Genetic Diversity of Brook Trout (*Salvelinus fontinalis*) Populations Isolated Due to Abandoned Mine Drainage in the West Branch Susquehanna River Watershed, Pennsylvania

Fred Brenner, Ph.D.

Grove City College, Biology Dept.

&

Shawn Rummel, Ph.D.

Field and Research Manager

Trout Unlimited, Eastern Abandoned Mine Program &
Eastern Brook Trout Habitat Initiative

TROUT UNLIMITED

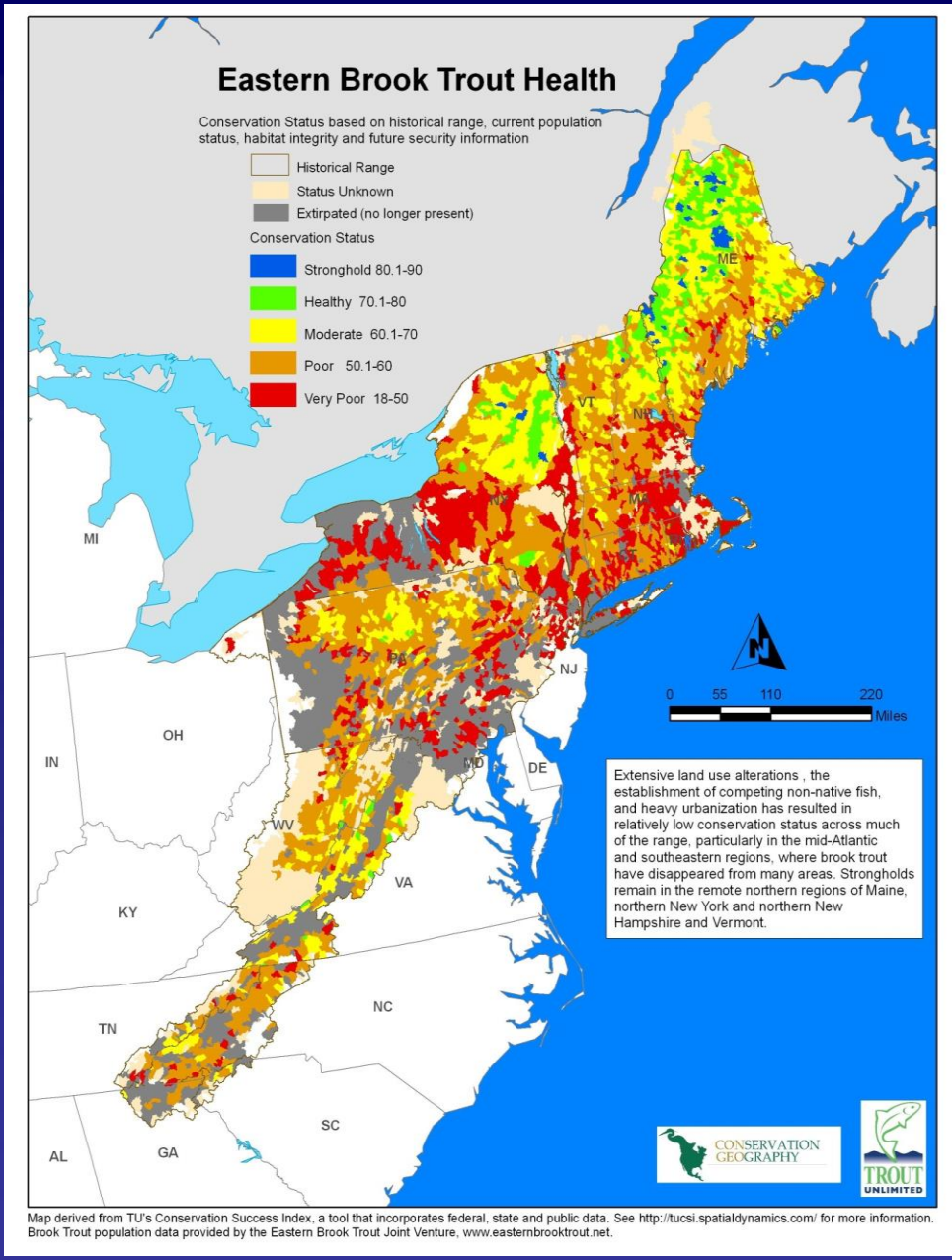
Eastern Brook Trout

- Recreationally and culturally important species
- Regional icon throughout native range
