
Ecological Considerations for the Design of Stream Crossings and Dams
Photo credit: Michael A. Miller

Dams

Sub-standard Culverts

Culvert Problems

- Inlet or Outlet drop
- Physical barriers
- Debris accumulation
- Excessive velocities
- Insufficient water depth
- Flow contraction (turbulence)
- Orifice Flow
- Absence of bank edge areas
- Discontinuity of channel substrate


Micrographia


Scott Jackson


Scott Jackson


Micrographia


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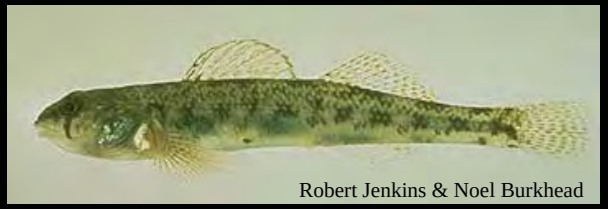

Robert Jenkins & Noel Burkhead


Barry Wicklow


Kenneth Catania

Ecological Processes

- Energy flow / Food chain support
- Interdependencies
- Predator-prey dynamics
- Hydrology
- Natural disturbances
- Movement of organisms and materials

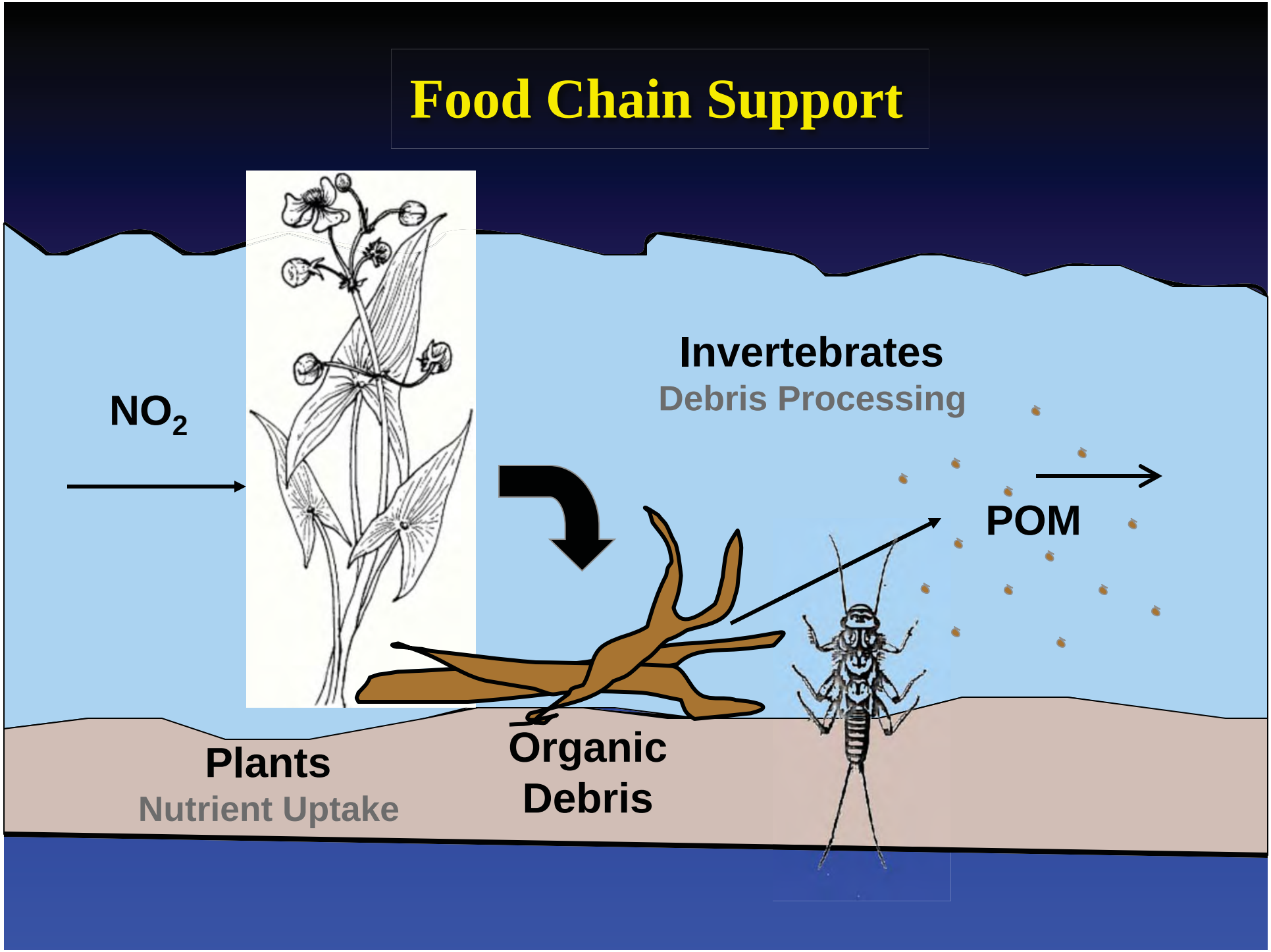
Interdependencies

Douglas Smith

Robert Jenkins & Noel Burkhead

The occurrence of some species is dependent on the present of others. For example many freshwater mussel species are dependent on specific fish hosts to complete their life cycles.

Food Chain Support



Predator-Prey Dynamics

What are the impacts of

- **fish stocking**
- **introduced fish**
- **absence of native anadromous fish**

…on stream communities.

