The economic effects of biofuel feedstock production on gamefish distribution

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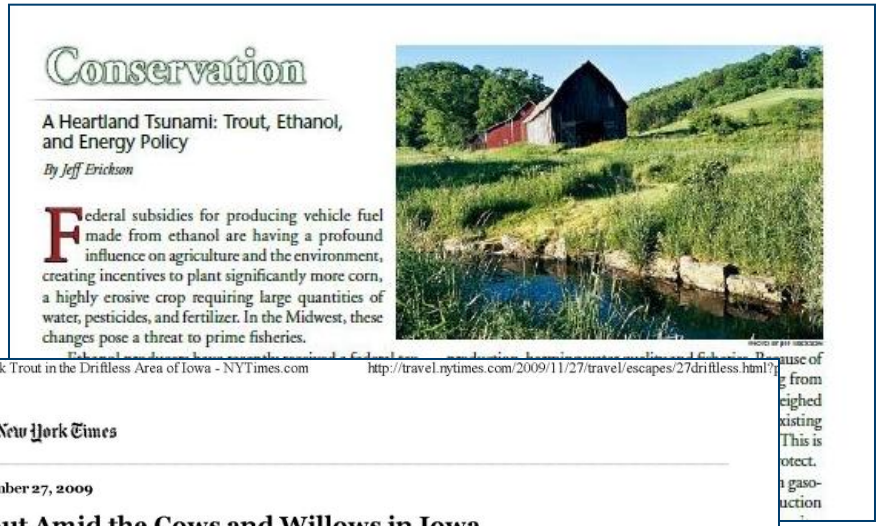
Motivation

- Anglers are concerned with angling quality
- Presents an opportunity to examine ecosystem services consumed in recreational activity
- Responsive to quality (richness) and quantity of fishing opportunities?



Conservation

A Heartland Tsunami: Trout, Ethanol, and Energy Policy

By Jeff Erickson

Federal subsidies for producing vehicle fuel made from ethanol are having a profound influence on agriculture and the environment, creating incentives to plant significantly more corn, a highly erosive crop requiring large quantities of water, pesticides, and fertilizer. In the Midwest, these changes pose a threat to prime fisheries.

Angling for Brook Trout in the Driftless Area of Iowa - NYTimes.com http://travel.nytimes.com/2009/11/27/travel/escapes/27driftless.html?

The New York Times

November 27, 2009

Trout Amid the Cows and Willows in Iowa

By GUSTAVE AXELSON

DECORAH, Iowa — "We can't fish my favorite trout stream today, because there's a Jersey bull in the pasture there that hates me."

Brad Johansen, my guide for this day of fishing in the Driftless Area of northeastern Iowa, was discussing our fishing options between bites of biscuits and gravy at a diner. Mr. Johansen, a high school science

Presentation Outline

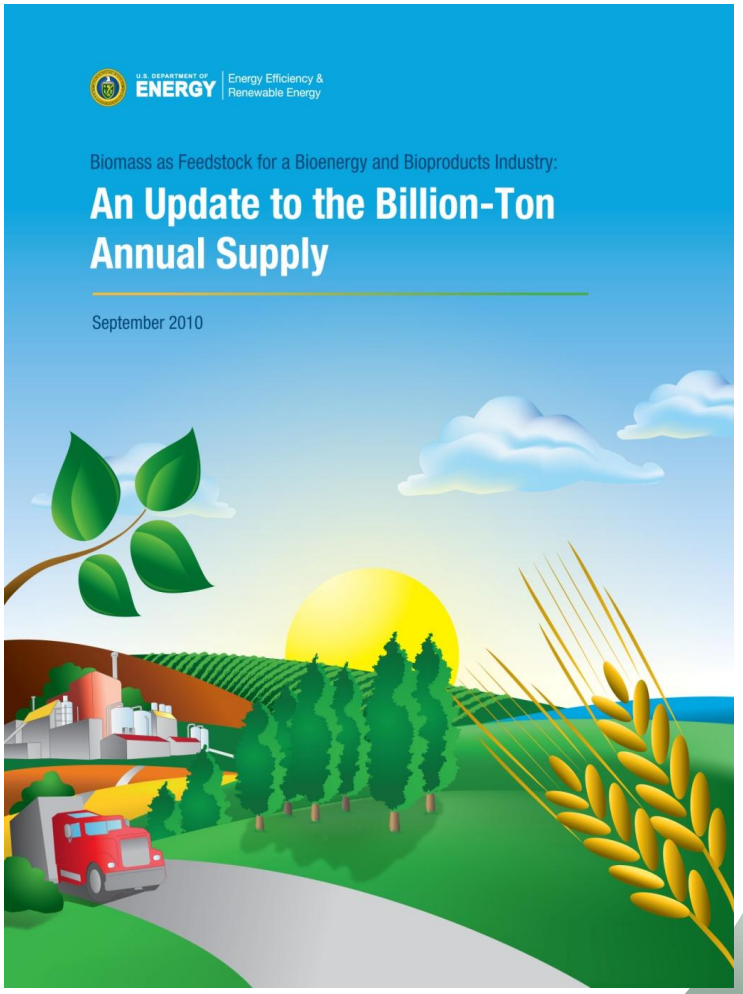
- Overview and conceptual framework
- Approach and Data
- Model
- Results
- Conclusion

