Members

Delaware River Basin Policy and Practice Workgroup Current Members

- Alex Jackson Smithfield Twp (Monroe Co, PA), Director of Conservation & Recreation, as of 1/25/23
- Christa Reeves (Musconetcong Watershed Assoc, NJ), as of 1/25/23,
- Dave Bressler (Stroud, PA), as of 1/25/23,
- Ian Brastow (Lopatcong Creek Initiative/New Jersey Highlands Coalition, NJ), as of 1/25/23,
- Joe Debes (Master Watershed Stewards, PA), EAC??? as of 1/25/23,
- Carol Armstrong (Master Watershed Stewards, Charlestown EAC, PA, Stroud Center Volunteer, Friends of Heinz Refuge, GVWA), as of 2/16/23,
- Tali MacArthur (POWR/PEC, PA)(*collaboration with this group per situational needs for both)
- Steve Tricarico (Tulpehocken Watershed Association/Berks Co Cons Dist, MWStewards, PA; planning commission for Bern township), as of May 2023

History and Group Charge

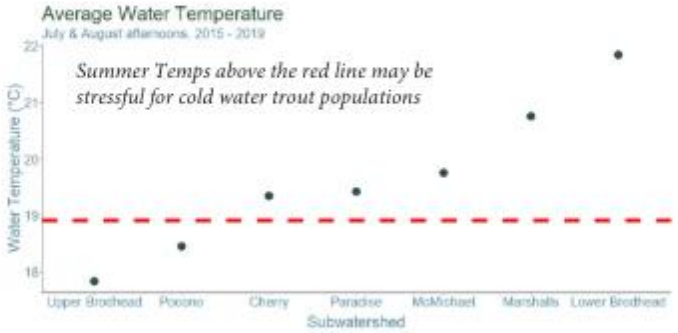
To develop the most effective way of employing stream monitor data – conductivity, temperature, depth, and sometimes turbidity – and related measures to advise and otherwise influence municipal entities. The charge includes an emphasis on stream quality in relation to land use and development.

Types of Products

- Primer Documents
  - 5 primer documents designed to educate environmental advocates on topics covered in the group charge: conductivity, temperature, depth, turbidity, and municipal engagement.

Types of Products

- One Pagers
  - Documents specifically designed to distil the information in the primers in more digestible ways
    - Examples of one-pagers
      - Executive Summary Documents
      - Sub-topic Summary Documents
      - Community Specific Documents



Brodhead Creek

Are Waters Getting Too Warm for Trout?

What Can You Do?

If you share your watershed with a trout population, one of the best ways to preserve the cold temperatures is to add native trees and shrubs to your property. By keeping your yard rooted with a diversity of plant life, you'll not only provide habitat for wildlife, but will anchor soils, absorb rainwater, and prevent pollutants from washing into the nearest stream. If your property is on a creek or lake, adding trees/shrubs forms a vital riparian buffer zone. Riparian buffer zones form critical habitat for wildlife like amphibians and birds. Buffer zones provide the best benefits at 300+ feet, with 150 feet being the minimum recommendation.

If you are an angler and you release the fish you catch, be aware of the water temperatures. Trout are incredibly stressed at water temperatures of 70 degrees F (20 C) and higher, with stress increasing with every additional degree change.

Live Temperature Data:

1. Google search engine for the query "USGS brodhead creek" or "USGS Lehigh river"; etc.
2. Visit monitormywatershed.org/browse/
   Then zoom into Pennsylvania -> Monroe County to view temperature data on your nearest Creek!

This data was provided by volunteer sample data from BWAs Streamwatchers. Continuous temperature data is provided by the EnviroDIY Monitoring Station

Brodhead Watershed Association
BWA

STROUD™
WATER RESEARCH CENTER

What is the Brodhead Creek?

The Brodhead Creek, located in Monroe County, PA, is a major tributary of the Delaware River. It flows off of the forested Escarpment of the Pocono Plateau, through suburban and agricultural municipalities, while finally joining the Delaware River near Stroudsburg. The Brodhead Creek Consists of 9 Sub-Watersheds, totaling over 312 square miles in drainage area. All special protection designated waters by the PA DEP and thus an endangered natural resource.

Trout in the Creek

All along the Pocono Plateau Escarpment, and from deep beneath the watershed, cold groundwater seeps through the conglomerate, siltstone, and sandstone bedrock into the Brodhead Creek.

