

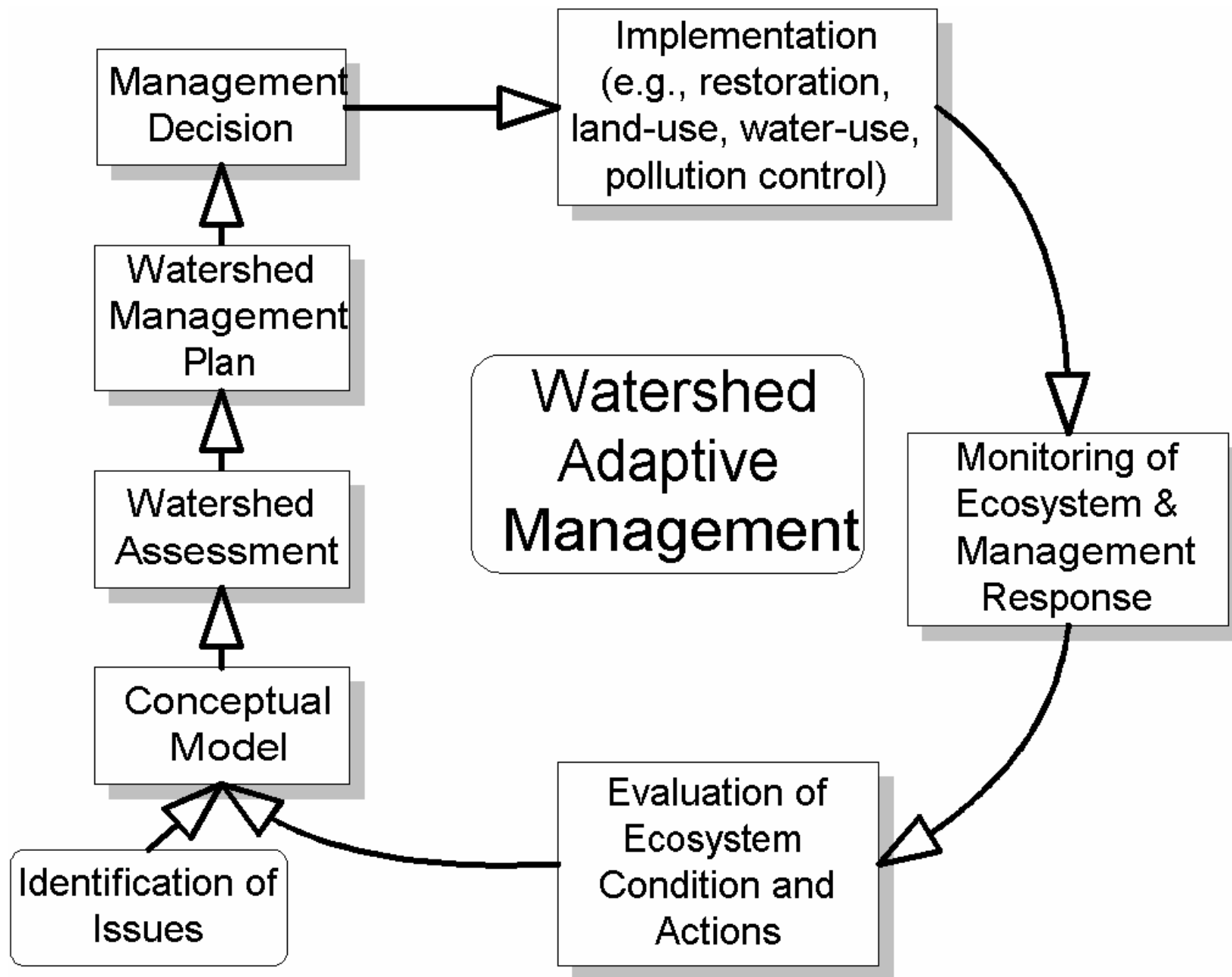
Planning and Measuring Watershed Management

Conceptual Modeling
Adaptive Management
Environmental & Performance Indicators

Fraser Shilling
Department of Environmental Science & Policy
University of California, Davis

