Models, Water Withdrawals, River Continuum and Ecological Impacts

- Rainfall-Runoff models give us flow time-series at any location we have bio-data.
- New technique leverages old theory to shows strong Biodiversity = f(Flow).
- Biodiversity = f(flow) relationship offers explanation of habitat mapping paradox.
- Drought flow habitat offer evidence of headwater influence on tailwater.
- A roadmap to improve hydro models for even better management of Water Use.

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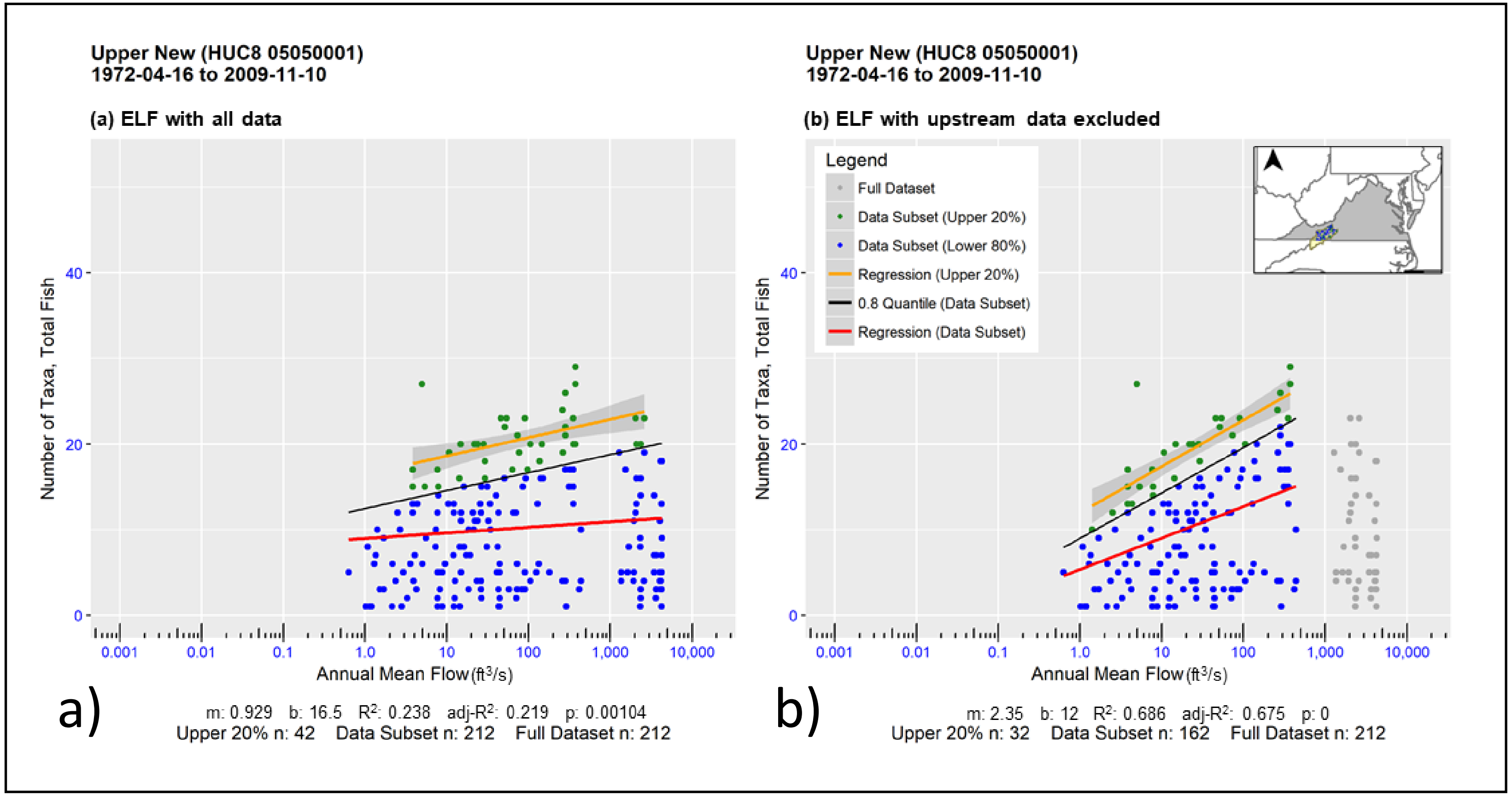
Flow Alteration: Species Richness & Consumptive Use