Headwater tributaries cascade down the 800+ foot Pocono Plateau escarpment in spectacular groundwater fed waterfalls and rapids, providing the perfect habitat for aquatic wildlife that are more sensitive to water temperature and dissolved oxygen changes. Species include macroinvertebrates (like Mayflys) and Trout, a group of fish closely related to salmon, which are incredibly popular among anglers to catch for food and sport. Three Trout species can be found within the watershed: Rainbow, Brown, and Brook Trout.

These species prefer cold and highly oxygenated waters, which make the Brodhead Creek a perfect place for them to thrive and for anglers to enjoy. Where they are thriving indicates to us an abundance of exceptional value water.

Intended Audience

Materials being developed are intended for usage by:

- Environmental Advisory Councils (EACs)
- Watershed Groups
- Anyone interested in participating in local decision making

What are the resources?

- ✓ Putting Stream *Temperature* Data to Work
- ✓ Putting Stream *Conductivity* Data to Work
- Putting Stream *Depth* Data to Work
- ✓ How to Engage with Municipal Leaders

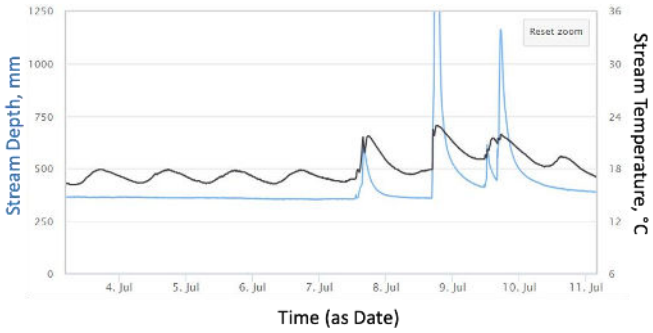
Manage My Watershed:

- Tools for Engaging with Municipal Leaders on Freshwater Issues

https://managemywatershed.org/engaging-with-municipal-leaders/

Putting Stream *Temperature* Data to Work: Issues Addressed

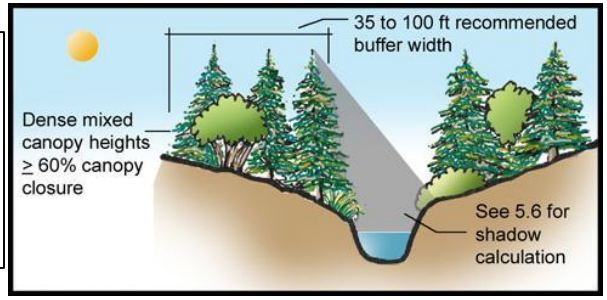
- Determinants of stream temperature
- Temperature thresholds for aquatic organisms
- Aquatic species adaptations to increasing stream temps
- Land use and development of concern
- When and how to approach municipalities based on temperature data



Aquatic Macroinvertebrates Temperature Tolerances (EPA)

