National Water Census / WaterSMART
ACF Focus Area

Environmental Flows Component

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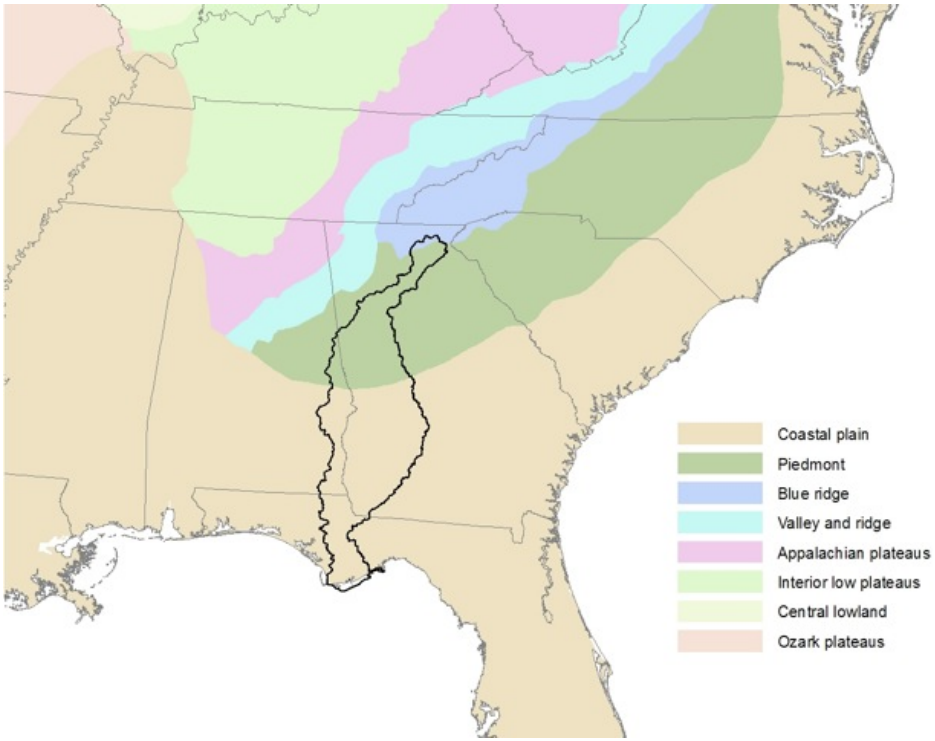
Goals

- *Better understand effects of streamflow variation on fishes and mussels*

- *Develop information useful for making decisions about watershed and streamflow management, when species conservation is an objective*

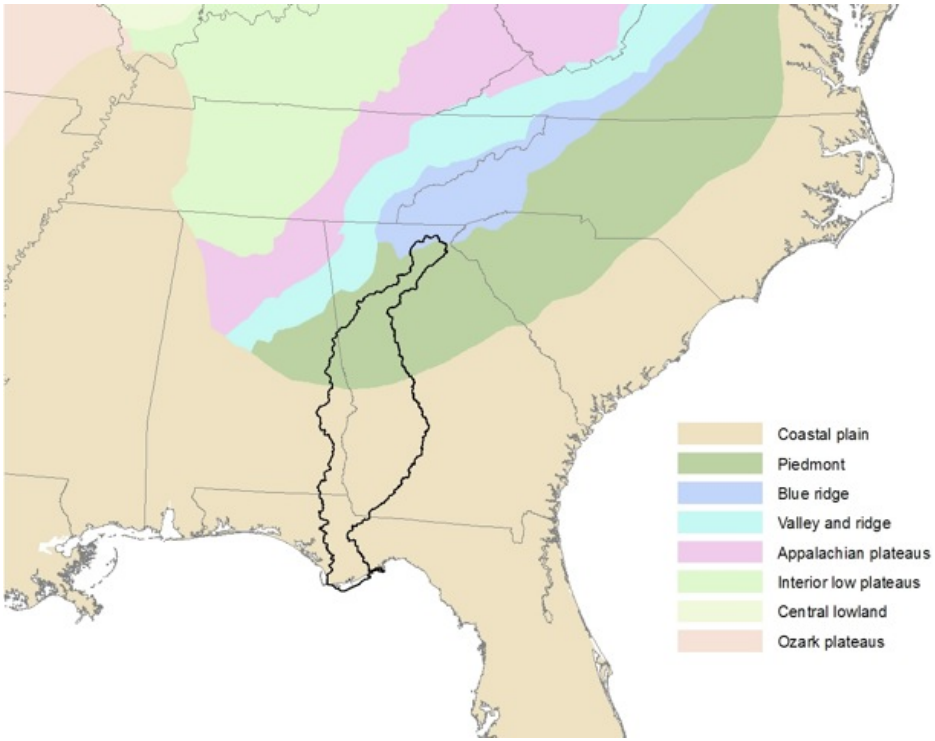
Physical and biological variety in the ACF basin provides a useful context for testing ideas about streamflow effects on biota

