Monitoring Monday – Let's look at Temperature

Join us each Monday as the Clean Water Team shares resources on water quality topic. This week we take a look at temperature.

Temperature is a measure of the average kinetic energy of water molecules. It is measured on a linear scale of degrees Celsius or degrees Fahrenheit.

Temperature is one of the most important water quality parameters. Temperature affects water
chemistry and the functions of aquatic organisms. It influences the:

- amount of oxygen that can be dissolved in water,
- rate of photosynthesis by algae and other aquatic plants,
- metabolic rates of organisms,
- sensitivity of organisms to toxic wastes, parasites and diseases, and
- timing of reproduction, migration, and aestivation of aquatic organisms.

Species	Growth	Maxima	Spawning**	Embryo Survival**
Bluegill	32 C (90 F)	35 C (95 F)	25 C (77 F)	34 C (93 F)
Carp		21 C (70 F)	33 C (91 F)	
Channel catfish	32 C (90 F)	35 C (95 F)	27 C (81 F)	29 C (84 F)
Largemouth bass	32 C (90 F)	34 C (93 F)	21 C (70 F)	27 C (81 F)
Rainbow trout	19 C (66 F)	24 C (75 F)	9 C (48 F)	13 C (55 F)
Sockeye salmon	18 C (64 F)	22 C (72 F)	10 C (50 F)	13 C (55 F)

* The optimum or mean of the range of spawning temperatures reported for the species.
** The upper temperature for successful incubation and hatching reported for the species.

Maximum weekly average temperature for growth and short-term
maximum temperatures for selected fish (degree C or F).
Adapted from EPA's Volunteer Stream Monitoring: A Methods Manual.

Water temperature can be influenced by many natural factors. One of the most obvious is solar energy, which can be influenced by seasonal and daily changes, shade (cover), and air temperature. The water's color and turbidity can also influence temperature, for example, suspended sediment absorbs heat. Inflow of groundwater which is usually colder than stream will cool a streams' temperature . Inflow of surface water into stream which is at a different temperature than the stream (Example: A drainage ditch or another stream) can raise or lower the streams temperature.

Anthropogenic influences that affect water temperature include the removal of riparian vegetation enabling direct sunlight, alterations to stream morphology (e.g., pool depth), water

diversions decreasing flow, accelerated soil erosion which increase in turbidity and heat absorption, increased storm water runoff, and cooling water discharges from power plants.

The effects of climate change on water resources related to temperature include lower levels of dissolved oxygen due to the inverse relationship that exists between dissolved oxygen and temperature. As the temperature of the water increases, dissolved oxygen levels decrease. It is also predicted that we will observe increases in pathogens, nutrients and invasive species. The concentrations of some pollutants such as ammonia and pentachlorophenol due to their chemical response to warmer temperatures will also rise. Already being observed is the increased rates of evapotranspiration from waterbodies, resulting in shrinking of some waterbodies. Rising temperatures will also stress aquatic species and lead to the loss of populations whose survival and breeding are temperature dependent.

The water quality objectives for freshwater ecosystems protect coldwater ("COLD") or warm water ("WARM") fishes. In general, the water quality objective does not allow temperature of any water supporting these fishes to be increased by more than 5 F above natural receiving water temperature. However, the water quality objectives vary from region to region in California. Therefore, you should check with the Regional Water Quality Control Board in your area. Water quality objectives are included in their Basin Plan. For bays, estuaries, and ocean waters, elevated waste discharges cannot cause surface water temperatures to rise greater than 4 F above the natural temperature.

Temperature is measured in the stream with a thermometer or a meter. Alcohol-filled thermometers are preferred over mercury-filled because they are less hazardous if broken. Armored thermometers for field use can withstand more abuse than unprotected glass thermometers and are worth the additional expense. Meters for other tests, such as pH (acidity) or dissolved oxygen, also measure temperature and can be used instead of a thermometer.

RESOURCES:

Guidance Compendium for Watershed Monitoring and Assessment (Clean Water Team)
3.1.2 Temperature Measurements Principles and Methods (Information Paper)
3.1.2.0 Temperature Fact Sheet [English] | [Español]
3.1.2.1 Measurements of Temperature with Bulb and -Min-Max Thermometers (SOP)
3.1.2.2 Measuring Temperature with a Thermister Thermometer (SOP)
Stream Temperature Monitoring and Modeling in the Pacific Northwest (NOAA)
Sea Temperature Increase in the Pacific Northwest (USFWS)
Temperature and Water (USGS)
Water: Monitoring & Assessment – Temperature (USEPA)
Water Temperature Table of All Coastal Regions (NOAA)

VIDEOS:

- How Do We Tell Temperature?
- Fahrenheit to Celsius: History of the thermometer
- How to Read a Thermometer
- Temperature Sensors Explained
- Measuring ocean temperatures
- Climate Change: The Water Paradigm
- Impacts to Freshwater Aquatic Systems | Managing for a Changing Climate

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