

Forest Fires and Water Quality



Greenwood Fire, 2021, US Forest Service

Background

Forest fires harm rivers, creeks, and lakes by increasing erosion and runoff, reducing water quality, and disrupting aquatic ecosystems. Ash and debris clog fish gills, smother habitats, and raise salinity levels, making freshwater environments more hostile to sensitive species. This stresses aquatic life, disrupts reproduction, and destabilizes the food chain, threatening biodiversity from small invertebrates to larger fish and birds.

Communities that rely on fishing, tourism, and recreation face significant revenue losses as fish populations decline and water quality worsens. Increased salinity also raises water treatment costs, placing a financial strain on local governments. Farmers may struggle with reduced water quality for irrigation, affecting crop yields. These combined effects highlight the deep connection between environmental health and economic stability.

Material & Methods

For the experiment, 4g of wood ash were mixed into 500mL of room-temperature tap

water in a glass beaker. The ash-water mixture settles quickly, so it was kept agitated with a stirrer bar to ensure consistency; however, manual stirring before each measurement is also sufficient.



For water quality measurements, approximately 50mL of the ash-water mixture were decanted into

the calibrated GaiaXus Water Guardian. Readings were taken in “continuous” mode over several minutes, with all data automatically recorded in the GaiaXus App.

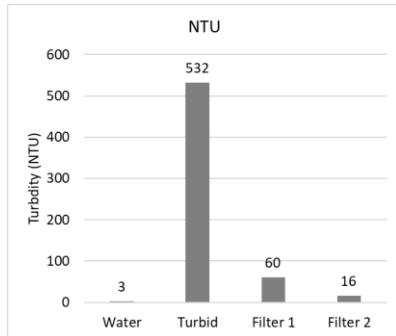
To demonstrate filtration effectiveness, 100mL of the ash-water mixture were slowly poured into a funnel lined with a standard coffee filter. After filtration, 50mL were measured using the GaiaXus Water Guardian as described above. The remaining 50mL underwent a second filtration through a cotton pad before final measurements were recorded.



Results

The Water Guardian reported 5 parameters of relevance to the experiment, turbidity (NTU), Conductivity (μS)/ Salinity (ppm), and color absorption in red and infrared.

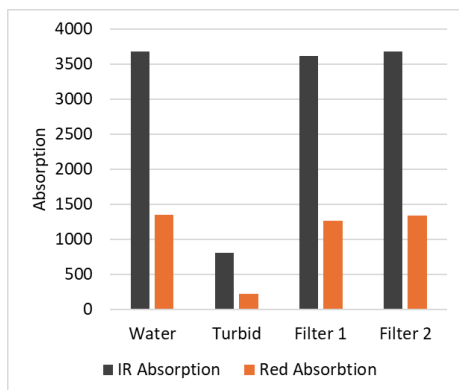
Turbidity



As expected, the particle load of the ash mixture dramatically increased the turbidity of the water, an effect that could be somewhat mitigated by two separate filtration steps. Note that the ash was “sieved” before to exclude large, floating debris.

Optical Clarity

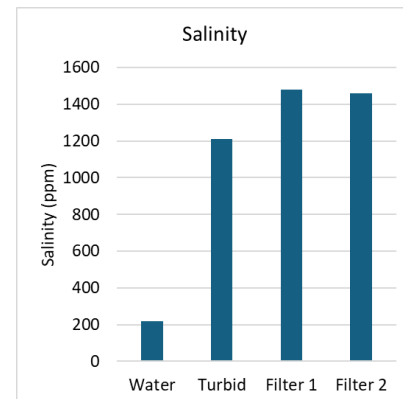
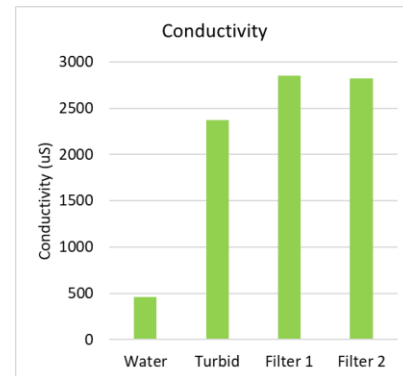
Optical clarity is discrete from turbidity, it describes the ability of water to transmit light irrespective of scattering light from particles (“turbidity”). The GaiaXus Water Guardian allows 2 color absorption, in the red (650nm) and IR channel (850nm). This is comparable to “Secchi Disk” readings.



Conductivity / Salinity

The system was calibrated with standard NaCl and both conductivity and salinity are reported.

Wood ash can dramatically increase both values, an effect that can not be filtered out in a classroom environment.



Discussion

Investigating the detrimental effects of forest fires on surface water adds a relevant dimension to environmental science and STEM classes. Mixing tap water with ash introduces visible particles that can be filtered, offering a hands-on demonstration of how physical pollutants affect water quality. More importantly, the invisible increase in salinity highlights chemical changes that impact aquatic ecosystems. This opens discussions on the salt tolerance of organisms



like macroinvertebrates and links to broader environmental issues, such as the effects of road salt on freshwater habitats.

This experiment offers a safe, tangible method for students to explore the environmental consequences of forest fires. It is easily adaptable; students can test different filtration methods, compare various wood ash types, or add materials like sand or clay to simulate erosion. Further, they can expand the investigation by measuring other water quality parameters, such as pH levels and nutrient pollution. This flexibility fosters critical thinking, encourages scientific inquiry, and deepens understanding of environmental science concepts within real-world contexts.

Safety

1. Observe good laboratory practice, wear PPE where appropriate
2. Wood ash can contain contaminants from burned plastic or other sources. Be mindful about where to source the wood ash from.
3. Dispose all materials in observance with local regulations

Further Reading

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About GaiaXus

GaiaXus LLC is a Maryland-based company developing tools for environmental STEM education and citizen science.

To contact the company, visit gaiaxus.com or email info@gaiaxus.com

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