Impact of Libby dam on River floodplain physical processes and ecosystem at the Kootenai River, ID, USA

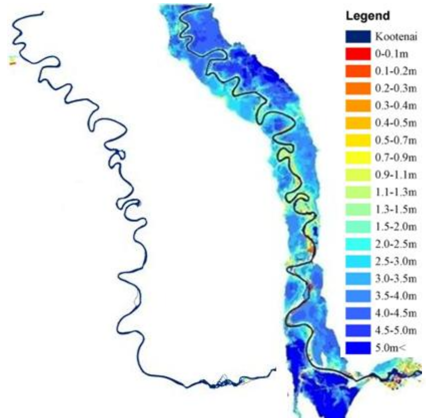
Funding Agents: Bonneville Power Administration, Fish and Wildlife Mitigation Program, Kootenai Tribe of Idaho
PIs: Dr. Klaus Jorde and Dr. Elowyn Yager
Students: Berhon Dibrani, Karen Zelch, Michael Burke, Rohan Benjankar and Yi Xie
Contacts: Klaus Jorde and Elowyn Yager, Center for Ecohydraulics Research, University of Idaho, Boise, ID.

The Kootenai River Basin is an international watershed 41,900 km² in size, encompassing parts of British Columbia, Montana, and Idaho. The headwaters are located in Kootenay National Park, British Columbia. It is the second largest tributary to the Columbia in terms of runoff volume, and the third largest in terms of watershed area.

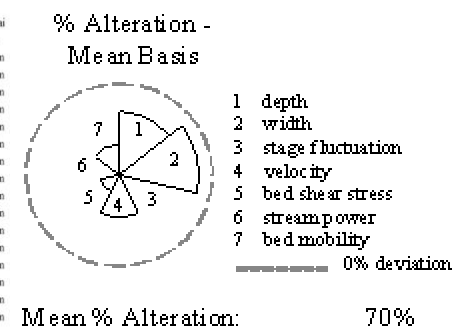
The construction of Libby Dam in 1972 significantly altered the hydrograph, fish migration patterns, temperatures, nutrient availability, sediment transport, and vegetation dynamics below the dam. Many of the tributaries in the canyon portion of the Kootenai River have experienced interstitial flow in the summer due to the development of large alluvial fans and low water levels.

Regulation of the Kootenai River between Libby Dam and Kootenay Lake has altered the natural flow regime, resulting in a significant decrease in maximum flows (60% net reduction in median 1-day annual maximum, and 77-84% net reductions in median monthly flows for the historic peak flow months of May and June, respectively). Bed shear stress and average velocity in the channel showed the largest change, which was predicted to be 79 and 55% of pre-regulation conditions, respectively.

The Kootenai River floodplain is almost completely disconnected from its main channel because of levees and the altered hydrological regime from Libby Dam. The decrease in flood frequencies and magnitudes combined with extensive river modification has completely changed the physical processes and vegetation dynamics that act on the floodplain. Our floodplain simulation showed that more than 90% of previously inundated areas have been lost due to river modification (dyke and levees) and dam operation.



5 year RI inundated floodplain:
Historic vs. Post-Dam



Total alteration:
Historic vs. Post-Dam

Project Objectives:

- Develop modeling tools (1D and 2D hydrodynamic models) that quantify the impacts of Libby Dam and levees on physical processes (flow, sediment transport, channel morphology changes etc.) that act in the river and on the floodplain. The impacts are based on a comparison of current conditions and reference scenarios before the dam and levee construction.
- Develop models that calculate the feedback between physical and biological processes (e.g. vegetation establishment and recruitment) to determine human impacts on river and floodplain ecology.
- Use hydraulic, sediment transport and vegetation models to evaluate future restoration and mitigation locations and techniques in the Kootenai River and floodplain.

