

Thermal Stratification

"In the lake" - Physical/Chemical Events

As a lake warms in spring, it absorbs heat from the "top down". Lakes are very efficient solar collectors. Wind energy mixes the water (also from the top down). Warm water is less dense, "lighter", than cold water. Furthermore, the density difference per degree Centigrade becomes larger as waters become warmer. As surface water collects heat in the spring it tends to float on colder, deeper water. Eventually, the density differences caused by temperature difference overcome the ability of wind to keep the lake mixed. Hence, thermal stratification develops and the bottom water stagnates (becomes isolated from the atmosphere and oxygen exchange). This "stratification-stagnation" has profound effects on water quality, habitat, and nutrient cycling in the lake.

TEMP = the observed temperature (in degrees C).

DO = the observed dissolved oxygen content in milligrams per liter (mg/L) which is equivalent to parts per million (ppm). Generally, fish require more than about 3-4 mg/liter DO (temperature dependent) while most of the small animals that eat algae (zooplankton) require more than 1 mg/liter.

% SAT= The oxygen concentration at the observed temperature compared with the concentration expected at that temperature if the water were at equilibrium with atmospheric oxygen content. When % SAT exceeds 100, photosynthesis is producing excess oxygen. When less than 100%, respiration is consuming more oxygen than is being replenished (just as we consume oxygen and exhale carbon dioxide).

RTRM = "relative thermal resistance to mixing". The density of water varies as a function of water temperature: maximum density occurs at 4 degrees Centigrade. RTRM is an index that quantifies the intensity of density differences due to the temperatures of adjacent water strata. The higher the RTRM, the greater the density difference, hence the more difficult it is for wind mixing to occur. Generally, RTRM 30 identifies the boundary conditions of the mid-depth "metalimnion" while RTRM maximum identifies the location (depth) and intensity of the thermocline. In general, a "strongly stratified lake" will exhibit an RTRM max > 80 (when a 1 meter depth increment is used).

RVG = "relative viscosity gradient". The viscosity of water also changes as a function of water temperature. RVG is an index that quantifies the intensity of viscosity gradients due to temperature differences between adjacent water strata.

SECCHI DEPTH = depth to which a 20 cm (8 inch) diameter white disk can be seen by the human eye. This measurement is a very simple informative parameter. Typically, aquatic macrophytes ("rooted weeds") will be limited to the depth of Secchi transparency, and the "compensation depth" (depth at which photosynthetic oxygen production offsets respiratory oxygen consumption) typically equals about 1.7-1.9

times the Secchi depth (approximately the 1% level of incident "photosynthetically active radiation" or "PAR"). Although these features relative to Secchi disk depth do vary somewhat between lakes, it is a very informative parameter.

ANOXIC BOUNDARY = for convenience, the depth at which oxygen concentration drops below 1 mg/liter is interpolated by the computer program, and is listed on the printout.

PAR = "Photosynthetically Active Radiation" PAR is measured using a Lycor light sensor. Incident light at the lake surface is measured, as well as the attenuation of incident light down through the water column. PAR is used to identify the approximate depth of one percent light penetration (estimates compensation depth).

Transmissivity = the percentage of a beam of light in the photosynthetic wavelength range that is transmitted through 20 cm of water. The greater the percent transmissivity, the lower the turbidity of water, and greater the clarity.

ORP – (Oxidation-Reduction Potential): This is a measure of how reducing an environment is. When aerobic, the ORP will be highly positive. When water is devoid of dissolved oxygen, ORP measures how "intense" anaerobic conditions are.

Conductivity, Specific Conductivity (Sp Cond) – measures how easily an electric current is conducted by water. The higher the conductivity, the greater the concentration of dissolved substances (ions, salts, etc.).