Overview: Conceptual Framework

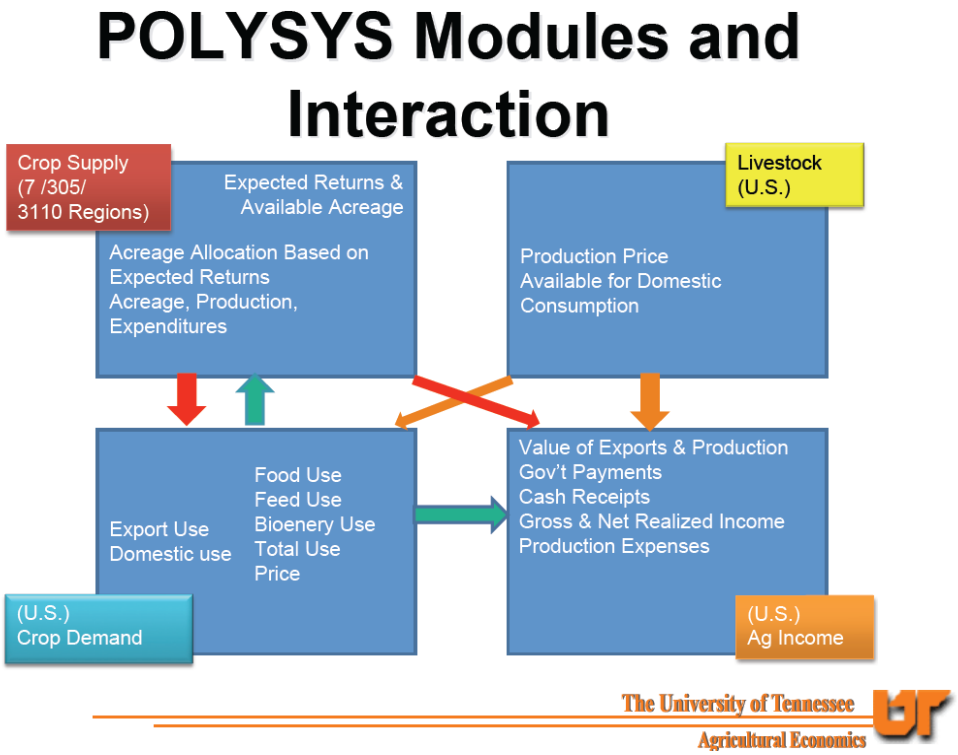
- EISA mandates 21 billion gallons of second generation by 2022
- New landscapes include arrangements of
  - Herbaceous energy crops (switchgrass, miscanthus, energycane, energy sorghum)
  - Woody energy crops (Hybrid poplar, pine, eucalyptus, and willow (SRC))
- Different landuse scenarios vary in association with water quality and aquatic biodiversity
- Q: What is the relationship between fish richness and fishing privilege and activity?

Overview: what is the potential biomass production from agriculture?

- 2005 – Billion-ton study estimated an agriculture potential ranging from slightly less than 0.6 to nearly 1 billion dry tons
- 2010 – Billion-ton Update finds similar quantities (by 2030) depending on scenario (crop yields) and prices offered
  - Estimated sustainable biomass resource supplies (by county for crop residues and energy crops)
    - Address concerns and issues from the 2005 study
    - Improve the data, the methodology, and future projections
  - Bioenergy KDF