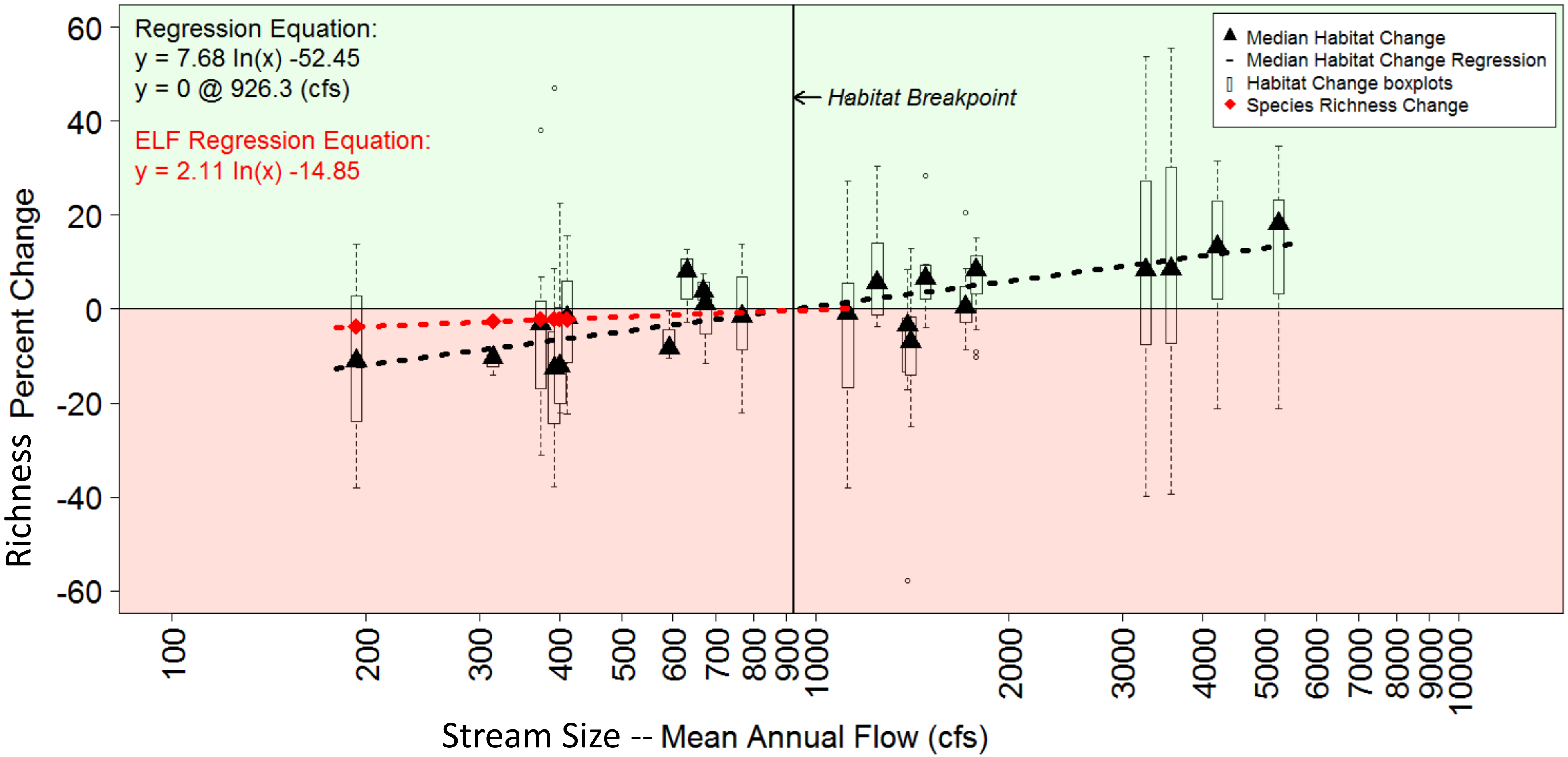
a. Instream-flows scientists have struggled to find broad relationships dEcology = f(dQ).
b. Hydro models used because bio-stations >> stream gages.
c. Models are great @ mean Q, but worse at fine timescale.
d. **Percent of Flow (Pof) works w/model & E=f(Q) uncertainty.**
e. Common approach is to group all stream data (see Figure a).
f. River Continuum Concept tells us we should see a breakpoint.



e. Subset @ RCC Breakpoint yields significant trends in whole data set, and a very strong relationship with upper 20% Quantile Regression (Figure b). Upper 20% line, **Ecologocial Limit Function (ELF)** [1,2].
f. **Result: We can now estimate consumptive-use effect on taxa richness (i.e. biodiversity) at HUC8 scale.**

Small Streams: Mean Habitat = f(Withdrawal)

Percent change in Habitat due to a 20% withdrawal of stream flow during average flows.