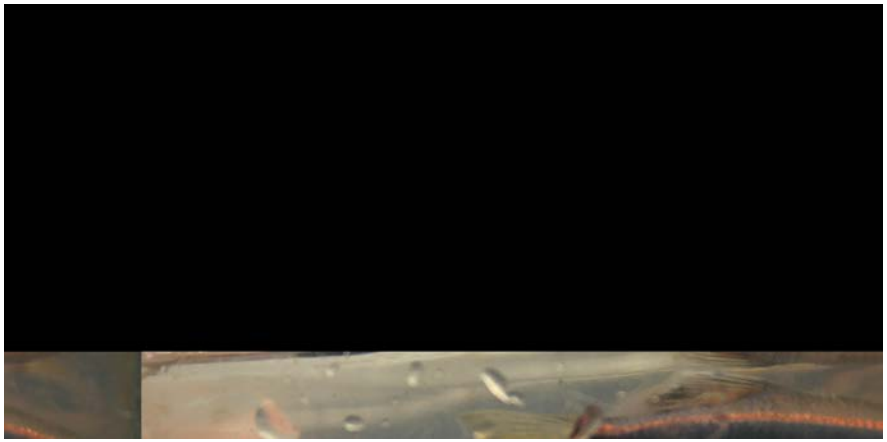


Apalachicola-Chattahoochee-Flint basin (ACF)

- ~ 51 000 square km
- Blue Ridge, Piedmont, Coastal Plain

Physical and biological variety in the ACF basin provides a useful context for testing ideas about streamflow effects on biota





A. Fritts

Apalachicola-Chattahoochee-Flint basin (ACF)

- ~ 110 fish species (10 endemic species)
- ~ 27 extant freshwater mussel species (6 federally listed)