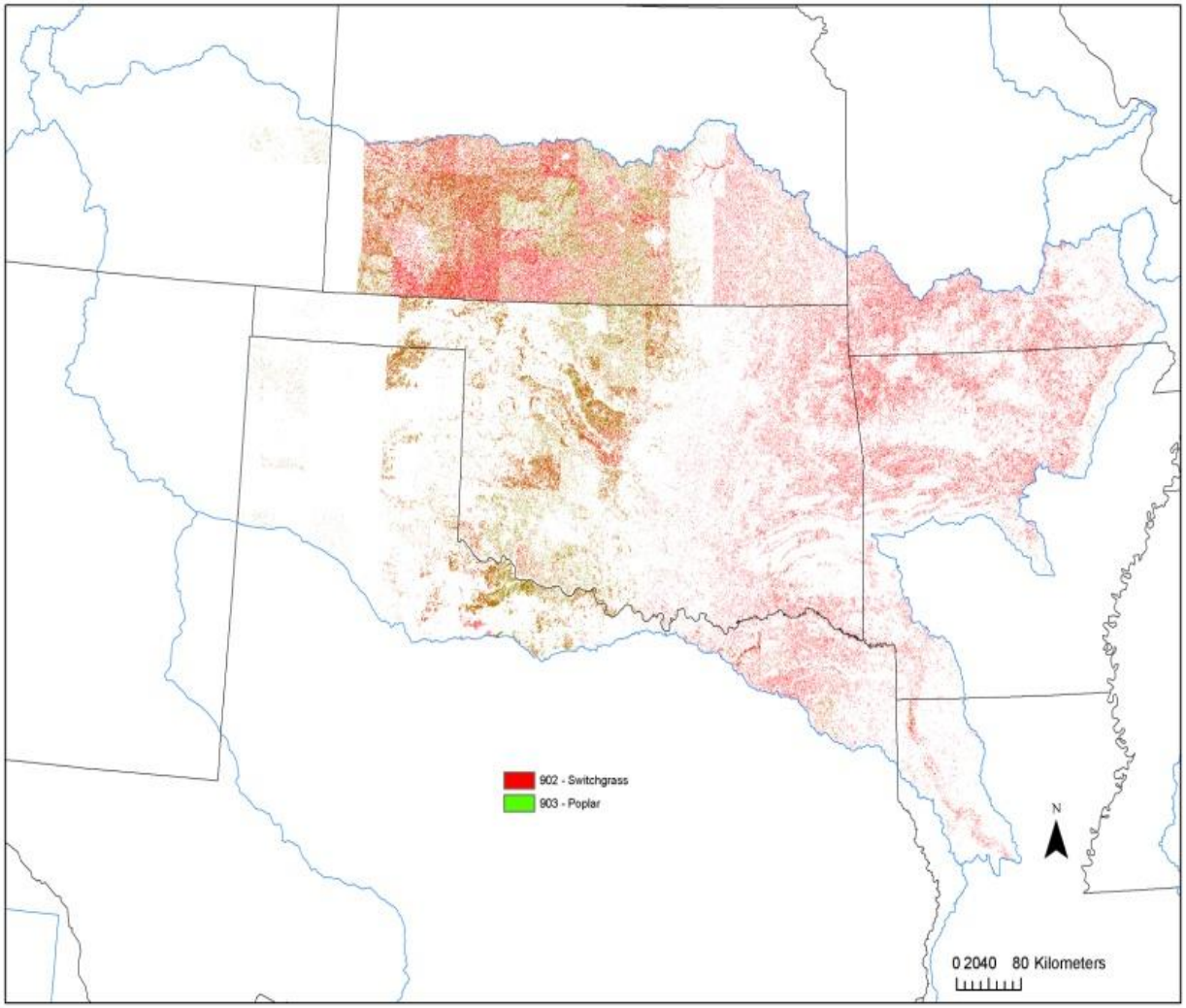


Overview: POLYSYS modeling framework



- Simulates US Agricultural Sector
- USDA baseline forecasts, all forecasted food, feed, fiber, and export demands are met
- County-level supply curves
- Includes perennial crops, fixed land supply
- Representative 2030 scenario:
  - $60/dt market price, perennial crop annual yield growth 4%

Overview: Resource Assessment and Agricultural Forecasting



- Preliminary POLYSYS scenarios of biofuels market for perennial biomass crops production
- Highest conversion to switchgrass is from wheat and pastureland at high yield growth and contract prices

Approach: Economic Model

- Revealed behavior approach
- Total use = f (F, C, B)
  - Where
    - Total use= resident and non-resident activity days (based upon privilege status and total trip days)
    - F= ecological final goods (e. g. lakes, streams, rivers)
    - C= capital infrastructure (e. g. access to sites)
    - B= biophysical final goods (native fish richness and native game fish richness)

Data: Sources and method

- County-level license sales (2008-9)
- National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (2006)
- Net Economic Values of Wildlife-Related Recreation in 2006 (2009)

Revealed Behavior → Fishing Privilege

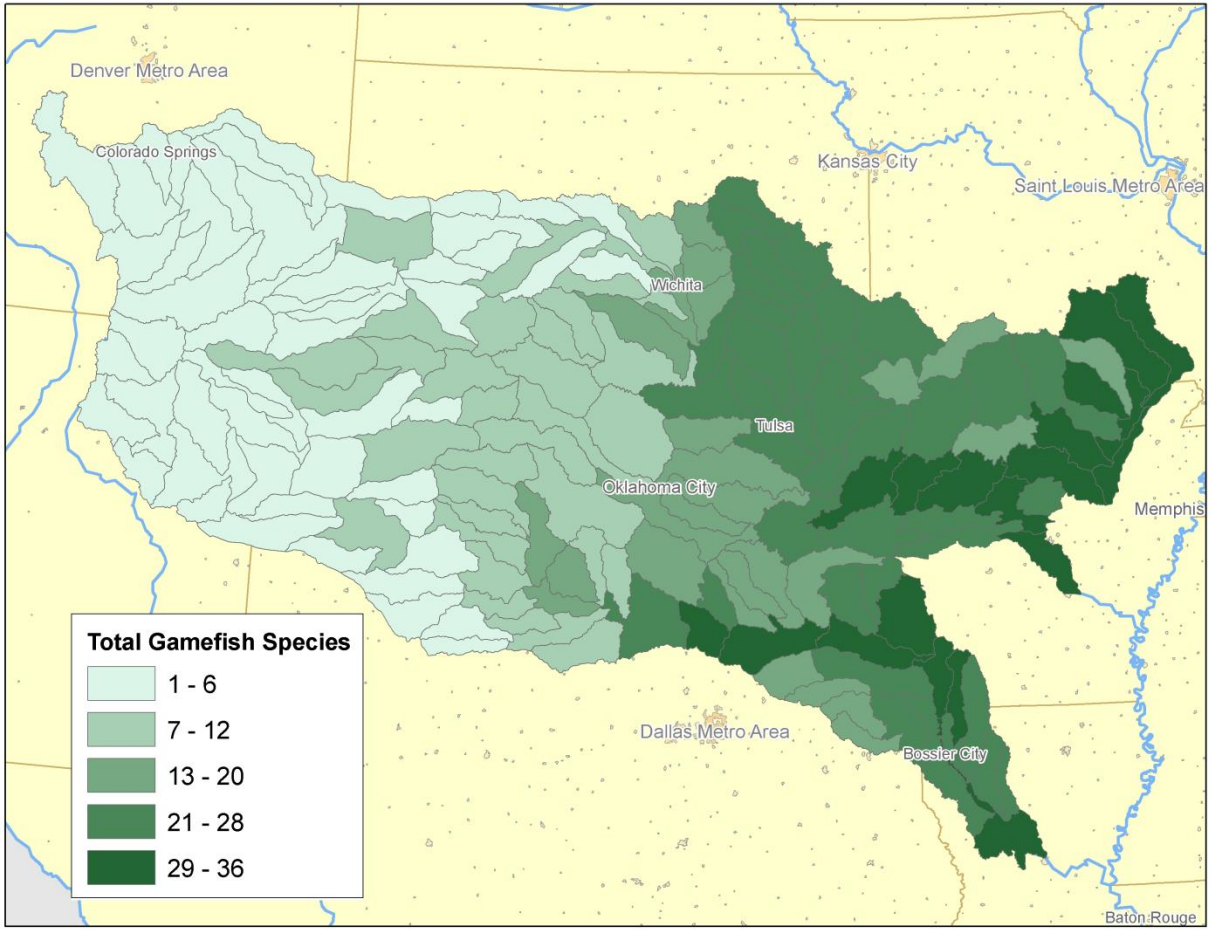
Resident and Nonresident Activity

Average Activity Days	Average Annual Expenditure	Average Daily Expenditure	Total variable expenditures

- Total Privilege
  - Population with fishing rights
    - Temporary (6 classes,1 day - 2 weeks)
    - Annual (2 classes, annual fishing and combo)
- Activity days
  - Income unobserved
  - Allows combining temporary and annual privileges, (Total and Nonresident activity days correlation .95, and Total and Resident activity correlation .99)

