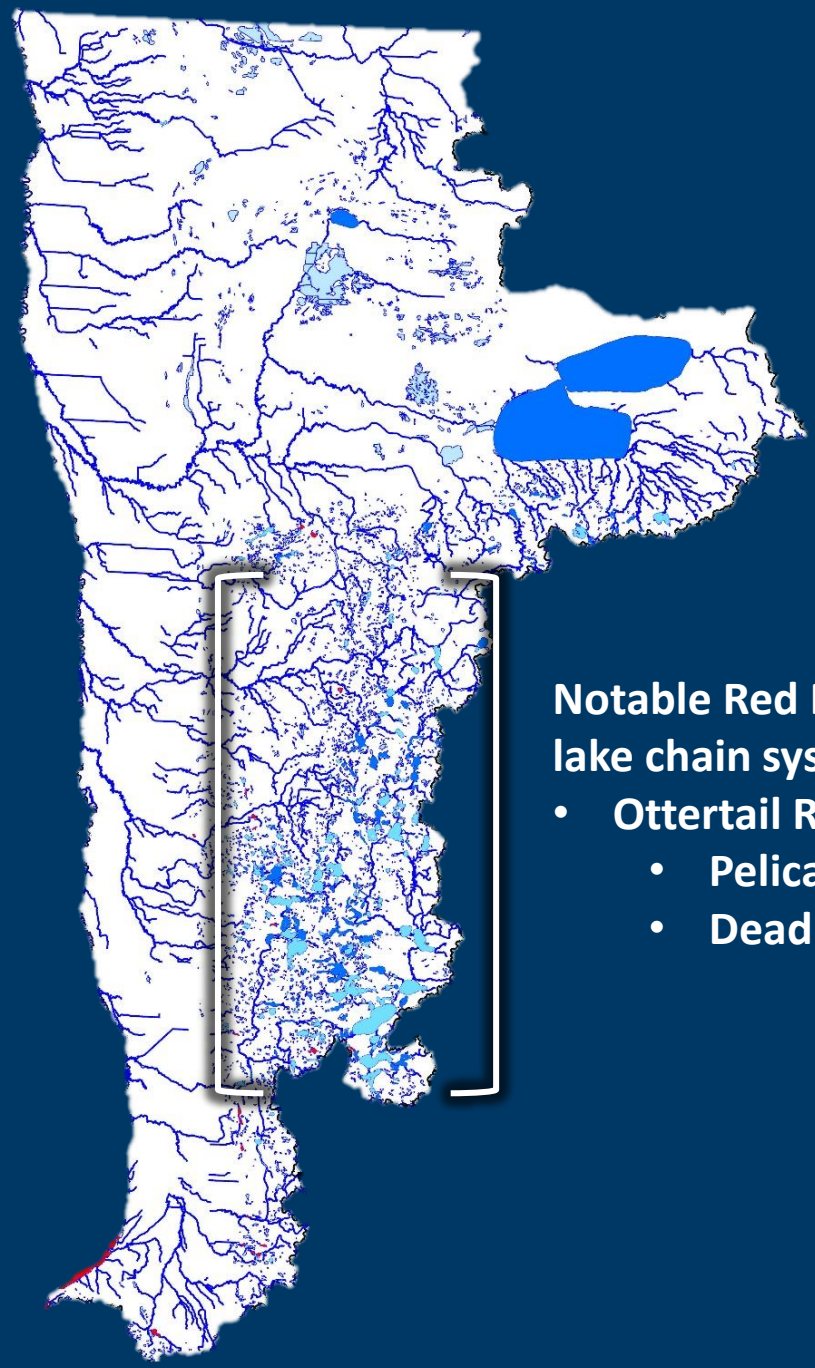






Riverscape Components

- Glacial lake chains
  - Moraine stream network
    - Wide range of stream habitat types
  - Lake habitat diversity
    - “Structure”
      - Abiotic – bathymetry, substrates, etc.



Notable Red River lake chain systems:

- Ottertail River
  - Pelican River
  - Dead River

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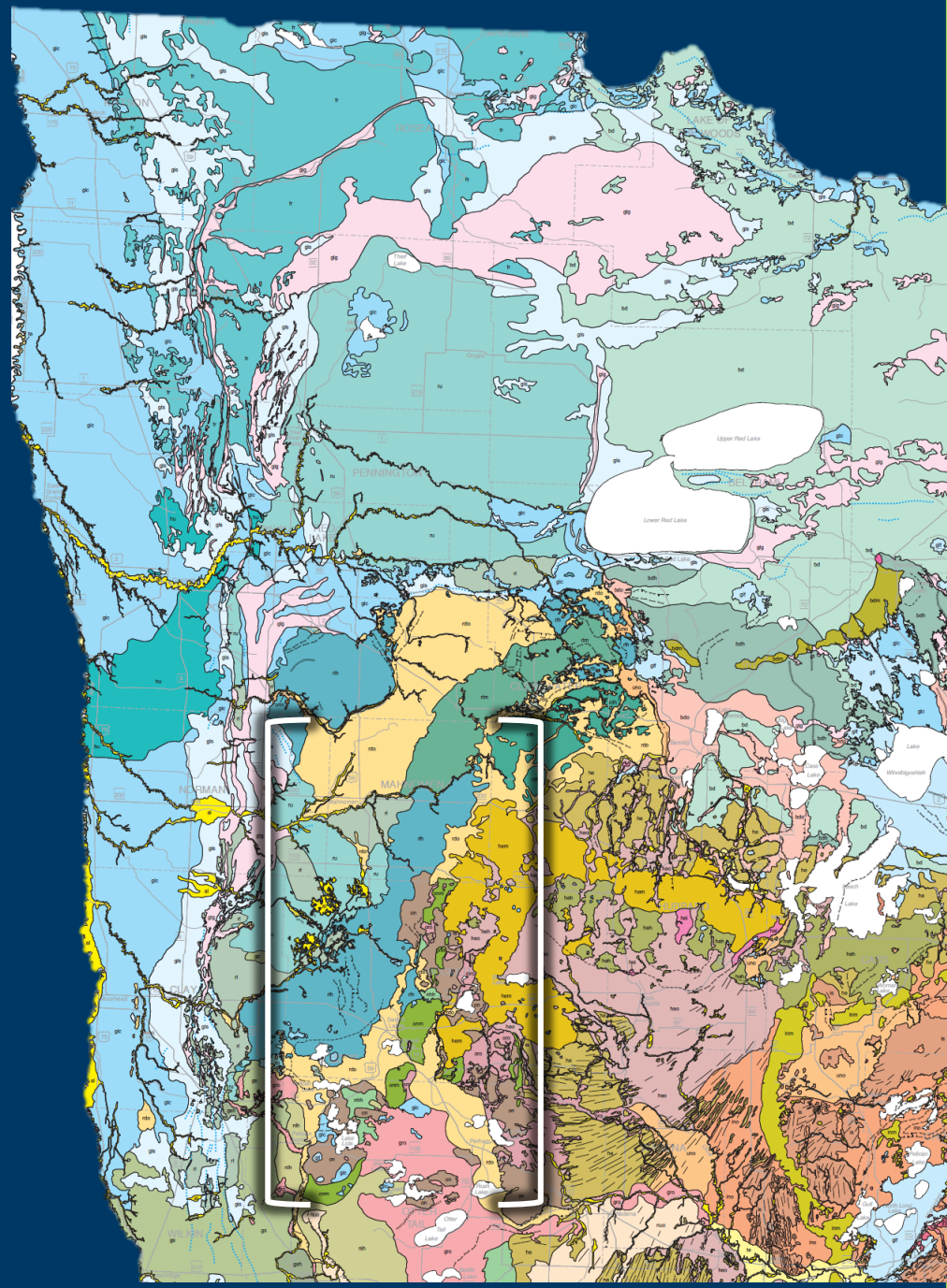

