

Shenandoah Watershed Study (SWAS) a long-term stream water quality monitoring program 1979 - current

A Collaboration between



University of Virginia, Environmental Science Dept.



Shenandoah National Park



Environmental Protection Agency (via SHEN)



June 8, 2018

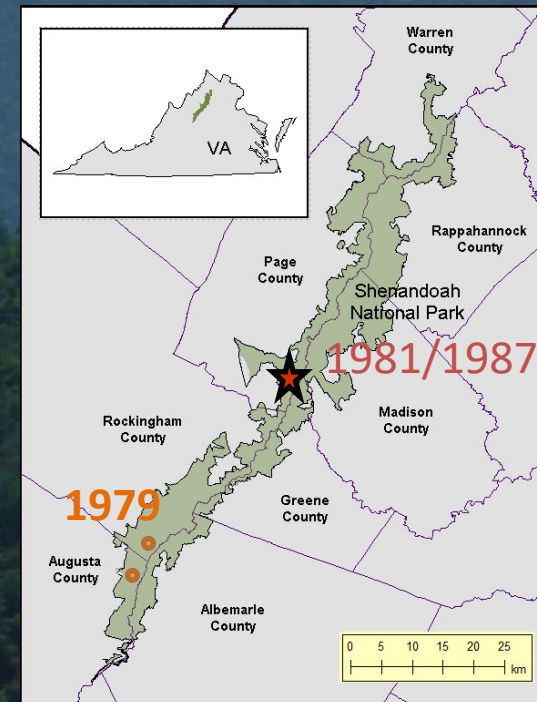
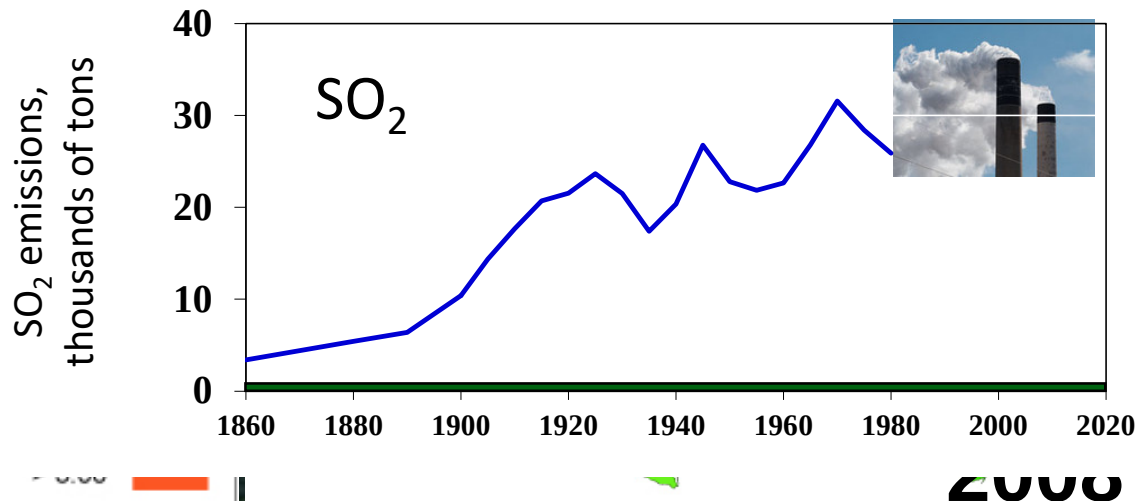
Evaluating the impact of acid deposition in southeastern U.S. streams

The Shenandoah Watershed Study started in 1979

Cooperative Agreement between UVA and SHEN



VA28
NADP station since 1981
CASTNET station since 1987



Title IV 1990 Clean Air Act Amendments – acid deposition control

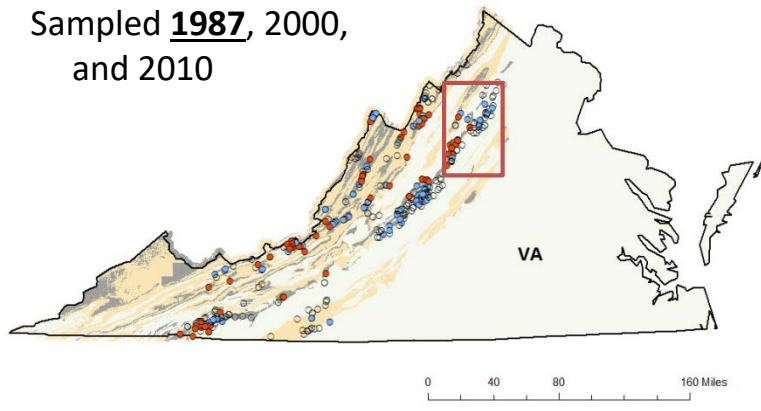
...and what are the factors that determine watershed recovery from acid deposition?

