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Managing Water Resources Development in a Changing Climate
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Monday, May 4
1:30 PM – 2:00 PM
Session 6: Water Quality I

1. Water Quality Effects of Fire Retardant Application in a Small Tundra Lake near Hughes Alaska - Ben Kennedy, Bureau of Land Management, Fairbanks, AK

In June of 2007 the Alaska Fire Service inadvertently dropped an estimated 1,000 gallons of the fire retardant in a small (3 acre) shallow tundra lake near Hughes Alaska. The fire retardant consisted of 80% water, 14% fertilizer type salts--ammonium polyphosphate, 6% coloring agent, corrosion inhibitors and flow conditioners. Assessment of aquatic impacts from the retardant application included collection of water chemistry samples from the lake that received fire retardant and from a second lake of similar size and depth approximately two miles south to use as background reference of natural water quality. For many Interior Alaska lakes, the most important nutrient factors causing a shift from a lesser to a more productive state are phosphorus and nitrogen. Preliminary analyses indicate a ratio of total nitrogen to total phosphorus (TN:TP) of greater than 30:1 for the reference lake, suggesting plant/algae growth in the tundra lakes is limited by phosphorus. Elevated total phosphorus concentrations of 0.47 to 0.13 mg/l, for the fire retardant lake persisted from June 2007 through March 2008. In May and August of 2008, total phosphorus concentration in the fire retardant lake was similar to recorded phosphorus concentrations of 0.025 to 0.050 mg/l in the lake with no fire retardant. Accelerated seasonal growth of rooted aquatic plants (macrophytes) in the retardant lake, compared to the natural lake, was evident during the summer of 2007 and 2008.

2. Mercury Distribution In Water and Biota in Diverse Southeast Alaskan Watersheds - Sonia Nagorski, University of Alaska Southeast, Juneau, AK (co-authors: Daniel Engstrom, John Hudson, Eran Hood, David Krabbenhoft, John DeWild, George Aiken)

There is scarce information on mercury in southeast Alaska, although lake sediment records indicate mercury accumulation is on the rise. Local sources of mercury are insignificant, but global sources upwind of Alaska are increasing their output of Hg-laced emissions, primarily from the burning of coal. Our project assesses the current scale of mercury contamination in selected southeast Alaskan watersheds (in water, sediments, and biota) and examines the landscape characteristics that largely explain its distribution. We measured mercury concentrations in freshwater fish, benthic macroinvertebrates (BMI), streambed sediments, and stream water in 17 southeast Alaskan watersheds. Our study watersheds are located within Glacier Bay, Klondike and Sitka NPs and cover a wide range of watershed size, age, and landscape cover. Our results show that the concentration of total mercury in water was highly correlated with the percent of the watershed covered by wetlands and the concentration of dissolved organic carbon (DOC), and particularly the hydrophobic fraction of DOC. Dissolved organic carbon is known to preferentially transport Hg out of wetland-rich environments and is plentiful in many southeast Alaskan streams due to the abundance of peatland environments. Methylmercury, the toxic form of mercury that is produced in reducing environments such as wetlands, was below detection in the water of all of the newer, recently glaciated streams, but was found to be present above detection (up to 20% of the total mercury) in several of the older streams draining landscapes with relatively developed wetlands. Patterns of methylmercury in fish and aquatic macroinvertebrate tissues showed preferential accumulation in biota from older, wetland-dominated watersheds over those in younger, glacially-influenced streams. These findings suggest that ongoing glacial recession may be increasing the sensitivity of watersheds within southeast Alaska to atmospheric mercury inputs.

3. Watershed Yields of Organic Mattera and Nutrients in Southeast Alaska as a Function of Glacial Coverage - Durelle Scott, Virginia Tech, Blacksburg, VA (co-authors: Eran Hood, Jason Fellman, Rob Spencer, Rick Edwards, Dave D'Amore)

The delivery of fresh water, carbon, and nitrogen and phosphorous from high-latitude regional watersheds is important to the ecology and nutrient balance of coastal marine ecosystems in the Northern and Southern

hemispheres. Here we quantify seasonal and annual riverine dissolved organic matter (DOM) and nutrient loads in three adjacent coastal watersheds along the Gulf of Alaska (GOA), and examine the bioavailability of DOM from watersheds along the GOA during the peak glacier melt period. We find that the glacier coverage within these coastal watersheds alters the timing and magnitude of fresh water, DOM, and nutrient yields. Our results suggest that a lower glacier coverage within a watershed results in higher DOM yields, but timing of delivery is more variable as storm events become the primary runoff source. However, the glacier dominated rivers have old DOM (> 5,000 years) rich in proteinaceous compounds that is highly bioavailable to marine microorganisms (23 – 66%). These findings are consistent with the idea that DOM in pro-glacial streams is largely derived from sub-glacial microbial populations. We also found that an abundance of early successional plant species that fix nitrogen can result in higher inorganic nitrogen yields in watersheds undergoing rapid deglaciation. We conclude that changes in the amount, timing, and bioavailability of DOM and nutrients due to reductions in glacier contributions may affect the productivity of near shore coastal ecosystems.

4. Modeling Water Quality Impacts of Corn Production for Ethanol in the Upper Mississippi River Basin - Paul Hummel, AQUA TERRA Consultants, Decatur, GA (co-authors: Anthony Donigian, Jr., David Wells, Roberta Parry)

The renewable fuel program established by the Energy Independence and Security Act (EISA) mandates the use of 36 billion gallons of renewable fuel by 2022. This volume effectively includes 15 billion gallons of ethanol made from corn kernels by 2015. The production of biofuels has become an important industry in the US and has seen a dramatic expansion in production capacity, and continued plans for expansion. Of the potential crops for biofuel production, corn has the highest rates of application of fertilizers and pesticides, leading to the concern that higher corn production could result in an increased loading of nutrients, pesticides, and sediment to waterways. Given this potential for problems associated with corn-based ethanol production, the focus of this study was to model and assess the potential impacts on surface waters resulting from the expected increase in corn production in the Upper Mississippi River Basin (UMRB). The UMRB was selected because it represents many potential issues associated with ethanol production, including its connection to major water quality concerns such as the hypoxia problems identified in the Gulf of Mexico. The Soil and Water Assessment Tool (SWAT) model was used to perform the project's modeling due to its established technical capabilities, widespread use, comprehensive representation of watershed processes, and efficient computational execution. A baseline model scenario was established using the most current databases available for the study area including the 2001 NLCD and Cropland Data Layer (2004-2006) for land use, the USDA-NRCS STATSGO for soils data, and the Conservation Tillage Information Center (CTIC) and Agcensus 2002/1997 for identifying the cropping rotation and management practices for the agricultural land areas. Using the national ethanol production goals, future model scenarios were run for the years 2010, 2015, 2020, and 2022. A subset of selected land uses were converted to corn to meet the ethanol goals for each future scenario. Additionally, baseline corn yields were adjusted in future scenarios to reflect expected advances in crop science. Flow and sediment, nitrogen and phosphorous loads were output at the HUC-8 level for all scenarios.