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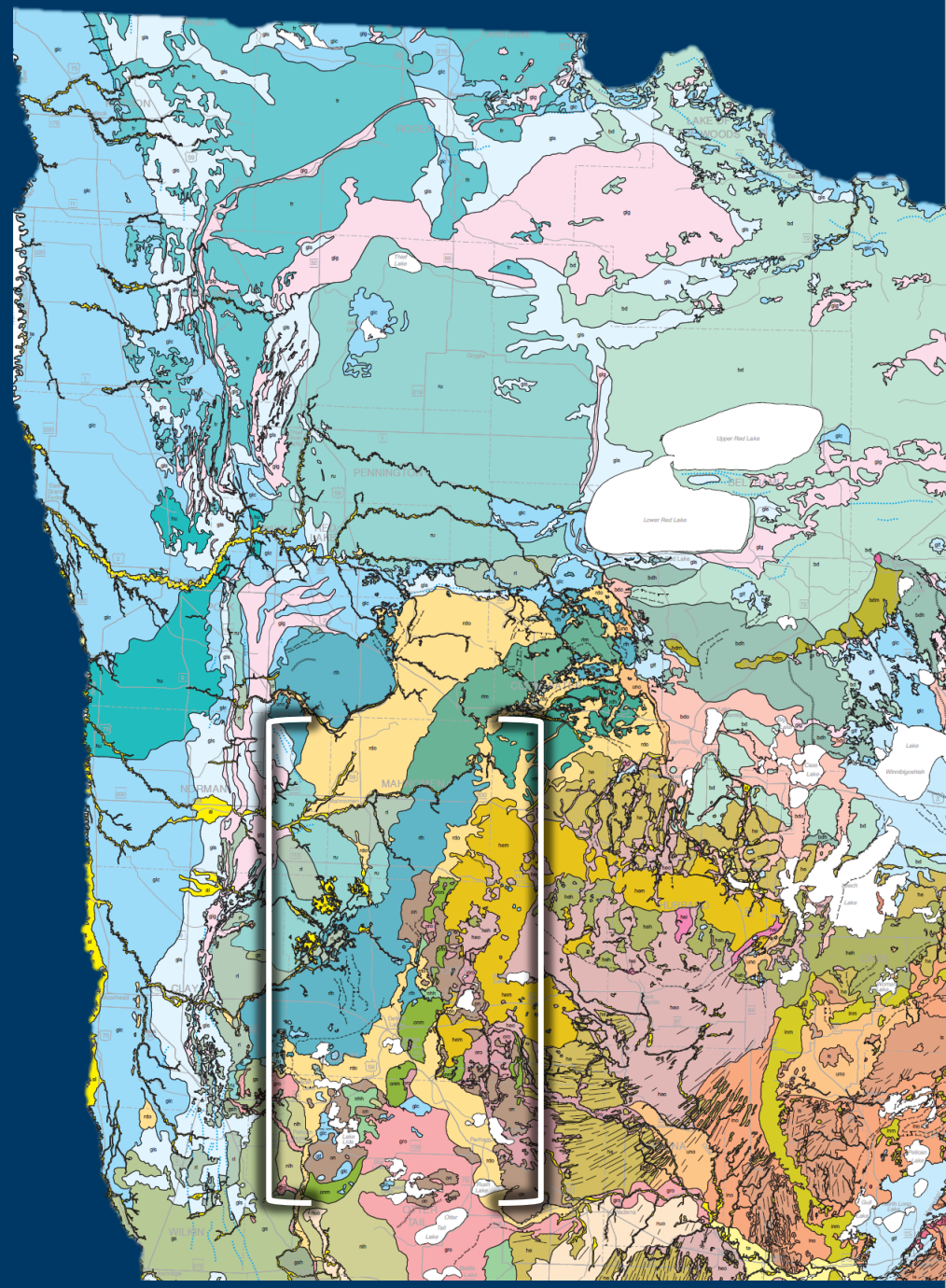
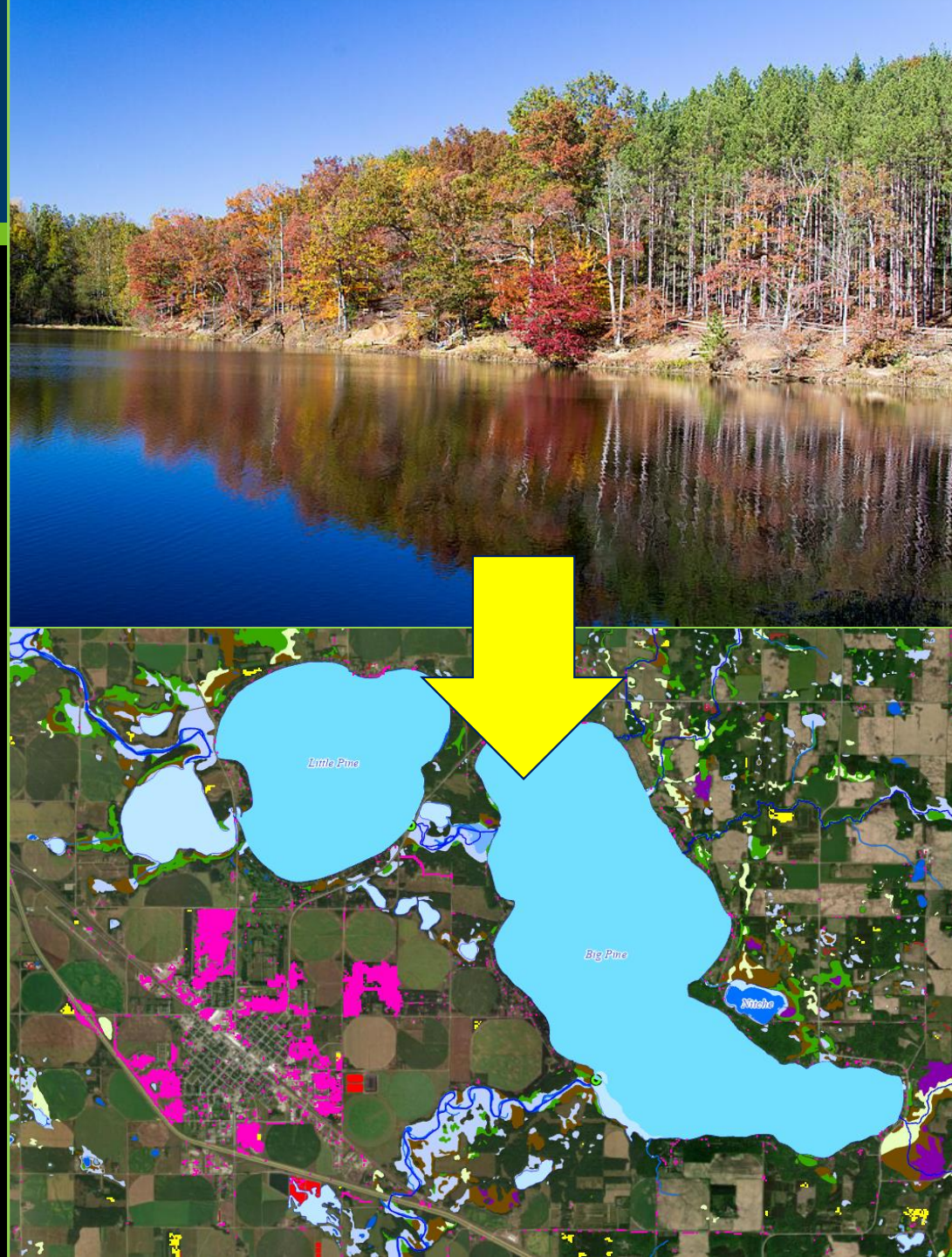
    - “Structure”
      - Abiotic – bathymetry, substrates, etc.
      - Biotic – vegetation, wood, etc.
- Physiochemical Habitat
  - Hydrologic/hydraulic
  - Thermal
  - Chemical
    - Water quality, nutrients



