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Watershed Management Techniques for Brook Trout Habitat Improvement, Lake Superior South-Shore Streams, Wis.

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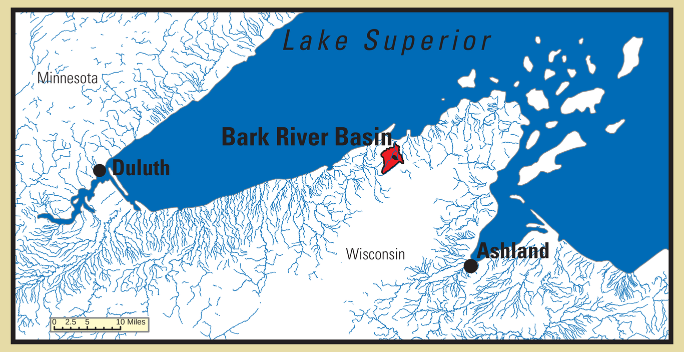
OVERVIEW

The Bark River is a forested tributary to Lake Superior in Wisconsin. In 2005, we began an integrated multi-agency study of brook trout habitat rehabilitation, erosion and sedimentation control, stream hydrologic and geomorphic conditions, and runoff and infiltration characteristics from upland forests. Previous studies in the vicinity of the Bark River indicated that available brook trout spawning habitat is dependent on the location of ground-water discharge zones, the severity of floods, and erosion/sedimentation processes. Rehabilitation techniques tested on gullies as part of this study included grade control (mainly natural, onsite materials), addition of large woody debris for increasing roughness, slowing and infiltrating flow and trapping sediment, and native plant restoration. Alder shrubs were removed from perennial reaches; thick alder growth trapped sand, which widened the channels and buried spawning areas. Snowpack moisture variability under different tree species canopies is being measured to assess forest type contributions to spring snow melt magnitude, and to model hydrologic effects of forest cover changes. Headcutting, incision, bank erosion, and sediment deposition in ravines are monitored through semi-annual measurements of gully cross sections and erosion pins. In perennial reaches upstream and downstream of the ravines, streamflow is monitored with continuous stage recorders and suspended sediment samples are collected after floods from single-stage samplers. Habitat and brook trout populations are surveyed annually. Results from this integrated study will be used to evaluate the applicability of the gully stabilization techniques and upland/riparian forestry practices for other steep tributaries along the south shore of Lake Superior.

Glacial sands topped with lake clays set the stage for large eroding bluffs, like this one on nearby North Fish Creek



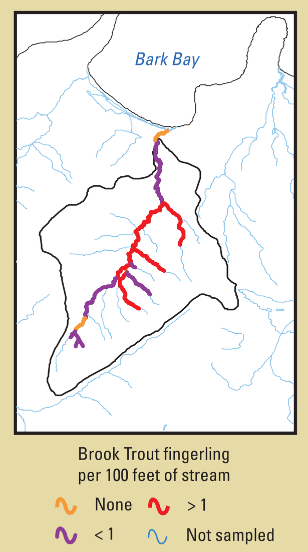
Relative sources of sediment to the Bark River (%)

Upland	Roads	Main stem incision	Banks	Land-slides	Ravines/ Gully erosion
5	10	10	20	20	35

Previous studies on sediment sources to the Bark River determined that the majority of sediment is derived from gully erosion in headwaters, followed by landslides and bank erosion along the mainstem.

Slugs of sand move through perennial stream reaches, covering spawning beds and limiting habitat.

