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The influence of salmon and wetland-derived nutrients on watershed productivity in the Tongass National Forest

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Abstract Text:

Stream productivity in northern forested watersheds is enhanced by inputs of organic and inorganic nutrients from the carcasses of spawning salmon returning to their natal streams. In addition, runoff from abundant wetlands provides substantial inputs of organic carbon, nitrogen and phosphorus to these rainforest streams. Understanding the role of salmon and wetland nutrient subsidies in stream biogeochemical budgets is an important management goal for the Tongass National Forest. Currently, there is little quantitative information about spatial and temporal changes in the magnitude of nutrient inputs from salmon and wetlands. This study quantified inputs of salmon and wetland-derived nutrients to streams in the Tongass National Forest with the goal of guiding the forest management strategies established in the Tongass Forest Plan. Currently, we are evaluating the relative importance of wetland and salmon nutrients in the annual nutrient budget of our study streams. Our initial results suggest that spawning salmon provide more than 50% of the streamwater inorganic nitrogen and more than 80% of the streamwater inorganic phosphorus during the summer. Organic nutrients derived from wetlands comprise the bulk of the streamwater organic nutrient budget on an annual basis. Microbial incubations using dissolved organic nutrients leached from wetland soils further suggest that dissolved organic matter (DOM) from wetlands is an important source of carbon and energy for heterotropic microbes in aquatic ecosystems. We are also using fluorescence spectroscopy to characterize and fingerprint DOM derived from different watershed sources. To date, we can differentiate DOM derived from spawning salmon, algal leachate, and different wetland soil types (forested wetlands, bogs, and fens). The ability to fingerprint DOM sources will aid in understanding changes in the relative contribution of these different nutrient sources to watershed productivity. The results of this study are providing novel information about the biogeochemical basis of watershed productivity in coastal temperate rainforest systems and will be useful for predicting the effects that changes in management practices or global climate will have on watershed health and productivity in coastal temperate rainforest streams.

Impact Statement:

National Forest managers are challenged to develop new approaches to effectiveness monitoring which demonstrate that management efforts are efficient and comply with mandated Forest Plans. Our research will provide novel and much needed tools to do watershed assessments at more integrated scales and will provide data on the biogeochemical basis of watershed production to better predict the impact of timber harvest and climate change. Fisheries managers will have a better understanding of how salmon-derived inputs interact with watershed inputs so as to more efficiently plan nutrient amendment programs to restore productive salmon fisheries.