Mental Model

- "Riverscape" Big Idea, Revisited
- Adjusting our thinking:
  - Moving beyond "view from shore"
  - System view:
    - Landscape, land use narrative
    - Habitat components
      - System types
      - Structure types
      - Physiochemical
    - Geophysical processes
  - "What upstream factors create the habitat in front of me?"



Themes

- Landscapes and Fish Habitat
- Riverscape Management
- Applications

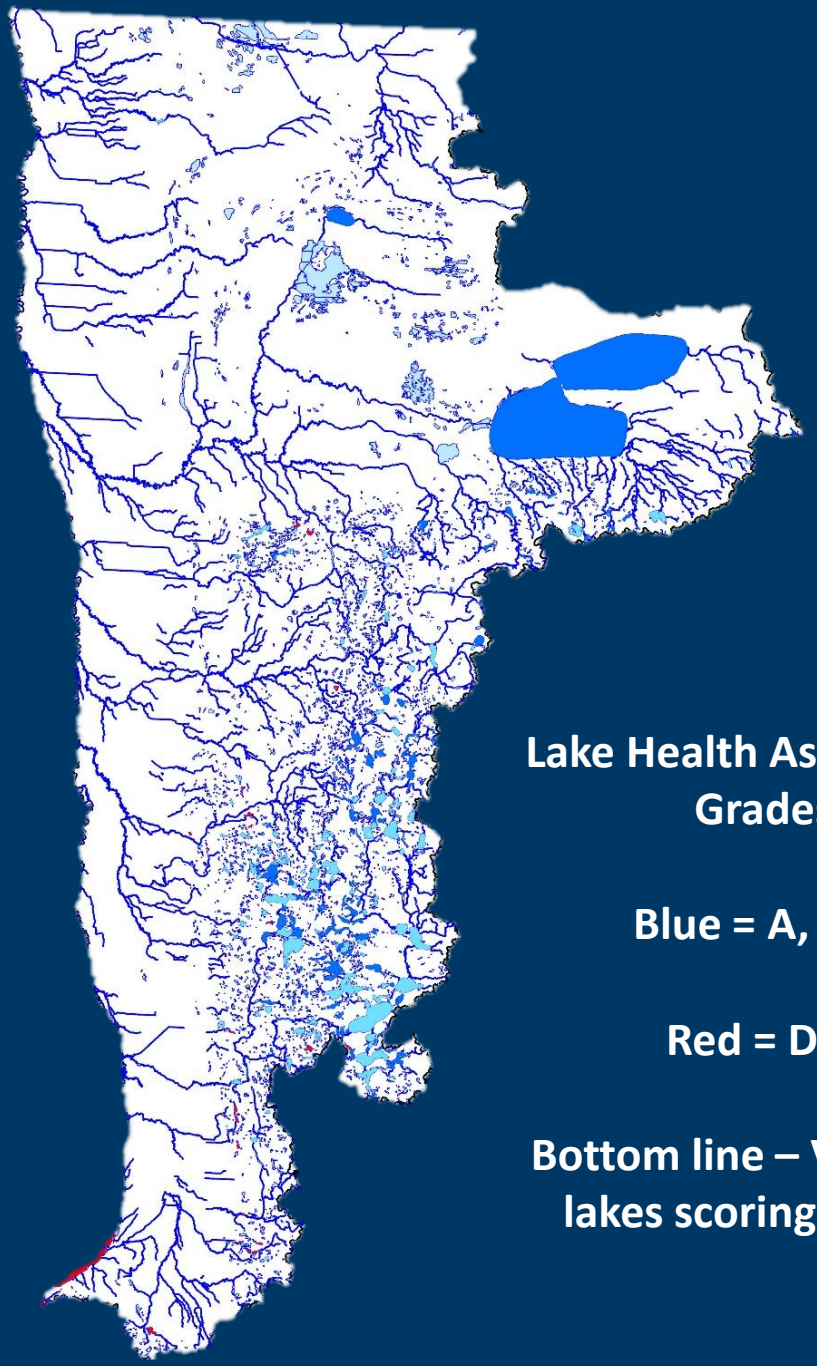
Habitat Management

- “In-the-water” projects
  - Targeted actions
  - Contextually unique:
    - Landscape influences
    - Structural habitat
    - Physiochemical habitat

- “Water-adjacent” projects
  - More generalizable, toolbox actions
  - Terrestrial processes more predictable
    - Shoreland protection, runoff tools

Management – where?