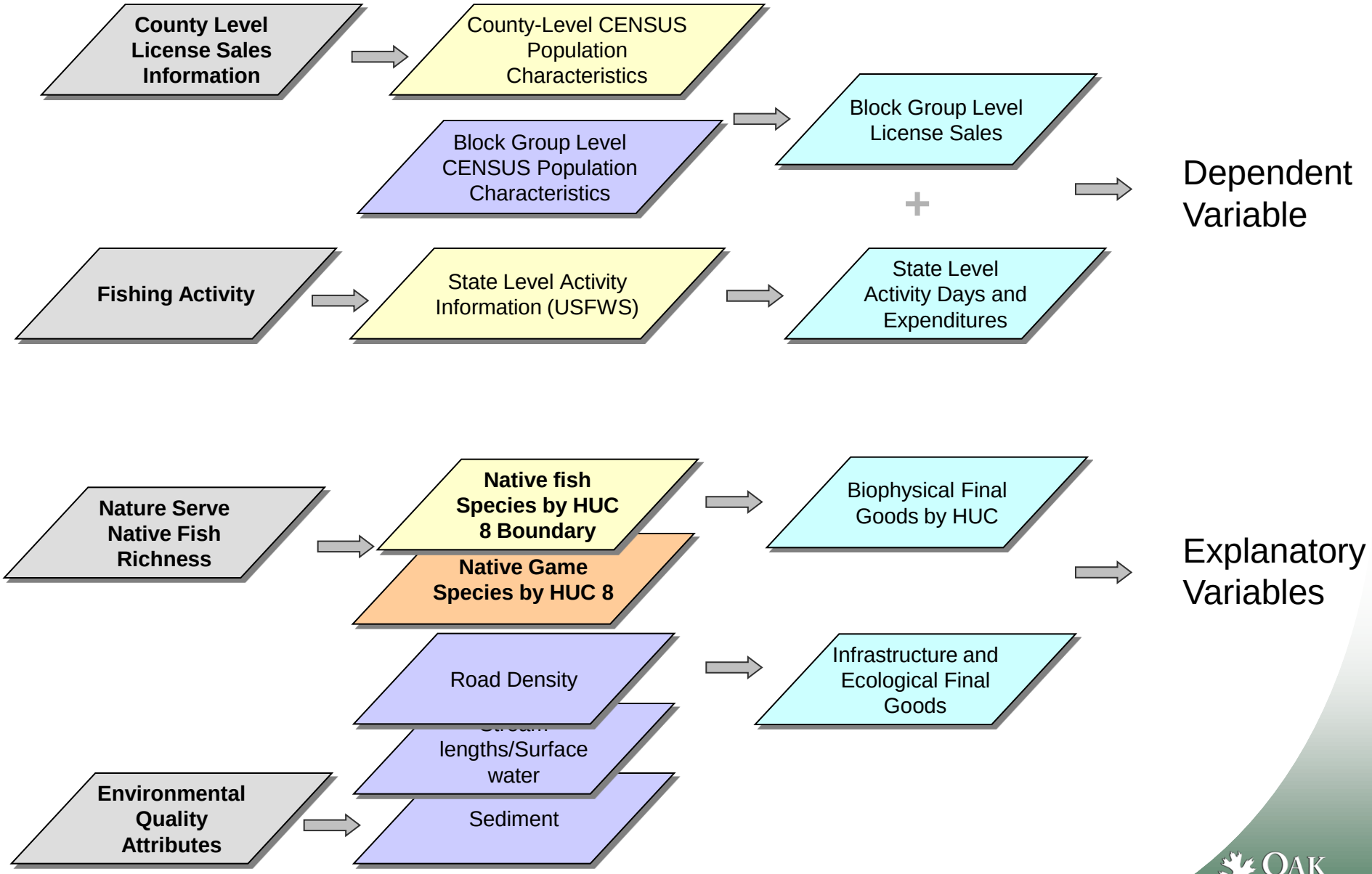
Approach: Study area and data

Native Gamefish Richness

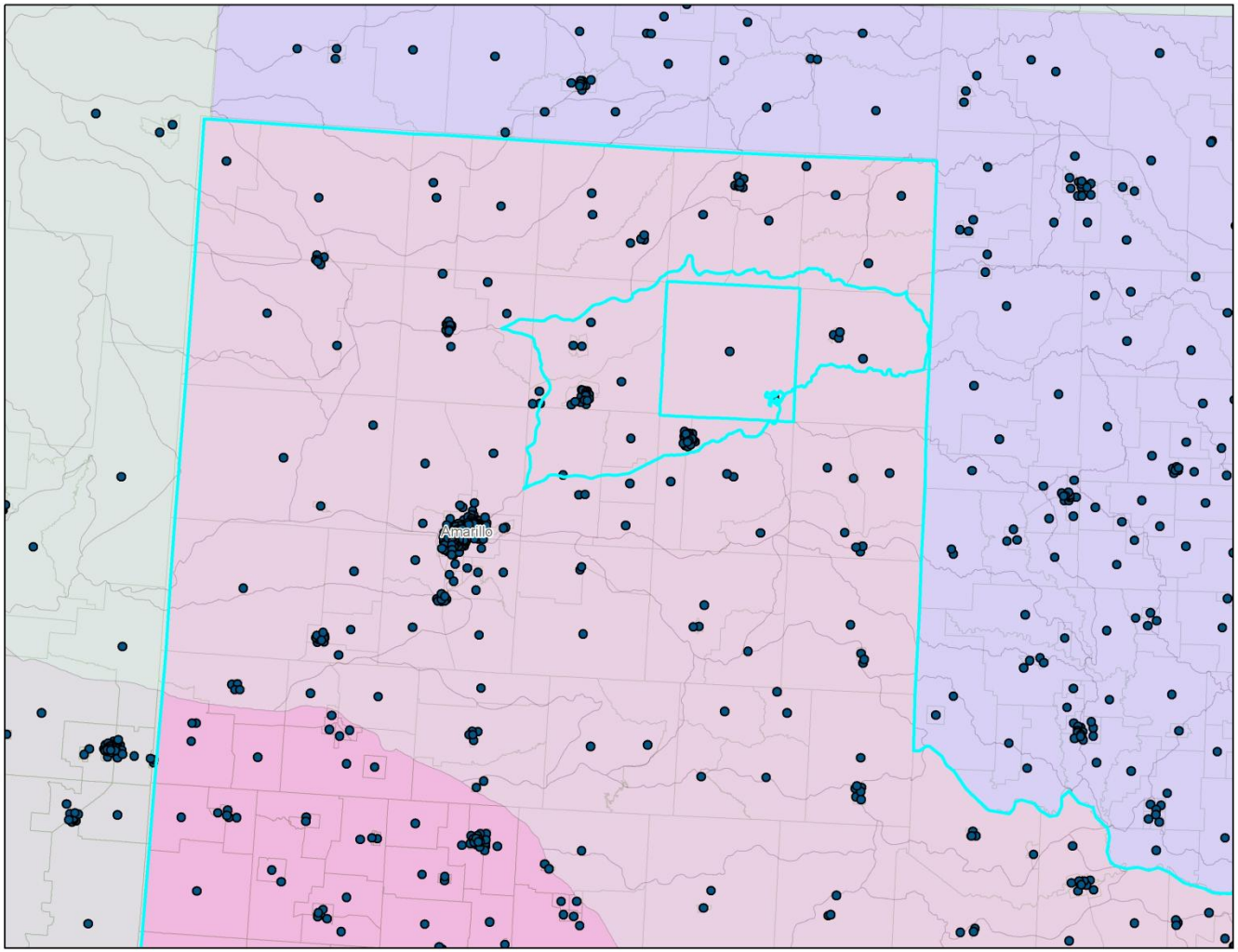


- Arkansas White Red River Basin HUC-8 regions (n=173)
- 8 states, 322 counties, 1353 census tracts, 7783 block groups (lowest level of census population reporting)

