Black Earth Creek & Limnology Minifacts & Analysis

Sheet 8

Temperature Levels

Information on Temperature Levels & Water

1. Some Basic Facts

A. Water, (H_2O) freezes at 0° C and boils at 100° C.
B. Cold water is heavier than warm water and sinks to the bottom of lakes. However if water gets so cold that it turns to ice, it will float.

2. Temperature and Aquatic organisms

A. Most aquatic organisms are 'cold blooded'; their body temperature changes with the temperature of the environment.

1. Warm temperatures will speed up the metabolism (life functions) of aquatic organisms.
2. Colder temperatures will slow down their metabolism.

3. What Happens as Water Temperature is Increased?

A. The amount of O_2 (oxygen) required for life is increased. This is called increasing the BOD (*biological oxygen demand*).
B. The amount of dissolved O_2 that the water can hold is decreased.
C. A sudden change of 5° C (or more) will instantly kill most fish.
D. Any pollutants in the water become more poisonous.
E. Algae 'blooms' (algae population explosions) occur.
F. The rate of rot and decay (decomposition) increases; this requires even more O_2.
G. Desirable species of plants die – blue-green algae (scum) multiply.

4. What Factors Affect Water Temperature?

A. Cold incoming spring water will cool lakes and streams.
B. Weather conditions (air temperature, sun, and wind) will change water temperature.
C. Man usually warms water by changing stream banks and by pollution discharge (thermal pollution).
D. The greater the amount of water, the slower it is to change in temperature.

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5. Some Terms to Remember

Preferred Temperature - temperature range at which an organism likes to live.
Breeding Temperature - temperature at which organisms reproduce. Fish eggs require colder temperature than what most adults prefer.
Lethal Temperature- temperature at which the organism dies. When this occurs we say that the temperature is a limiting factor for that species.

Temperature Conditions for Aquatic Organisms
Temp. °C

Organism	Breeding T	Preferred T	Lethal T
Desirable plants Undesirable plants		4 to 25 25 to 30	
Lake Trout Brook Trout	8 10	10 15	26 26
Game fish Northern, Walleye, Bass, Musky		18 to 25	32
Pan fish		19 to 27	32
Rough fish Bullheads & Catfish Carp & other RF Minnows		 19 to 29 30	 32 32 29 to 37
Macroinvertebrate Bottom organisms Stonefly, Mayfly, Water Beetles, Water Strider		 4 to 27 10 to 20 10 to 20 10 to 20	 32 29 29 29

6. Special Facts

A. As you increase the temperature you decrease the quality of the aquatic environment.
B. Above 26° C, *it is impossible for any species of fish* (naturally found in Wisconsin) *to reproduce.*

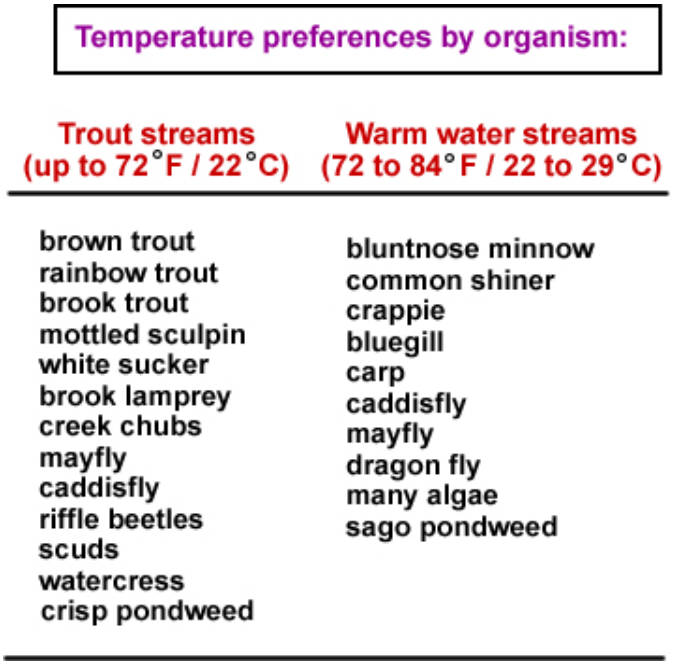

Figure 4

Preferred temperature ranges for common Dane County stream organisms

7. Measuring temperature

It is easy to measure the temperature of a stream site. Any water-resistant household thermometer will register stream temperature in about two minutes. An unbreakable thermometer is best. In deeper streams, you may want to measure the temperature near the surface and close to the bottom to discover any variation.

The stream's temperature variations are more informative: sun to shade, day to night, week to week, maximum to minimum, or upstream to downstream.

For example, when water reaches a certain temperature fish will die. However, it has to stay at that temperature for a while. So, brown trout, which are expected to die at temperatures above 78º F (26º C), may survive if the temperature goes up slowly enough and goes down again fairly soon.

Researchers have set temperature limits for fish by experimenting with them in a laboratory. The standard is a 12-hour median tolerance limit (TLm). This is the temperature at which half the fish will die if held there for 12 hours.

Compare sun and shade - Check and record the temperature of your stream in a shady spot and in a sunny one. Are they different? By how much? If they are not different, consider which factors may be affecting the temperatures. For example, was the shady spot only a small area downstream of a long sunny stretch? Water warms and cools slowly, so there may not have been enough shade to cool the stream where you measured it.

Measure upstream and downstream - Measure the temperature at two points on your stream about a mile apart. Compare the two. Observe the area around your recording site. Try to explain why they are the same or different. (How much shade is there? Are the widths and depths different?)

If natural factors do not seem to explain a difference of several degrees, check the stream banks for possible sources of thermal pollution.

Check temperatures over time - Set a max-min thermometer in your stream. Check it every day for a week or every week for a month and write down the maximum and minimum temperatures it recorded at your measuring station. Using the Fish TLm chart, predict what types of fish could be living in your stream. Remember to consider the season. If you are measuring temperature in April or October, you won't get the year's highest temperatures.

Additional activities Factors which affect temperature - Experiment with some of the factors which affect temperature. Fill several identical containers with water. Set them in a sunny spot outside, in a sunny window, or under a heat lamp. Vary their conditions like this:

1. **Clear**

2. **Turbid**—Collect turbid water from a stream or lake.

3. **Shaded**—Use a cardboard box or large book to shade it.

4. **Light bottom**—Put 2-3 inches of sand in the bottom.

5. **Dark bottom**—Put dark colored rocks in the bottom.

6. **Volume**—Find a container that is at least twice the size of the others and fill it with water.

Effect of air temperature and drought on creeks - A trout stream in Vernon County, WI.

In the 1980s Robert L. Hunt, Wisconsin Department of Natural Resources fisheries research biologist was studying trout in Timber Coulee Creek. His study included 1988, one of the hottest, driest years on record. This is a slightly edited version of his comments on how temperature affected the trout. (The Treatment Zone and Reference Zone were two adjacent one-mile sections of the stream. The treatment related to changing fishing restrictions.)

Yearling and older brown trout in the Treatment Zone declined in number by 40% from April to October 1988. In the Reference Zone there was a 44% decrease.

These declines . . . were probably related primarily to environmental stress. A deleterious combination of severe drought, the most severe in Wisconsin since 1936 (U.S. Geol. Survey 1989), and abnormally high air temperatures persisted throughout the spring and summer of 1988.

A minimum-maximum temperature recorder was monitored weekly from July through September. Maximum water temperatures of 82º F in mid July and 79º F in mid-August were recorded, temperatures well above the preferred range for brown trout and several degrees higher than the 73º F maximum observed in 1984.