Flooding

Importance of Movement

- Daily movements
- Changes in habitat conditions
- Reproduction
- Exploit vacant habitat
- Population continuity
- Dispersal

Adult Spawning Migrations

Spawning Habitat
Eggs & Alevin

Requirements:

- **Clean, well oxygenated gravels**

Salmon Fry

Requirements:

- **Margin habitats with slow-moderate current**
- **Sufficient invertebrate prey**
- **Interstitial spaces**

Early Parr

Requirements:

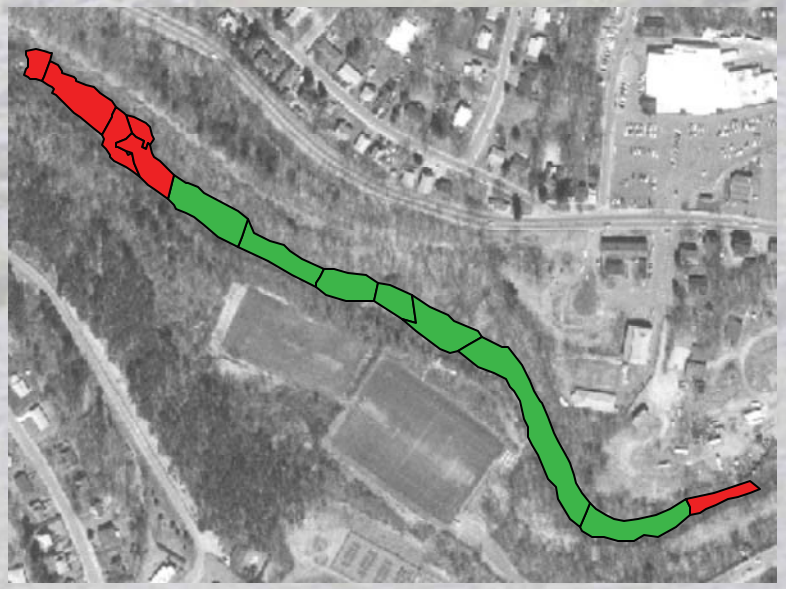
- **Habitat with moderate-swift current**
- **Sufficient invertebrate prey**
- **Adequate interstitial spaces**

Late Parr / Pre-smolt

Requirements:

- **Overwinter cover**
- **Require larger shelter**
- **Appropriate water chemistry**
- **Ability to emigrate from natal streams at certain times of the year**

At this stage salmon make extensive movements seeking appropriate winter habitat



Habitat suitable for Fallfish

Site4.shp

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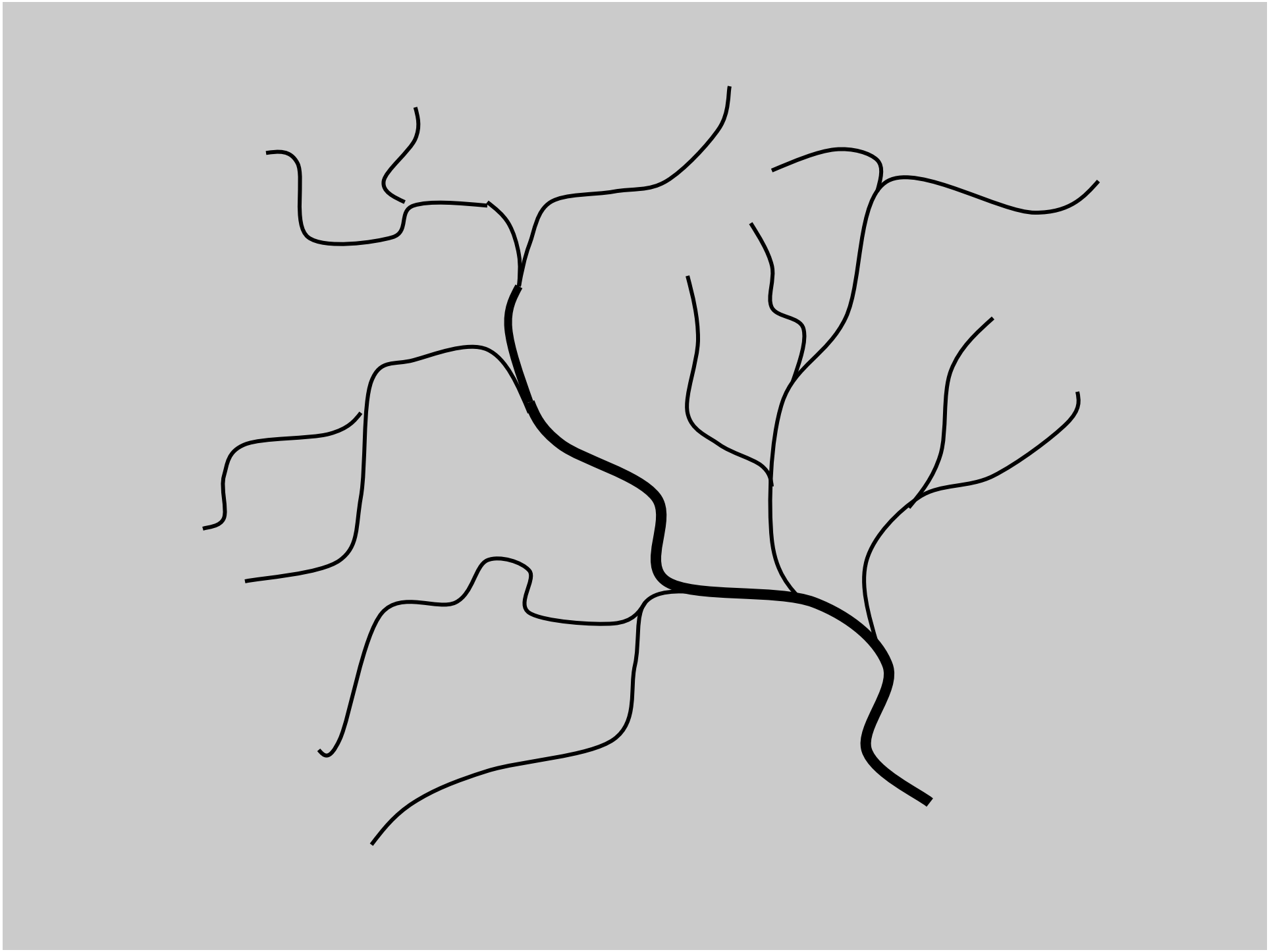
Piotr Parasiewicz