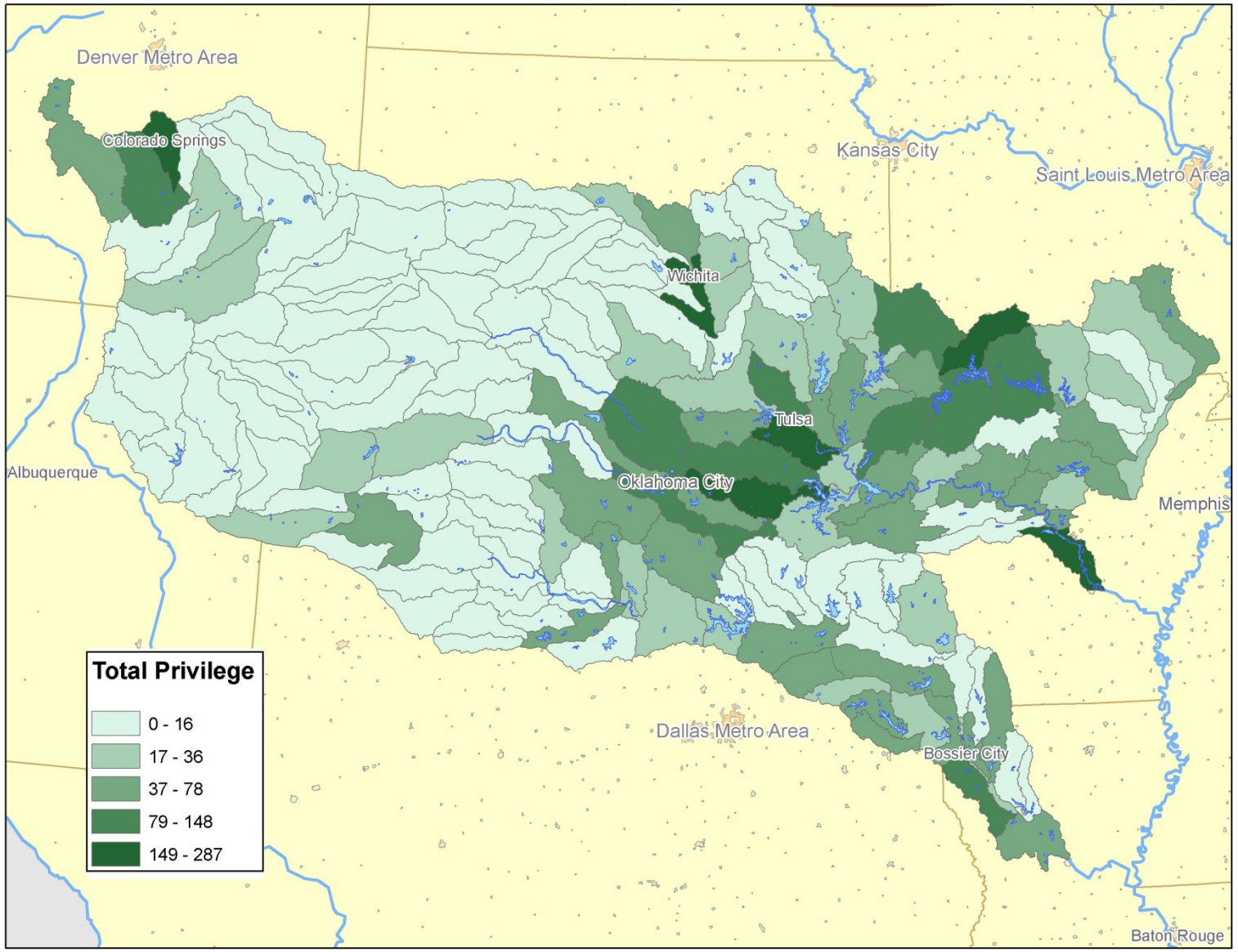
Approach: Data Arrangement



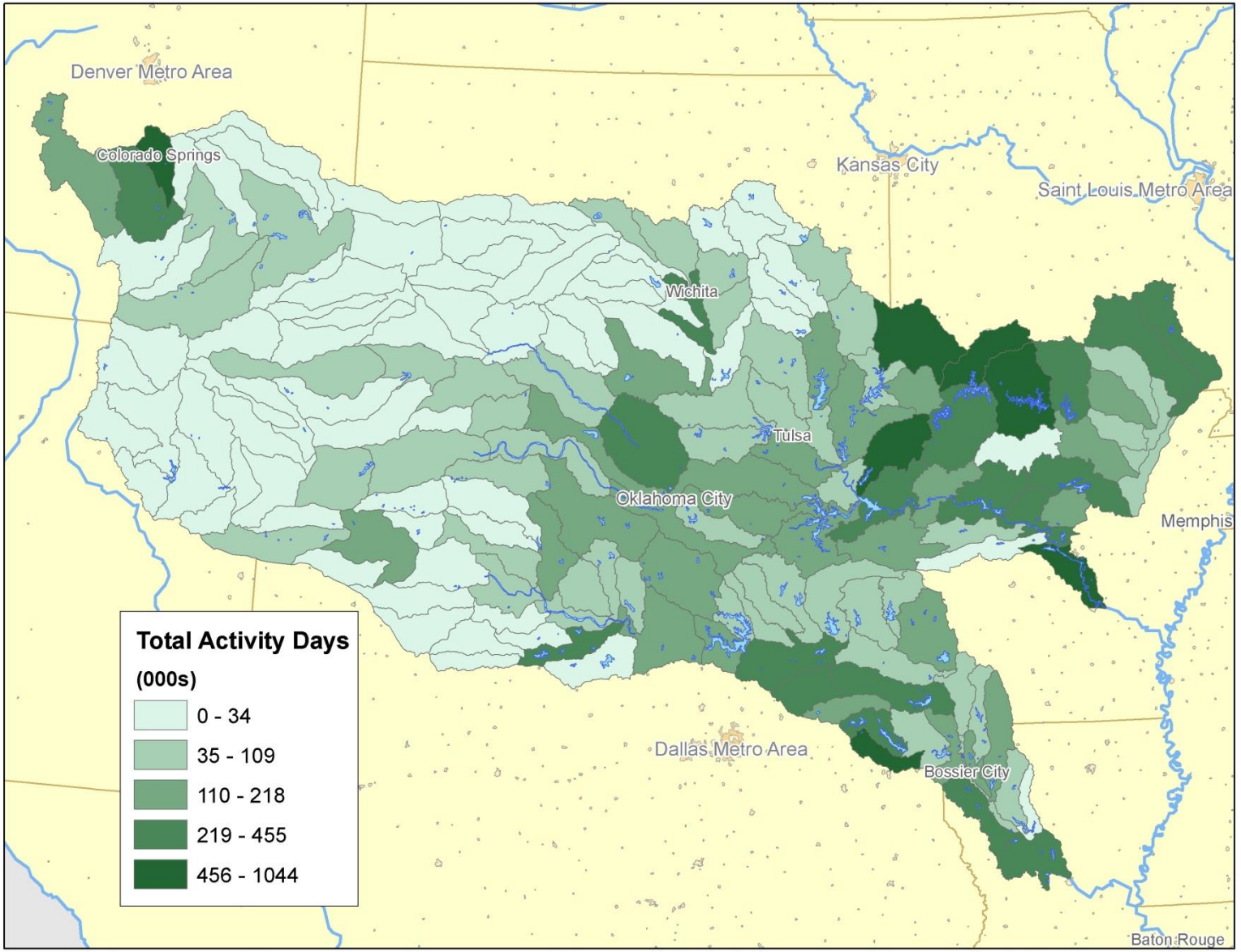
Approach: Block Groups and Watershed Boundaries