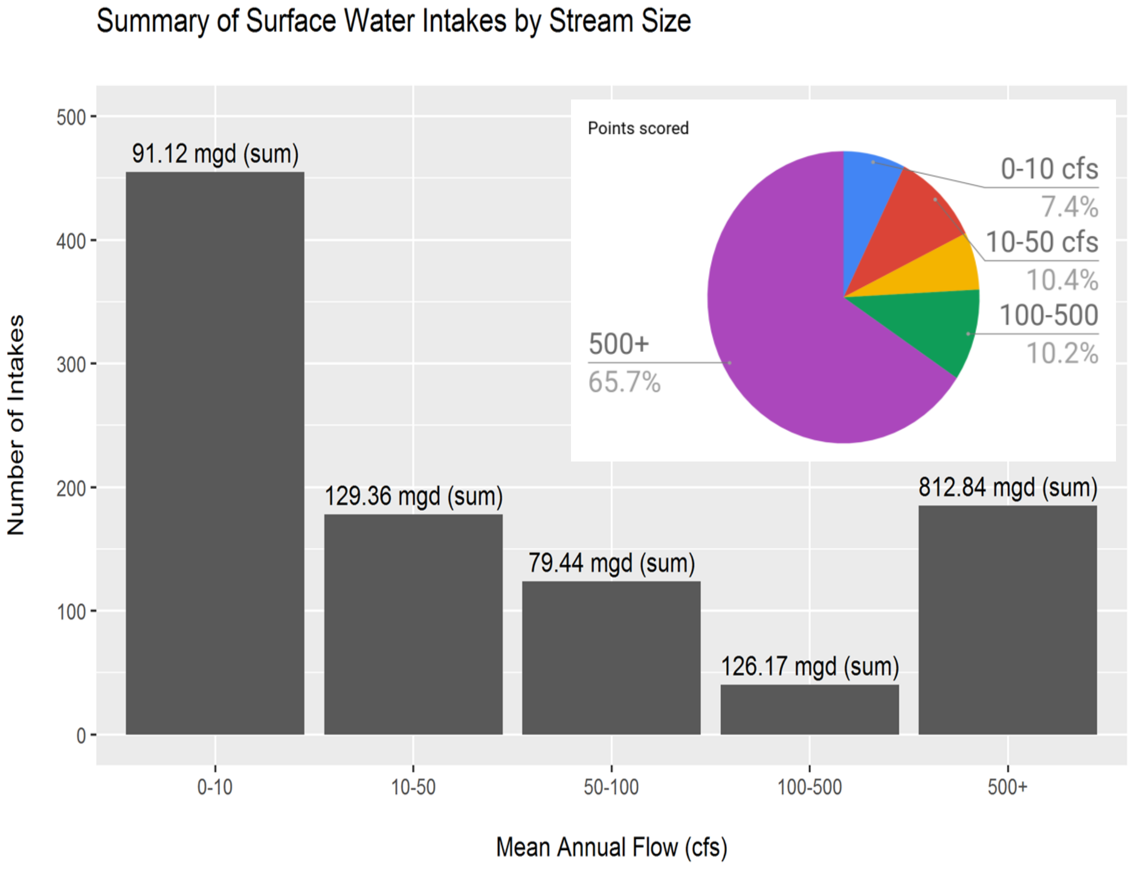
What Does ELF Say About 10-20% in Virginia?