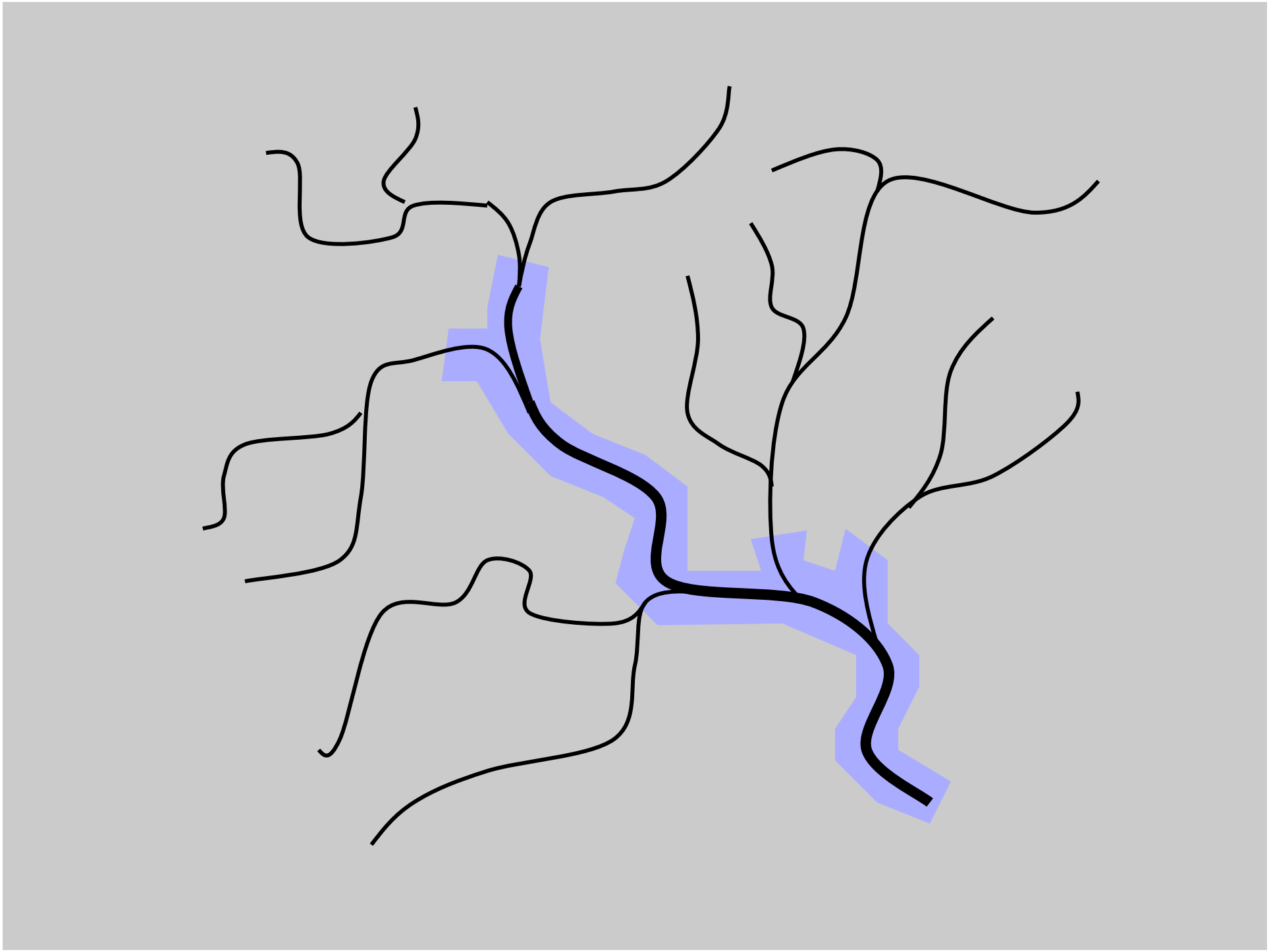
Impacts of River & Stream Crossings

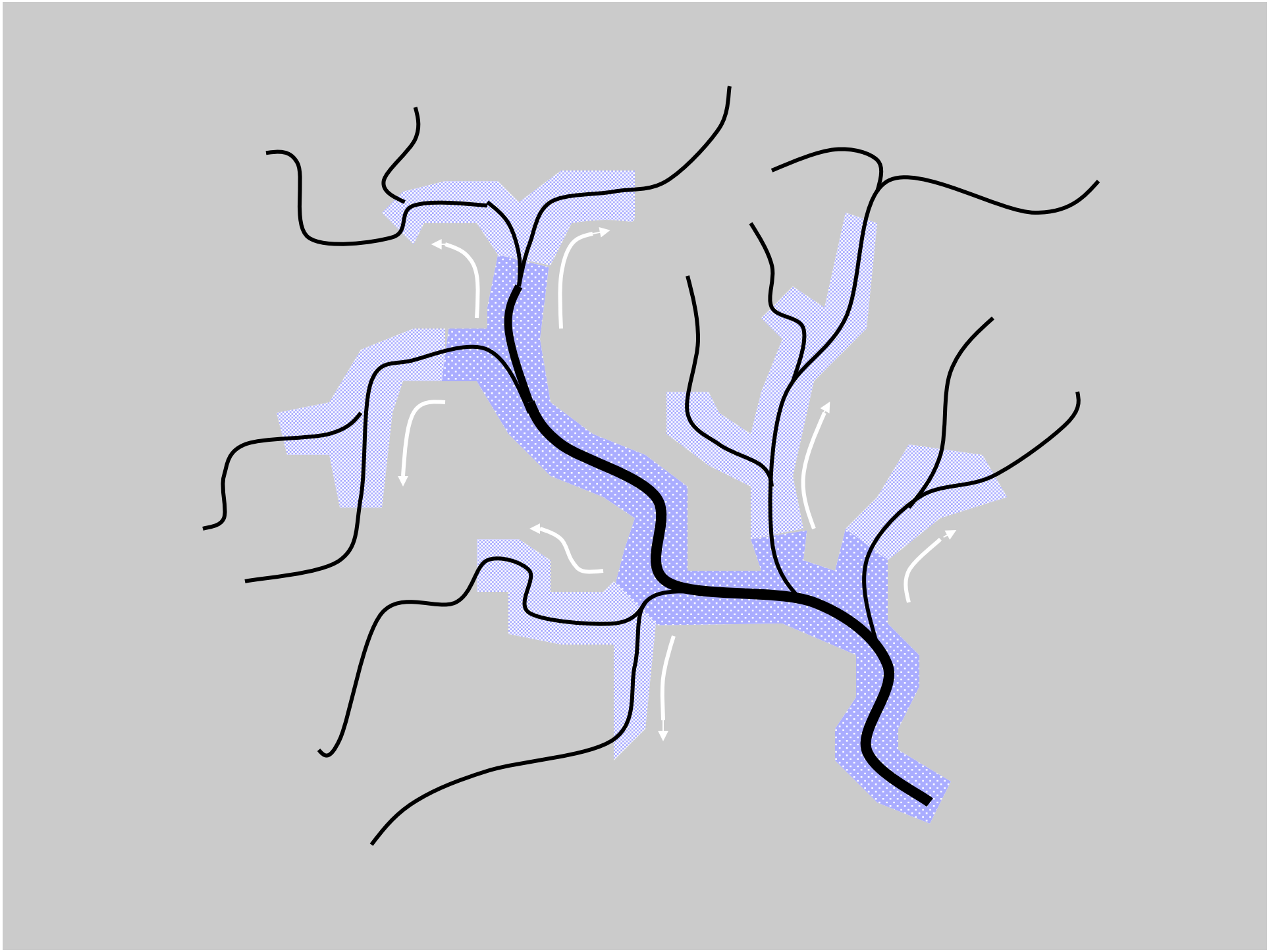
- Habitat loss and degradation
- Roadkill leading to loss of populations
- Alteration of Ecological Processes
- Reduced access to vital habitats
- Population fragmentation & isolation
- Disruption of processes that maintain regional populations

