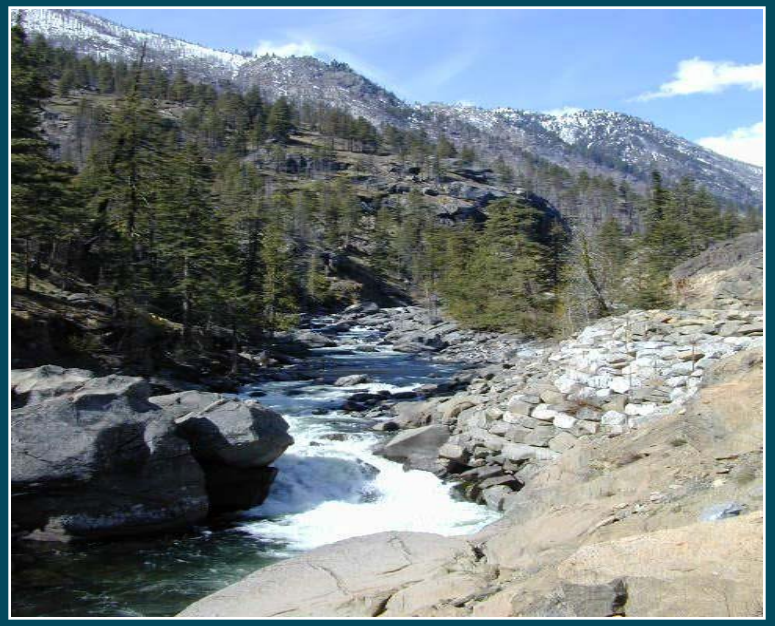
ISAB Food Web Review: Fish Production & Restoration



ISAB – Presentation to Columbia River Estuary Conference, Astoria, Oregon
May 26, 2010

Independent Scientific Advisory Board
for the Northwest Power and Conservation Council,
Columbia River Basin Indian Tribes,
and National Marine Fisheries Service
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204

J. Richard Alldredge, Ph.D., Professor of Statistics at Washington State University.

*David Beauchamp, Ph.D, Cooperative Fish Research Unit at U of Washington

James Congleton, Ph.D., Emeritus Fisheries Professor, University of Idaho

*Charles Henny, Ph.D., Emeritus Scientist, USGS

Nancy Huntly, Ph.D., Professor of Wildlife Biology at Idaho State University.

Roland Lamberson, Ph.D., Professor of Mathematics and Director of Environmental Systems Graduate Program at Humboldt State University.

Colin Levings, Ph.D., Scientist Emeritus and Sessional Researcher at Centre for Aquaculture and Environmental Research, Department of Fisheries and Oceans, Canada.

Robert J. Naiman, Ph.D., Professor of Aquatic and Fishery Sciences at U of Washington

William Pearcy, Ph.D., Professor Emeritus of Oceanography at Oregon State University.

Bruce Rieman, PhD, Research Scientist Emeritus, U.S. Forest Service, Rocky Mountain Research Station

*Greg Ruggerone, Ph.D., Fisheries Scientist for Natural Resources Consultants, Affiliated Research Scientist Alaska Salmon Program, U of Washington

Dennis Scarnecchia, Ph. D., Professor of Fish and Wildlife Resources at University of Idaho.

Peter Smouse, Ph.D., Professor of Ecology, Evolution, and Natural Resources at Rutgers University.

Chris Wood, Ph.D., Head of Conservation Biology Section at Department of Fisheries and Oceans, Canada.

Review Objective

- **Provide a fundamental understanding of aquatic food webs in the Columbia River Basin and their effects on native fish restoration efforts**

- Spatial scope: tributaries, lakes, impoundments and the mainstem Columbia and Snake rivers, as well as the estuary and plume

- **The review has five sections:**
  - General concepts and applications
  - Description of the physical settings
  - Key environmental processes affecting food web characteristics
  - Food webs in typical habitats
  - System perspective re: contemporary and emerging issues

Scope of ISAB Review

- Compile and review the diverse literature to produce a coherent summary
- Identify future research directions for improving restoration of fish and wildlife in the Columbia River Basin