- Only native salmonid throughout most of range
- Indicators of high quality water
- Economically important:
  - In 2006, U.S. trout fishermen spent $4.8B on fishing related expenses*
    - $13.6B economic impact
    - Supports 100K+ jobs

** 2006 National Survey Report*

Current Status of Eastern Brook Trout

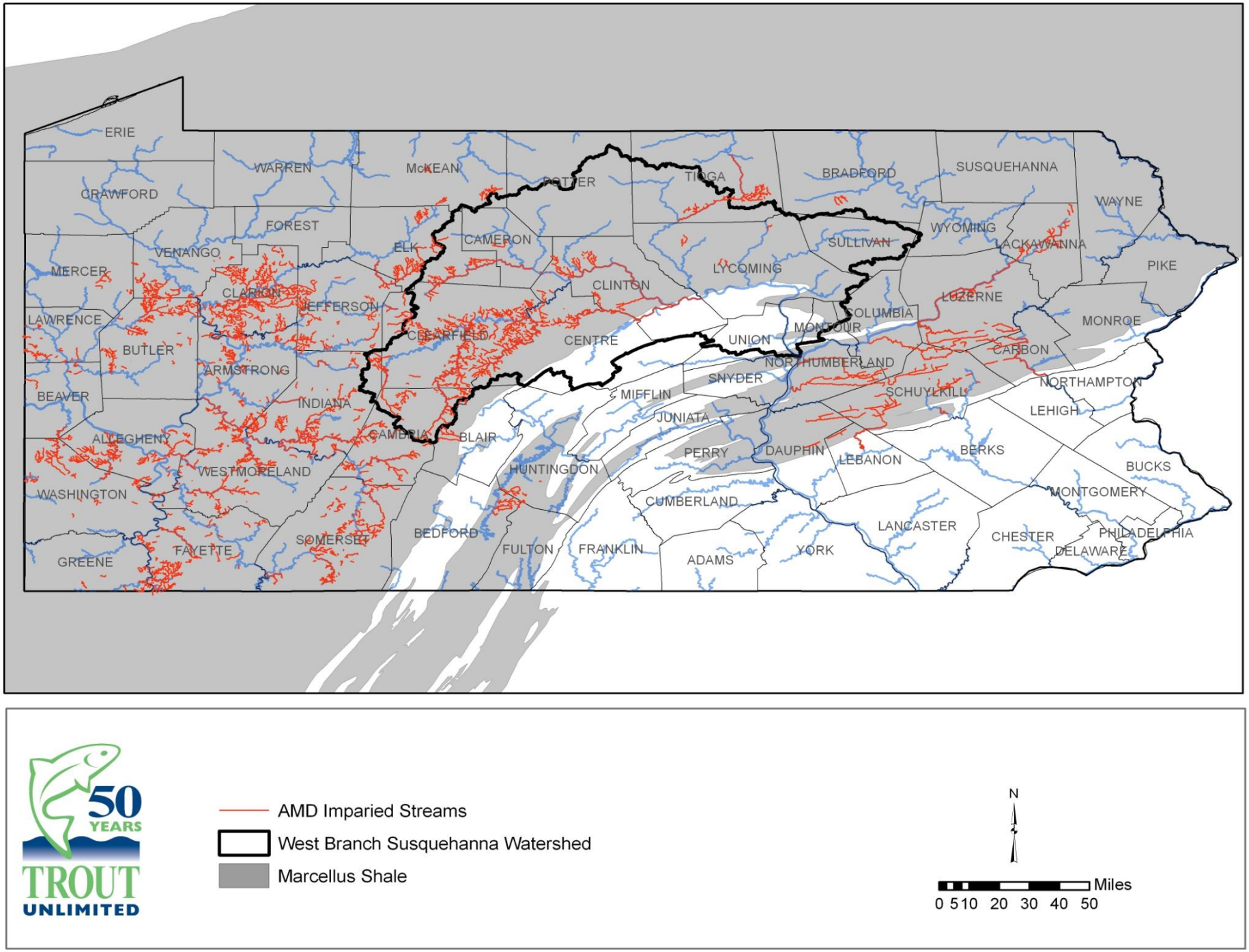
- Declining throughout native range
- Primarily confined to 1st order headwater streams
- EBTJV
  - <5% watersheds have undisturbed populations
  - Extirpated from 21% of subwatersheds
  - Data needed for 32% subwatersheds