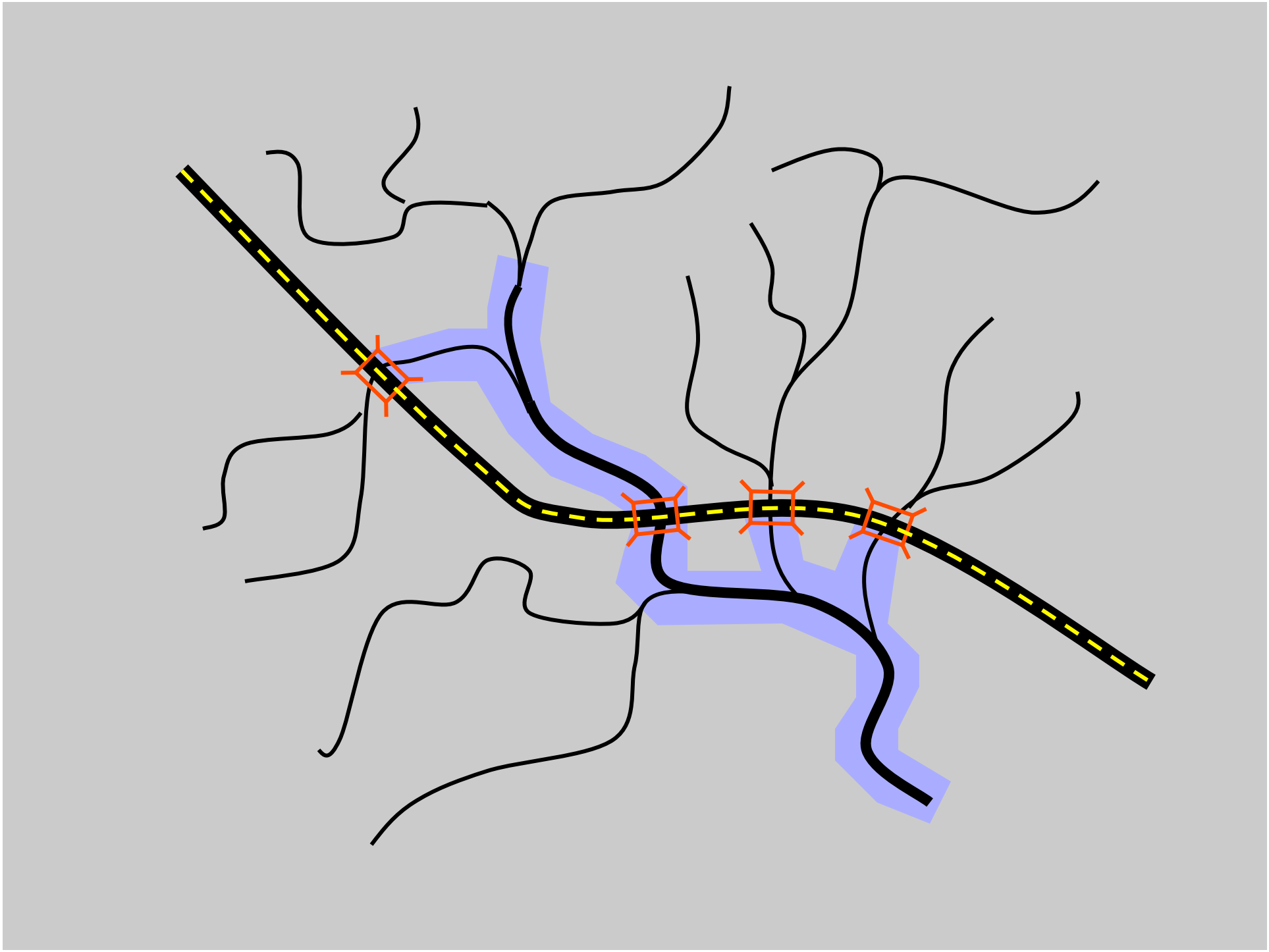
Reduced Access to Vital Habitats

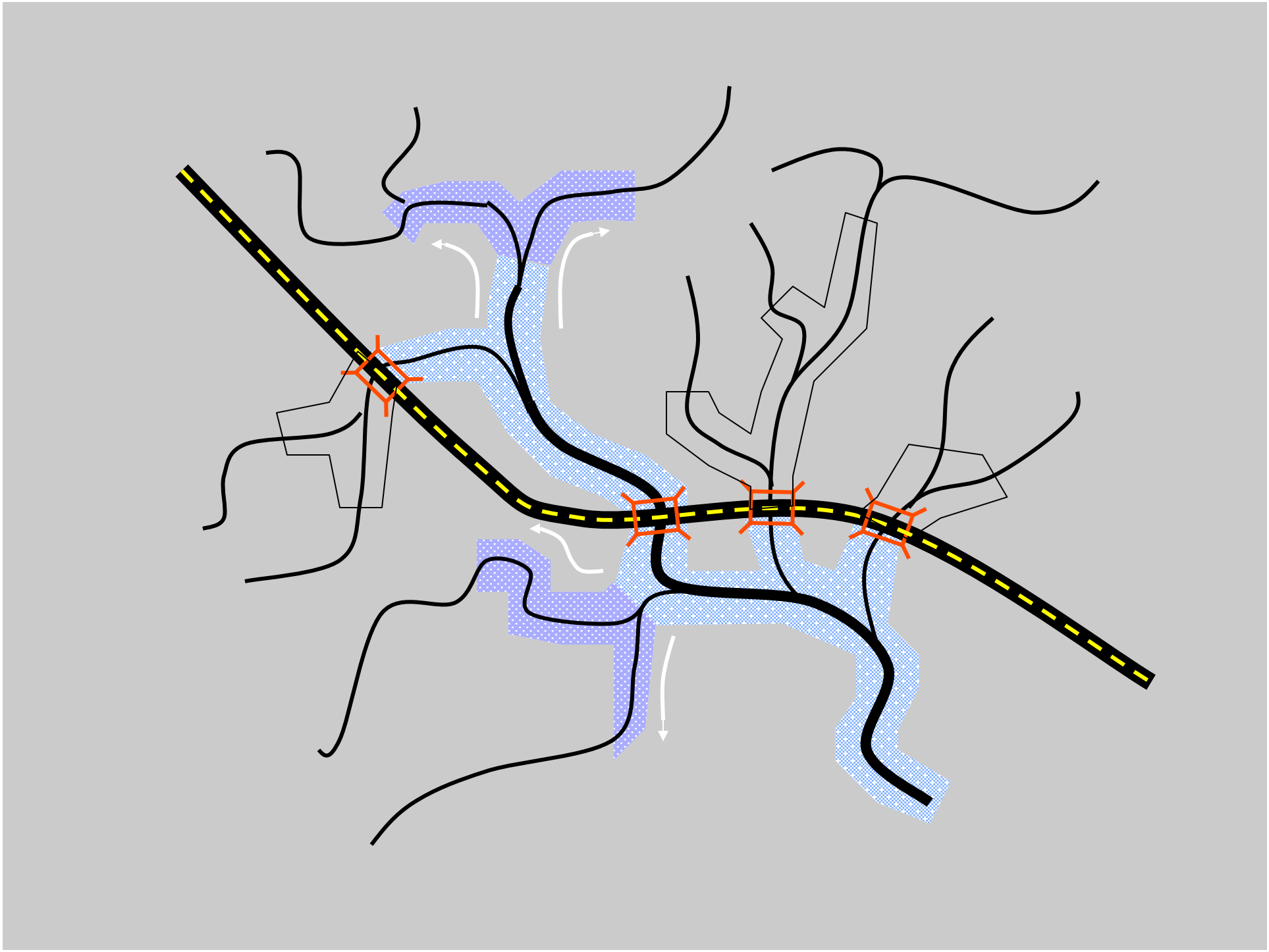
- Spawning habitat
- Nursery habitat
- Foraging areas
- Deep water refuges
- Seasonal habitats











Population Fragmentation and Isolation

- Barriers to movement subdivide or isolate populations
- Smaller and more isolated populations are more vulnerable to:
  - extinction due to chance events
  - genetic changes

Population Viability

Short-term viability

N_e = 50 to 200+

Long-term viability

