Aquatic Studies Konza LTER

Walter Dodds[1], Keith Gido[1], Craig Paukert[2], Jim Koelliker[3], Matt Whiles[4], and Gwen Macpherson[5]

[1]Division of Biology, Kansas State University
[2]Kansas Cooperative Fisheries and Wildlife Research Unit, Kansas State University
[3]Department of Biological and Agricultural Engineering, Kansas State University
[4]Department of Zoology, Southern Illinois University Carbondale
[5]Department of Geology, University of Kansas


Today's talk
• The past
• The future

What we proposed

- Assess how changes in hydrology will interact with stream biota to regulate ecosystem functioning in intermittent prairie streams.
- Assess how landscape and hydrological variation affects stream invertebrate community production.
- Continue long-term studies of groundwater at Konza to 1) evaluate the long-term effects of watershed treatments and climatic variability on groundwater chemistry and nutrient flux, 2) develop estimates of weathering rates (part of an LTER cross-site study) and 3) quantify contributions to stream water chemistry.

What we did- Infrastructure

- Built experimental stream system (up to 36 units now)
- Purchased new OI- Analytical Flow Solution IV nutrient autoanalyzer


25


2

What we did- Monitoring

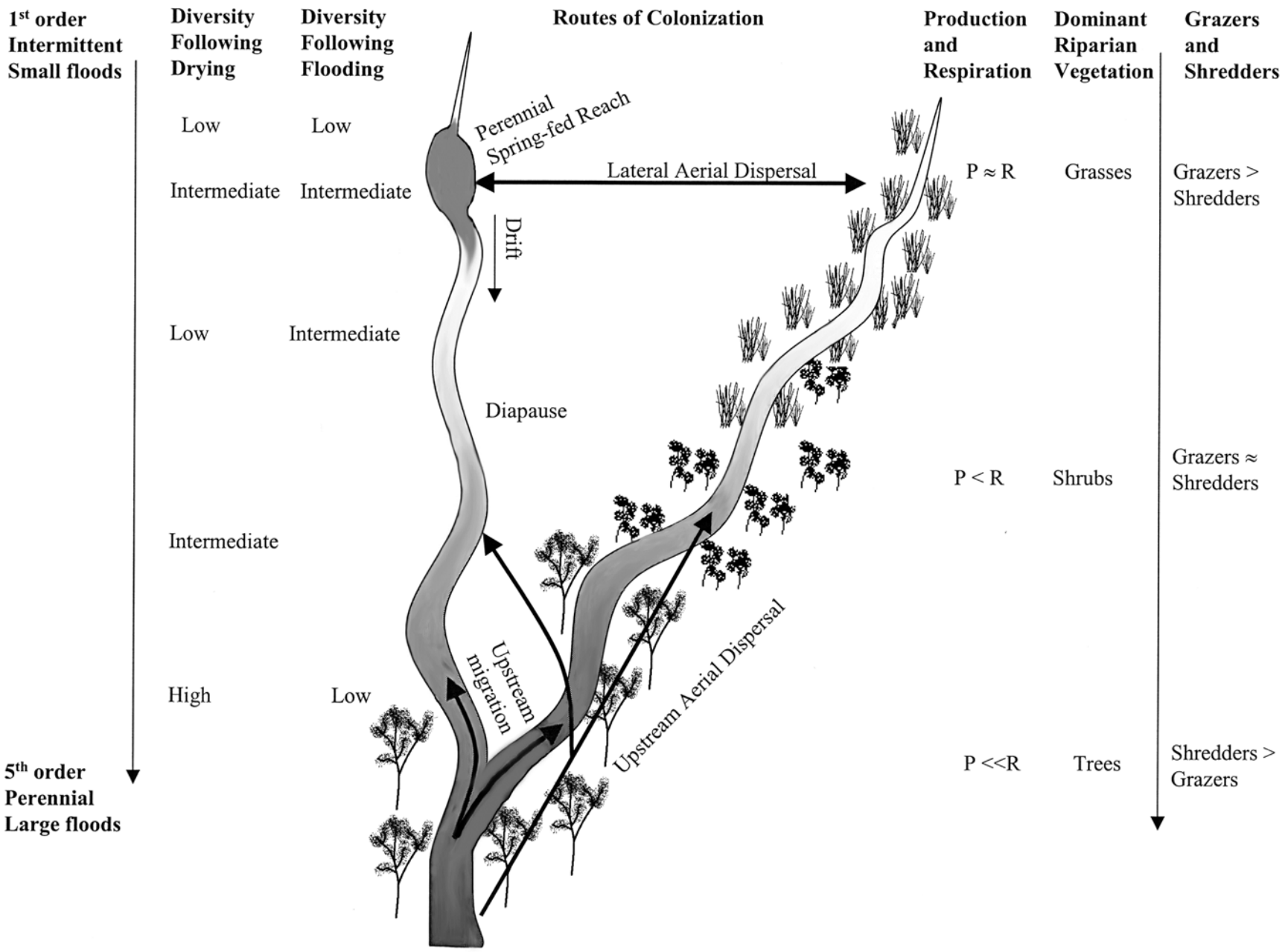
- Continued monitoring stream nutrients and discharge (decreased nutrient sampling frequency at base flow to once a week)
- Continued groundwater sampling
- Continued fish sampling (expanded number of sites)