Watershed Adaptive Management

- Watershed management
 - Watershed assessment
 - What can we influence?
 - Conceptual modeling
 - Select and use environmental and management indicators



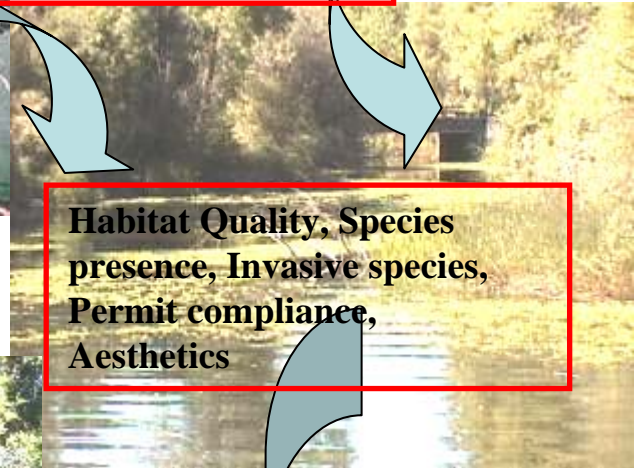
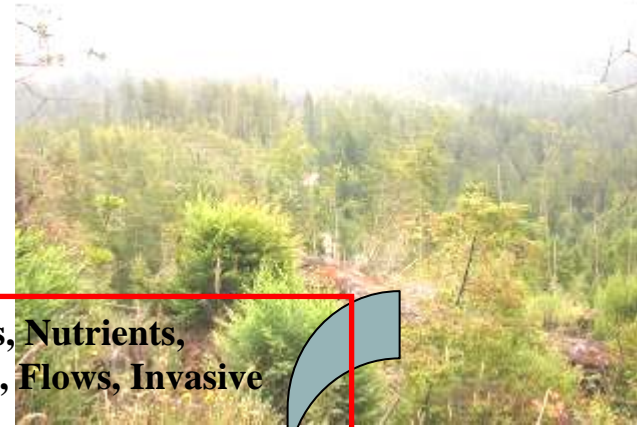
What is flowing downhill/ downstream?



Metals, Nutrients, Sediment, Flows, Organic carbon



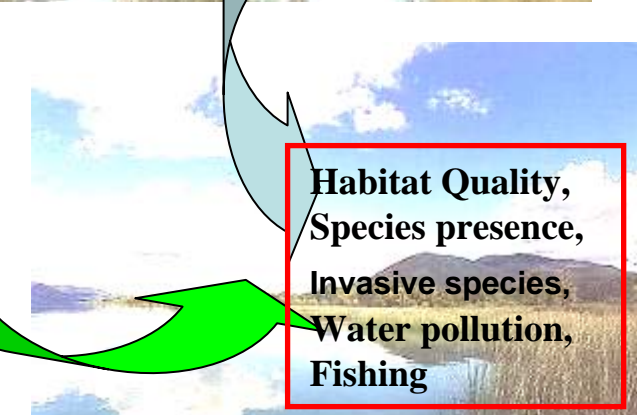
Pesticides, Nutrients, Sediment, Flows, Invasive species



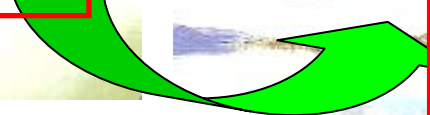
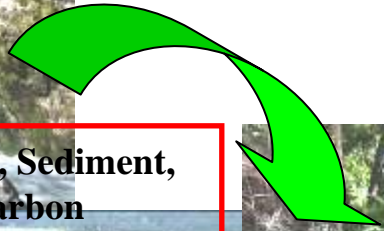
Habitat Quality, Species presence, Invasive species, Permit compliance, Aesthetics



Habitat Quality, Species presence, Flooding, Permit compliance, Aesthetics



Habitat Quality, Species presence, Invasive species, Water pollution, Fishing



Watershed Adaptive Management

- Conceptual Modeling
 - Issues scoping and question formulation
 - Basic description of system
 - Show influences/relationships among processes and features
 - Use conceptual model to inform:
 - Management planning
 - Monitoring needs
 - Long-term evaluation of performance and success

Formulate the Question(s)

- Are you interested in overall watershed condition and drivers?
- Are you interested in a particular stressing activity or process?
- Are you interested in a specific place(s) in the watershed?
- What timeframe are you interested in?