USGS science for a changing world

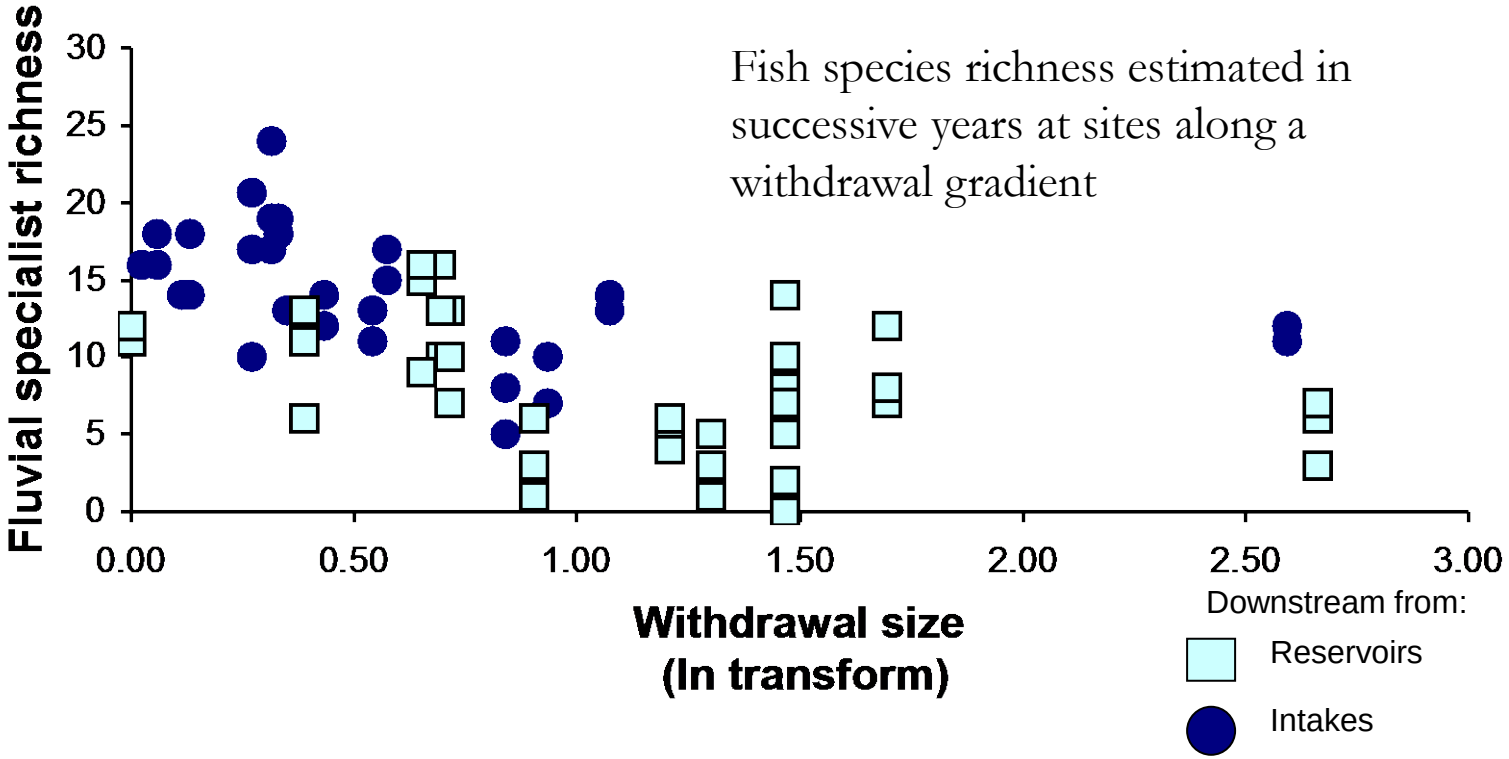
Overarching concept

Changes in streamflow regimes influence ecological function, including persistence of stream-dependent species

Quantifying "flow-ecology" relationships can help managers and stakeholders identify "ecological limits of hydrologic alteration" (ELOHA)

Use best-available data: ecological responses to hydrologic alteration

"Flow-ecology relations" based on data collected across flow gradients typically show much variability in how species respond



Freeman and Marcinek. 2006. Fish assemblage responses to water withdrawals and water supply reservoirs in Piedmont streams. Environmental Management 38: 435-450.

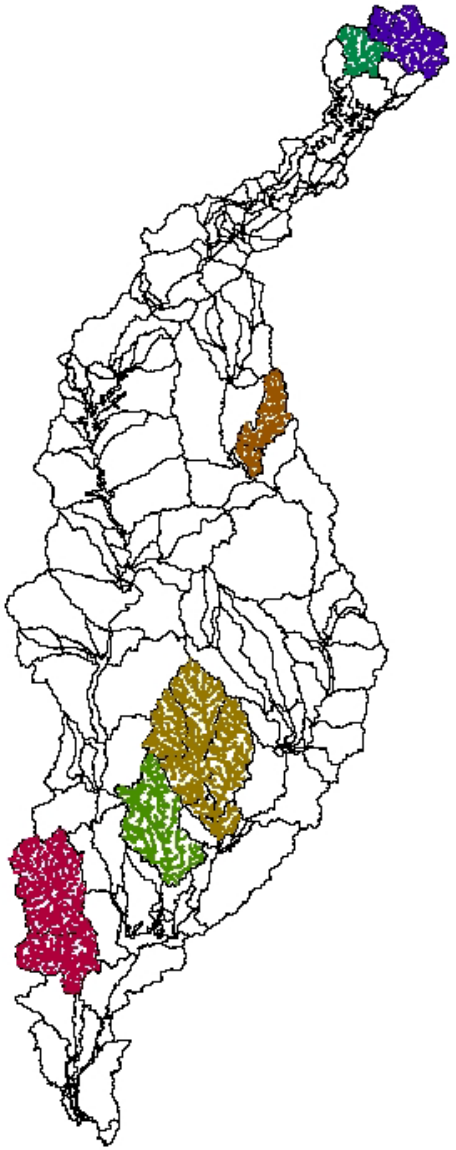
ACF WaterSMART Environmental Flows Component -