N_e = 500 to 5000+

Processes that Maintain Regional Populations ("Metapopulations")

- Supplementation ("rescue effect")
- Gene flow
- Re-colonization

Mudpuppy

Amphiuma

Hellbender

Cope’s Giant Salamander

Musk turtles

Softshell turtles

Importance of Small Streams

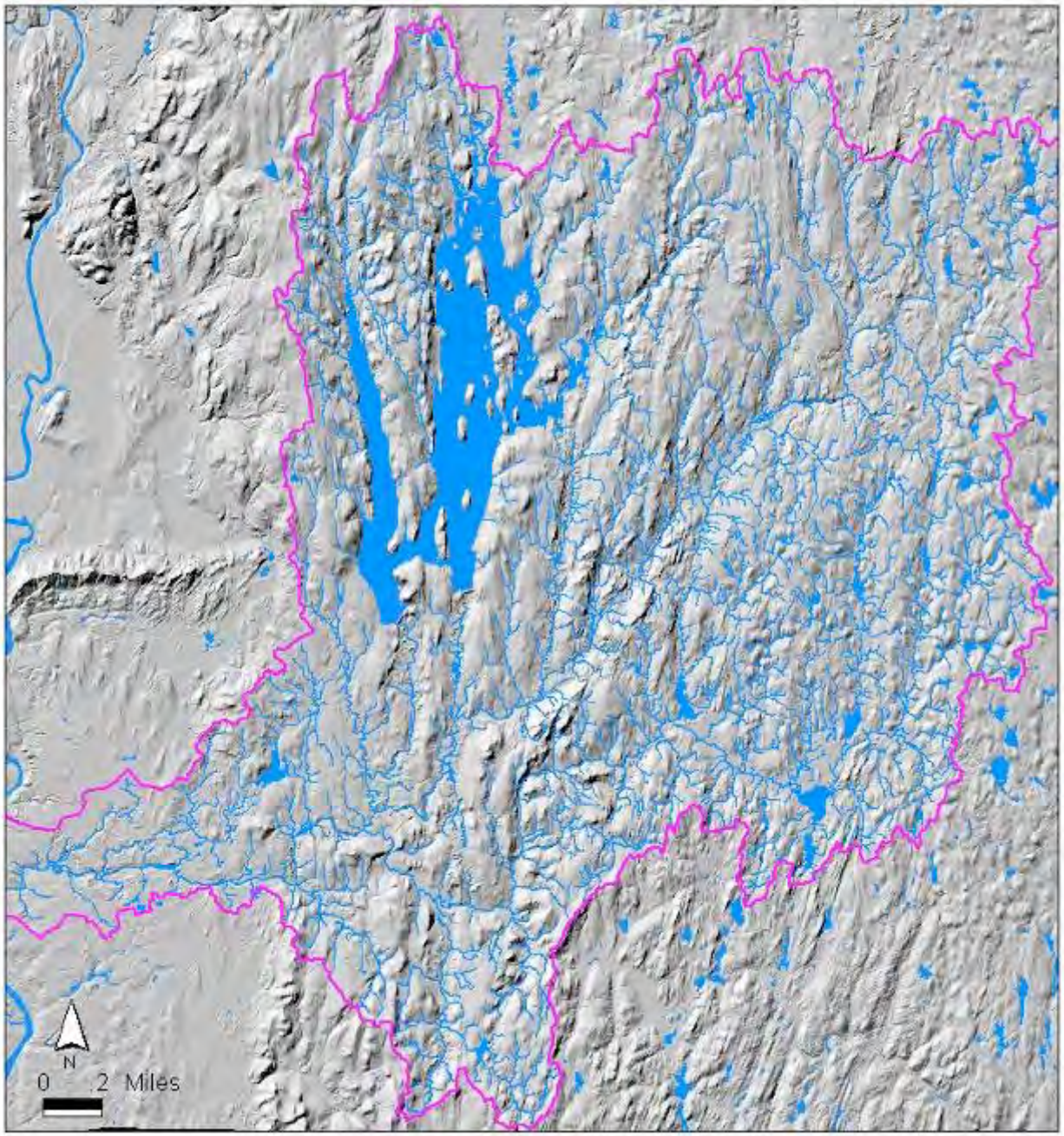
- Make up a large percentage of stream miles
- Cumulatively provide more habitat than large rivers
- Support species not found in larger streams and rivers
- Provide important spawning & nursery habitat for fish