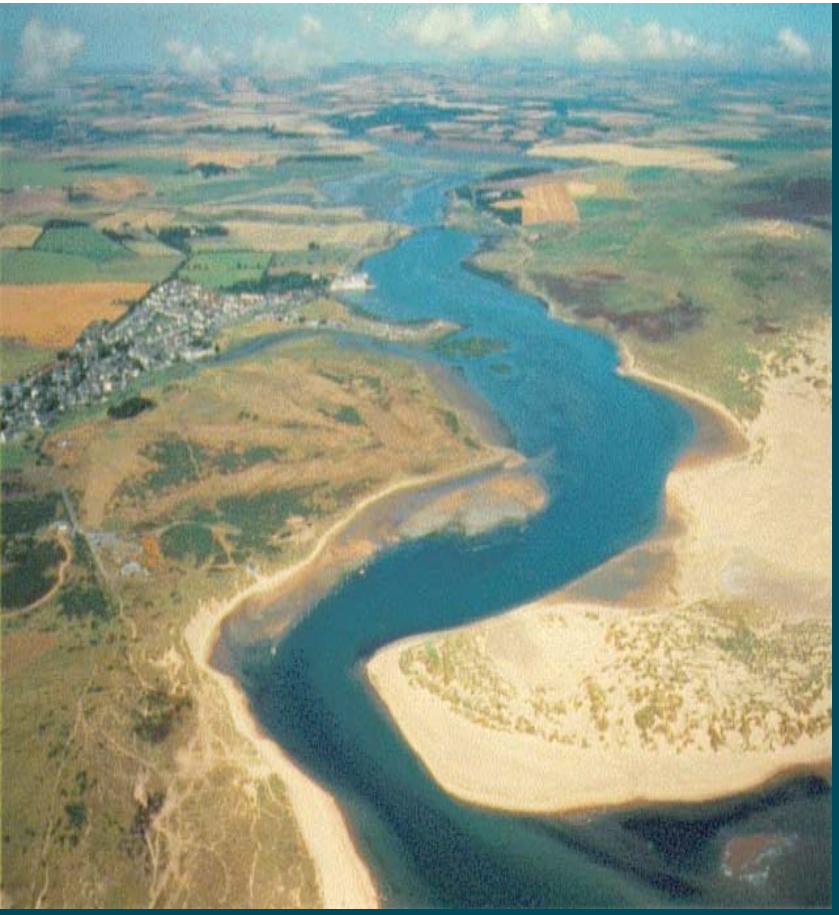
- We do not make policy recommendations; rather we present current scientific understanding in a form that can be used by policy makers