Data: Total fishing privilege



Results: Total observed activity days



Model: Full Linear Regression

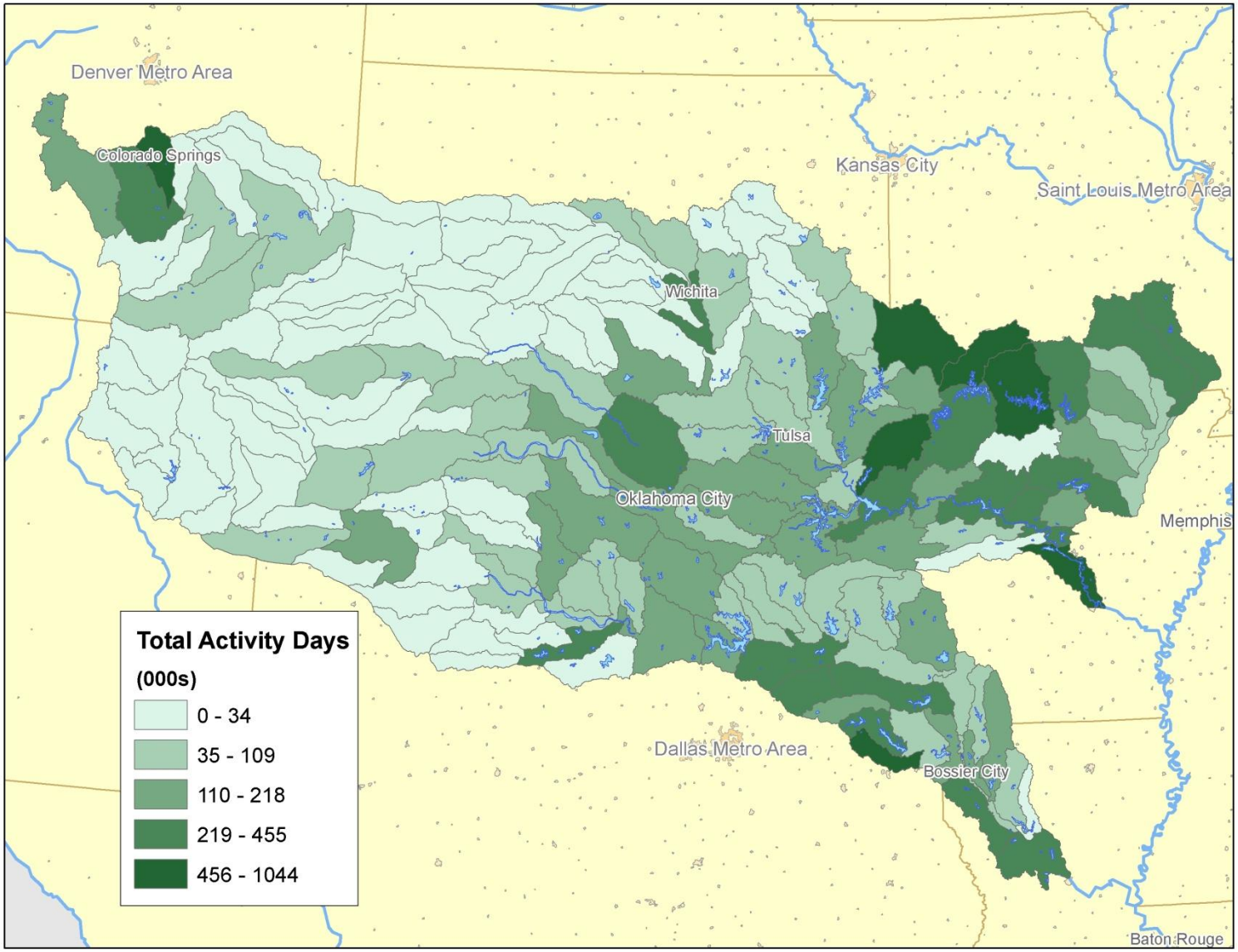
Total Use = f (Pop, N, G, S, A, Pw, Elev_Drain, TMDL, Stream2max, Stream3plus)

- Where
  - Total Use= resident and nonresident privilege and activity days
  - Pop= total population by HUC
  - N = total native fish species
  - G = total native game fish species
  - S = sediment concentration (mg/kg)
  - A = road density
  - Pw = percent of surface water by HUC
  - Elev_Drain = elevation drainage
  - TMDL= Total Maximum Daily Limit
  - Stream2max = first and second order stream lengths
  - Stream3plus = length of streams at third and higher order
- Estimated using a log-link Poisson distribution regression