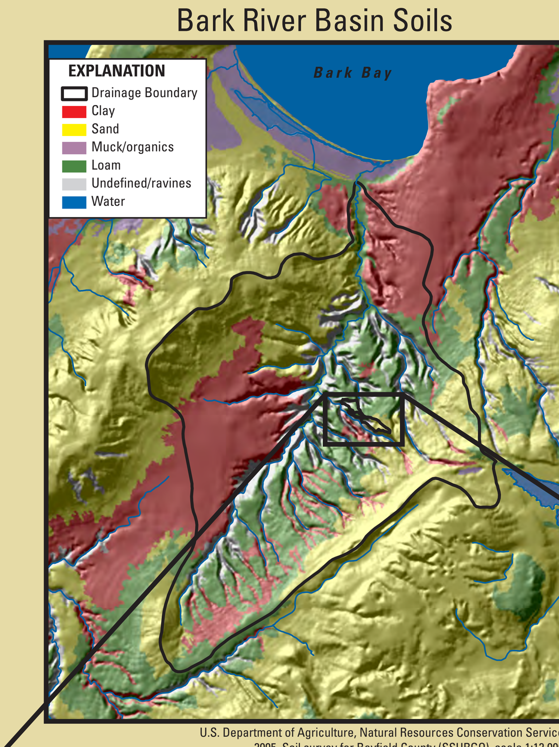
Brook trout are found along the main stem and eastern tributaries of the Bark River with unusually high baseflow.



Project goals

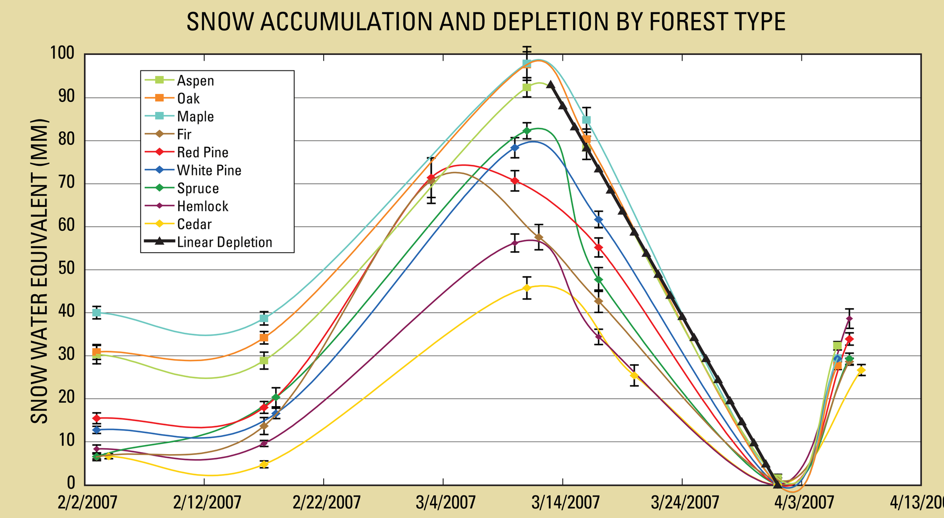
- Restore and improve brook trout habitat
- Demonstrate methods to reduce erosion from tributaries by reducing runoff from uplands and ravines
- Model the effects of forest change on streamflows

Bark River Basin Soils



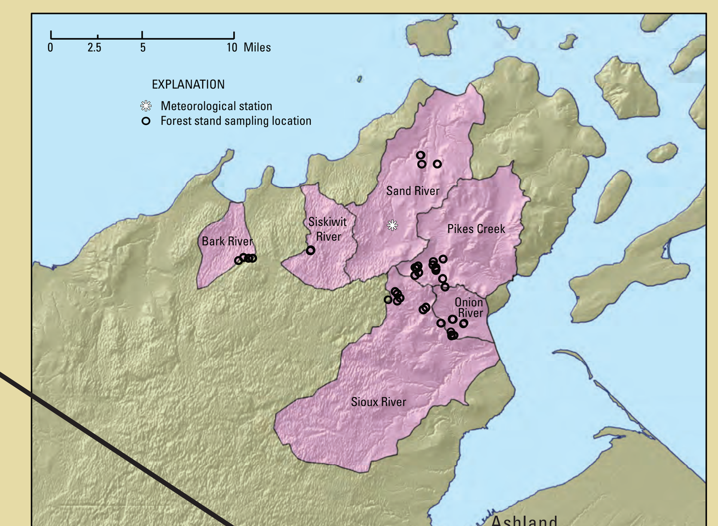
U.S. Department of Agriculture, Natural Resources Conservation Service, 2005, Soil survey for Bayfield County (SSURGO), scale 1:12,000.