- What's intact vs. problematic?
  - DNR Lake Health Assessment Grades
    - Average grade or higher = 97.4%
  - MPCA River Stressor Identification
    - Barriers harm fisheries – fish need to move
  - WRAPS, 1W1P coordination
    - Riverscape habitat protection & improvement strategies



Lake Health Assessment Grades

Blue = A, B, C

Red = D, F

Bottom line – VERY few lakes scoring poorly.

Management – how?

- "Riverscape" approach to habitat:
  - Protect intact resources
    - Stream function, riparian integrity
      - Watershed coordination, public water rules, easements, etc.
    - Maintain lake biotic structure
      - Aquatic plant management
      - Shoreland coordination
      - Aquatic management areas

Photo: InForum News

Management – how?

- "Riverscape" approach to habitat:
  - Target problems:
    1. Connectivity impairments
    2. Landscape & hydrologic issues
    3. Shoreland issues

Photo: EOTSWCD

1. Connectivity restoration

- Remove or modify barriers to fish passage
  - Restore habitat access & dispersal for fish species & life stages

- What are the riverscape impacts of barriers?
  - Total barrier – 34% of species missing upstream
    - Sport fish loss due to migratory & seasonal behaviors

  - Partial barrier – cumulative impacts
    - “Ratcheting baseline” declines
    - Sport fish commonly impacted
      - Same mechanisms as above

Seasonal use (foraging, overwintering, nursery)

Life history strategies (“headwaters” species)

Spawning migrations

2. Landscape & Hydrology

- Stream form & function
  - Multi-purpose partnerships
    - River habitat form/function component
    - Local benefits (e.g. flood damage reduction)

- Hydrologic processes
  - Collaborative water management
    - Watershed Districts, SWCDs, BWSR
    - WRAPS, 1W1P linkages
  - Sediment transport & discharge dynamics
    - Large-scale BMP implementation
    - Riverine & downstream habitat benefits

Stream Form & Process Restoration

Hydrology improvements:
WASCOBs, channel side inlets, wetland restorations
(*tend to be Clean Water funded*)

3. Shorelands

- Basic issue: development alters nutrient delivery, water quality, & near-shore habitat
- Critical shoreland habitat acquisition
  - High-profile preservation partnerships
- Lakeshore restoration programs
  - SWCDs, Watershed Districts
    - Nutrient runoff & erosion control
    - Partnership projects at problem sites

Northern Waters LAND TRUST

CLEAN WATER LAND & LEGACY AMENDMENT

High-profile habitat preservation

Becker Co. SWCD shoreland restoration example

Themes

- **Landscapes and Fish Habitat**
- **Riverscape Management**
- **Applications**

Today's focus: Sport fish & fishing

Sturgeon Recovery

- Collaborative 30-year recovery effort

WATCH NOW

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"Kings in the North – Red River Lake Sturgeon" 30-minute documentary

Sturgeon Fishing

- Collaborative 30-year recovery effort

Targeted Connectivity Improvements – Better Fishing

WATCH NOW

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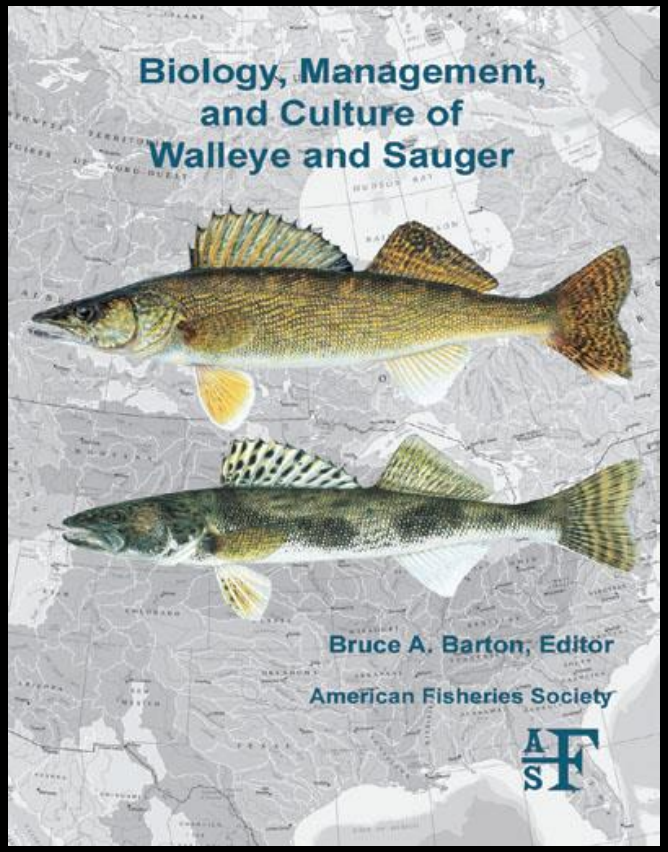
Walleye Applications

- Walleye Life History
  - Reproduction & Habitat Use
    - Lake Resident – Lake Spawner
    - River Resident – River Spawner
    - Lake Resident – River Spawner



Chapter 5: Walleye and Sauger Habitat
Sec. 3 Reproductive Strategies

Walleye Research

- Walleye Life History
  - Reproduction & Habitat Use
    - ★ Lake Resident – Lake Spawner
    - River Resident – River Spawner
    - Lake Resident – River Spawner

