

MONITORING THE ANATOMY OF STRATIFICATION – DIAGNOSTIC AND MANAGEMENT IMPLICATIONS

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ABSTRACT

Summer thermal stratification in lakes and reservoirs has a profound effect on the structure and function of physical, chemical, and biological ecosystem characteristics. The vertical distribution of heat (temperature) and dissolved oxygen during stratification dictates what flora and fauna is able to inhabit the ecosystem; cold water fisheries, zooplankton refuge, phytoplanktonic layers, etc. The intensity of density gradients regulates vertical fluxes of oxygen (downward) and bottom-generated constituents (upward). The relative position of the thermocline (steepest density gradient) and compensation depth (approximate penetration depth of 1% incident light) determines whether a lake ecosystem is “light controlled” or “diffusion controlled”. That, in turn, often determines whether blooms of N-fixing Cyanobacteria will occur; causing poor water clarity, taste and odor episodes, and habitat loss.

Stratification is usually monitored by measuring temperature and dissolved oxygen at depth increments from the surface to the bottom. Unfortunately, those data are very rarely examined in terms of density gradient. Stratification cannot be adequately quantified by examining only a temperature profile because the change in density of water as a function of temperature is not linear. Density change per degree becomes very large at warmer temperatures. However, in warm lakes it takes small decreases in surface temperature to destabilize stratification; resulting in either a monomictic or polymictic ecosystem. Relative Thermal Resistance to Mixing (RTRM) is a simple computation index that accounts for the non-linear density change as a function of temperature. It is cumulative; total RTRM of the water column indicates stratification stability. This presentation examines the anatomy of stratification, provides specific diagnostic methods for using collected data, and describes a number of case studies where such a quantitative examination resulted in successful innovative management methods, including:

- Interflow of water from a high quality oligotrophic storage reservoir, through a eutrophic reservoir without mixing, to a water supply intake.
- Diagnostic results from monomictic lakes and tropical reservoirs revealing that stratification often intensifies as latitude decreases, and stratification instability in very warm tropical waterbodies.
- Management of *how* stratification develops, creation of multiple thermoclines with a high quality cool water layers between (Layer Aeration) to restore cold water fishery and zooplankton refuge habitat and improve raw supply water quality.

KEYWORDS

Stratification, thermocline, RTRM, hypolimnion, compensation depth, lake ecosystem