Frequency and types of monitoring

"Decadal" Survey

341 streams (66 within SHEN)

Sampled **1987**, 2000,
and 2010



Chemical analyses

Stream chemistry

- pH
- **Acid anions:** sulfate, nitrate, chloride
- **Base Cations:** calcium, magnesium, potassium, sodium, ammonium
- **Acid Neutralizing Capacity (ANC)**

Biological Evaluations

Fish in Sensitive Habitats – FISH 1992-1995

- Habitat assessments
- Fish population surveys

66 sampled **quarterly**

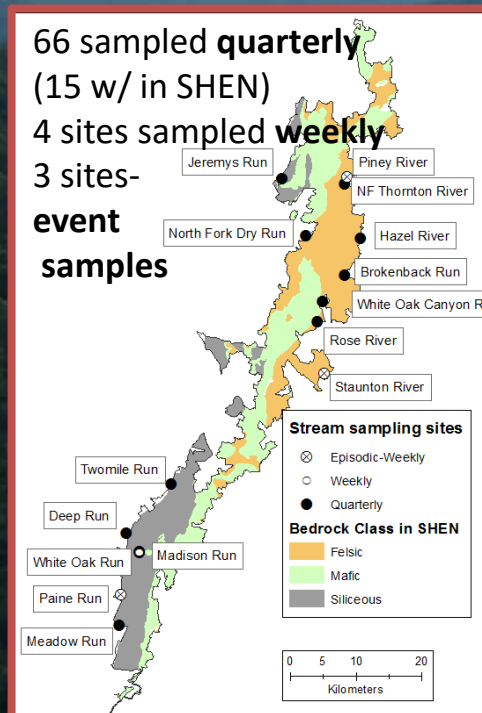
(15 w/ in SHEN)