Quantify changes in biota at individual sites and relate changes to variation in streamflow & landscape context:

- *Sample fishes in a variety of ACF streams, late spring and late summer/early fall*

- *Use observed changes in species occurrences to estimate streamflow effects on species persistence, colonization*

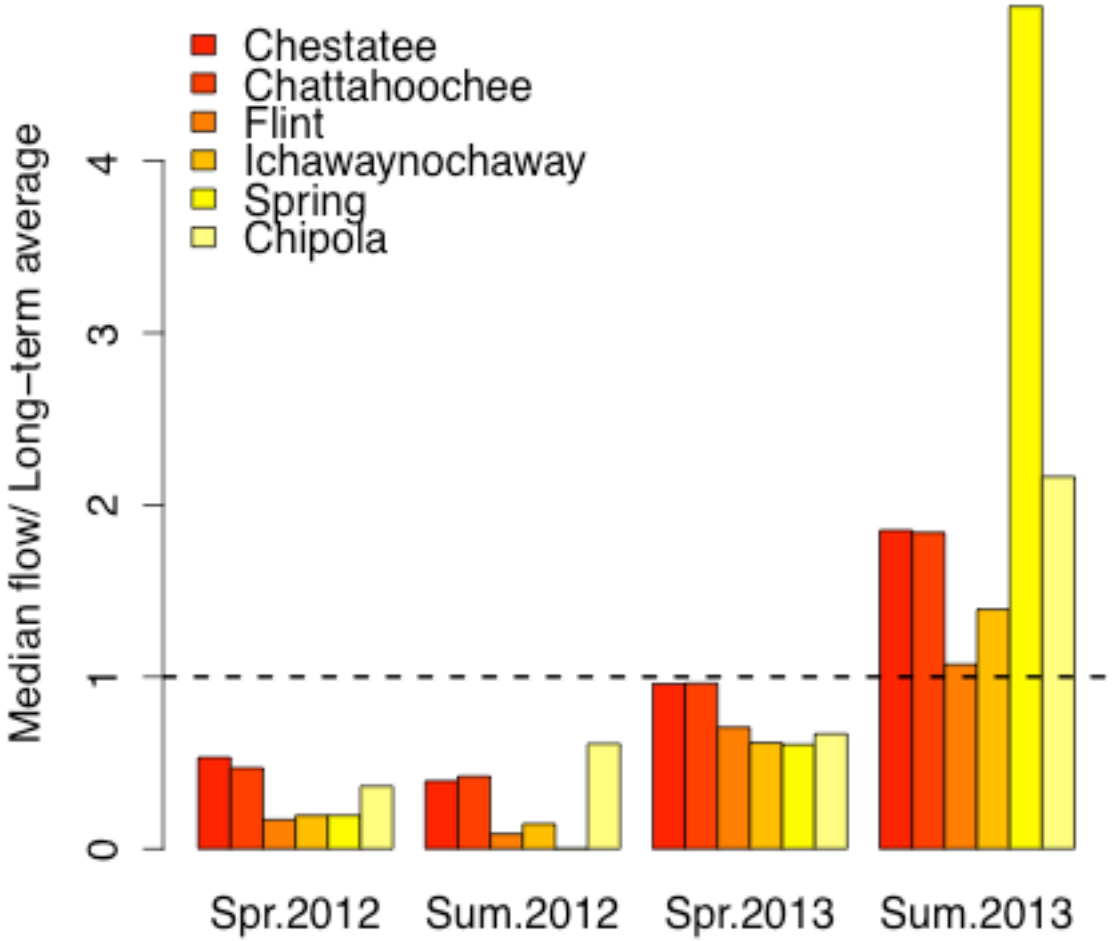
- *Ultimately, combine estimates of flow effects with management scenarios to forecast species persistence across entire watersheds*