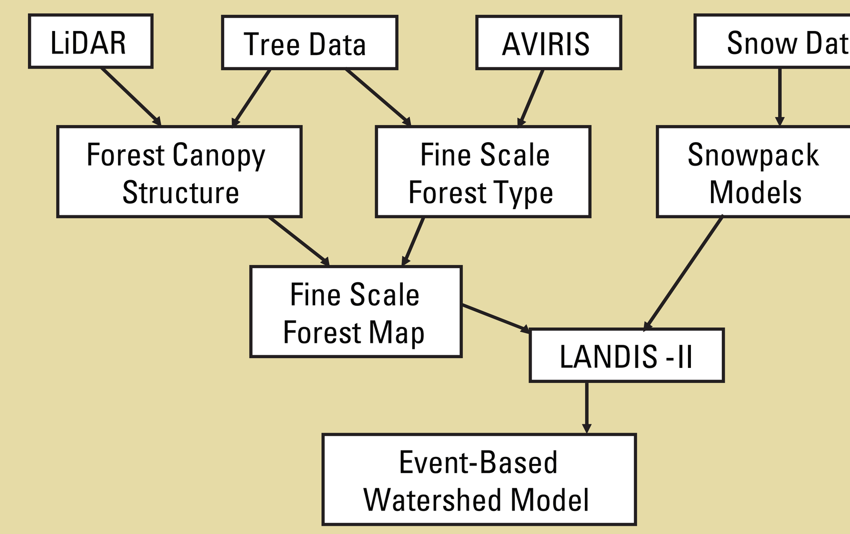
FOREST TYPE IMPACTS ON SNOWMELT



Tree planting – May 2007

At peak accumulation snow water equivalent (SWE) of snowpack in deciduous stands are 18% to 65% more than in coniferous stands. Snowpacks beneath deciduous stands did not differ significantly; however, coniferous species had significantly lower SWE than the deciduous stands. These differences varied by coniferous species against the deciduous species as a group--spruce (18% less SWE), followed by white pine (20% less SWE), red pine (30% less SWE), fir and hemlock (42% less SWE), and cedar (55% less SWE). Variations in water content are assumed to result from spatial distribution of trees and structural differences in canopies, not snowfall patterns.





Modeling Approach

This conceptual diagram shows how a variety of data types will be integrated and used by a forest disturbance and succession model (Landis-II) and a watershed hydrology model. These models seek to analyze how different forest management and disturbance scenarios might affect streamflows.

RAVINE REHABILITATION-A Bioengineering Approach

Vegetation/Planting

November 2005

October 2006

May 2007

In fall 2005, dense clusters of speckled alder (*Alnus incana*) were cleared from the upper reaches of ravine 2 to promote re-colonization of the herb layer and allow for the installation of erosion-control turf reinforcement mats. Some trees and snags were removed to relieve long-term pressure on highly erodible banks. In 2006, three native sedge species (*Carex* spp.) were planted in and around the stabilized erosion control mat and other physical controls, and on actively eroding sand banks. Sedges planted in the spring of 2007, in the sand banks, are expected to stabilize the sand bank as well as the deposited channel sediments.