Wood turtle
Scott Jackson
Beaver
Muskrat
© 2003 John White
Scott Jackson
Snapping turtle
Star-nosed mole
Kenneth Catania
Otter
Spring Salamander
Scott Jackson
Dusky salamander
Mink

Openness


Expanded Bridges

CHICOPEE WATERSHED



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MA Riverways Program

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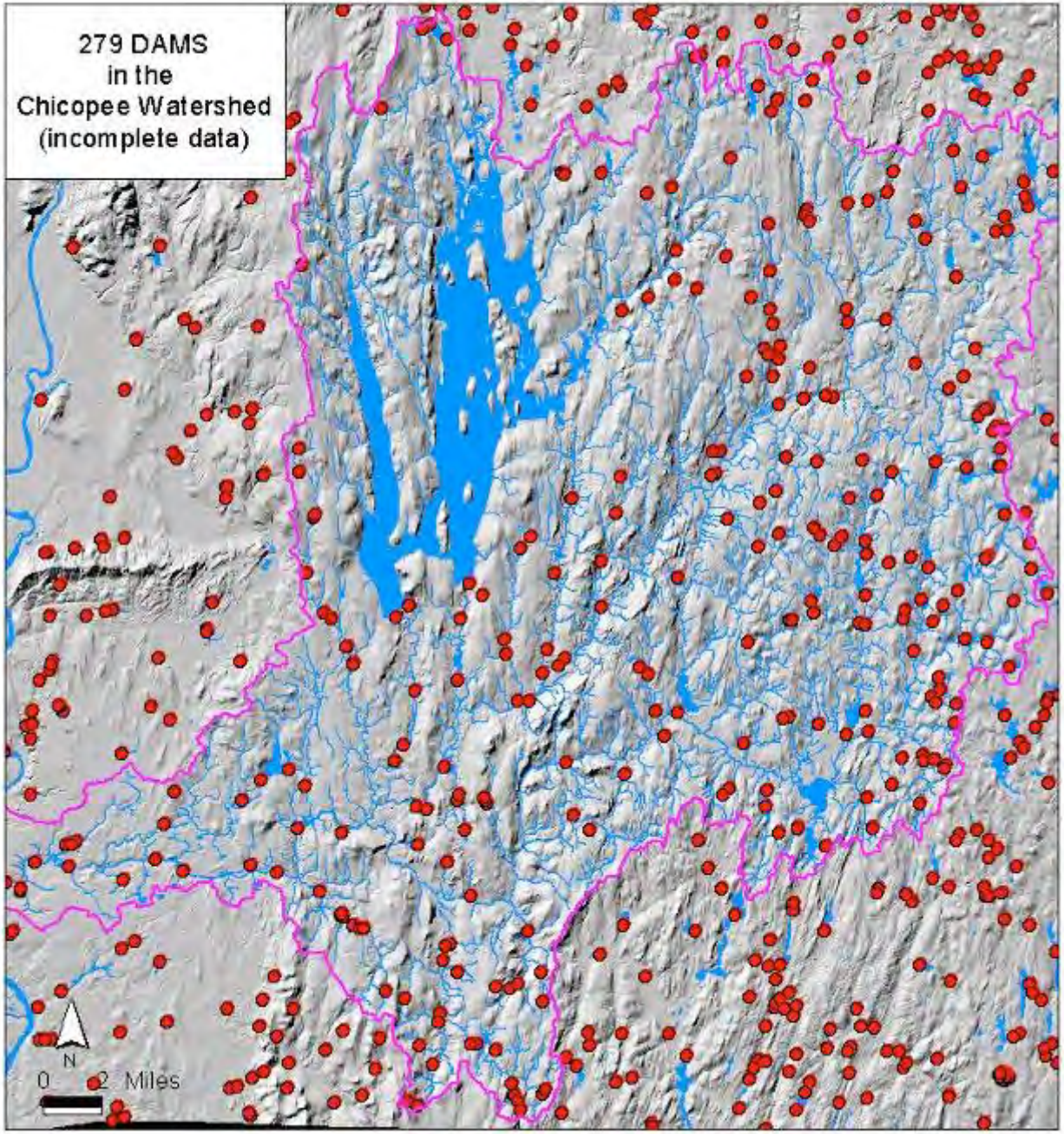