What we did- Broader impacts

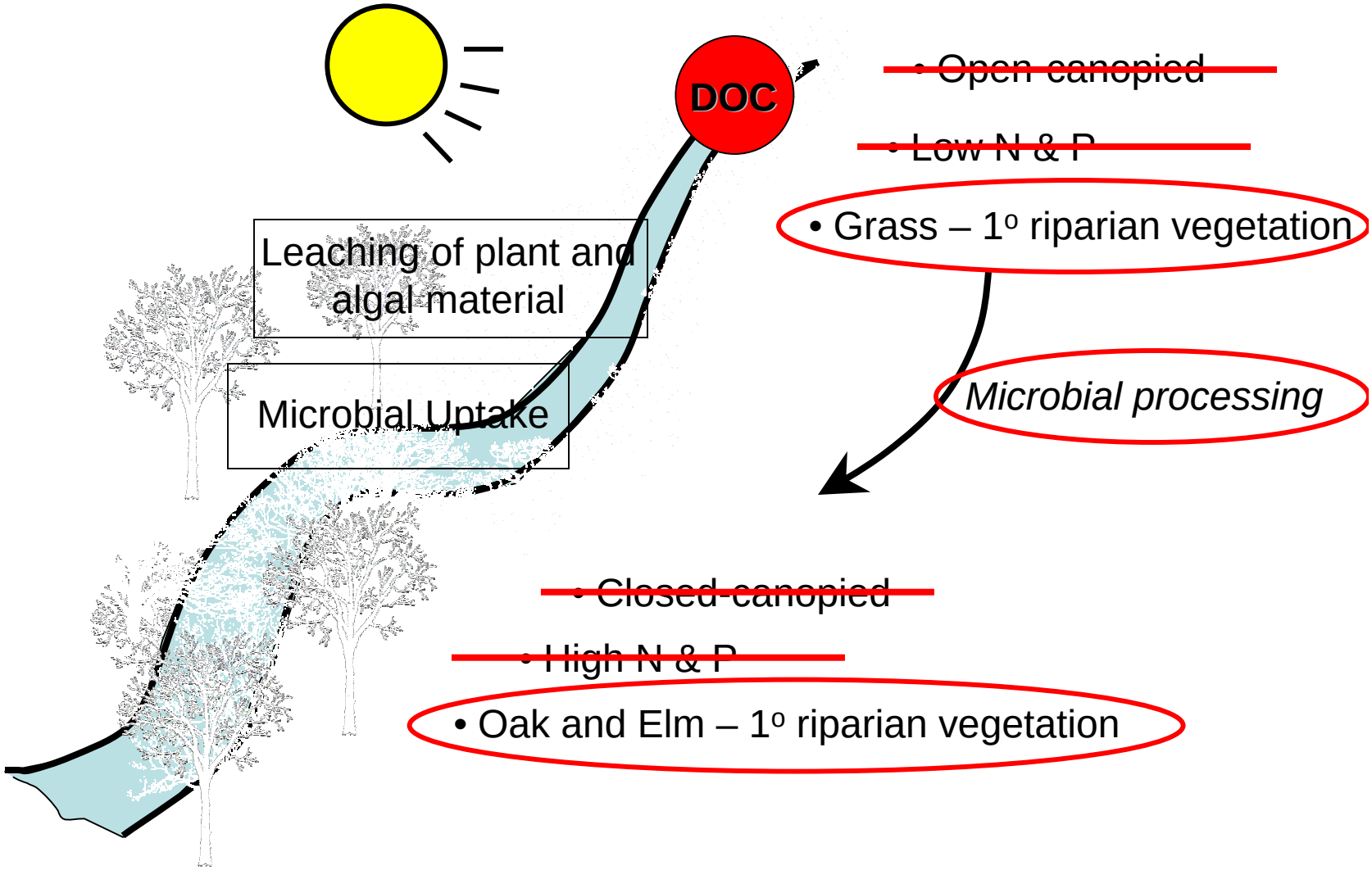
- Student training
  - Melody Bernot (PhD), Katie Bertrand (PhD), Jessica Eichmiller (MS), Jeff Falke (MS), Nate Franssen (MS), Jon O'Brien (PhD), Tim Strakosh (PhD), Mandy Stone (MS), Kym Wilson (MS); Current: Justin Murdock (PhD), Alyssa Standorf (PhD), Darren Thornbrugh (MS), Dan Whiting (MS), Wes Bouska (MS)
- 35 Publications (2003-2007)
- Major related grants
  - LINXII, Gido NSF, EPA Star Thresholds, NSF EPSCoR Kansas Ecological Forecasting, KDOT, STREON experimental component to NEON if funded
- Konza as baseline for native conditions in region

Major results

- Established rates of N cycling, retention and metabolism relative to agricultural and urban streams, developed stoichiometric approach to aquatic ecosystems
- Characterized dissolved organic carbon availability and sources in Kings Creek
- Assessed effects of drought, flood and species interaction on fish communities and feedbacks to aquatic ecosystem function
- Analyzed riparian vegetation effects on secondary production
- Developed a conceptual view of prairie streams; what makes them unique

