Geophysical Research Abstracts
Vol. 15, EGU2013-6515, 2013
EGU General Assembly 2013

Relating river geomorphology to the abundance of periphyton in New Zealand rivers

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Aquatic plants (including both periphyton and macrophytes) are a natural component of stream and river systems. However, abundant growth of instream plants can have detrimental impacts on the values of rivers. For example, periphyton in rivers provides basal resources for food webs and provides an important ecological service by removing dissolved nutrients and contaminants from the water column. However, high abundance of periphyton can have negative effects on habitat quality, water chemistry and biodiversity, and can reduce recreation and aesthetic values. The abundance of periphyton in rivers is influenced by a number of factors, but two key factors can be directly influenced by human activities: flow regimes and nutrient concentrations. Establishing quantitative relationships between periphyton abundance and these factors has proven to be difficult but remains an urgent priority due to the need to manage the ecological impacts of water abstraction and eutrophication of rivers worldwide. This need is particularly strong in New Zealand, where there is increasing demand for water for industry, power generation and agriculture. However, we currently have limited ability to predict the effects of changes in the mid-range flow regime on the presence/absence, abundance and composition of aquatic plants. Current water allocation limits are based on simple flow statistics, such as multiples of the median flow, but these are regional averages and can be quite unreliable on a site-specific basis. This stems largely from our limited ability to transform flow data into ecologically meaningful physical processes that directly affect plants (e.g., drag, abrasion, bed movement). The research we will present examines whether geomorphic variables, such as frequency of bed movement, are useful co-predictors in periphyton abundance-flow relationships. We collected topographic survey data and bed sediment data for 20 study reaches in the Manawatu-Wanganui region of New Zealand which have at least 3 years of flow, nutrient concentration and periphyton biomass data (laboratory measures of chlorophyll a and metrics derived from visual assessments). For each reach we set up a 1-d hydraulic model and established relationships between discharge and a number of hydraulic and geomorphic variables, including the discharge required to mobilise the bed sediment. These were then related to the flow and periphyton monitoring records to examine the strength of relationships.