Thermal habitat; 1st year weather-related linkages

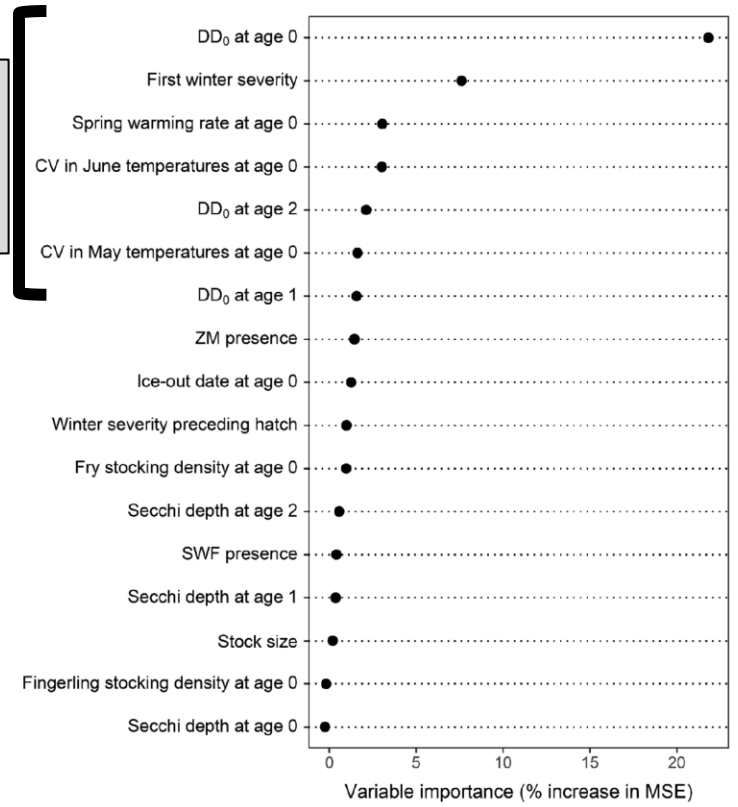
NRC Research Press

ARTICLE

Drivers of walleye recruitment in Minnesota's large lakes

Andrew E. Honsey, Zachary S. Feiner, and Gretchen J.A. Hansen

Fig. 3. Variable importance (measured as the percent increase in mean squared error (MSE) when a given variable is permuted) of the predictor variables included in the random forest model. Higher values on the *x* axis indicate higher variable importance. DD_0, mean annual degree-days above 0 °C; CV, coefficient of variation; ZM, zebra mussel (*Dreissena polymorpha*); SWF, spiny water flea (*Bythotrephes cedarstroemii*).



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% Vegetation of Littoral Area; Rearing cover, lake type

Contents lists available at ScienceDirect

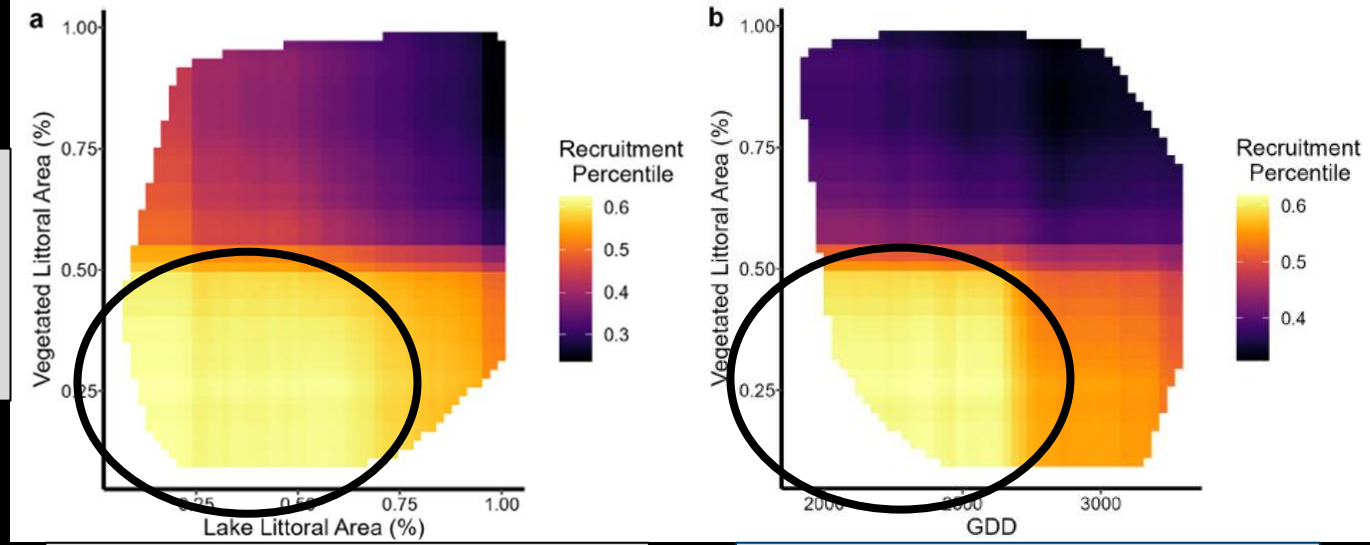
Fisheries Research

ELSEVIER

journal homepage: www.elsevier.com/locate/fishres

In the weeds: Aquatic macrophytes serve as important indicators of walleye recruitment in Upper Midwestern lakes

Robert P. Davis [a,b,*], Ellen A. Albright [a], Catherine L. Hein [a], Michael R. Verhoeven [c], Heidi M. Rantala [d], Zachary S. Feiner [a,e]



Littoral Area; "Shallows", spring warming

Thermal habitat; weather-related sweet spot

Project potential?

- Walleye Life History
  - Reproduction & Habitat Use
    - ★ Lake Resident – Lake Spawner
    - River Resident – River Spawner
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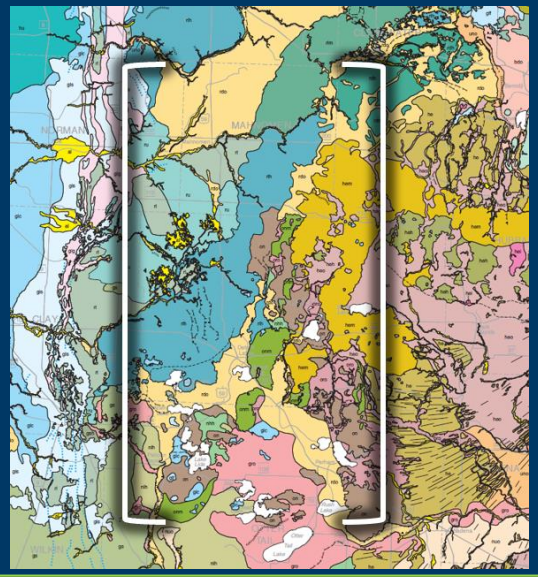
What about in-lake spawning habitat?



Recall the riverscape history and geologic maps:

- Glacial moraines, outwashes of "lakes country" – deposited vast quantities of gravel, cobble, etc.
- Lakes rich in lithophilic spawning habitat, not known to be limiting

Project potential?

- Walleye Life History
  - Reproduction & Habitat Use
    - ★ Lake Resident – Lake Spawner
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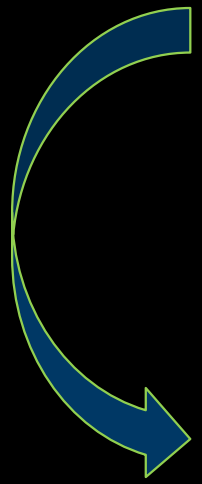


Bottom Line: no clear in-lake habitat actions to improve Walleye year class production.