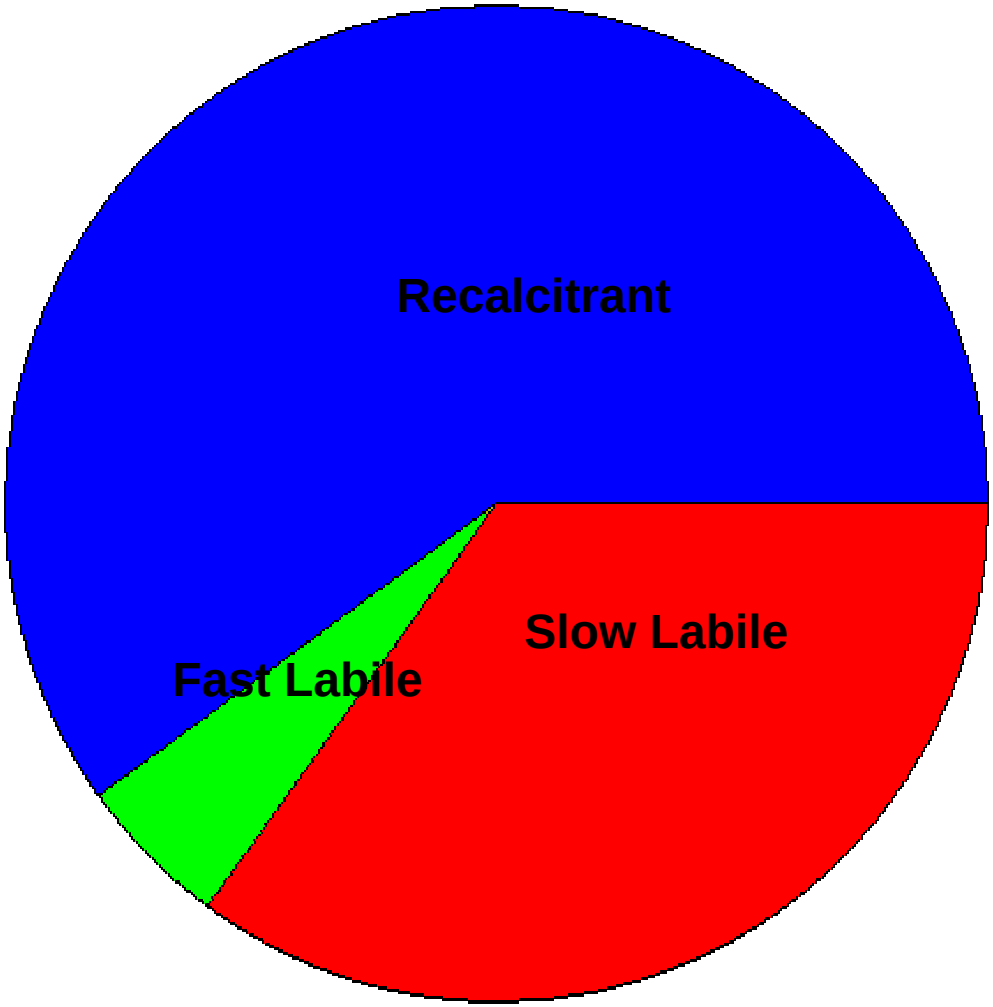

1st order
Intermittent
Small floods
Diversity
Following
Drying
Diversity
Following
Flooding
Routes of Colonization
Production
and
Respiration
Dominant
Riparian
Vegetation
Grazers
and
Shredders
Low
Low
Perennial
Spring-fed Reach
Lateral Aerial Dispersal
P ≈ R
Grasses
Grazers >
Shredders
Intermediate
Intermediate
Drift
Low
Intermediate
Diapause
Grazers ≈
Shredders
P < R
Shrubs
Intermediate
Upstream
migration
Upstream Aerial Dispersal
High
Low
P <<R
Trees
Shredders >
Grazers
5th order
Perennial
Large floods