Data Source: EBTJV

Major Threats to Native Trout

- Climate & Atmospheric Inputs
  - Increasing water temps.
  - Acid deposition
- Land Use
  - Agriculture
  - Forestry
  - Development
- Resource Extraction
  - Coal
  - Natural Gas



50 YEARS
TROUT UNLIMITED

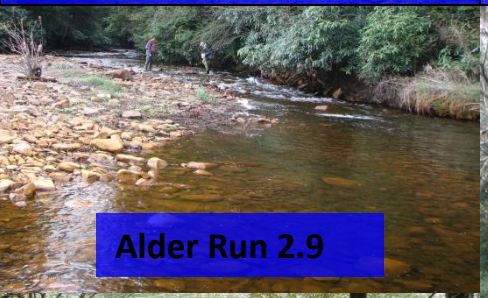
AMD Imparied Streams
West Branch Susquehanna Watershed
Marcellus Shale

N

0 5 10 20 30 40 50 Miles

Water Chemistry Impact

pH	acidity	Fe	Al

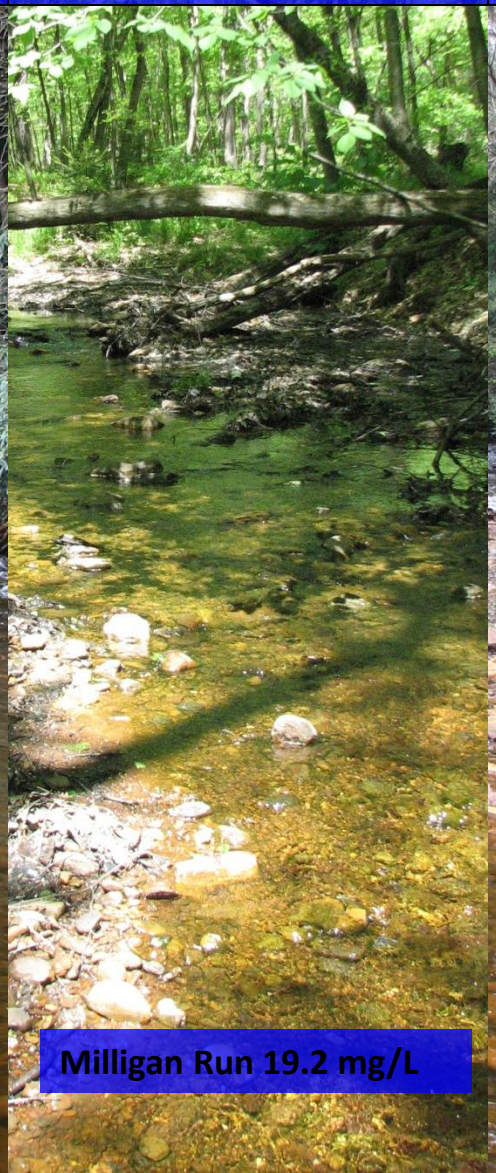


Alder Run 2.9

UNT 25913 2.9

Milligan 2.9

Alder Run 247 mg/L

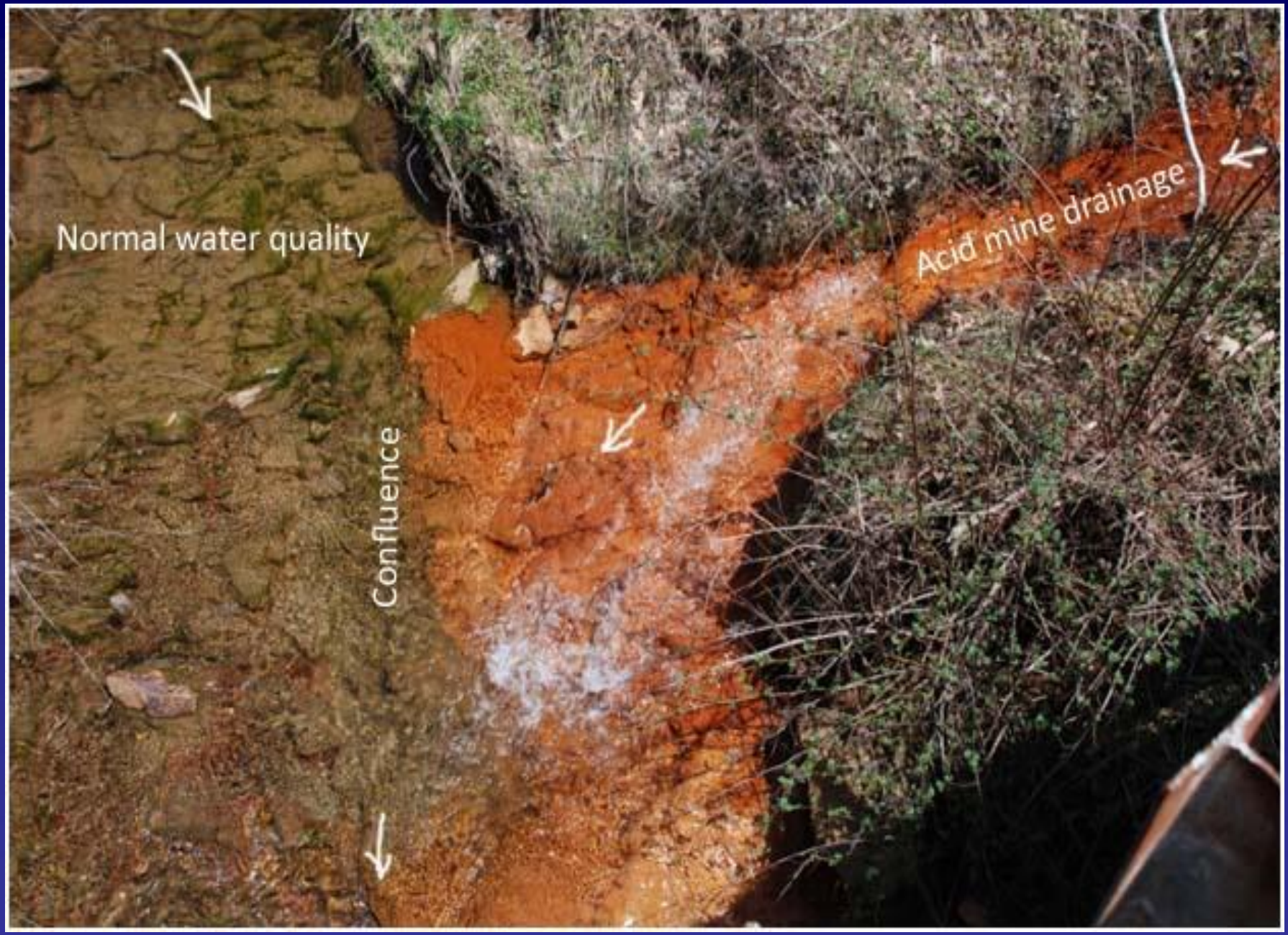


Milligan Run 19.2 mg/L

Alder Run 46.6 mg/L

Impact of AMD on Aquatic Ecosystems

- Water Quality
  - Decreased pH
  - Increased metal concentrations; Fe, Al, Mn
- Habitat
  - Precipitating metals often coat substrate (limits benthic macroinvertebrate habitat and fish spawning habitat)
- Benthic Macroinvertebrates & Fish
  - Loss of pollution sensitive taxa
  - Decreased growth, reproduction, or death
  - Increased avoidance behavior or movements for mobile organisms
  - Dissolved metals are toxic to fish (Al > 0.5 mg/L)
  - High metal concentrations interrupt respiration in fish
  - Isolation of populations due to water quality barrier