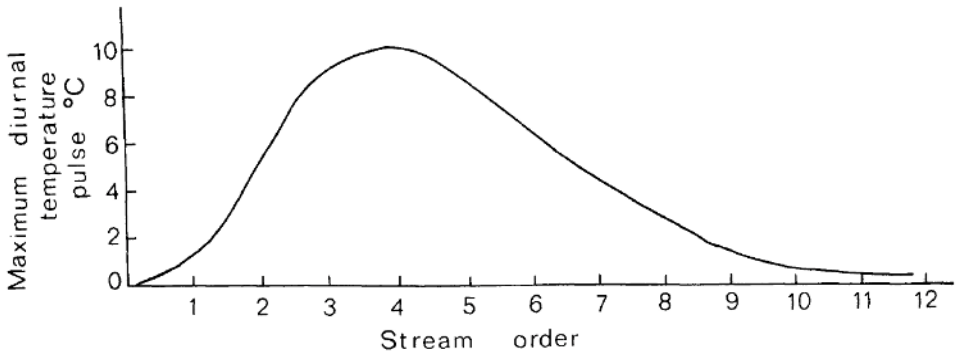
Optimal growth: **13–16 °C**

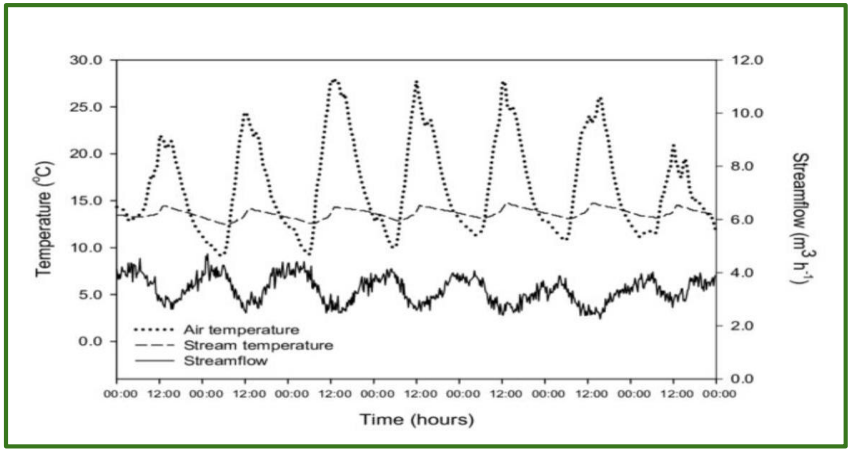
Upper Lethal Temperature: **21–30 °C**



Determinants of Stream Temperature

- *Atmospheric and groundwater sourcing*
- *Solar radiation*: seasonal variations, depth of penetration
- *Seasonal and diel variations* increase with stream order
- Influence of stream *morphology* and stream *mixing*
- *Exceptions to temperature uniformity*: potholes, seeps, thermal 'refugia', confluences, spatial connectivity





Ecological Impacts of Stream Temp

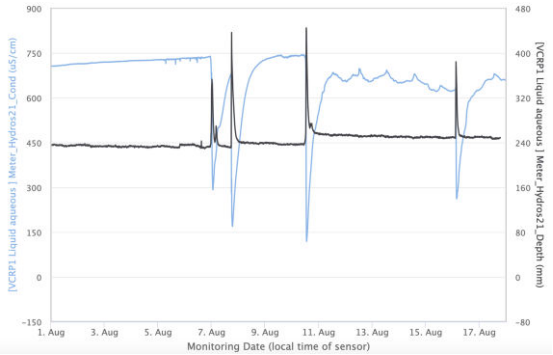
- *Adaptation of fish to temperatures:*
  - Triggering stress responses and lethality
  - Fish behavior
  - Different impacts on mainstem and tributary
- *Other factors affecting aq. sp. survival*:
  - De-oxygenation,
  - Catch-and-release,
  - Stream connectivity needed for forage and use of thermal refugia availability/productivity
- *Management*
  - Catch-and-release interaction with temperature

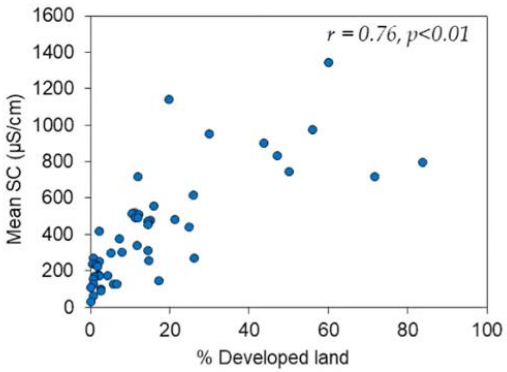
Land Uses Affect Temperature Background and Studies

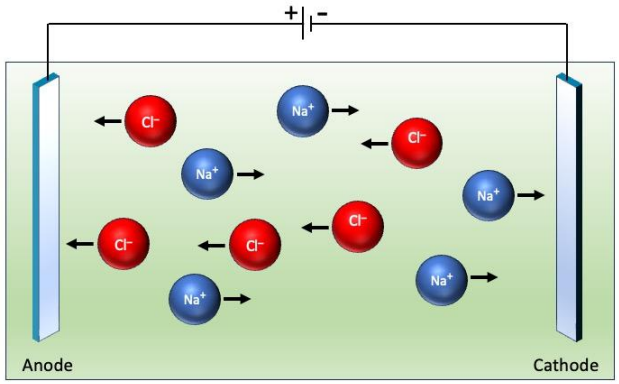
- *Deforestation*, buffer widths
- Types of *impervious surfaces*, impacts on water quality, stream ecosystem, wetland plant and amphibian communities
- *Impoundments*: dams (height), volume, widening of impoundment, ponds, lakes, weirs that impede flow, stormwater basins
- *Discharge of heated effluents*: roof drains, waste water from chemical plants, refineries, power plants
- *Streamflow depletion* through pumping of surface water, and *groundwater depletion*