The prairie stream DOC continuum

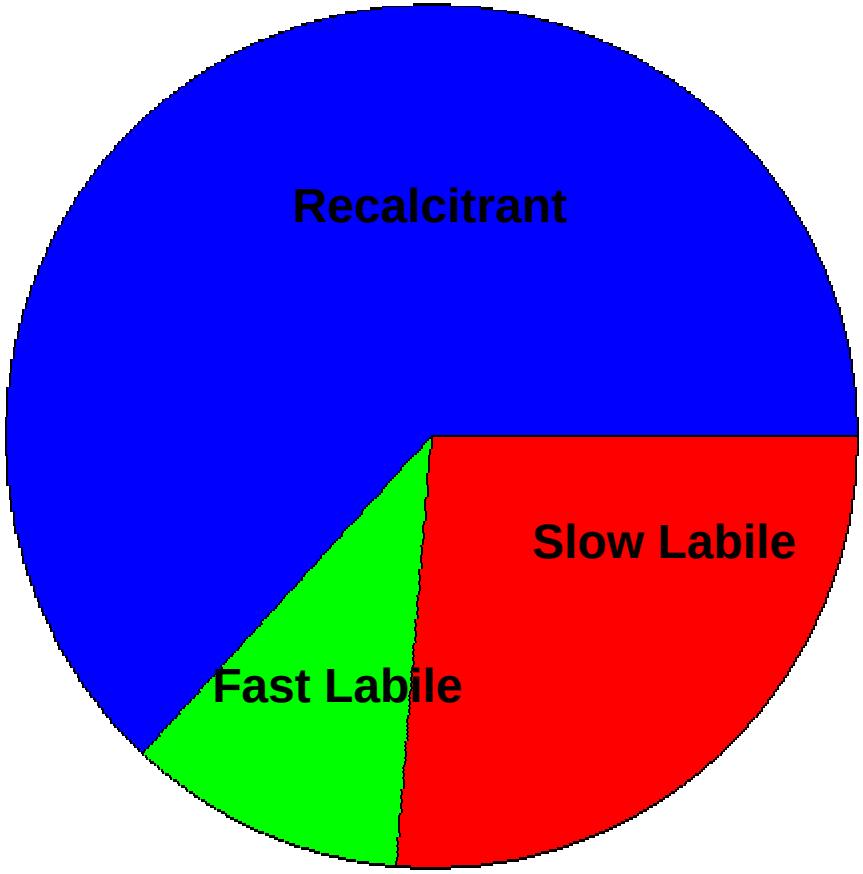


The prairie stream DOC continuum

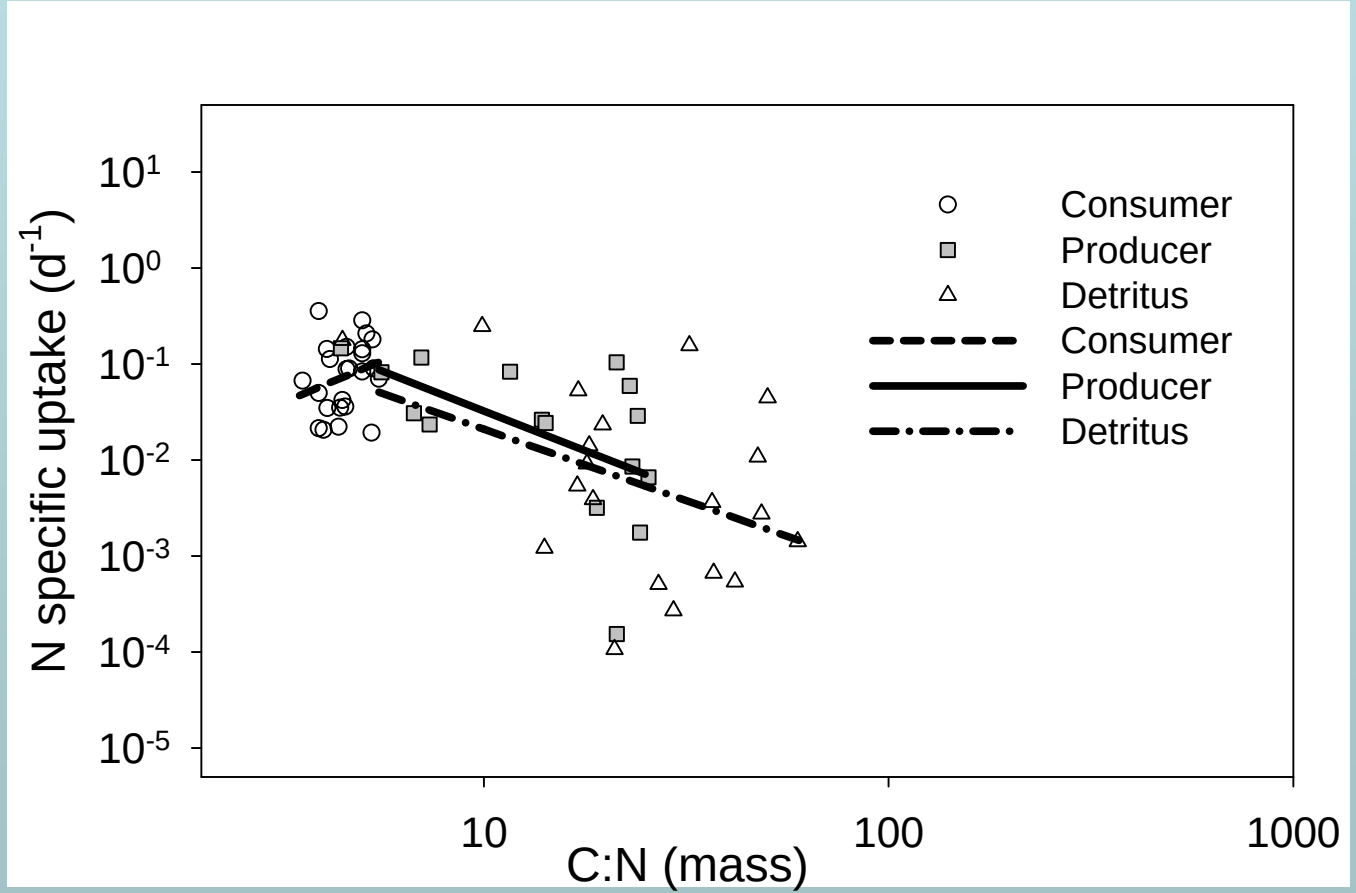
UPPER



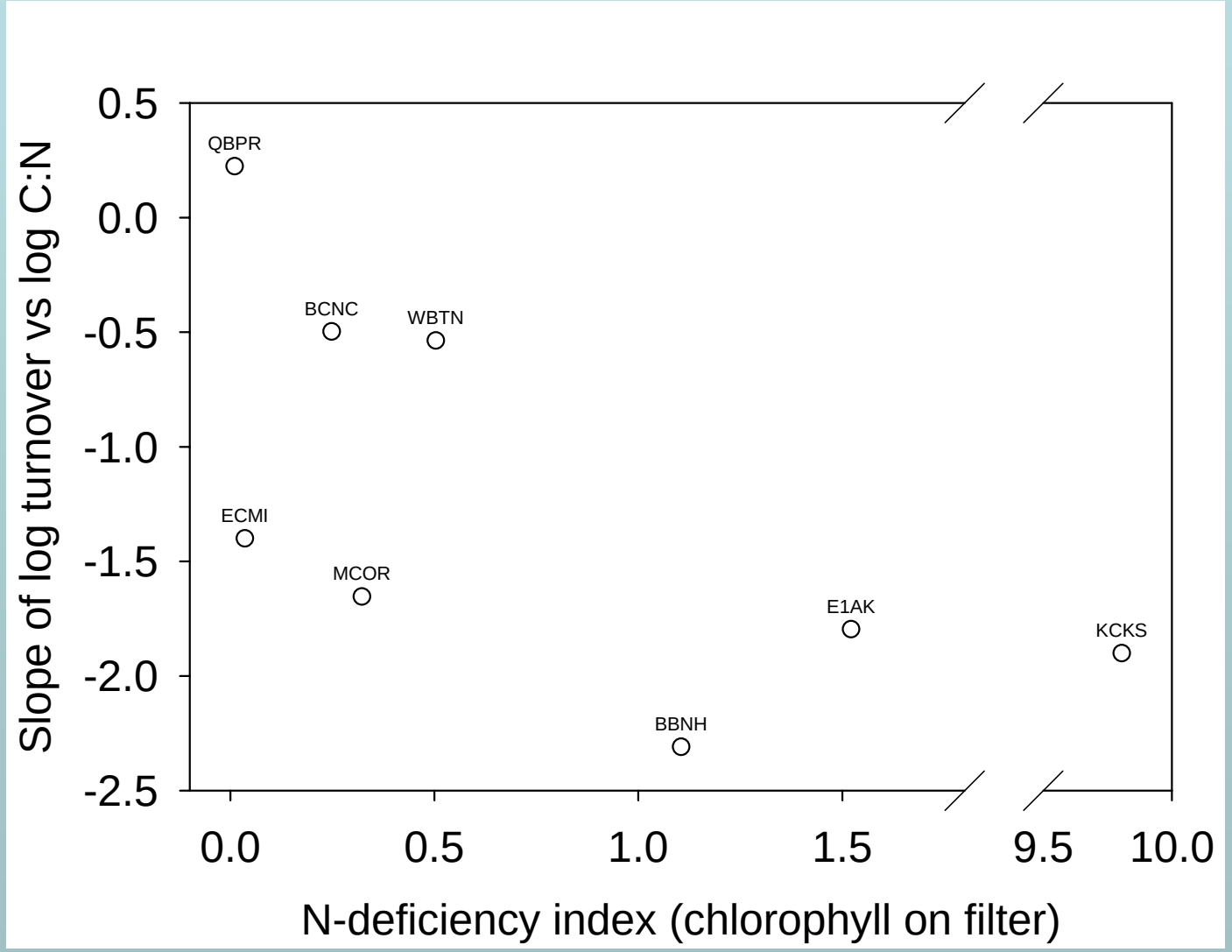
LOWER



N-specific turnover positively correlated to C:N for streams



N limitation apparently influences steepness of N turnover vs. C:N relationship

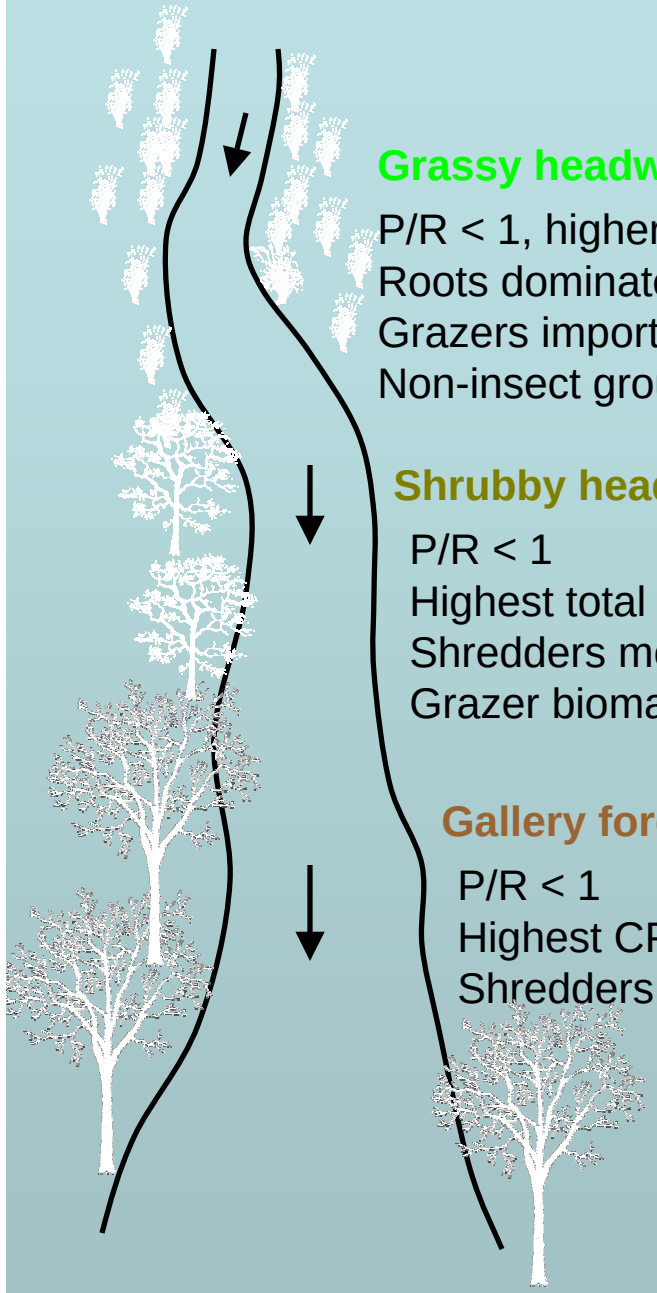


Coarse Organic Material on a Prairie Stream Continuum

Category	Grassy	Shrub	Gallery Forest