Normal water quality
Confluence
Acid mine drainage

Objectives

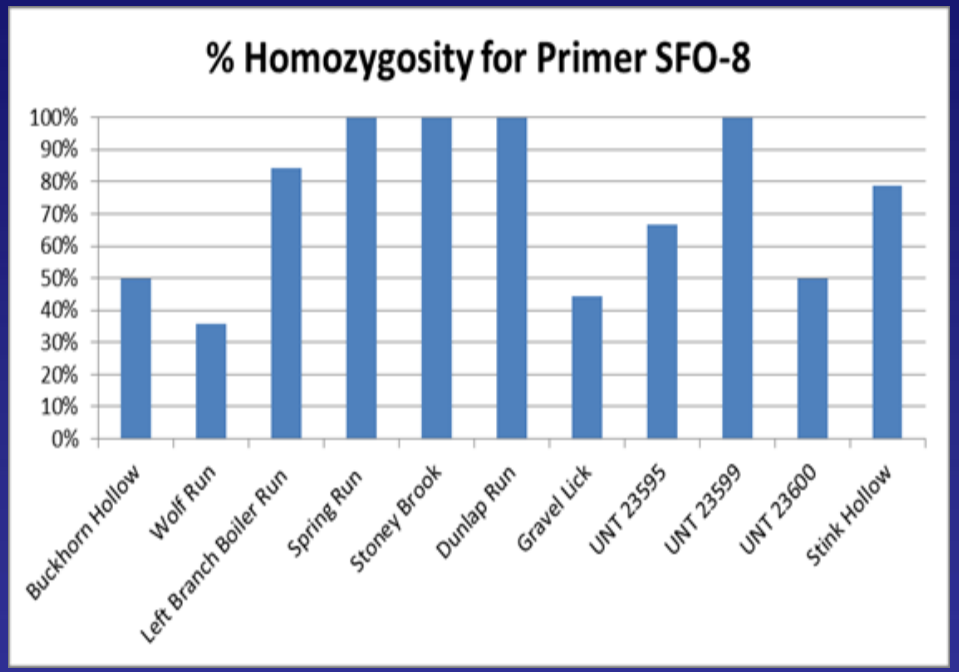
- Assess overall genetic diversity of brook trout in the West Branch Susquehanna River watershed
- Determine if AMD is causing isolation of brook trout populations
- Monitor biological recovery following remediation
- Determine if genetics of isolated populations become more similar following remediation

Methods

- Streams were sampled for brook trout using a pack back electric shocker.
- A fine clip was obtain from the each fish and preserved in 70% ethyl alcohol.
- A polymerase Chain Reaction (PCR) was complete on each sample confirmed by
- Gel electrophoresis. Samples were sequenced
- using an Applied Biosystems 310 sequencer.

Preliminary Genetic Results

- Microsatellite and mtDNA
- Isolation may exist due high frequency of homozygosity observed
- Due to limited number of samples, unable to determine if populations are truly isolated



Summary

- The preliminary results to date indicate higher than expected Homozygosity indicated that these isolated populations do not exhibit a Hardy-Weinberg equilibrium.
- Suggesting that these are not randomly breeding population and that inbreeding is occurring in these isolated population.
- The acidic discharges appear to limit the movement of brook trout in these steams.

Future Work

- Continue to sample additional streams in the watershed to increase our sample sizes.
- These samples will include both streams receiving abandoned mine drainage and non-AMD non-impact streams in the watershed.
- This is an ongoing study that will also involve sampling AMD impacted streams before and treatment systems are installed.