

Vital Signs: The Five Basic Water Quality Parameters

The five following parameters are basic to life within aquatic systems. Impairments of these can be observed as impacts to the flora and or fauna with a given waterbody.

Dissolved Oxygen

It is the amount of oxygen dissolved in water.

Most aquatic organisms need oxygen to survive and grow.

- Some species require high DO such as trout and stoneflies.
- Other species do not require high DO, like catfish, worms and dragonflies.

If there is not enough oxygen in the water the following may happen:

- Death of adults and juveniles,
- Reduction in growth,
- Failure of eggs/larvae to survive,
- Change of species present in a given waterbody.

Temperature

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

It 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.

Electrical Conductivity/Salinity

Solids can be found in nature in a dissolved form. Salts that dissolve in water break into positively and negatively charged ions. Conductivity is the ability of water to conduct an electrical current, and the dissolved ions are the conductors. The major positively charged ions are sodium, (Na^+) calcium (Ca^{+2}), potassium (K^+) and magnesium (Mg^{+2}). The major negatively charged ions are chloride (Cl^-), sulfate (SO_4^{-2}), carbonate (CO_3^{-2}), and bicarbonate (HCO_3^-). Nitrates (NO_3^{-2}) and phosphates (PO_4^{-3}) are minor contributors to conductivity, although they are very important biologically.

Salinity is a measure of the amount of salts in the water. Because dissolved ions increase salinity as well as conductivity, the two measures are related. The salts in sea water are primarily sodium chloride (NaCl). However, other saline waters, such as Mono Lake, owe their high salinity to a combination of dissolved ions including sodium, chloride, carbonate and sulfate.

Salts and other substances affect the quality of water used for irrigation or drinking. They also have a critical influence on aquatic biota, and every kind of organism has a typical salinity range that it can tolerate. Moreover, the ionic composition of the water can be critical. For example, cladocerans (water fleas) are far more sensitive to potassium chloride than sodium chloride at the same concentration.

Conductivity will vary with water source: ground water, water drained from agricultural fields, municipal waste water, rainfall. Therefore, conductivity can indicate groundwater seepage or a sewage leak.

pH

pH is a measure of how acidic or basic (alkaline) the water is (the term pH comes from the French: "puissance d'Hydrogène" which means strength of the hydrogen). It is defined as the negative log of the hydrogen ion concentration.

The pH scale is logarithmic and goes from 0 to 14. For each whole number increase (i.e. 1 to 2) the hydrogen ion concentration decreases ten fold and the water becomes less acidic.

As the pH decreases, water becomes more acidic. As water becomes more basic, the pH increases

- Many chemical reactions inside aquatic organisms (cellular metabolism) that are necessary for survival and growth of organisms require a narrow pH range.
- At the extreme ends of the pH scale, (2 or 13) physical damage to gills, exoskeleton, fins, occurs.
- Changes in pH may alter the concentrations of other substances in water to a more toxic form. Examples: a decrease in pH (below 6) may increase the amount of mercury soluble in water. An increase in pH (above 8.5) enhances the conversion of nontoxic ammonia (ammonium ion) to a toxic form of ammonia (un-ionized ammonia).

Turbidity

Turbidity is a measure of the amount of suspended particles in the water. Algae, suspended sediment, and organic matter particles can cloud the water making it more turbid

Suspended particles diffuse sunlight and absorb heat. This can increase temperature and reduce light available for algal photosynthesis. If the turbidity is caused by suspended sediment, it can be an indicator of erosion, either natural or man-made. Suspended sediments can clog the gills of fish. Once the sediment settles, it can foul gravel beds and smother fish eggs and benthic insects. The sediment can also carry pathogens, pollutants and nutrients.