Leaves	2.00 (0.12)[a]	**52.45 (10.46)[b]**	**33.47 (11.09)[b]**
Grass	**10.72 (1.84)[a]**	< 1.00[b]	< 1.00[b]
Wood	10.66 (2.50)	18.21 (5.21)	33.29 (16.85)
Macrophyte	**6.11 (1.36)[a]**	< 1.00[b]	< 1.00[b]
Roots	**28.52 (9.96)[a]**	< 1.00[b]	< 1.00[b]
Total	58.01	71.66	67.76

Total organic matter storage greatest in middle, shrubby reach

Results Summary



Grassy headwaters

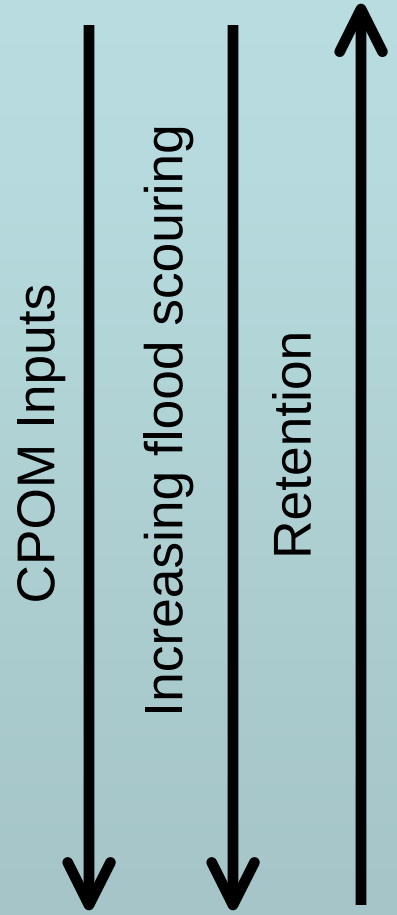
P/R < 1, higher 1º production
Roots dominate CPOM
Grazers important, shredders low
Non-insect groups dominant