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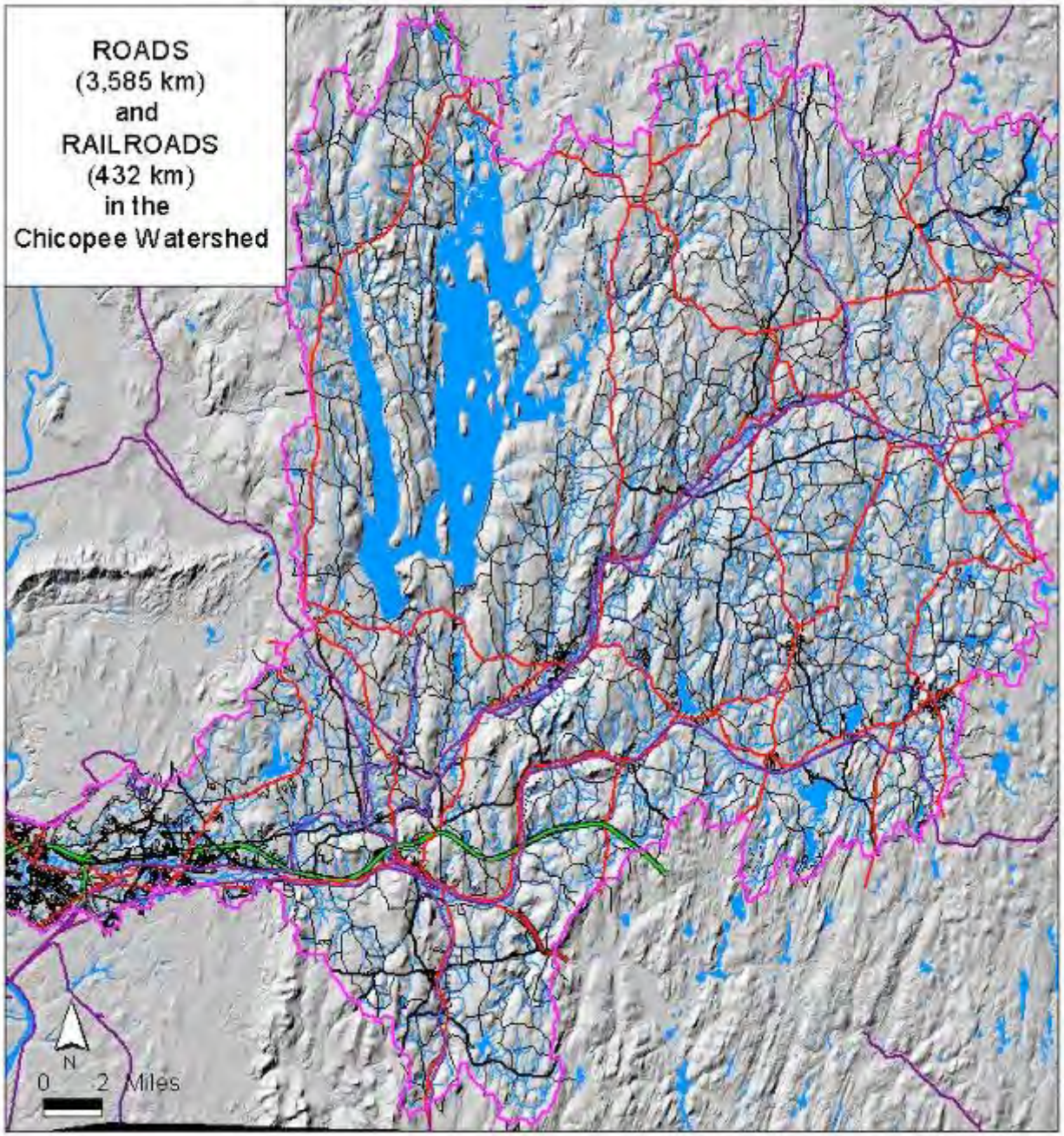

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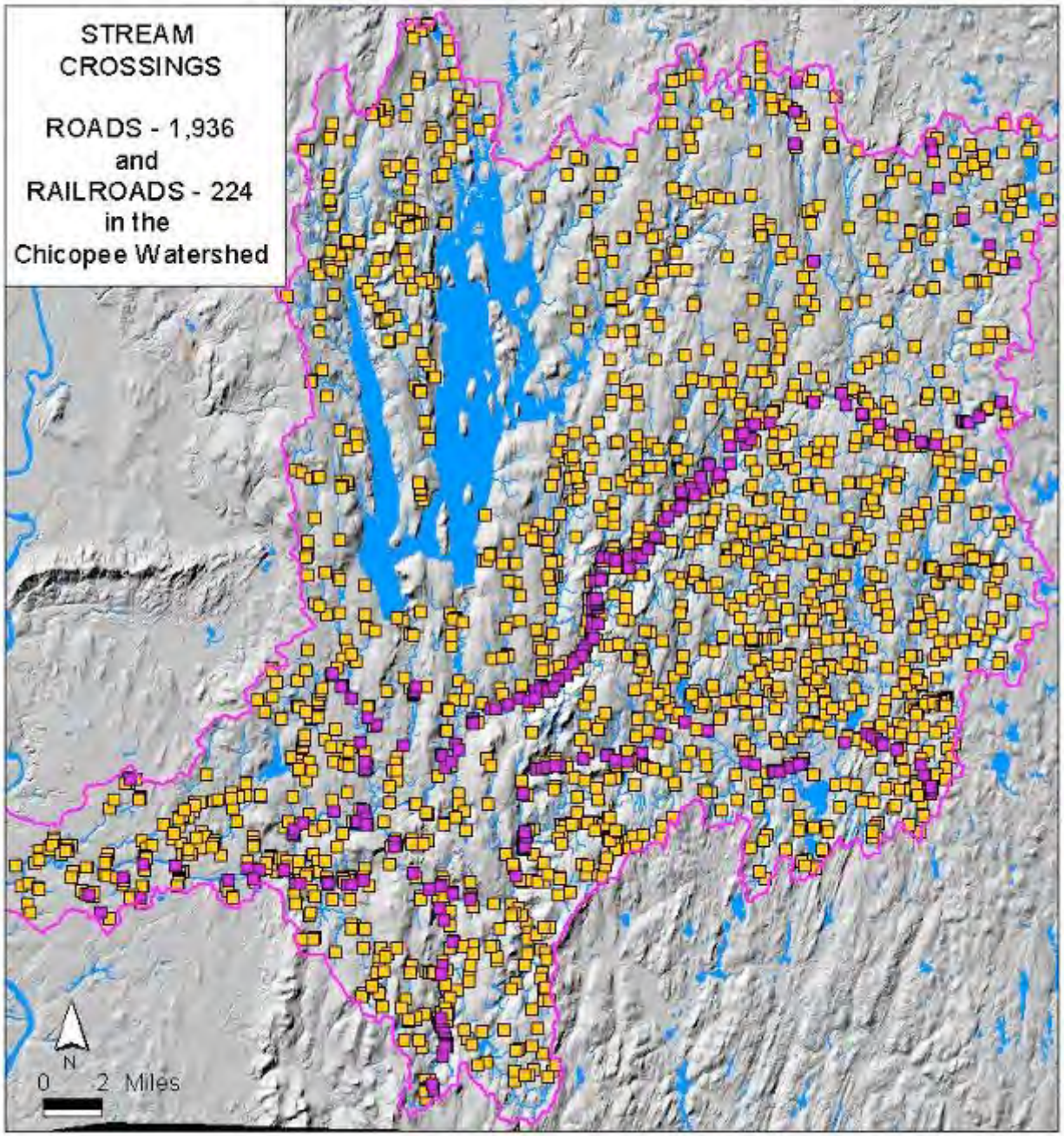