Watershed Adaptive Management

- Questions and goals
 - Are algal blooms a natural occurrence in the watershed and what is contributing to them?
 - What are the primary influences on mercury entry into fish and how can we manage them?
 - Reduce invasive plant arrival and spread
 - Reduce mercury concentrations in fish

Watershed Adaptive Management

- Questions and goals

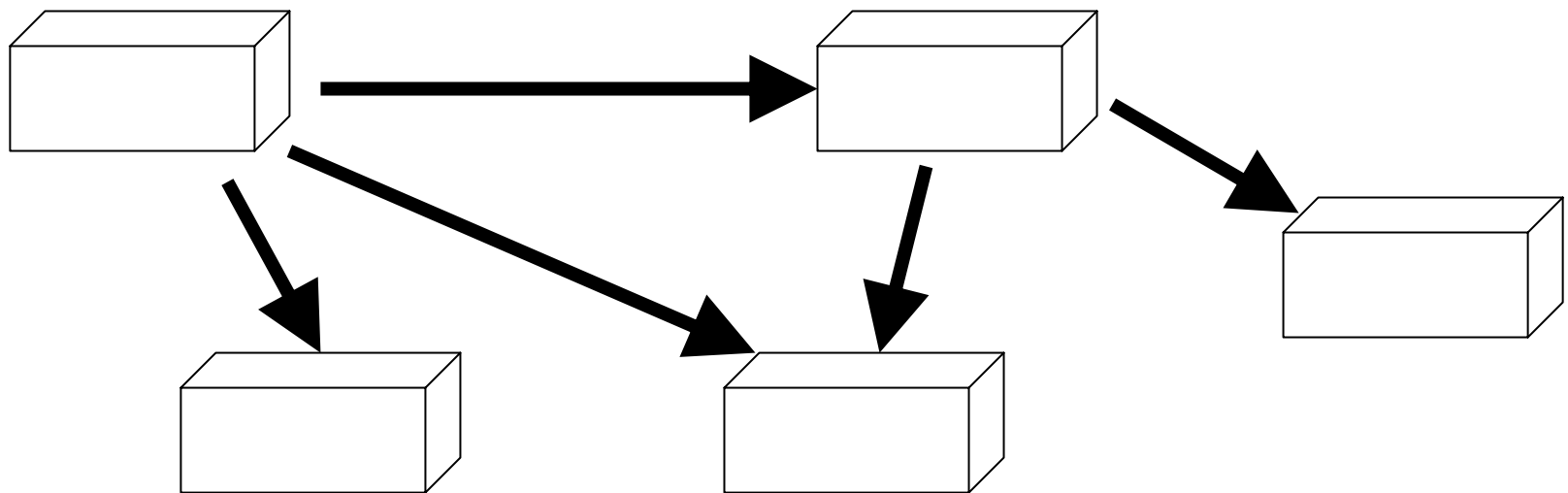


- What are the conditions in the watershed (e.g., mercury in fish), what influences these conditions (e.g., new mercury, benthic oxygen concentrations), and what can be managed in the system?