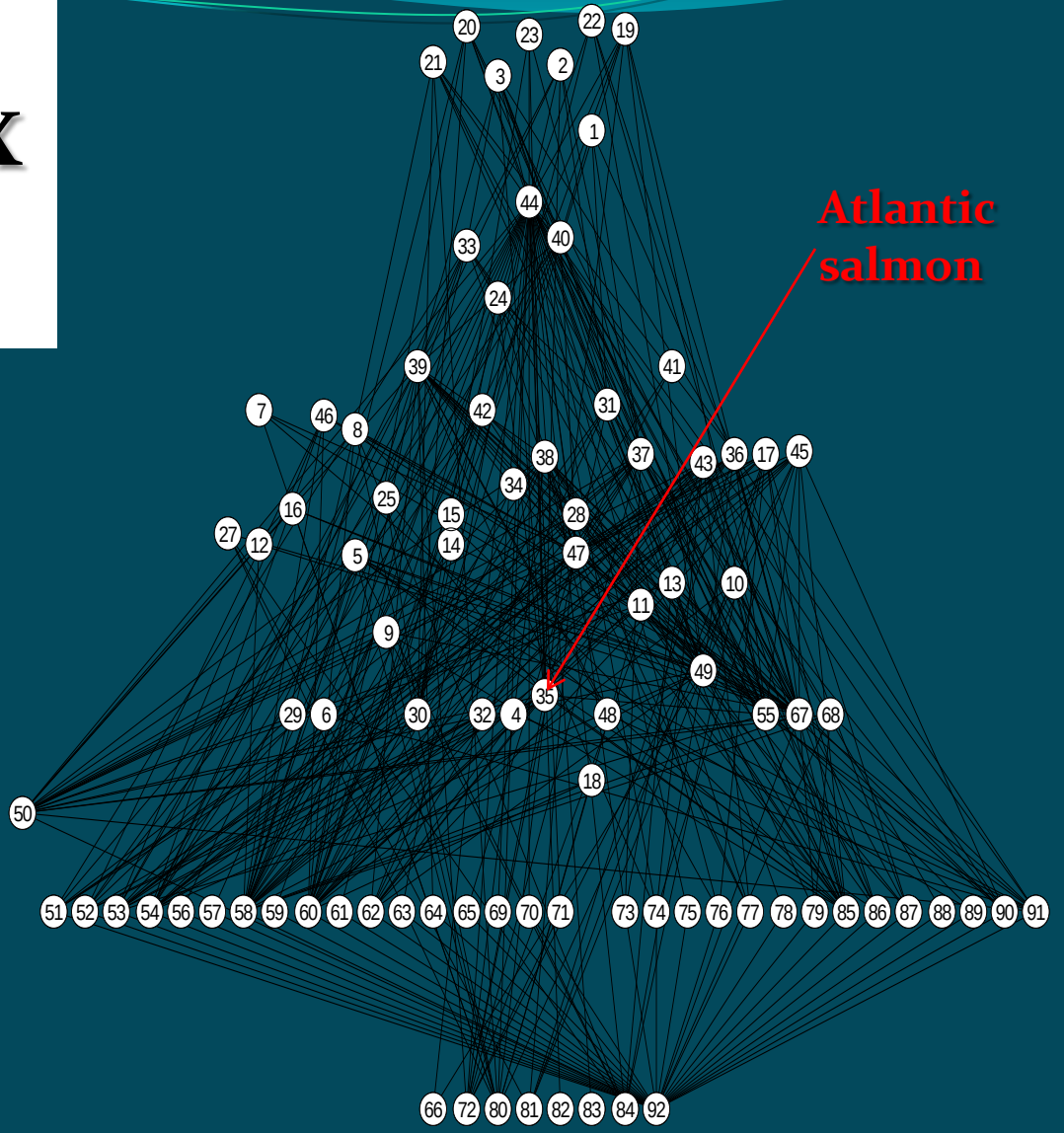
Food Webs are the Foundation for Fish Production

It is through the food relation that animals touch each other and the surrounding world at the greatest number of points, …. the struggle for existence becomes sharpest and most deadly; and, finally, it is through the food relation ….. that animals are brought in contact with the material interests of man.

