EFFECTS OF HYDROLOGIC FRAGMENTATION ON STREAM ECOSYSTEM PROCESSES IN THE CACHE RIVER, IL

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Upper Cache River
• Altered flow regime
• Bank erosion
• Headcutting

Lower Cache River
• Altered flow regime
• Sedimentation
• Low dissolved oxygen
• In-stream habitat loss
• Alteration of riparian vegetation

IL EPA 2008
Cache River, Urbana Rd, 31Jul12

Source: USGS.gov
Dissolved Oxygen Profiles, Cache River, IL
July 18-20, 2010

Lower Cache River, East of Tunnel Hill Trail, near Wetland Center
Upper Cache River, North of Tunnel Hill Trail, west of Train tracks

Lower Cache River, West of Tunnel Hill Trail, near Wetland Center
**Dissolved oxygen**

\[ \text{DO} = 7.95Q^{0.12} \]

\( n = 33, \quad R^2 = 0.27 \)

95% Confidence Intervals
Net Ecosystem Metabolism

NEM = GPP - CR

p < 0.05
NEM = GPP - CR
Significantly lower dissolved oxygen in the water column when a 100% duckweed cover is present

**NEM = GPP - CR**
Leaf litter decomposition

NEM = GPP - CR

$NEM = GPP - C$R

$p < 0.001$

Leaf Litter Decomposition (d$^{-1}$)

Upper

Lower

Physical Forces? Microbial Processes?
Increased Flow in Dry Months

- Decreased Duckweed Cover
- Increased Dissolved Oxygen
- Increased Snag Habitat
- Increased Water Velocity

- Increased Light Penetration
- Increased Atmospheric Mixing

- Increased Primary Production
- Increased Dissolved Oxygen

- Increased Secondary Production

- Increased Stream Integrity
- Transfer of Energy to Upper Trophic Levels
- Increased Drift
Indirect vs. direct effects of flow

**EPT taxa**

**Passive filter feeders**

![Image of EPT taxa]

![Graph of Macroinvertebrate Community P vs. Snag Density](https://example.com/graph.png)
Total invertebrate abundance and biomass

- Log Abundance (m²)
  - Upper: 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.0, 4.1, 4.2, 4.3, 4.4, 4.5
  - Lower: 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.0, 4.1, 4.2, 4.3, 4.4, 4.5

- Log Biomass (mg/m²)
  - Upper: 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0
  - Lower: 2.4, 2.5, 2.6, 2.7, 2.8, 2.9

- Upper: p=0.006
- Lower: p=0.10
Total invertebrate abundance and biomass

Biomass of average upper Cache invertebrate ~5 times greater than lower Cache invertebrate

\[ p=0.006 \quad p=0.10 \]
Passive filter feeder biomass

\[ y = 24.083x + 0.06 \]

\[ R^2 = 0.535 \]

\[ p < 0.001 \]
Drift biomass

Drift Biomass (mg/min)

- Ostracods, Cyclopoids, Oligochaetaes

$p < 0.05$
Dissolved Oxygen
-Varies spatially
-Heterotrophic

Duckweed
-Limits light
-Promotes hypoxia

Decomposition
-Limited by hypoxia?
-Physical processes?

Macroinvertebrates
-Snag B higher in Upper Cache
-Drift B higher in Lower Cache

Increased Stream Integrity

Transfer of Energy to Upper Trophic Levels

Decreased Duckweed Cover

Increased Water Velocity

Significantly lower light penetration in the water column when a 100% duckweed cover is present.
Significantly lower light penetration in the water column when a 100% duckweed cover is present.

Increased Flow in Dry Months

- Decreased Duckweed Cover
- Increased Dissolved Oxygen
- Increased Snag Habitat
- Increased Water Velocity

- Increased Light Penetration
- Increased Atmospheric Mixing
- Increased Secondary Production
- Increased Drift

- Increased Primary Production
- Increased Dissolved Oxygen

- Increased Stream Integrity
- Transfer of Energy to Upper Trophic Levels
Simulated Reconnection

- Summer 2012-2013
- Water will be pumped into the water-starved section of the lower Cache River during low flow summer months.
- Allow us to physically manipulate the flow in the river to simulate reconnecting the river.
- Use the experiment to compare with our long-term studies.
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100% Duckweed

0% Duckweed