Putting Stream *Conductivity* Data to Work
Issues Addressed

- Understanding stream e-conductivity and underlying ions.
- Geological influences:
  - Ion decomposition
  - Rock dominance, weathering
  - CO^2
- Concentrations of stream ions increase with human activity

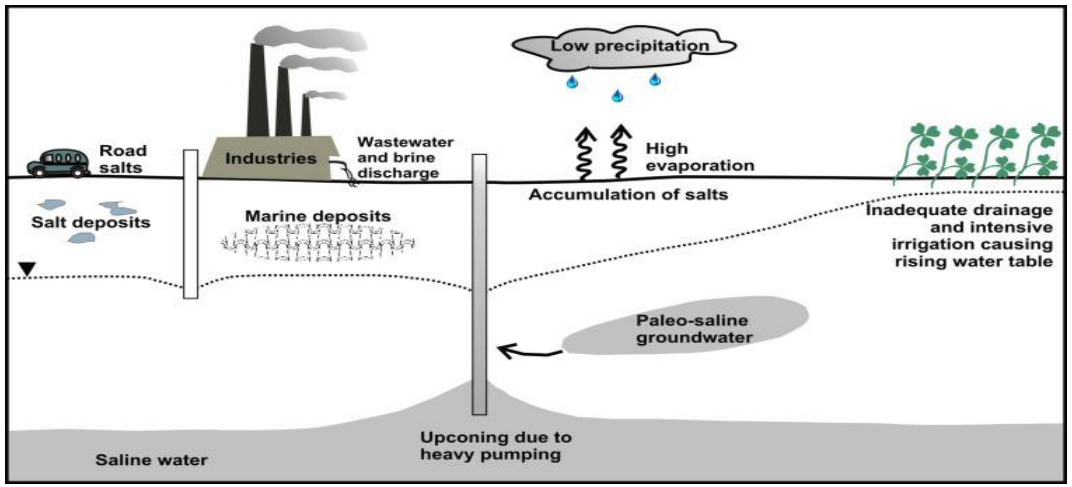






Freshwater Salinization

- *Increasing conductivity* in freshwater systems
- Caused by *anthropogenic runoff of salts* into freshwater at a faster rate than they can be naturally flushed out.
- Major sources of inland salinization are *wastewater treatment plants, roads and parking lots, agriculture, and irrigation of dry areas that lack adequate drainage*.
- Also *increased evaporation, decreased precipitation* accelerated by:
  - Climate change
  - Excessive groundwater pumping
  - Industries that dispose of wastewater with high salt levels



Freshwater Salinization Syndrome

- Concurrent increasing trends in conductivity from increasing chlorides, pH, alkalinity, and base cations
- Salt (road salts, brines from fracking fluids) increase salinity *and* alkalinity
- Human-accelerated weathering of natural minerals drive both salinization and alkalinization (explained)
- Many different salt ions are toxic to aquatic life
- Threatens: Safe drinking water
  Ecosystem health
  Biodiversity
  Human infrastructure corrosion
  Food production

FSS affected
37% salinization, and
90% alkalinization
of the drainage area of
contiguous U.S.-
most rapid in Eastern
U.S.

Ecological Impacts

- *Chlorides trending higher* through 2020 (DRBC)*
- High conductivity of 500 to 10,000 µs/cm require more energy for organisms to maintain *osmoregulatory* balance
- *Benthic invertebrates thrive in low SC waters*, but could find lower SC niches within high natural background SC
- EPA – good mixed freshwater stream fisheries range from *150 to 500 µs/cm*
- *Model of SC tolerance for potential management* (Cormier et al.)
- *Impacts of FS on food webs* due to chemical cocktails
- Other species investigated: *Crayfish, fish, salamanders*

Land Use causing increased conductivity

- Food processing facilities – wastewater with metal ions*
  - Electric conductivity recorded ranged from 20.40 to 1487 µS/cm. Distillery effluents were up to 5100 in the stillage
  - Citizen activism has raised food industry's awareness of impact on the environment
- Wastewater treatment plant effluents from household products, food, industrial discharges, human waste – many chlorides
- Direct industrial discharges to water bodies without significant treatment
- Congress sets national pollution control requirements for each industry based on the best technology *the industry can afford.*
- *Local regulations can also have impacts.*