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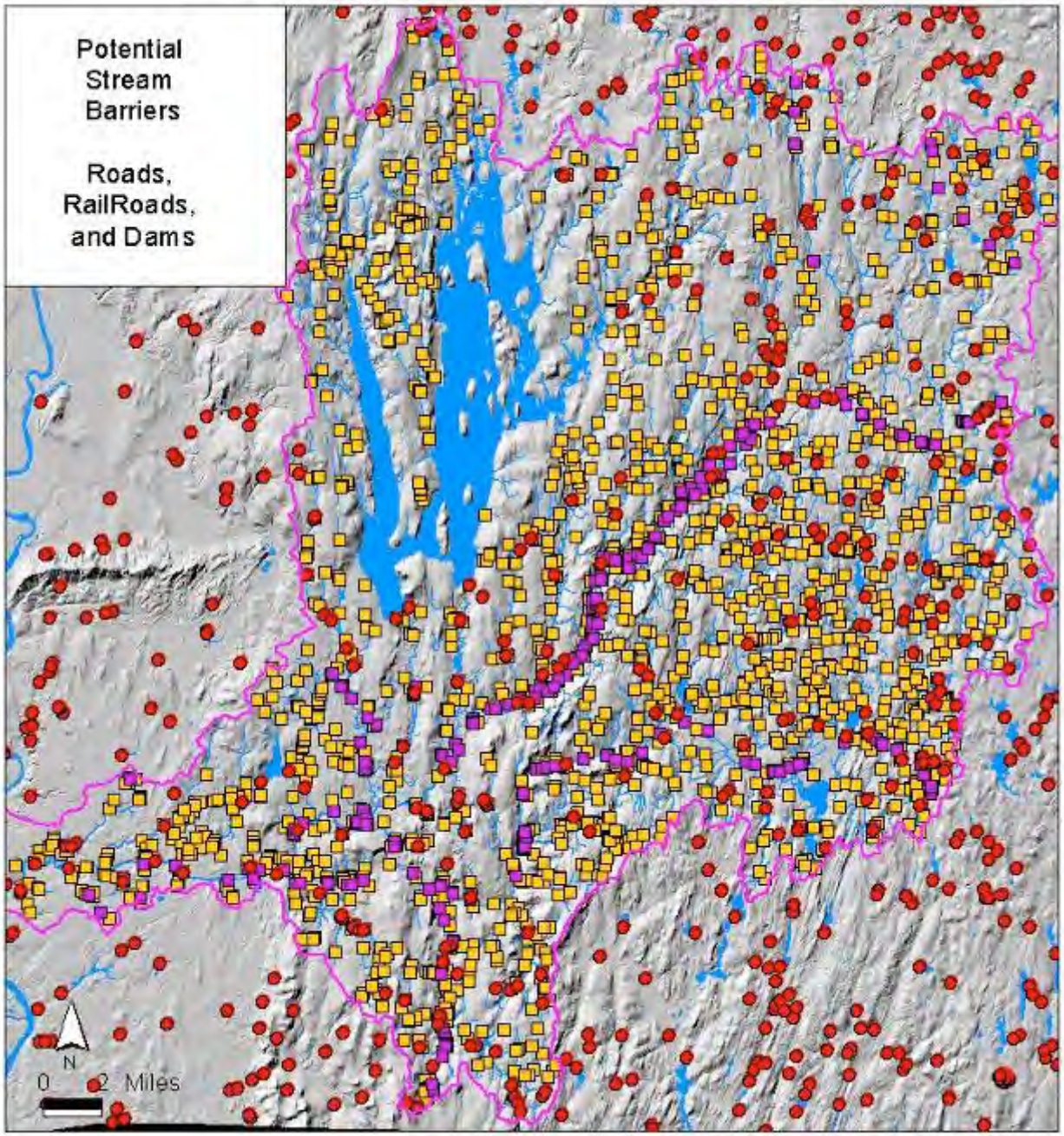

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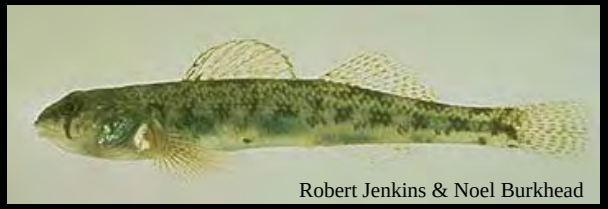
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Aldo Leopold, 1953:

“If the biota, in the course of eons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering.”