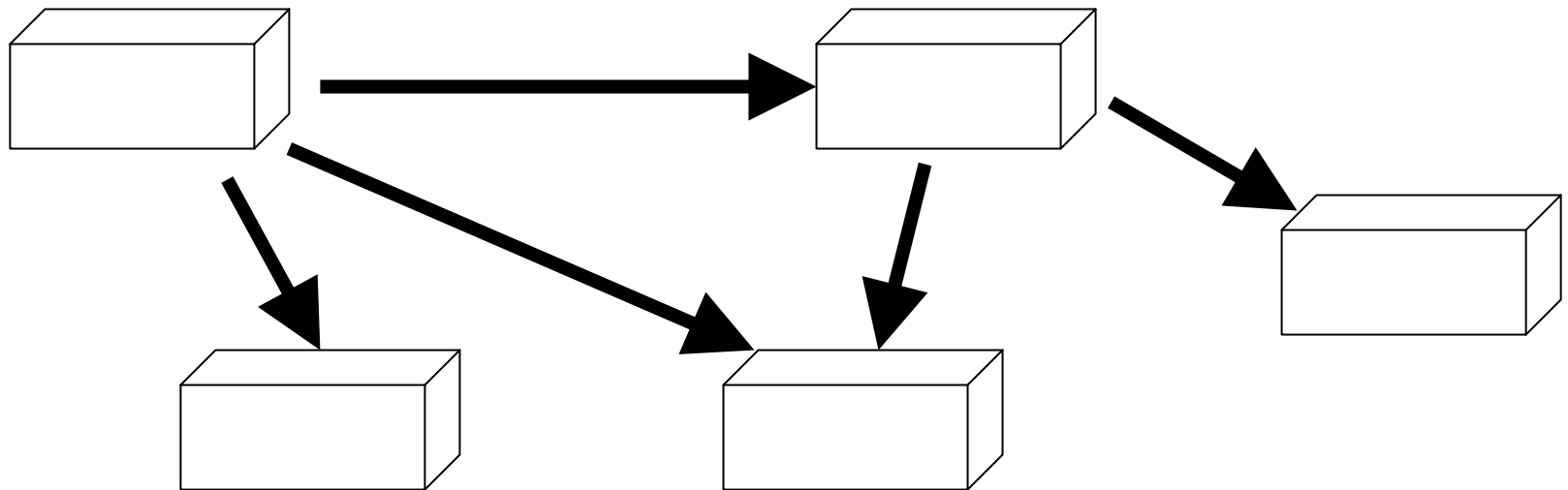
- Develop conceptual model (a diagrammatic or narrative representation of how a system works)

Influence diagrams and conceptual models



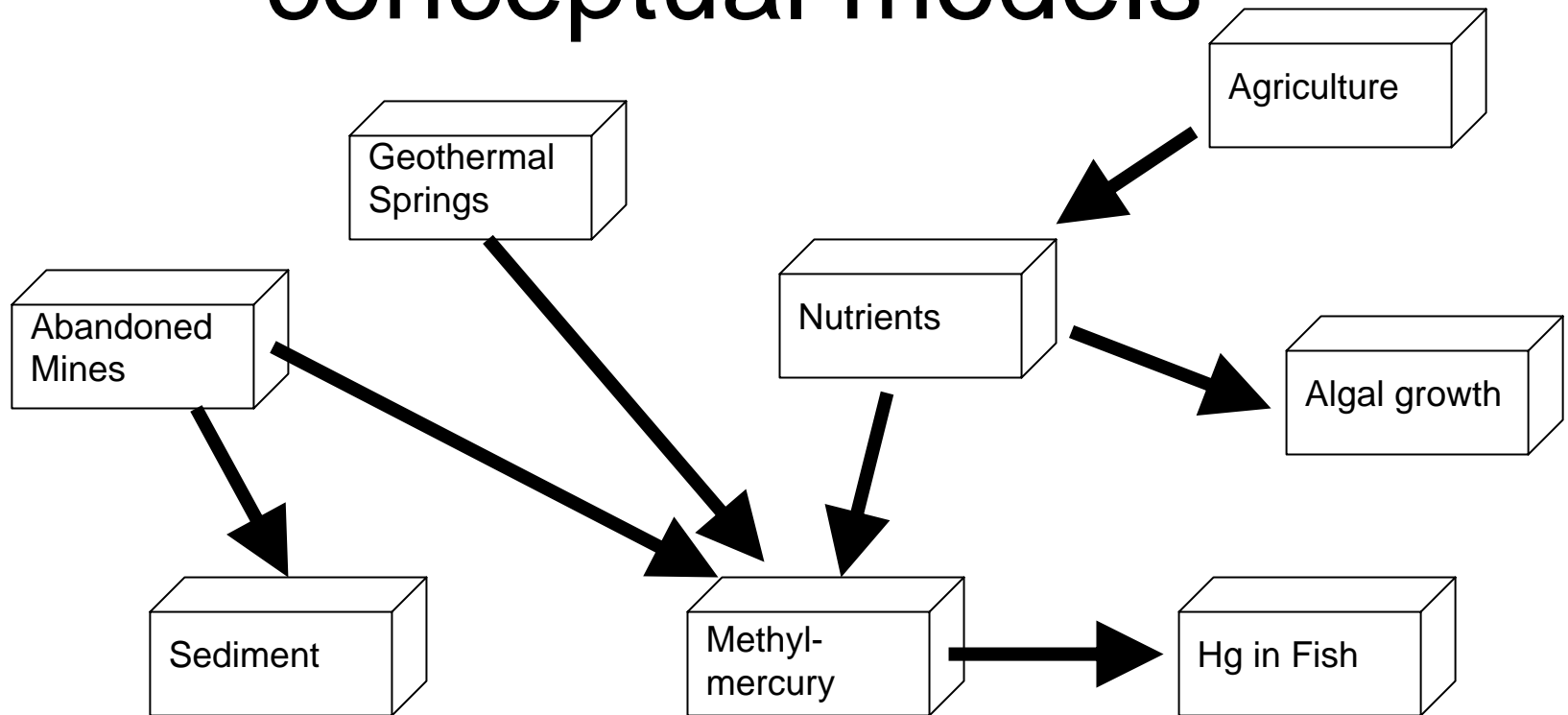
Boxes indicate concepts and arrows indicate influence or connection. The boxes can be attributes or processes, the arrows can be hypotheses, or based on knowledge of the system