4 sites sampled **weekly**

3 sites-

event

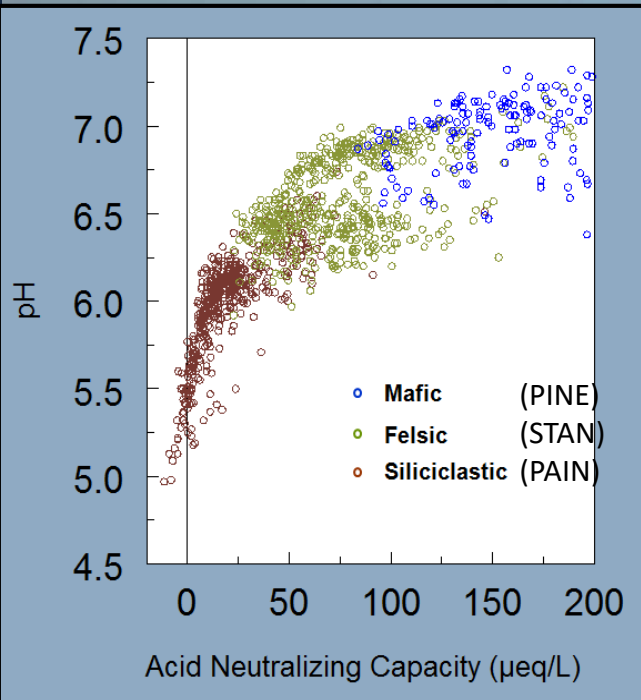
samples



Hydrologic monitoring

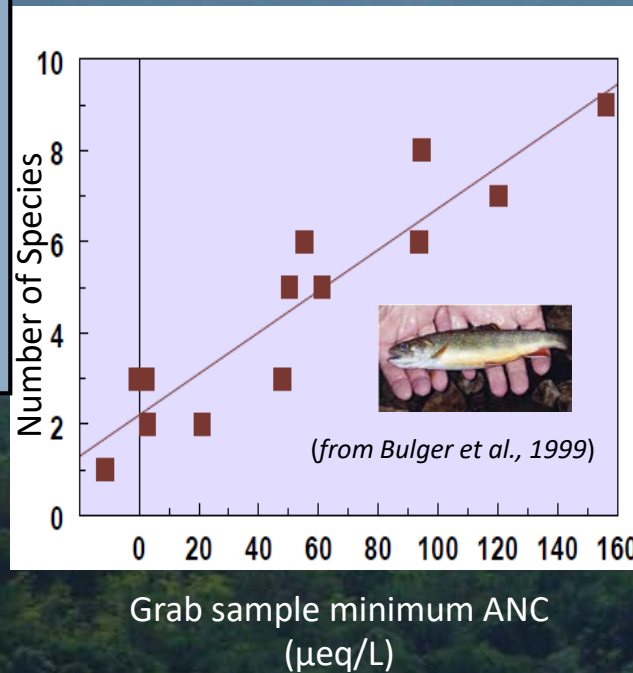


Initial findings: local response to acidification and fish health



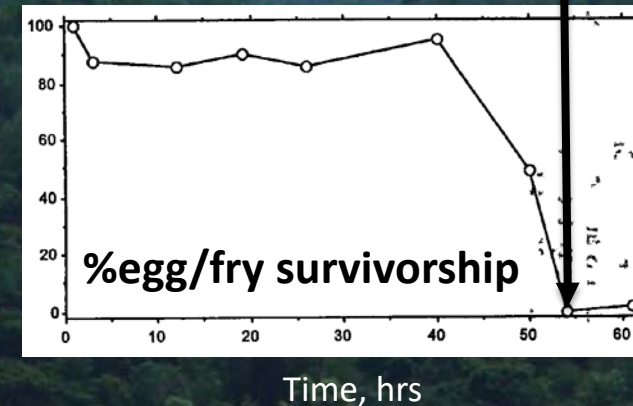
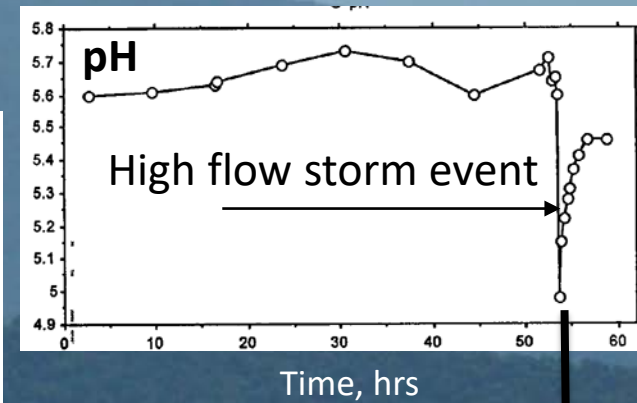
Differences in bedrock composition and weathering (base cations and ANC) within SHEN watersheds results in gradient of responses to acid inputs with a stream pH range from neutral to acidic.

Chronic effects on fish abundance



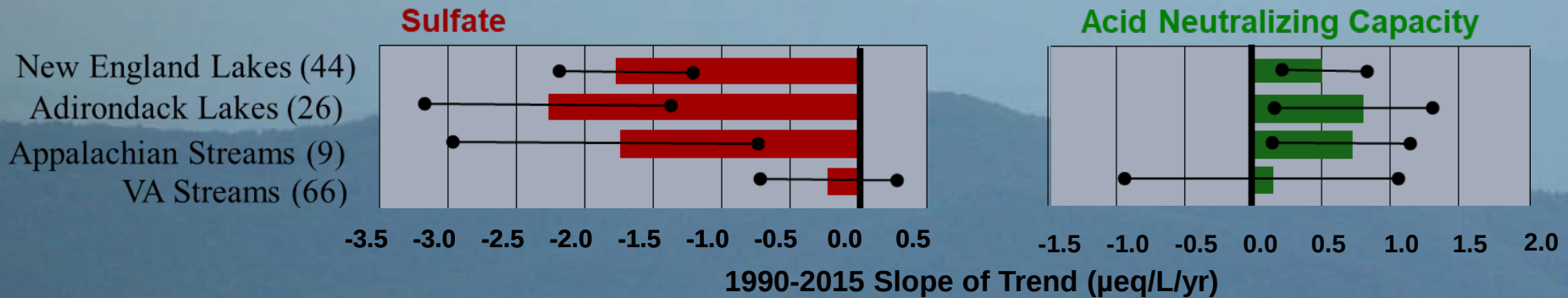
FISH- Fish In Sensitive Habitats 1992-1995