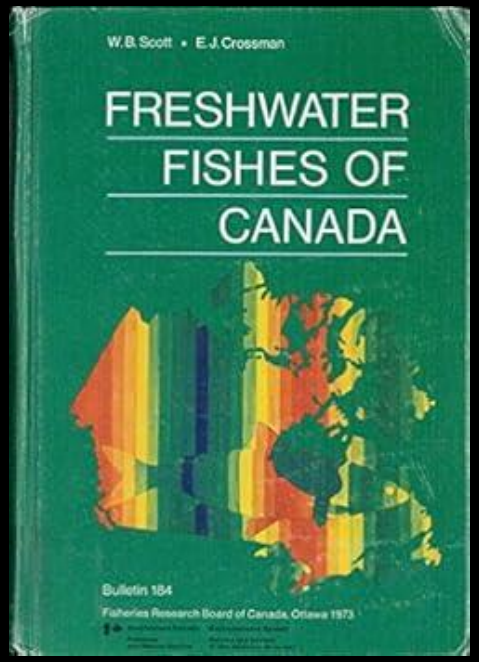
Statement based on:

- Reproduction/recruitment research
- Habitat modification trials
- Current riverscape habitat patterns

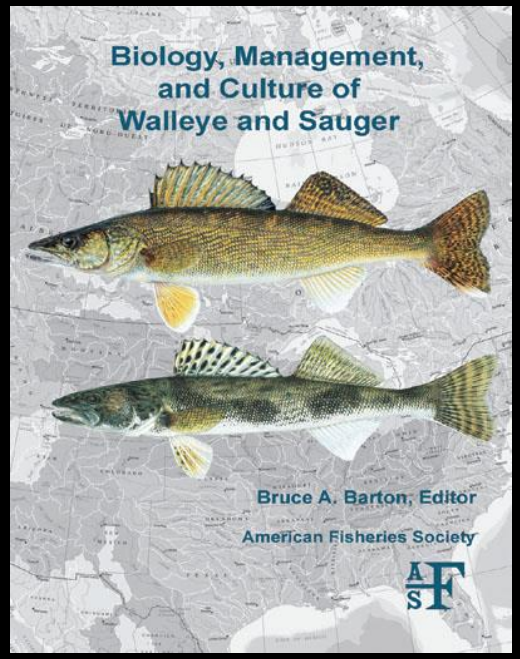
Project potential?

- Walleye Life History
  - Reproduction & Habitat Use
    - Lake Resident – Lake Spawner
    - ★ River Resident – River Spawner
    - ★ Lake Resident – River Spawner

- River spawners combined, same behavioral and habitat use patterns



Scott & Crossman 1973



Barton, editor 2011

In the spring, Walleyes 1.) undertake movements upstream or into tributaries to 2.) riffles, rapids, or areas of faster current and 3.) exhibit lithophilic spawning preferences.

Walleye Habitat Use

Pelican River Lake Chain System

Pre-Project

- Connectivity impairment
- Spawning habitat lost

Post-Project

- Connectivity restored
- Spawning habitat created

Walleye Habitat Use

DNR Walleye Egg Take Operations

Strain	Spawn Take Location	Riverine Component/Influence?
Lower Mississippi	Cannon River	Yes
	Knife River	Yes
	Lake Sarah	No
Mississippi	Big Lake Creek	Yes
	Boy River	Yes
	Cut Foot Sioux	Yes
	Pine River	Yes
Pike River	Pike River	Yes
Red River	Dead River	Yes
	Sallie	Yes
Spicer-Crow River	Diamond	No
	Green	Yes
	Koronis	No*
	Rice	No*

<u>Bottom Line:</u> riverine habitat is foundational to Minnesota's Walleye production and lake stocking program

Known N. Fork Crow River spawning run

Habitat Management

Roseau River System

Pre-Project

Issue: discharge-dependent barrier

Angler concerns:
“We just haven’t seen the Walleyes in the upper river like we used to.”

Full Removal

Habitat Approach: barrier removal

Restored year-round connectivity, exploit spring dispersal & habitat use to “restock” impacted reaches.

Year-1 Results?

Targeted habitat management:
Better Fishing

Habitat Management

Red Lake River Projects

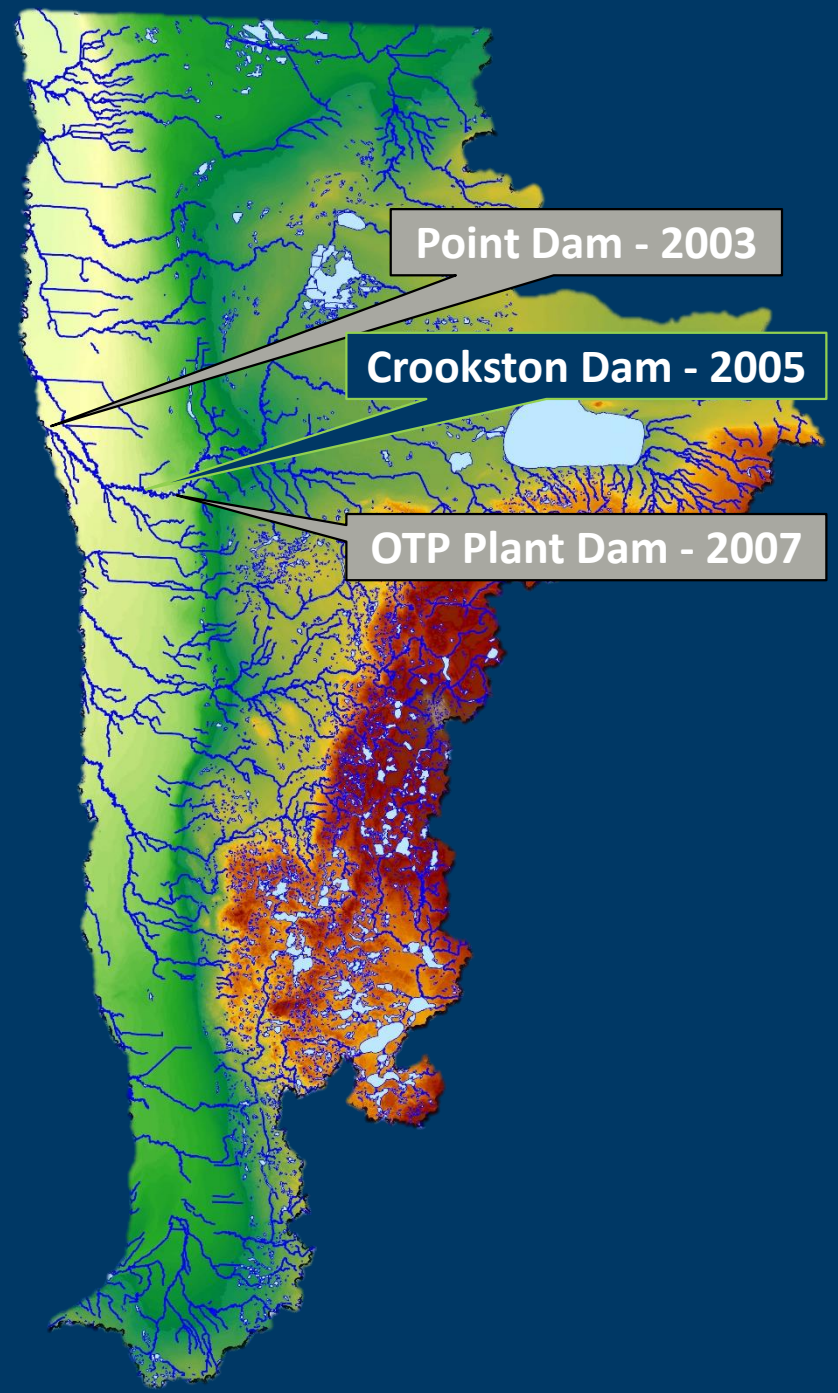
Reconnected hundreds of miles in RLR & tributaries to beach ridge spawning reaches & downstream overwintering habitat

