Investigating Organic Carbon and Fine-grain Sediment Source Dynamics Along Fanno Creek, Oregon
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Abstract

Systematic mapping and measurement of sedimentation patterns, volumes, and rates, using a combination of Geographic Information Systems (GIS) and field techniques, are being used to determine the sources and sinks of organic carbon along Fanno Creek. From these methods, the spatial distribution and connectivity of erosion and deposition features (e.g., cutbanks and floodplains) is observed, and localized sediment transport volumes are being quantified. Field mapping, supplemented with remote sensing data, is being used to determine areas of erosion and deposition and whether those processes are related to mass-wasting or fluvial processes. Dendrogeomorphic analysis (i.e., relating tree core data to stream-bank root exposure) is being used to determine minimum rates of erosion at several sites throughout the basin. Erosion and deposition rates for specific storm events at seven focus sites in the basin are being estimated using repeat measurements of erosion pins and deposition plates.

Preliminary results indicate that 1) mass-wasting processes are more prevalent in the basin than fluvially driven processes for eroding and transporting sediment, 2) more dynamic erosion and deposition occurs at stream meander sites than straight-channel sites, 3) sediment sources and sinks are largely determined by local stream geology (e.g., hardpan clay substrate), local bank protection, and floodplain land use/cover, 4) individual storm events dictate the temporal distribution of erosion and deposition, 5) in-stream wood plays a vital role in retaining sediment, organic debris, and trash during the low flow season, and 6) riparian alteration and bioturbation by wildlife (e.g., beaver and nutria) have created areas susceptible to erosion and deposition by both fluvial and mass-wasting processes.

Fanno Creek Basin

Basin characteristics:
- Watershed Area: 684
- Stream Length (km): 27
- Mean Annual Precipitation (mm): 101
- Geologic Setting: volcanics (primarily basalt) of Columbia River and Boring basalts and Willamette Group terrestrial rocks
- Larger rivers: Fanno Creek, Summer Creek
- Major tributaries: Forest Creek, Vermount Creek, Woods Creek, Ash Creek, Summer Creek

Approach

Sediment sources and sinks were assessed with several techniques:
- Erosion Pin Measurements
- Repeat Cross Sections
- Deposition Plate Measurements
- Dendrogeomorphic Measurements
- Geomorphic Mapping

Features:
- Floodplain
- Bar
- Drainage Blockage
- Secondary bar
- Overbank
- Vegetation
- In-channel trees
- Trees on floodplain
- In-bank dams
- Storm drain erosion
- Bank reinforced
- Sediment sources and sinks

Mapping

Measurement of erosion and deposition:
- Deposition: 9-12.3 g/m²/year
- Maximum Erosion: 0.1-10.0 g/m²/year
- Erosion depths: 0-105 cm
- Maximum Erosion Rate: 0.2-58.3 cm/year
- Average Erosion Rate: 0.0-13.2 cm/year

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In 2010, the U.S. Geological Survey (USGS) began investigating the sources and sinks of organic carbon in the highly urbanized watershed of Fanno Creek, a tributary of the Tualatin River, Oregon. Organic matter, more specifically organic carbon, is abundant in Fanno Creek and has been tied to a variety of water-quality concerns, including large algal blooms and periods of low dissolved oxygen concentrations in the Tualatin River. Runoff from impervious surfaces produces flashy streamflow response, which often undercuts stream banks and leads to severe instability along parts of the channel. Since organic carbon is commonly found in the fine-grained, organic-rich bed and bank sediments throughout the watershed, developing a better understanding of sediment transport dynamics should greatly improve the effectiveness of restoration efforts.