Identifying Natural and Anthropogenic Sources of Phosphorus to Stream Networks and Critical Aquatic Habitats using SPARROW Modeling

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Phosphorus is necessary for biological processes but excess amounts can result in algal blooms and water quality degradation. On regional scales, stream monitoring is usually not adequate to understand sources and transport. To address this, the U.S. Geological Survey developed the SPARROW (Spatially Referenced Regressions On Watershed Attributes) model, which allows for the simulation of phosphorous or nitrogen transport at both monitored and un-monitored catchments. The model was used to understand factors affecting phosphorus transport in California and a portion of Oregon, USA, which contain a complex mixture of lithologies, land uses, and climate. Model calibration is accomplished by testing potential sources such as fertilizer, point sources, land use types, and lithology. Lithological sources, point sources, and cultivated land were determined to be significant phosphorus sources to streams. Precipitation and soil clay content were significant transport variables. Streams of all sizes had significance for phosphorus loss by various processes. Rock types resulting in elevated levels of phosphorus loading from natural sources included volcanics, glacial deposits, and Mesozoic to Cenozoic marine deposits. Some marine formations, such as the Monterey in southern California, which contains sequences of phosphatic shales, are responsible for elevated concentrations and yields of phosphorus. In contrast, mixed metamorphic and igneous assemblages such as argillites, peridotite, and shales in northern California result in some of the lowest phosphorus stream yields.