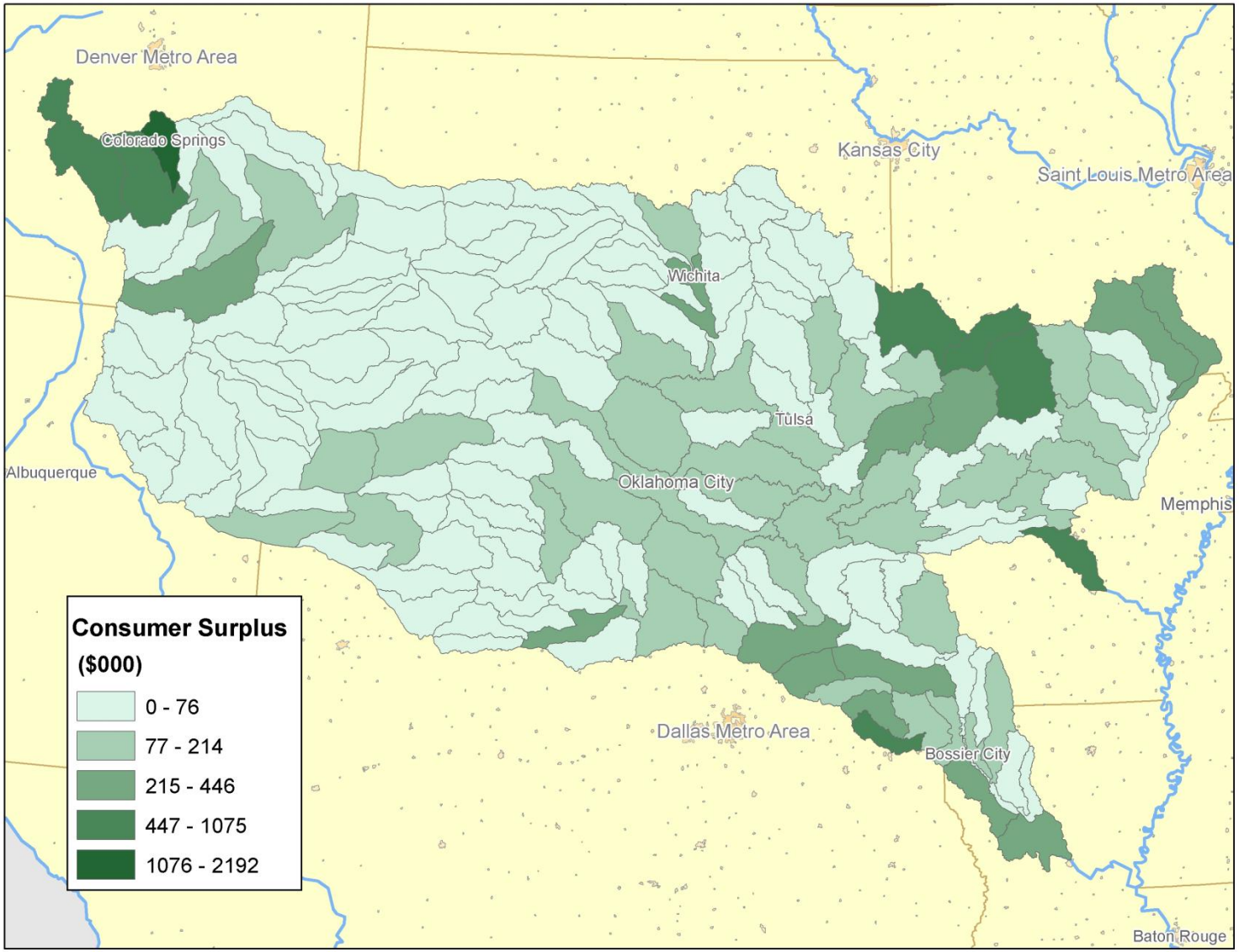
Results: Reduced Model Results

Parameter	Estimate	Standard Error	95% Confidence Limits		Z	Pr > |Z|
Intercept	9.5127	0.2497	9.0233	10.0020	38.10	<.0001
POP_T	0.0017	0.0010	-0.0003	0.0036	1.67	0.0943
N_GameFish	0.0417	0.0074	0.0271	0.0563	5.59	<.0001
SEDmgkg	-0.0003	0.0001	-0.0005	-0.0001	-3.00	0.0027
Roads_km	0.0002	0.0000	0.0001	0.0002	5.06	<.0001
p8_Water	0.0794	0.0188	0.0426	0.1163	4.23	<.0001

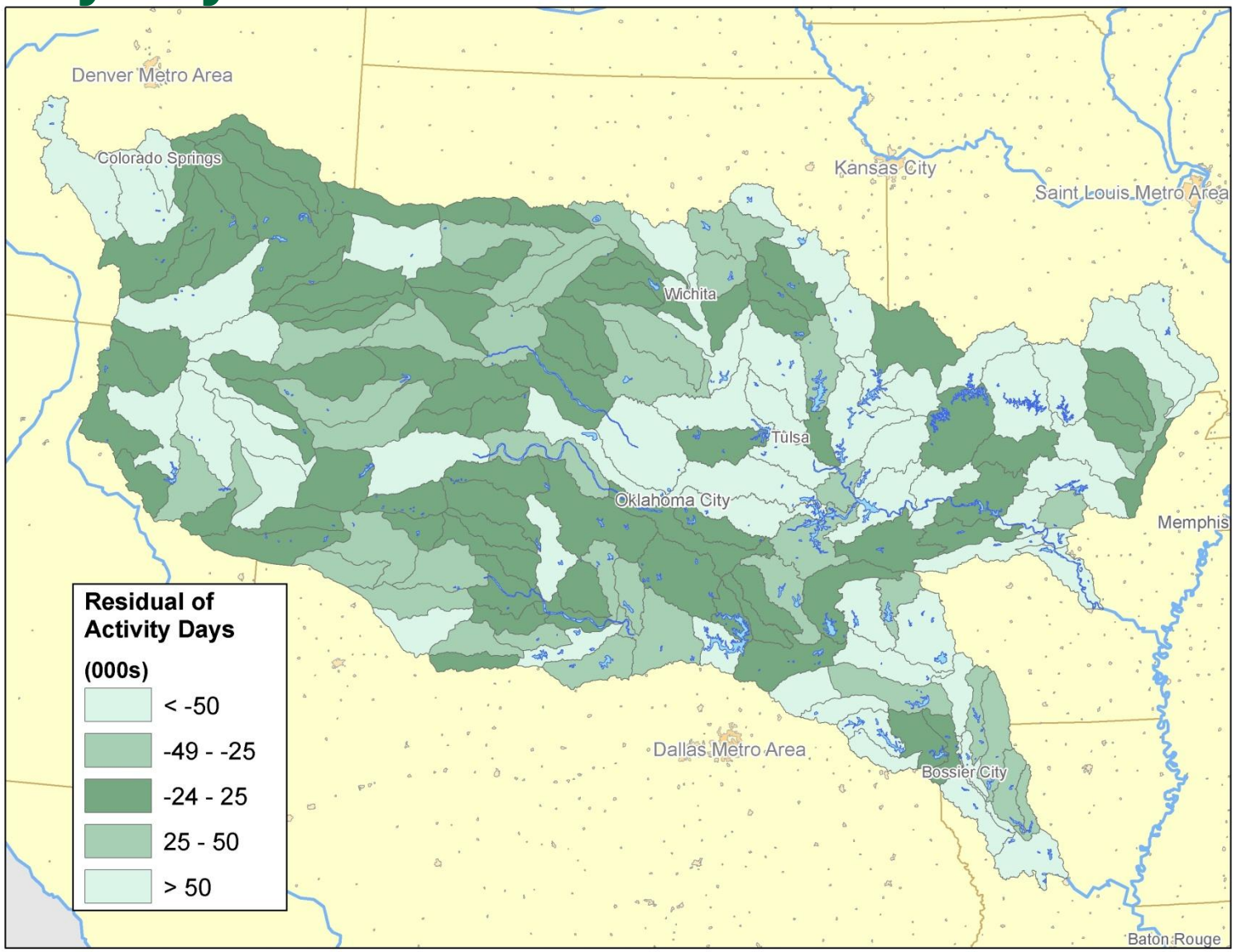
Results: Total observed activity days



Conclusion: Consumer Surplus



Results: Residual of observed and predicted activity days



Spearman R= 0.816 (p<.0001); Pearson R= 0.753 (p<.0001)

Current Model Limitations

- Specification of stocked warm and cold water fishes (Loomis, 1998)
- Spatial resolution of fishery information
- Spatial context of population
- Quantitative fish density data
- Angling success and satisfaction

Conclusion

- We combine socioeconomic and ecological parameters to predict direct use, with correct anticipated sign of coefficients
- Omitted variable bias could be due to error in estimating total population, recreational amenities, and stocking frequency and distribution
- Total valuation of fishes in this area is a much larger and complex process

Future research

- Improving population estimates (raster approach)
- Include driving distance to water from population hubs to HUCs
- Multi-metric approach to ecosystem valuation related to fishes (including rare species; net economic value; non-use values; intrinsic values)
- Forecast use changes from future landscape and water quality scenarios

Thank you for your attention!

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