2000 – 0.05/net
2005 – 10.7/net

2000 – 0.16/net
2005 – 0.85/net

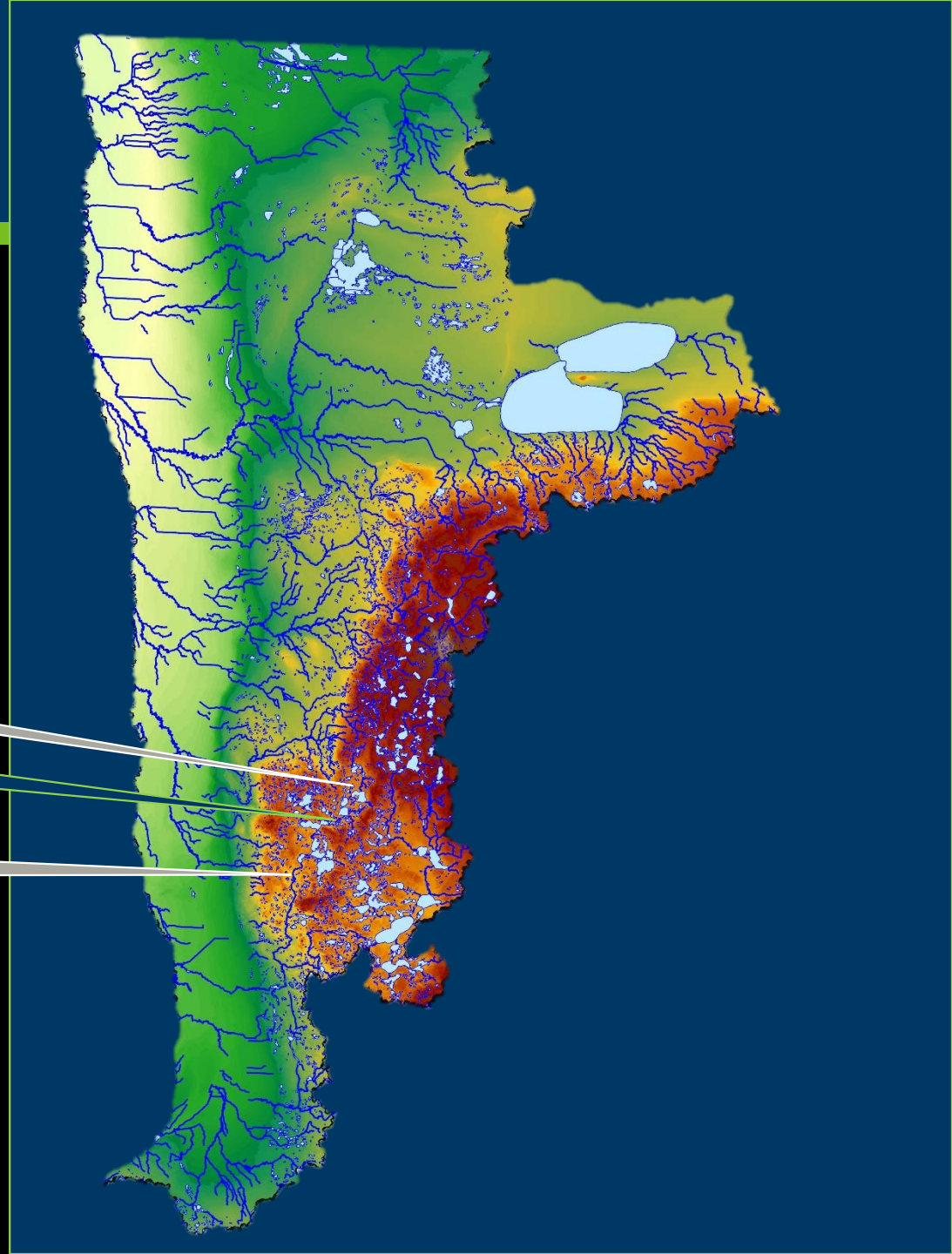
TRF angler – "1st Sauger I've caught here in 45 years!"