Influence diagrams and conceptual models



Constructing these diagrams with others in your watershed is one way to debate/agree on how things work, find gaps in knowledge, identify indicators, and develop plans of action.

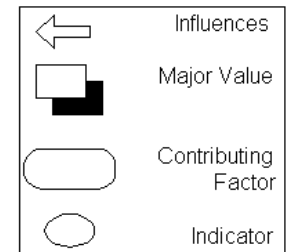
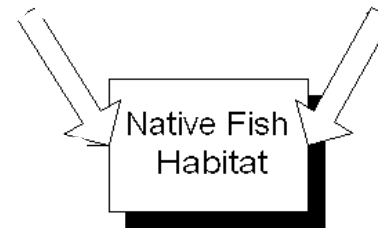
Influence diagrams and conceptual models



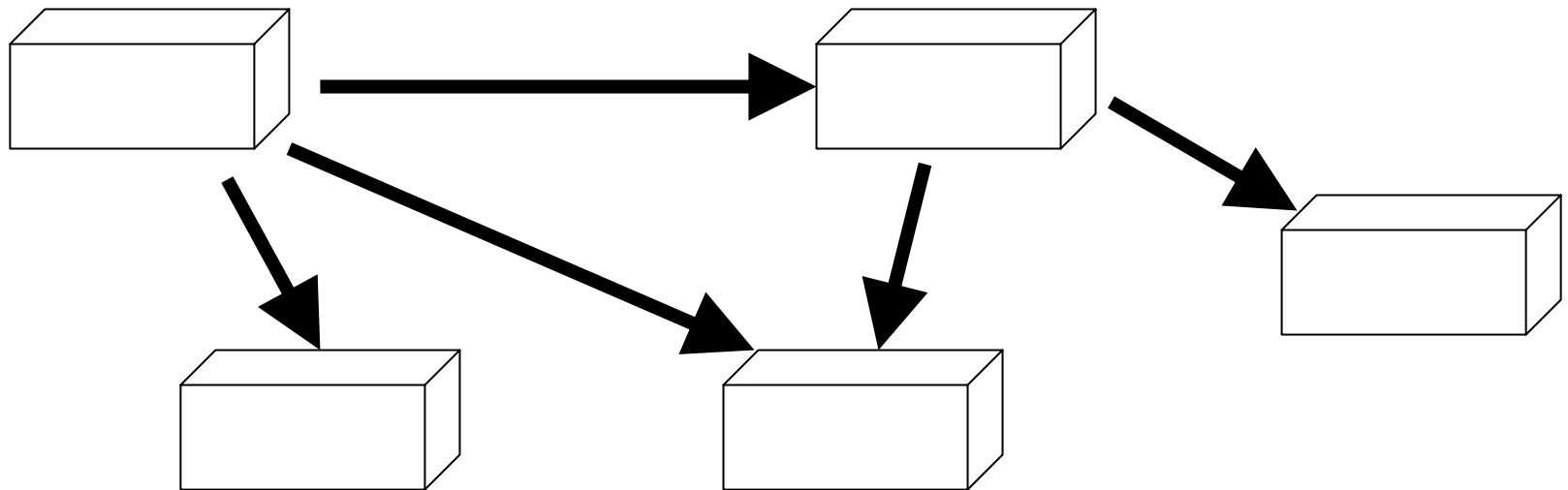
Starting with the issue of “Hg in fish” you can work backwards to find the natural and human influences and contributors to this problem.