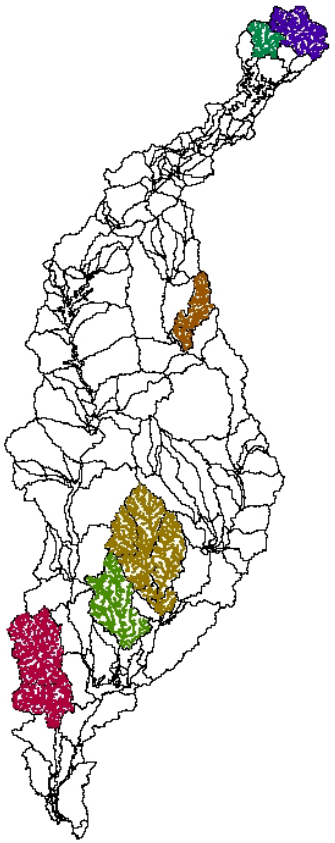


Fish sampling:
Replicate block-netted reaches

37 streams, 6 sub-basins
2 samples/year

Study has included drought to unusually wet conditions





Flow data for USGS gages in or near each of the 6 sub-basins

Preliminary analysis, flow effects on fishes:

- Using flow from nearby gages as a proxy for site-level flows

- Persistence, colonization of minnow species (Cyprinidae)

Minnows?!?

Preliminary analysis, flow effects on fishes:

- Using flow from nearby gages as a proxy for site-level flows

- Persistence, colonization of minnow species (Cyprinidae)

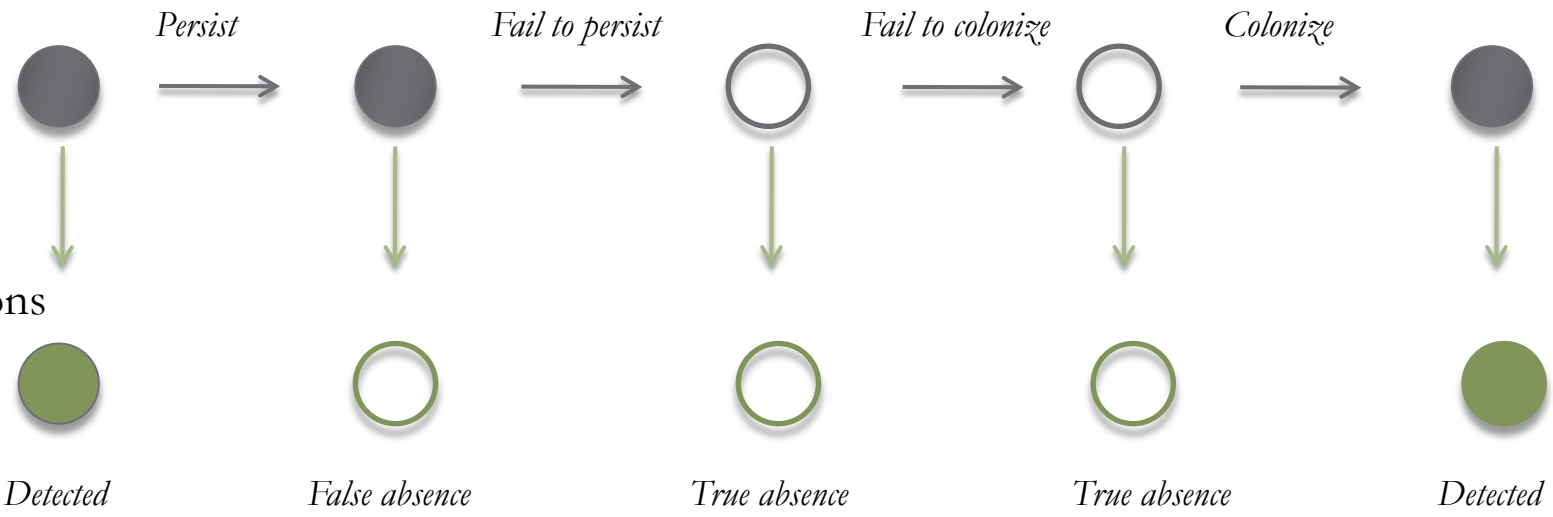
21 species in 11 genera
(~ 30% of observed taxa)