Dynamic Floodplain Vegetation Model Development For The Kootenai River, ID, USA

Developed by: Rohan Benjankar
Funding Agents: Bonneville Power Administration, Fish and Wildlife Mitigation Program, Kootenai Tribe of Idaho
Project PIs: Dr. Klaus Jorde and Dr. Elowyn Yager

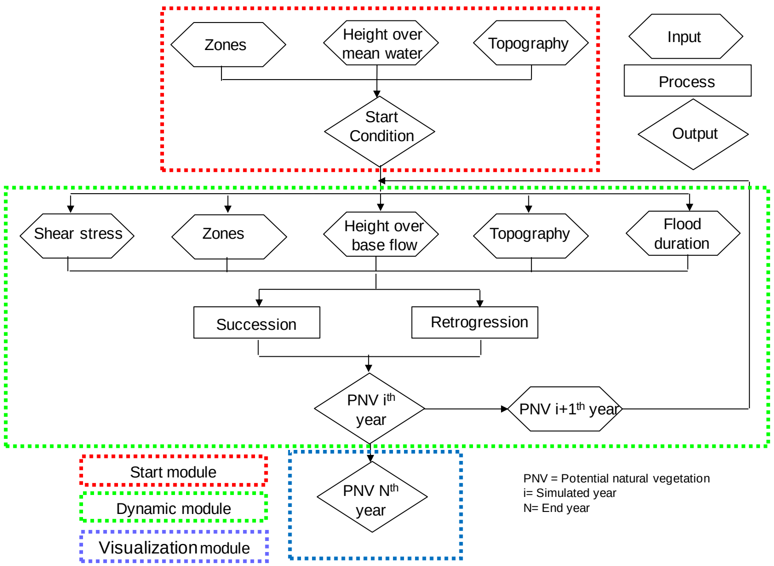


Figure 1: Model structure

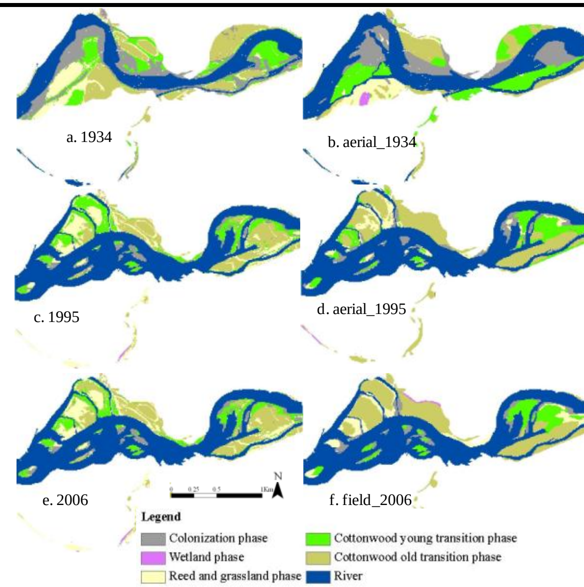


Figure 2: Simulated (left) and observed vegetation types

A vegetation model “CASiMIR-vegetation” was developed in ArcGIS environment using Model Builder as a part of Rohan Benjankar’s dissertation. The time-for-space-hypothesis approach was applied in developing the vegetation model. It is a grid-based (raster) type that simulates vegetation succession or retrogression in annual time steps within 10 m by 10 m grid cells. It consists of several modules: a start module, a succession/retrogression module, and a visualization module. In addition, the model functions with a Boolean logic and relies on hard thresholds provided by users. The fundamental concept for the vegetation model development was the functional relationship between hydrology, physical processes, riparian ecosystems, and vegetation types. The model assumes that vegetation will either develop following succession towards a maturation stage, or it will destroy (called recycling or retrogression) if the magnitude of certain physical parameters is greater than the threshold value for a specific vegetation. Current the model has been applied for different project in Korea, Austria, Portugal and US.

Project Objectives:

- ➢To develop a dynamic vegetation model that simulates spatial and temporal variability of vegetation based on river floodplain physical processes.

- ➢To develop a model to use as a tool for operational loss assessment and to manage a riparian floodplain vegetation.