Stream Size and Withdrawals

- Small (<10 cfs): ~45% *intakes,* 7% H_2O
- Large(>500 cfs): ~20% intakes, 65% H_2O
- Median % Withdrawal in 10 cfs, < 5%

Potential Taxa Change in 10 cfs Streams

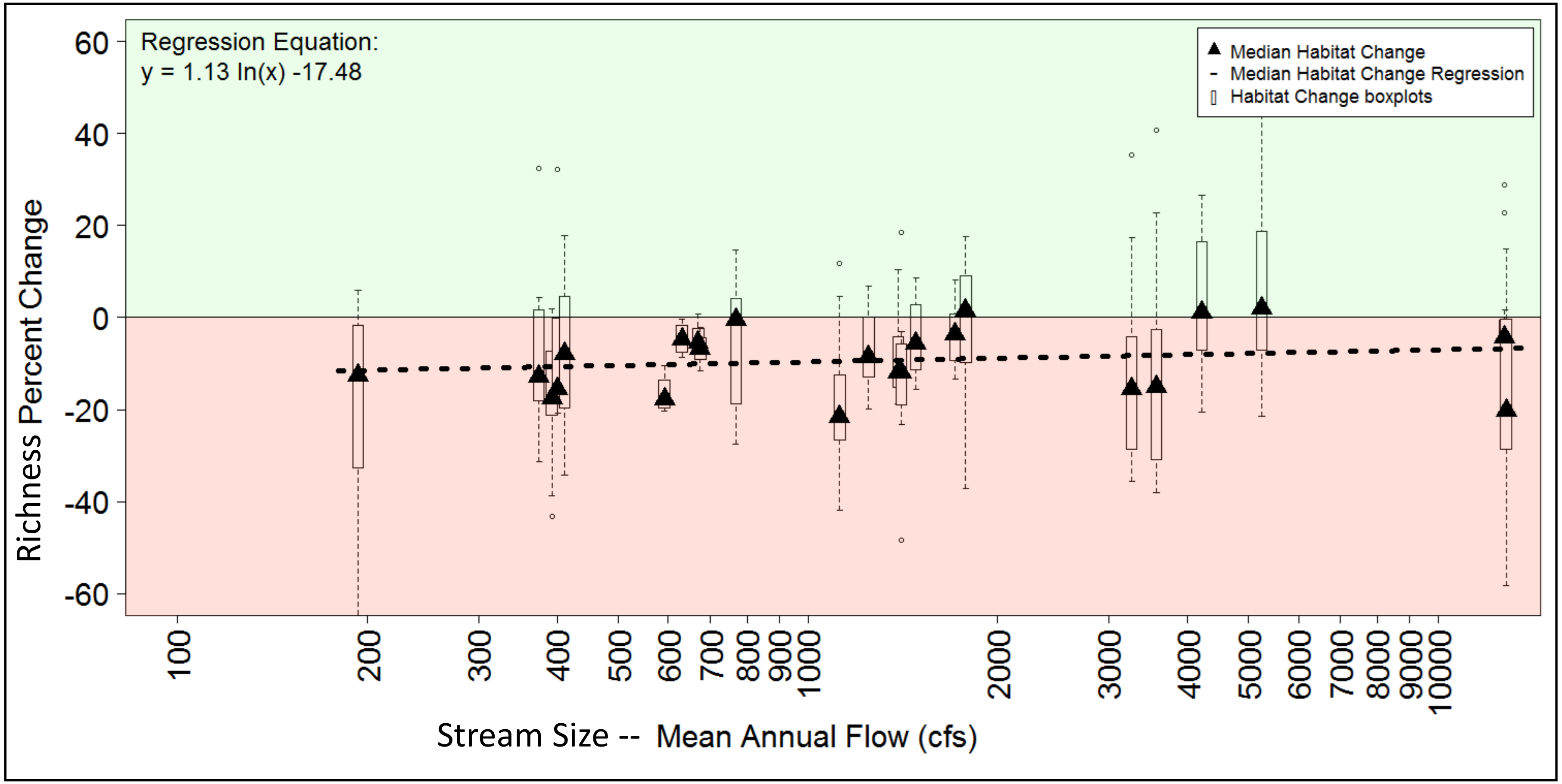
% CU	-10% Taxa	-0.5 NT*	-1.0 NT*
10%	0%	25%	0%
20%	10%	75%	25%



* Because the ELF is log(Q) the number of taxa change as flow decreases is constant at given % flow change.

A continuum: Low-Flow Habitat = f(Withdrawal)

- Percent change in Habitat due to a 20% withdrawal of stream flow during drought conditions (10%ile Q).
- Now we see that low-flow alterations may impact species **all the way from the headwaters to the Bay**.
- * Now we have to get our models to be really good at monthly low flows.



Citations

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