Data collection

Fall 2011 → **Early Sum 2012** → **Fall 2012** → **Early Sum 2013** → **Fall 2013**

Species dynamics

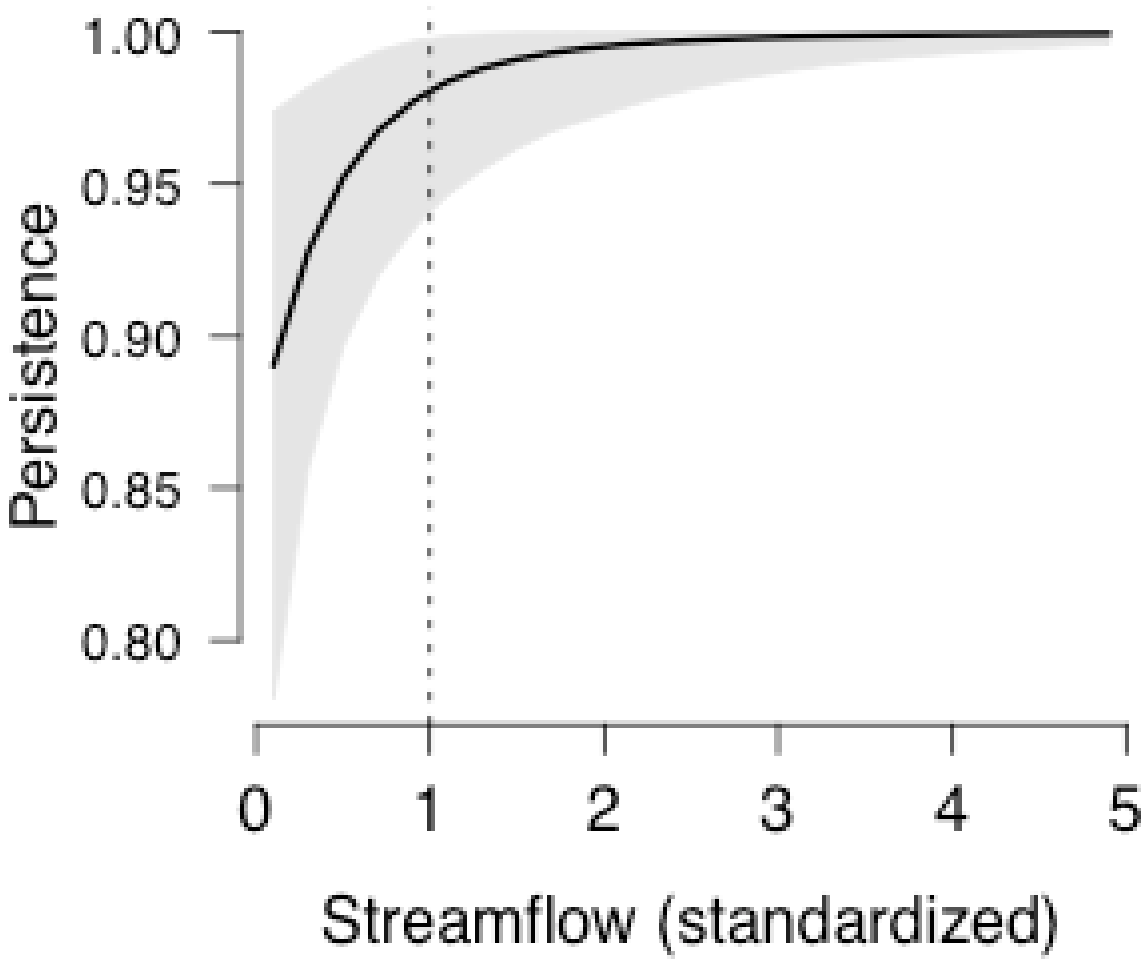
Species 1, Site 1



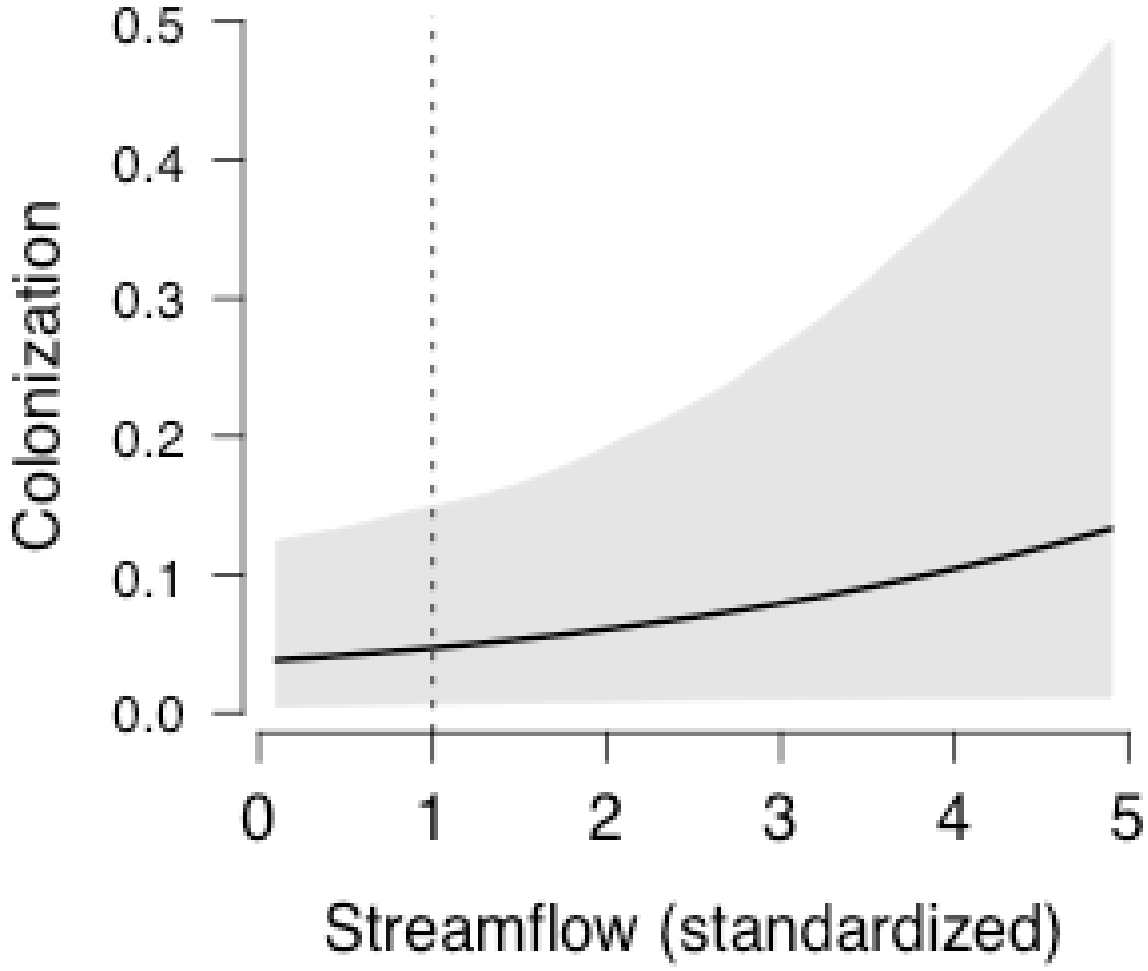
Analysis: Use *observations* to estimate effects of streamflow on the probability that species *persist* or *colonize, accounting for false absences*

MacKenzie et al. 2003, Ecology
Royle and Dorazio 2008, Academic Press
Kery and Schaub 2012, Academic Press