Shrubby headwaters

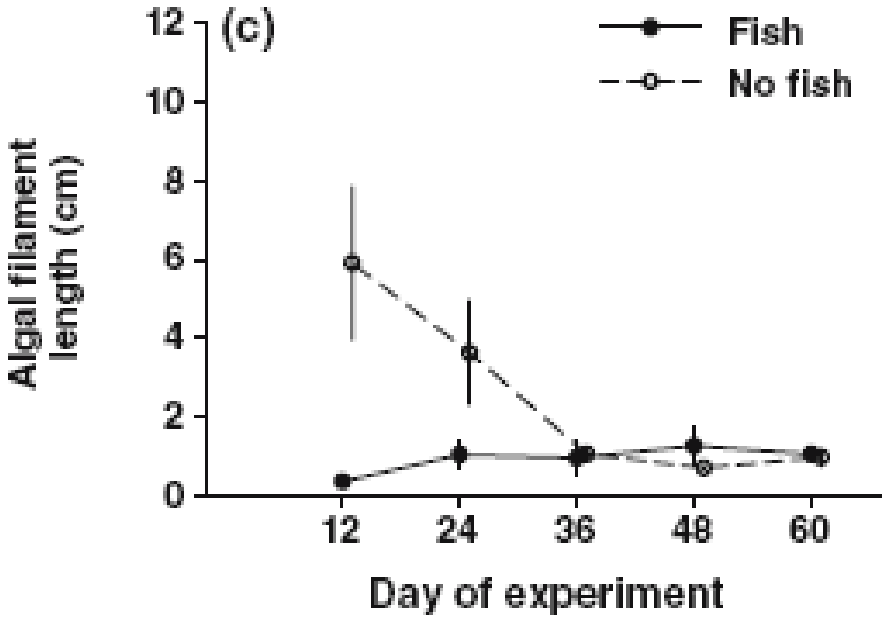
P/R < 1
Highest total OM in channel
Shredders more important
Grazer biomass still high