Stephen A. Forbes, The Food of Fishes, 1880

Food webs are highly complex systems





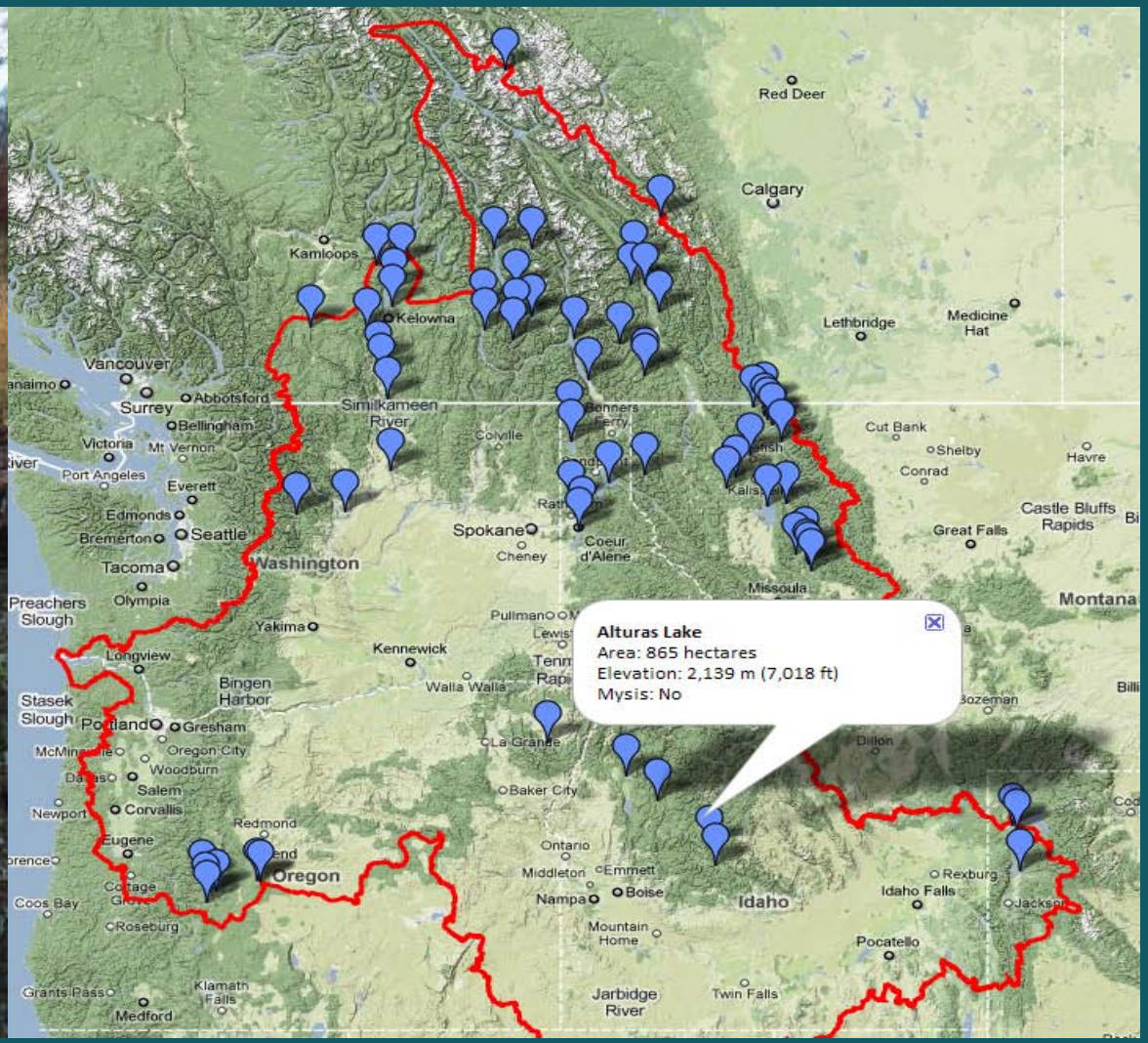
Ythan estuary, Scotland

Preliminary Points of Interest

- Mapping Habitat
- Bioenergetics
- Contaminants and Bioaccumulation
- Estuary and Plume