Physical Measures

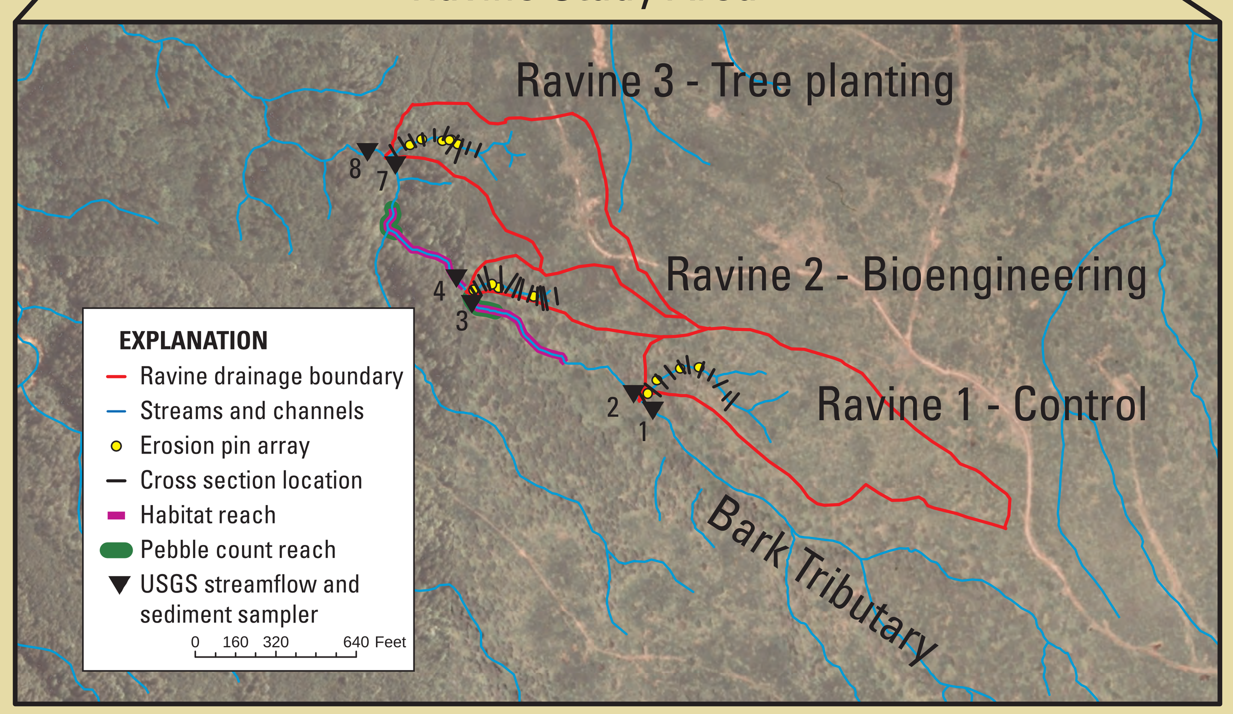
November 2005

A variety of physical measures were utilized in fall 2005 to slow runoff velocities, stabilize existing soil layers, and promote sediment deposition. These measures utilized locally available materials, for brush bundles and coarse woody debris structures, in addition to biologs, sandbags, and erosion-control mats. Eroding head-cuts, deeply incising ravine reaches, eroding sand banks, and areas of high potential energy received a combination of the above treatments.

May 2007

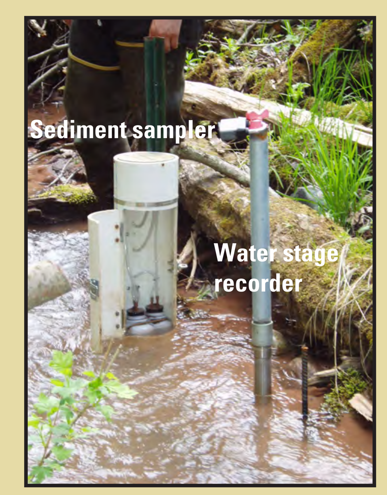
The area shown below was treated in fall 2005 with a combination of physical and biological measures. Armoring reduced incision in the channel and stabilized eroding sand banks. Increased roughness slowed runoff velocities and had promoted sand deposition by May 2007.