Targeted habitat management: Better Fishing



Habitat Management

Upcoming Project: Bucks Mill Complex
Pelican River Lake Chain



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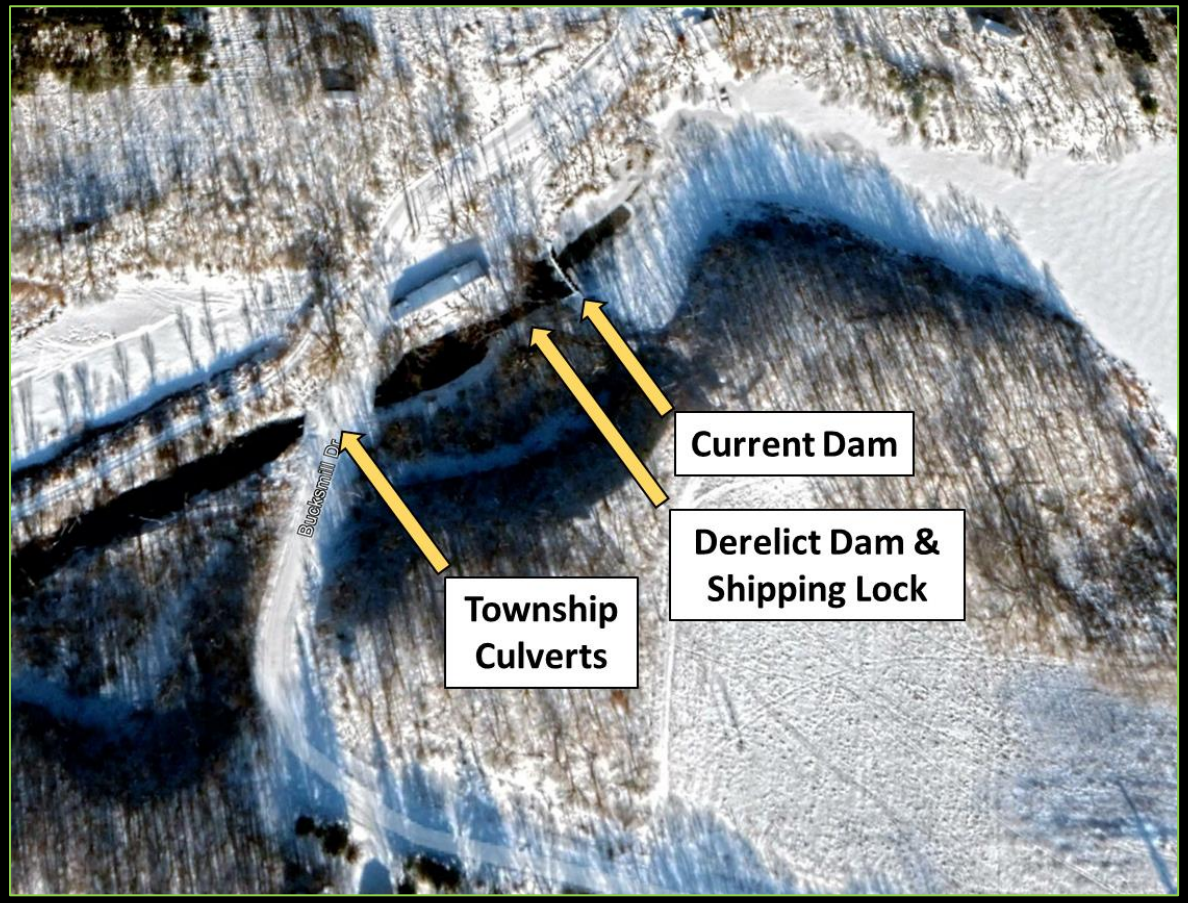
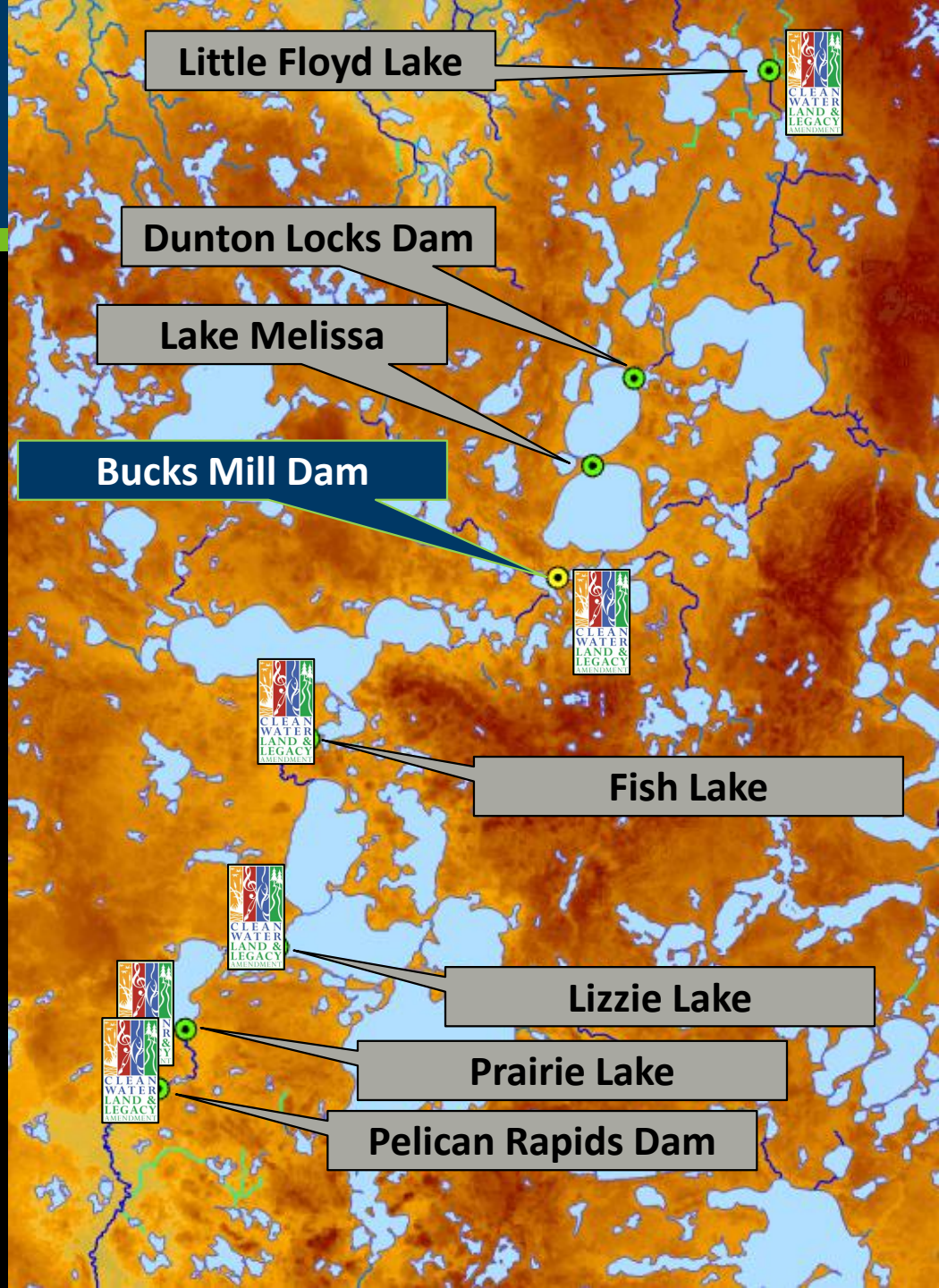


Habitat Management

Upcoming Project: Bucks Mill Complex
Pelican River Lake Chain

- **Dam Impacts:**
  - Blocks Walleye and other lithophilic spawning runs
  - Destroyed extensive spawning habitat
- **Benefits**
  - Eliminates final barrier fragmenting Pelican River lake chain system
  - Restore lithophilic spawning habitat
    - Lake Sturgeon, Walleye, native suckers, etc.



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