"Sonar" for Sediment: Evaluation of Sediment Surrogate Technologies in Idaho Rivers

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Elevated levels of fluvial sediment can reduce the biological productivity of aquatic systems, impair freshwater quality, and decrease reservoir storage capacity. The need to safely and cost-effectively measure fluvial sediment has led to the development of sediment surrogate technologies, particularly in locations where streamflow alone is not a good estimator of sediment transport because of regulated flow and varying sediment sources. An effective surrogate technology is low-maintenance over a range of hydrologic conditions, and measured parameters can be modeled to estimate sediment concentration and duration of elevated levels on a real-time basis. Among the most promising techniques is the measurement of acoustic backscatter strength (similar to sonar) using acoustic Doppler velocity meters (ADVMs) deployed in rivers.

The U.S. Geological Survey's Idaho Water Science Center has evaluated the use of acoustic backscatter as a surrogate for suspended sediment concentrations (SSC) in four Idaho rivers: the Boise, Clearwater, Kootenai, and Snake Rivers. The strength of acoustic backscatter theoretically increases as more particles are suspended in the water to reflect the acoustic pulse emitted by the ADVM. ADVMs of different frequencies (500 kHz to 3000 kHz) were tested to target various sediment grain sizes. Laser diffraction and turbidity also were evaluated as surrogate technologies at some sites. Results of the analysis show that acoustic backscatter can effectively be used to estimate SSC if the selected ADVM frequencies are appropriate for observed grain sizes and the amount of organic matter transported in the river is low or constant.