Mapping Habitat

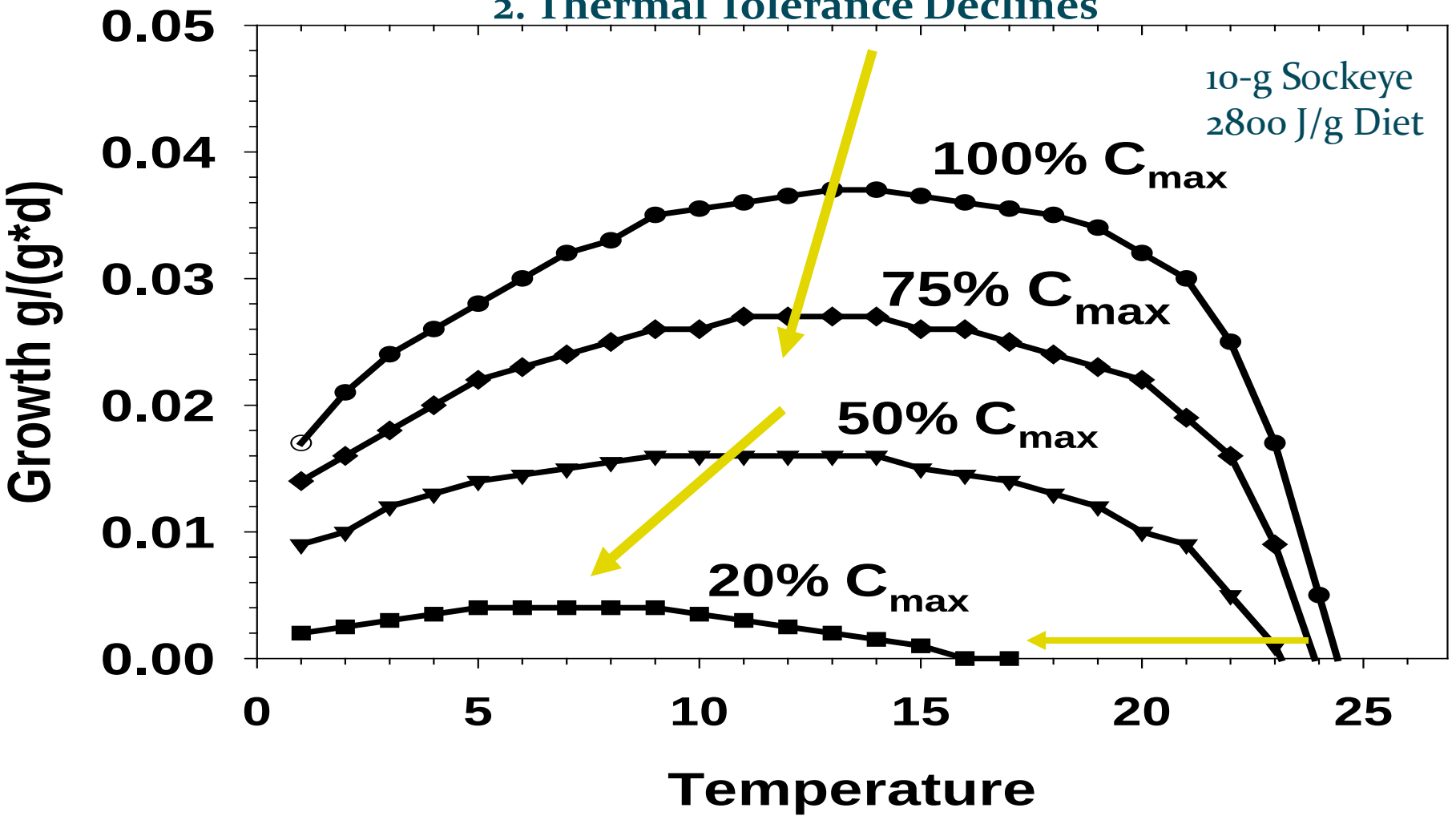
CRB Large Lakes



Bioenergetics

Effects of Feeding Rate & Temperature on Growth

As Ration Declines: 1. Optimal Temperature for Growth Declines
2. Thermal Tolerance Declines



Bioenergetics

Food demand of spring-summer Chinook salmon smolts

Lower Granite Dam to Bonneville, 461 km

~9 million hatchery and wild yearling Chinook, May 2008

~13 day migration

Total food required: 166.5 metric tons (MT)