Ravine Study Area



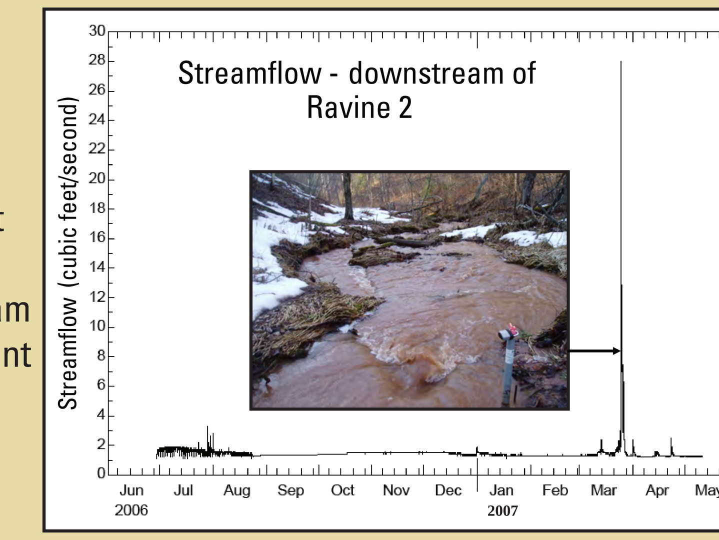
RAVINE AND STREAM MONITORING

Streamflow and sediment sampling

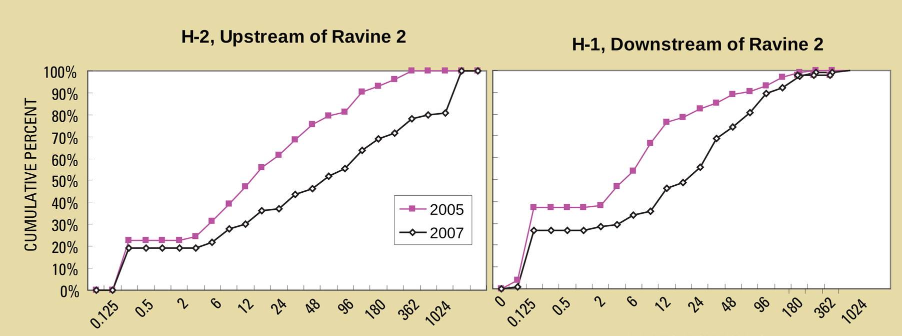


Monitoring began just prior to rehabilitation in 2005 and is ongoing.

Streamflow is continuously monitored at six sites along the perennial tributary of the Bark River, upstream and downstream of the three ravines. Suspended sediment is automatically collected at each site with a single-stage siphon sampler.

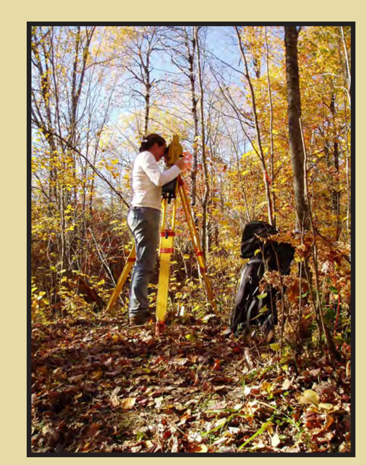


Streambed substrate

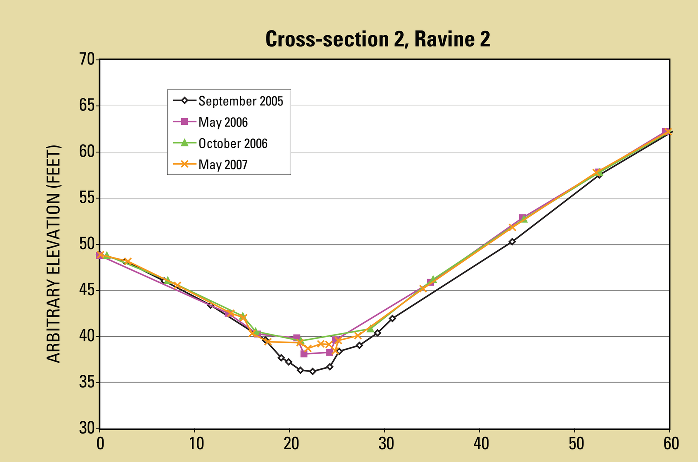


Pebble counts and habitat assessments are done semi-annually in the perennial tributary upstream and downstream of ravine 2. These surveys help document episodic changes in substrate and channel morphology caused by ravine runoff and sand inputs. Substrate size increased at both sites from 2005 to 2007 following instream alder removal. Additional time is needed to assess changes in substrate conditions due to bioengineering techniques and tree planting.

Cross-section surveys



Cross sections are surveyed in the spring and fall in all three ravines. Long-term changes in channel incision, bank erosion, and sand sedimentation are compared among the ravines.



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