Abstract View

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Combined Influence of Inflow and Lake Temperatures on Spring Circulation in a Riverine Lake

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ABSTRACT

Kamloops Lake is a long (25 km), deep (maximum depth, 145 m) intermontane lake in central British Columbia fed at its eastern end by the Thompson River (mean annual flow, 720 m^2 s^{-1}). Here I describe spring overturn and the onset of stratification on the basis of three conceptual models distinguishing among river-induced, surface-induced and edge-induced circulations. The lake during winter is characterized by weak reverse stratification; the incoming river waters are less dense than ambient lake water and thus tend to remain at the lake surface. During spring,, the shallow river water warms more rapidly than the deep water of the lake; as inflow water warms toward the temperature of maximum density (4°C), it becomes denser than lake water and thus tends to sink on entry into the lake. Further warning of the inflow water above 4°C decreases its density causing it to again enter the lake as a surface overflow. Although the inflow itself is less dense than lake water, some mixtures of the two will necessarily have temperatures near 4°C, and thus be denser than either parent water mass; this process is called cabbeling (cf. Foster, 1972). The dense mixtures then sink along a narrow frontal zone, filling the lake basin with 4°C water from the bottom upward, while new (unmixed) inflow water is held as an arrested wedge near the point of entry. When the whole lake is warmed above 4°C, the cabbeling instability disappears and the wedge of warm water is released to spread down the lake. Transport of warm water across the lake subsequently forms the spring thermocline. Budget considerations show that although surface heating of the open lake contributes the major portion of the spring heat income, the riverine flow dominates lakewide circulation patterns, and thus determines the distribution of material properties during and subsequent to spring overturn.

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