Gallery forest

P/R < 1
Highest CPOM inputs, but low storage
Shredders & grazers important



Effects of grazing minnows: meta-analysis of Konza experiments



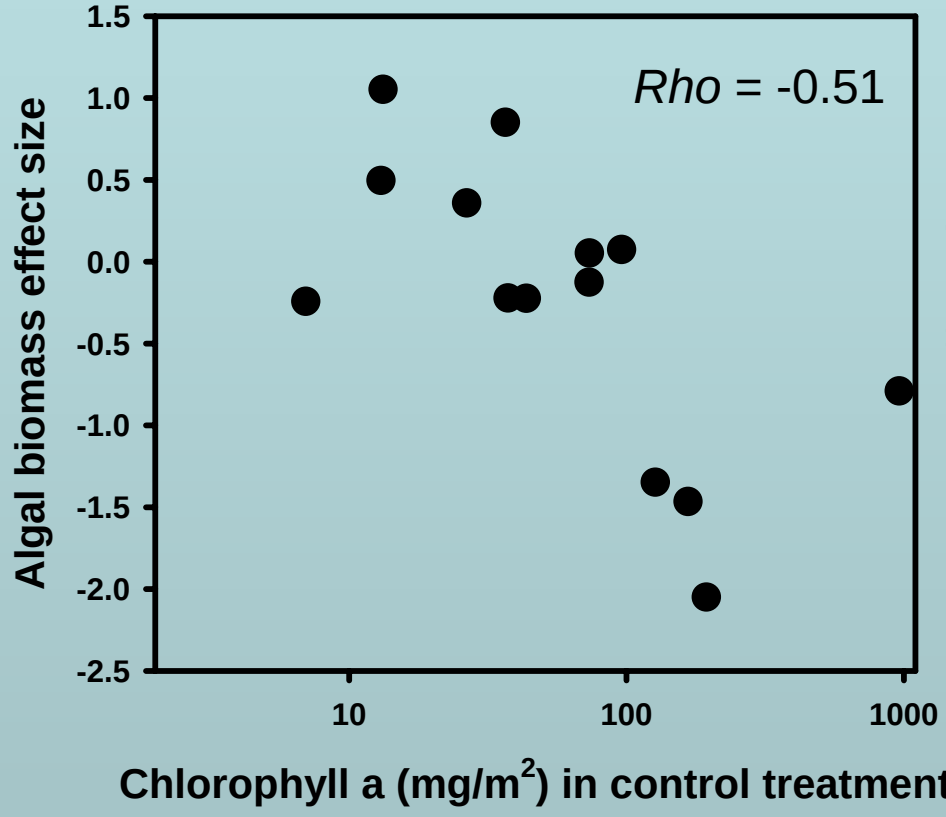
Experimental Streams 2003

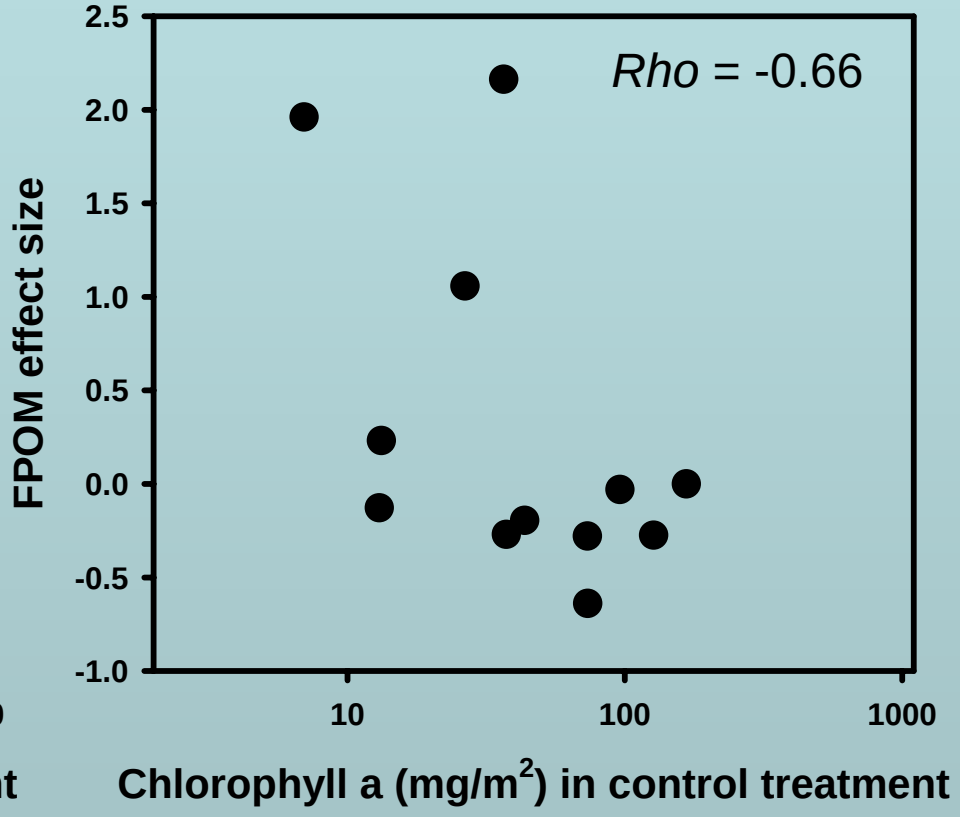
Field Experiment 2006

Meta-analysis

- 8 experiments since 2002
  - Data collected at approximately 2 and 4 weeks
- Questions
  - Are there consistent effects across experiments?
  - Are effect sizes of different processes correlated?
  - Can effect size be predicted by algal biomass in controls, temperature, or fish biomass
- Effect size calculated with Cohen's *d*
  - $d = M_1 - M_2 / s_{pooled}$

Net production vs. fish effect size





Future monitoring for detecting trends under directional climate change and interactions with aquatic communities

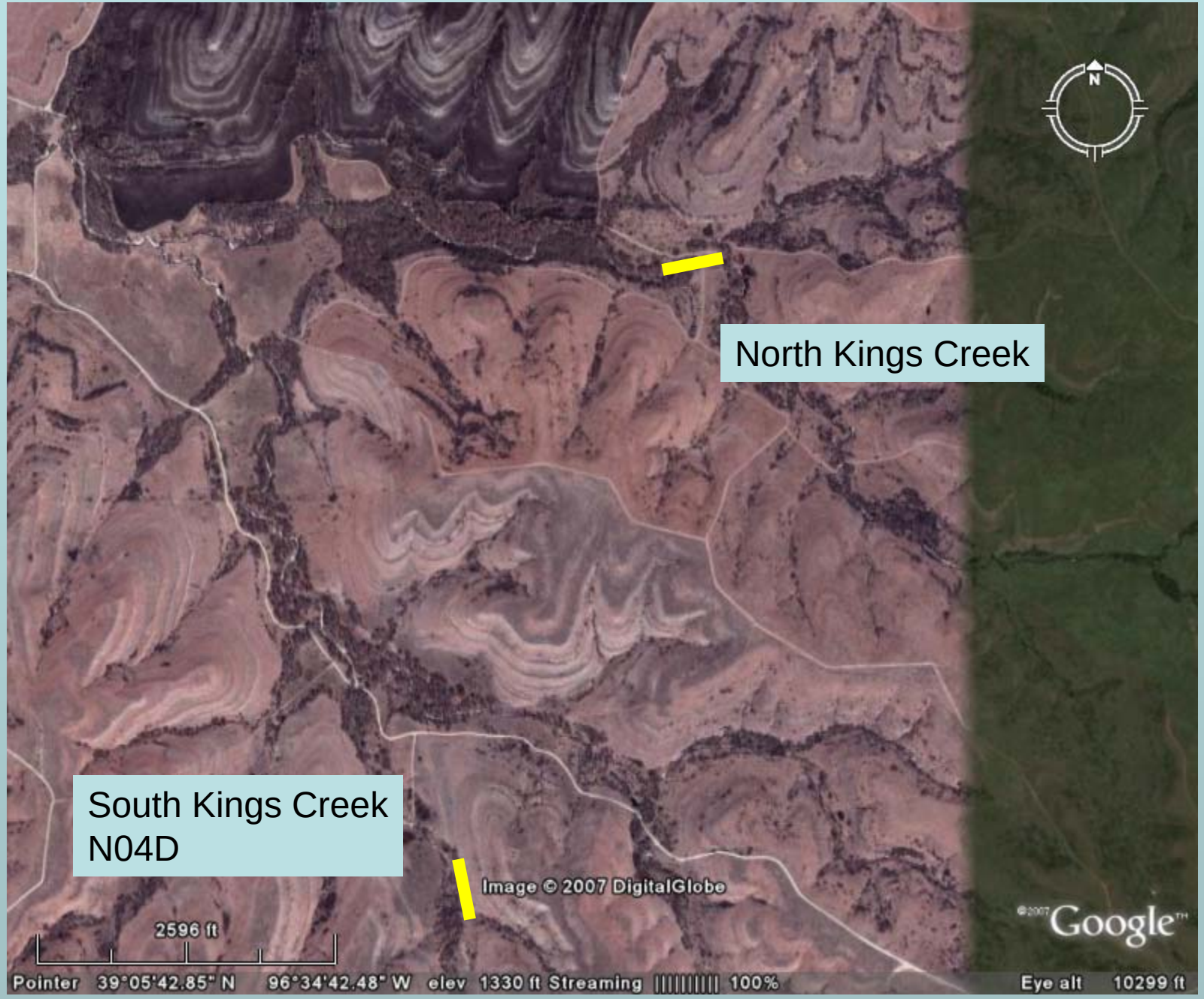
- Continue monitoring groundwater and stream water chemistry, groundwater level and stream discharge
- Continue monitoring fish communities
- Start monitoring dissolved oxygen (for metabolism) in at least one location