Episodic effects on stream chemistry and fish survivorship

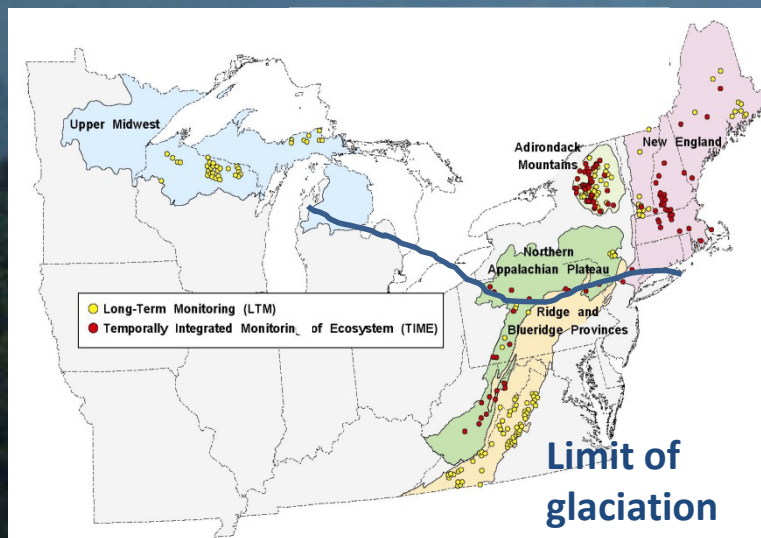


(from Bulger et al., 1999)

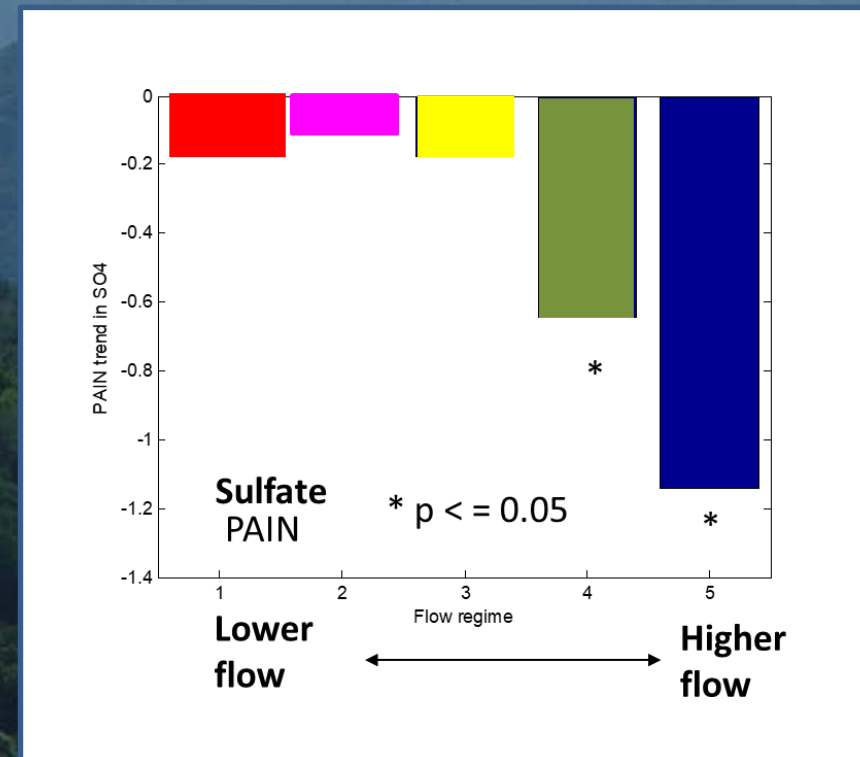
Recovery by region



Recovery by flow regime



- Due to the higher sulfate retention in the older, more weathered soils south of last glaciation in SHEN, the response to reduced acid inputs (SO_4^{2-}) due to the CAAA is delayed relative to NE watersheds.



- Improved recovery at high compared to low flow