33.3 MT dipterans

52.1 MT other insects

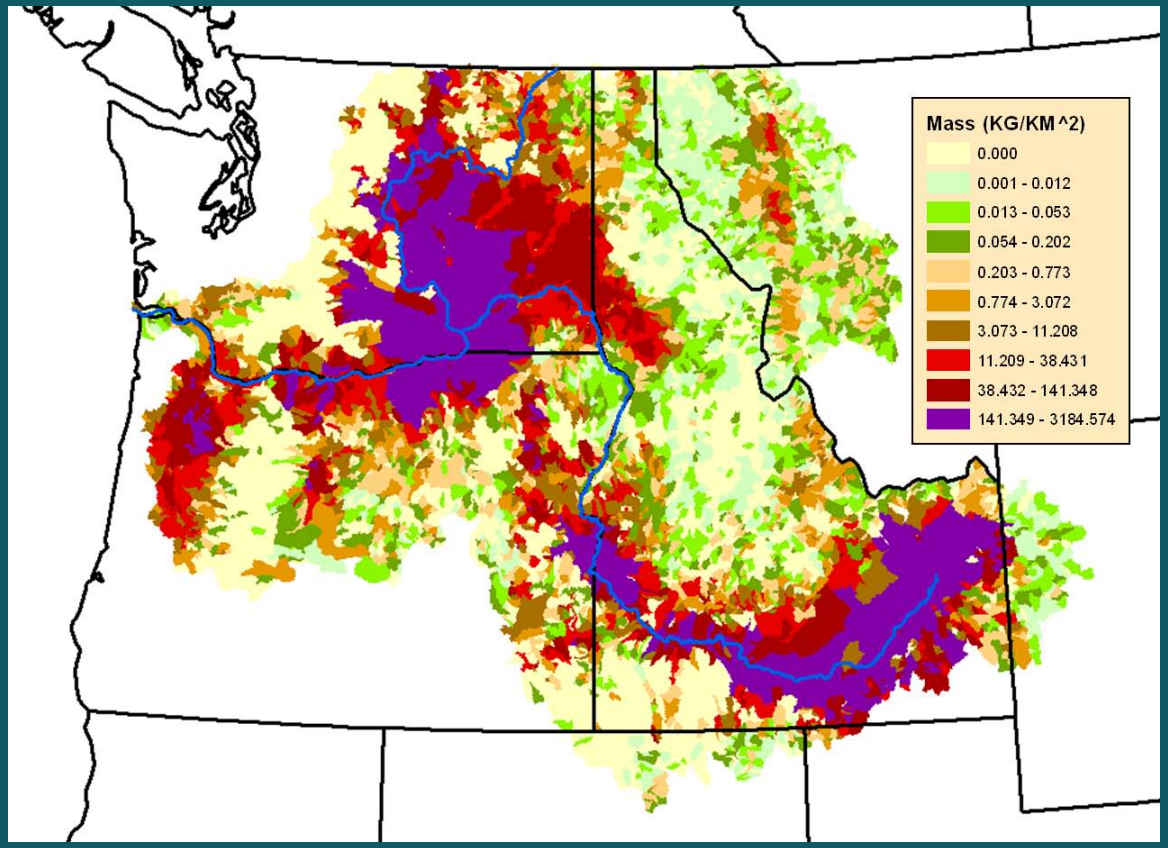
38.8 MT Daphnia

42.2 MT amphipods

Each million juvenile shad consume 25-52 MT of food during July-September

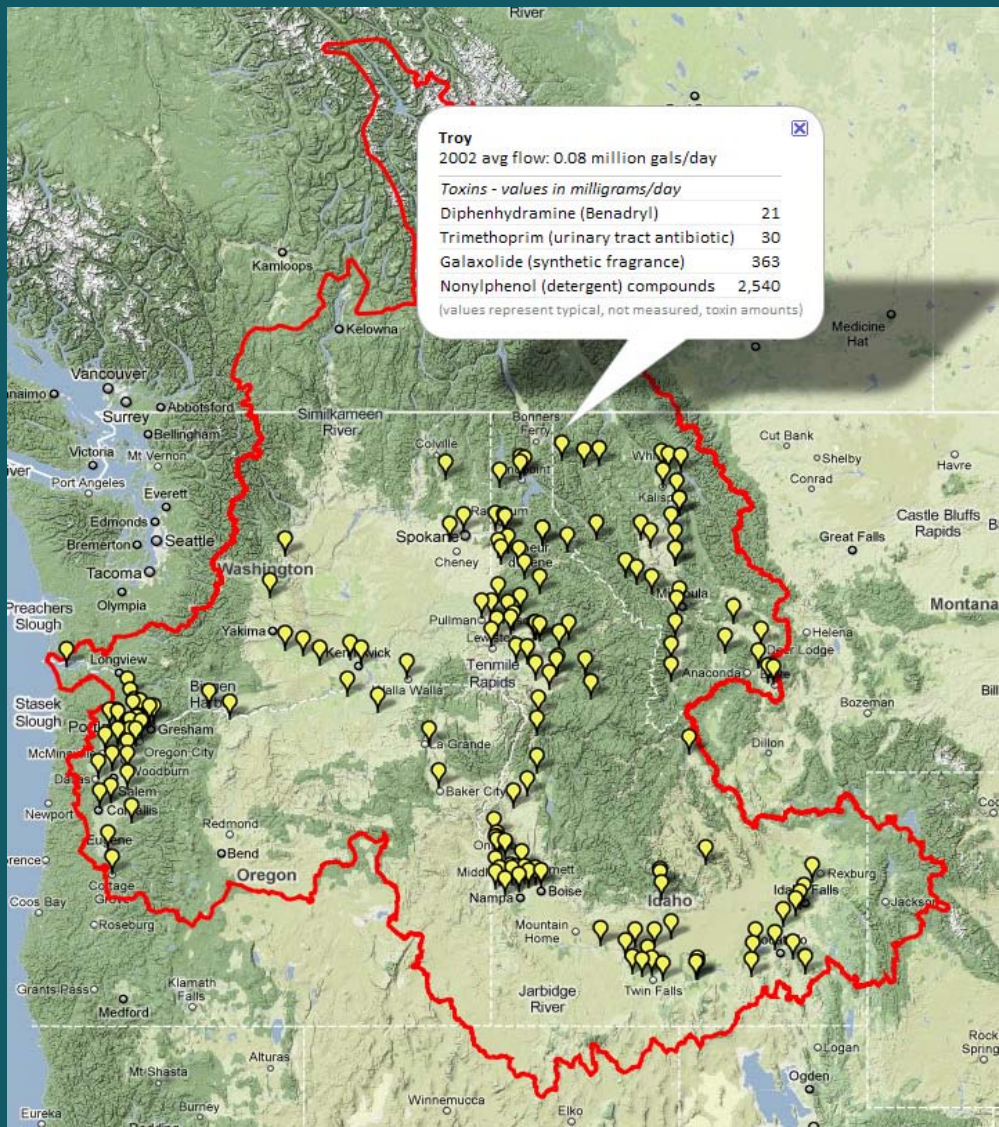
Contaminants & Bioaccumulation

- ~182 pesticides (herbicides & insecticides) in use
- 45,939 Mt of active ingredients applied annually

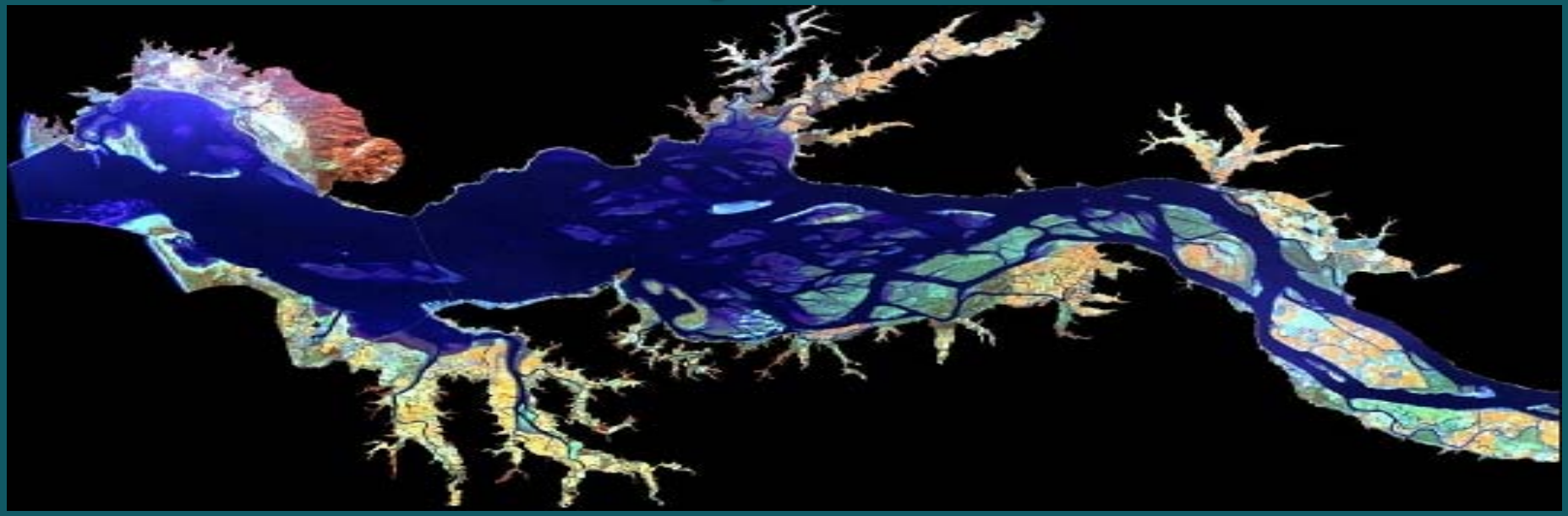


Contaminants & Bioaccumulation

- 169 (US) wastewater treatment plants
- Contributions from current and emerging industrial contaminants (e.g., PAHs, PBDEs, pharmaceuticals and personal care products) remain largely unknown



Estuary & Plume



- Estuarine Food Web Structure and Dynamics are Detrital Driven
- Historical Changes in the Estuary – Loss of Wetland Habitat/Food Webs
- Overlapping Food Webs Between the Plume and Estuary

Gaps in Understanding Food Webs

- *Historical Baselines*
- *Taxonomy*
- *Abundance, including Spatial and Temporal Trends*
- *Physical Controls on Structure and Processes, including Plume Dynamics*
- *Growth of Juvenile Fishes*
- *Effects of Hatcheries*
- *Chemical Contaminants*
- *Apex Predators*
- *Land-Water Interactions*
- *Water, Energy and Nutrient Fluxes at the System Scale*
- *Quantifying Ecological Networks*