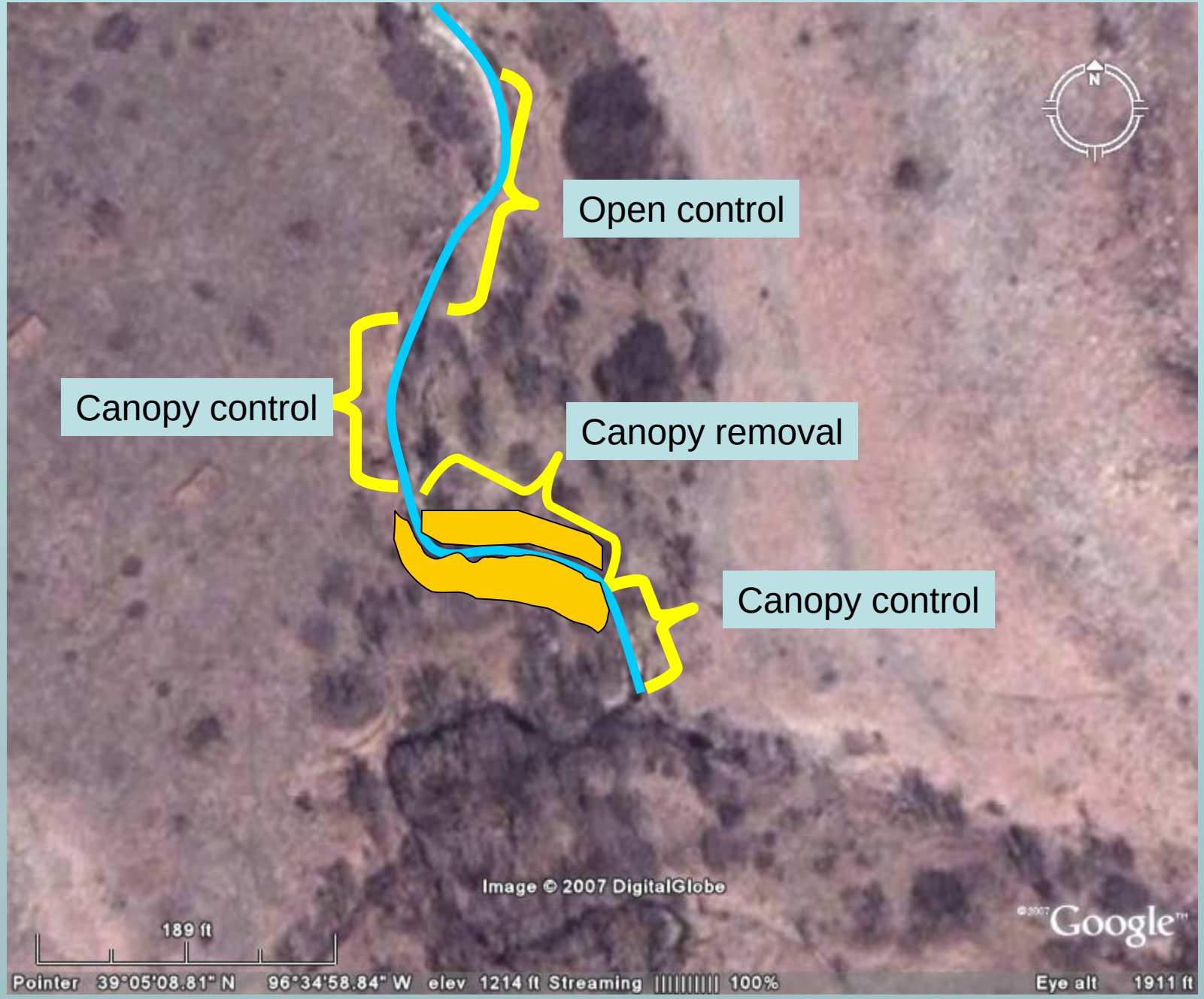
Future directions

- Assess the effects of riparian woody expansion on stream communities and ecosystems
  - 50 m removal, 30 m to each side
  - Nearby open reach, control riparian canopy reach above and below
  - Assess metabolism, algal biomass, invertebrate community, fish, food web (natural abundance)

Link to manipulative experiments

- Experimental stream work to assess interaction of community and carbon source
- Create gradients of disturbance, trophic composition, nutrient, or carbon loading


North Kings Creek
South Kings Creek
N04D
Image © 2007 DigitalGlobe
2596 ft
Pointer 39°05'42.85" N 96°34'42.48" W elev 1330 ft Streaming 100%
Eye alt 10299 ft
Google


Open control
Canopy control
Canopy removal
Canopy control
N
Image © 2007 DigitalGlobe
189 ft
Pointer 39°05'08.81" N 96°34'58.84" W elev 1214 ft Streaming 100%
Eye alt 1911 ft
Google