MONITORING

Monitoring streams' ecosystem health using biological indicators has proven to be an effective approach to measuring anthropogenic stressors and environmental changes. Fish, macroinvertebrates, algae and salamander communities often exhibit different responses to stressors. If researchers detect certain algae and bacteria tolerant to pollutants, one can conclude that pollution is likely present. Other organisms, like mayflies and many fish species, are intolerant of pollution. Their presence suggests a strong and healthy waterway, while their absence suggests an environmental imbalance. Many amphibians are very sensitive to environmental changes, and thus, are also examined to judge the health of ecosystems.

Biological samples give more information on habitat suitability over the long-term than one-time chemical samples. In addition to biological samples, waterways are being monitored and assessed by measuring stream geomorphology and water chemistry.

METHODS

Fish Sampling - Water quality and environmental conditions directly impact the health, tissue quality, abundance, and diversity of fish populations. For that reason, fish surveys are an accurate indicator of environmental conditions.

Electrofishing specifications are as follows: Depletion electrofishing at a 100 m reach (minimum of 2 passes, repeated until 50% or less of each given species is collected relative to the previous pass; reach lengths other than 100 m may be used for compatibility with historical data).

Salamander Sampling - Amphibians are sensitive biological indicators of environmental change. As tadpoles, salamanders breathe through their gills. The majority of salamanders develop lungs as adults. Once matured, these amphibians breathe through their skin and always remain close to water to keep themselves moist. Salamanders are extremely sensitive to toxins, pollutants in the water, soil, and atmosphere, and subtle environmental changes due to their porous and absorbent skin. When looking at the abundance,

condition, and diversity of the salamander population, researchers can draw conclusions about the water and environmental quality.

- Available cover (i.e., cobble or small rock) was turned by hand both in the stream and within 1 m of the stream. By use of aquarium dip nets, the salamanders were captured and identified to species.
- Two, twenty minute timed samples were taken within a 20 m reach of stream by a crew of 2.
- Location of the sampling area was upstream or downstream of the fish reach at the point furthest away from human traffic.

Macroinvertebrate Sampling - Macroinvertebrates are larger than microscopic invertebrate animals that inhabit stream bottoms; freshwater forms are primarily aquatic insects, worms, clams, snails, and crustaceans that function as accurate and reliable indicators of water quality. Macroinvertebrates show researchers many things about the past water conditions due to their relatively stationary lifestyles. Macroinvertebrate sampling is being done through collaboration with Stroud Water Research Center.

Macroinvertebrates are important to examine for several reasons: 1) they are sensitive to environmental impacts, 2) they are less mobile than fish, and thus cannot avoid discharges, 3) they can indicate effects of spills, intermittent discharges, and lapses in treatment, 4) they are indicators of overall, integrated water quality, including synergistic effects of and substances lower than detectable limits, 5) they are abundant in most streams and are relatively easy and inexpensive to sample, 6) they are able to detect non-chemical impacts to the habitat, such as siltation or thermal changes, 7) they are readily perceived by the public as tangible indicators of water quality, 8) they can often provide an on-site estimate of water quality, 9) they bioaccumulate many contaminants, so that analysis of their tissues is a good monitor of toxic substances in the aquatic food chain, and 10) they provide a suitable endpoint to water quality objectives.

- A Surber sampler was used at all of the sample sites to develop a quantitative view of the macroinvertebrate communities.
- Sixteen random samples were collected at each site.
- Identification to lowest possible taxonomic level, usually species.

Algae Sampling - Diatoms and soft algae are two groups of algae that are good indicators of water quality. Certain types of algae are sensitive and only grow in healthy regions. Other algae have high tolerance to pollution and are found in poorer conditions. Researchers collect and identify different species of algae allowing them to extrapolate more information regarding the region's condition.

- Algae is being collected and scoured using nylon brushes over a plastic dishpan and transferred to the sample bottle with site water.
- Epilithic algae habitats, or algae that lives on the surface of rocks, are being sampled using the SWAMP multihabitat method (Fetscher et al., 2009; Appendix III).
- The amount of scraped rock surface was quantified

Water Column Sampling - Water samples are analyzed and compared to historic data. Each sample is examined for level of dissolved oxygen, pH, conductivity, and temperature once brought back to the lab.

Water column samples were collected using a dip method in the center of the water column at the downstream portion of the study reach before any field crew members have entered the stream.

EQUIPMENT

In addition to sampling, researchers use environmental equipment to assess conditions of a site. The following are several tools that are used in the field to calculate discharge of a stream, gradient, GPS locations, and track the temperature of the water for several months at a time.

SonTek RiverSurveyor- The RiverSurveyor is a highly accurate Acoustic Doppler Profiler (ADP) system specifically designed to measure river discharge, 3-Dimensional water currents, depths, and bathymetry. RiverSurveyor is guided across the wetted width of a stream in a small boat while it sends out acoustic sonar signals that maps the bottom of the streambed while calculating velocity and discharge.

Laserplane- The Laserplane measures gradient of the stream at a given site. The equipment has two functioning parts: the range finder and the laser level. After leveling the range finder on a tripod, it measures the gradient of the stream. The laser level is placed at a point within the stream and emits a magnetic field at a level plane in all directions. The laser finder attaches to a meter stick, and its height is adjusted until it indicates that it has "found" the magnetic field. The vertical distance between the surface of the water and the magnetic field is taken. Without moving the laser level, this measurement is taken downstream and upstream of the magnetic field. The difference between the two measurements tells you the gradient of the stream between the two points.

TidBit v2 Temperature Logger- The temperature logger is a small (3x4 cm) cylindrical device that is submerged into the stream to collect temperature data every fifteen minutes for several months. The temperature logger is attached to a bracket that is adhered to a small boulder. The field crew takes GPS coordinates, photographs and measurements of where the small boulder and logger have been submerged, so it can be retrieved at a later point for data analysis.

Leica RTK- Real-time kinematic (RTK) is an effective tool for applications that require high precision (centimeter level) coordinate accuracy. Leica RTK communicates with 6 to 8 international satellites that pinpoint the location of the object observed.

SonTek Flowtracker- In conditions unsuitable for the RiverSurveyor, the Flowtracker is used to calculate discharge. The Flowtracker uses Acoustic Doppler technology to calculate velocity and discharge at a given site. Calculations must be made at consistent and precise intervals across the wetted width to fully calculate the discharge. This process requires more time to generate appropriate data.