Implications for Restoration

- *Identifying Properties Sustaining Desired Ecosystem States*
- *Sustaining Resilient Populations*
- *Hybrid Food Webs and Legitimate Targets*
- *Maintaining Productivity*
- *Anticipating 'Surprises' and Developing Response Framework*

Emerging Principles

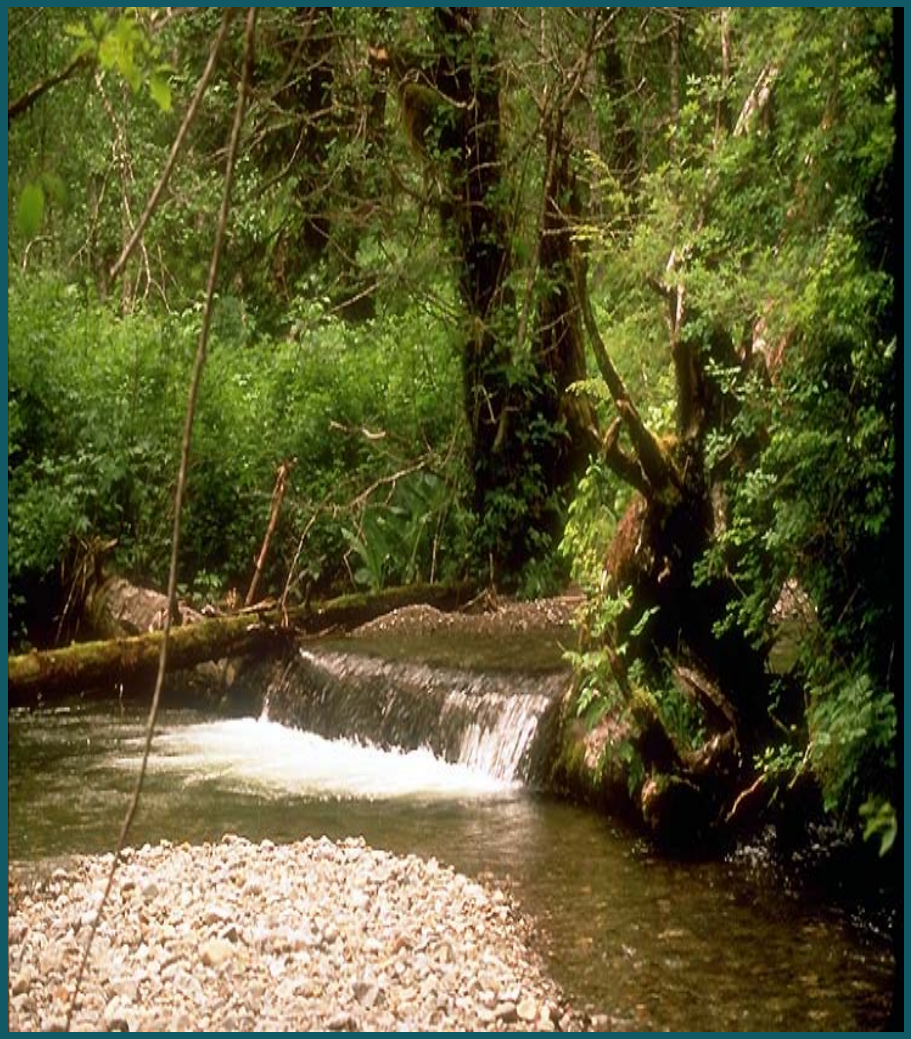
- *Minimize number and abundance of non-native species*
- *Monitor and contain use of artificial chemicals*
- *Manipulations to water, sediment and temperature, as well as artificial fish production, have system-scale consequences*
- *Predator-prey interactions and competition for food reverberate throughout the entire system*
- *Determine habitat-specific limitations on carrying capacity and growth*
- *Spatial diversity and temporal availability in foods have consequences for growth and survival*
- *Pathways by which nutrients and energy course through the system underpin productivity and resilience*

The Next Steps ….

- Significant writing and editing remain
- Final recommendations to be determined
- Review completed in Autumn 2010
- Presentation to the Northwest Power Planning and Conservation Council in late Autumn 2010

- Thank you!

Acknowledgments



- ISAB colleagues
- Council staff
- NOAA
- Other contributors