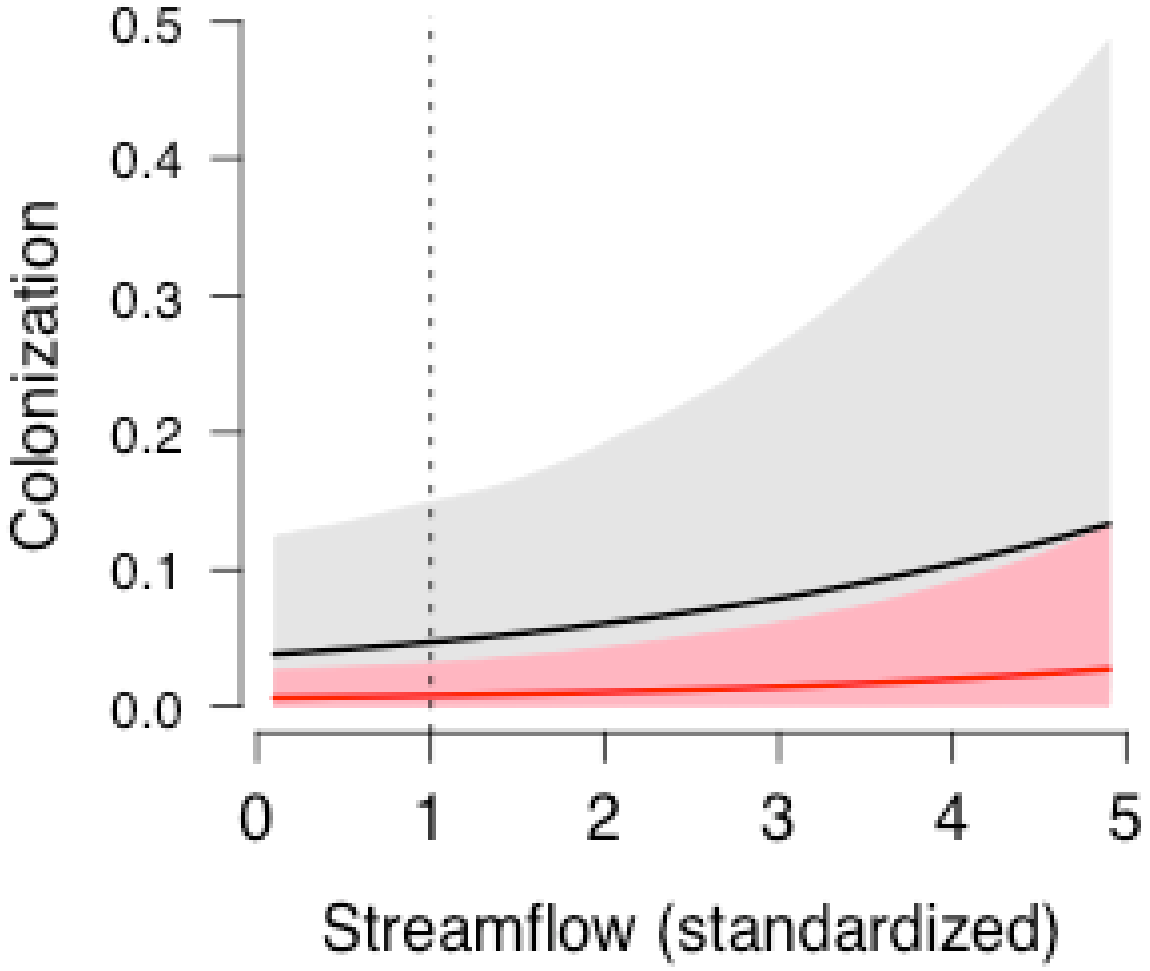
Persistence: High, but evidence of decline at lower streamflow



Colonization: Low, but evidence of increase at higher streamflow…



Colonization: Low, but evidence of increase at higher streamflow…but much lower in small headwater streams



N = 17 streams
DA < 55 km^2,
Dlink < 10

Mean estimated colonization, 95% credible intervals

Next steps:

- Incorporate stream-specific seasonal flow estimates (PRMS)

- Develop models for all fishes
    - Evaluate effects of stream attributes, species traits on persistence, colonization, vulnerability
    - Evaluate relative effects of high, median and low flows

- *Update and extend existing metapopulation model for supporting watershed-scale management*

- *Extend sampling through fall 2014 (at least)*