Ecosystem Restoration Conceptual Model

Action-Specific

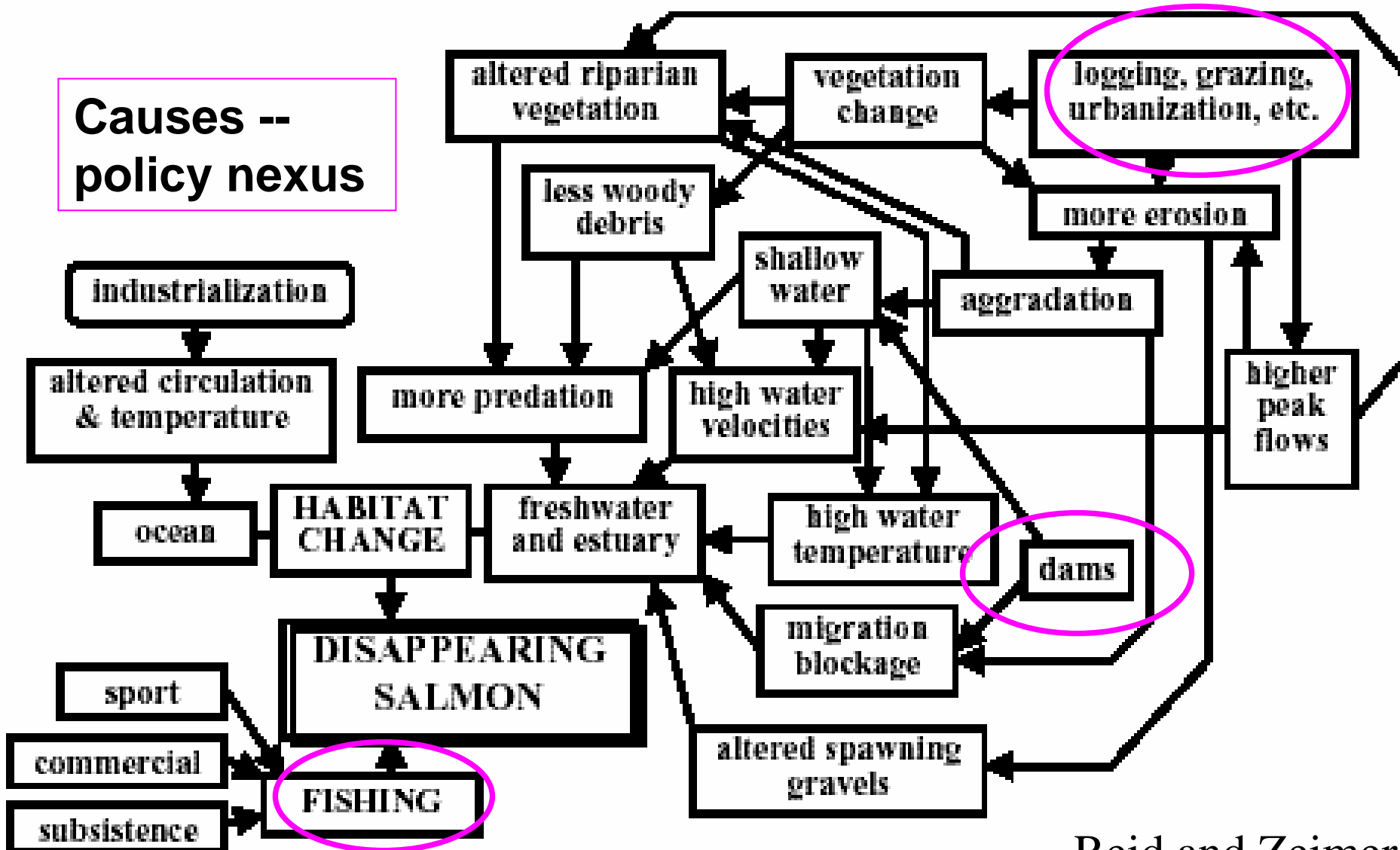


Influence diagrams and conceptual models



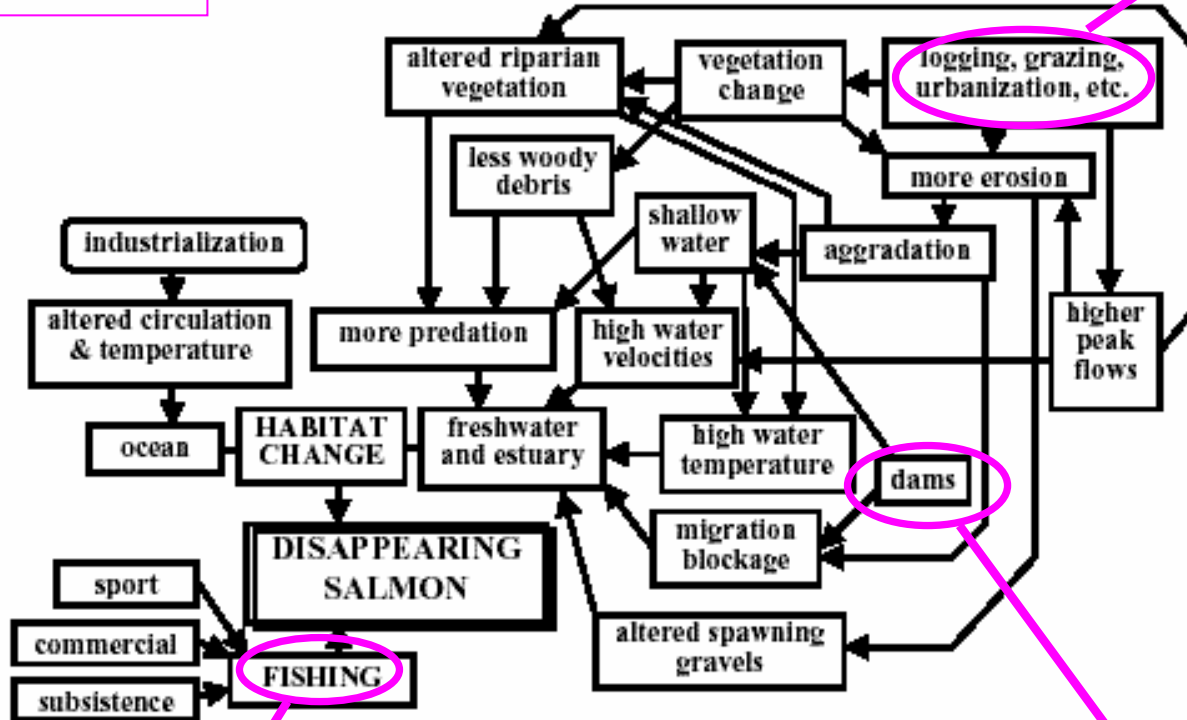
A jointly-developed conceptual model is an ideal way to describe conditions in a watershed among stakeholders, which can help to plan solutions.

Ecosystem Attribute Conceptual Model



Ecosystem Attribute Conceptual Model

Policy nexus



Endangered Species Act, SWRCB permits, THPs, CEQA, ACE 404

Endangered Species Act, Fisheries statutes, Int'l treaties

Endangered Species Act, FERC relicensing, SWRCB permits, ACE 404

