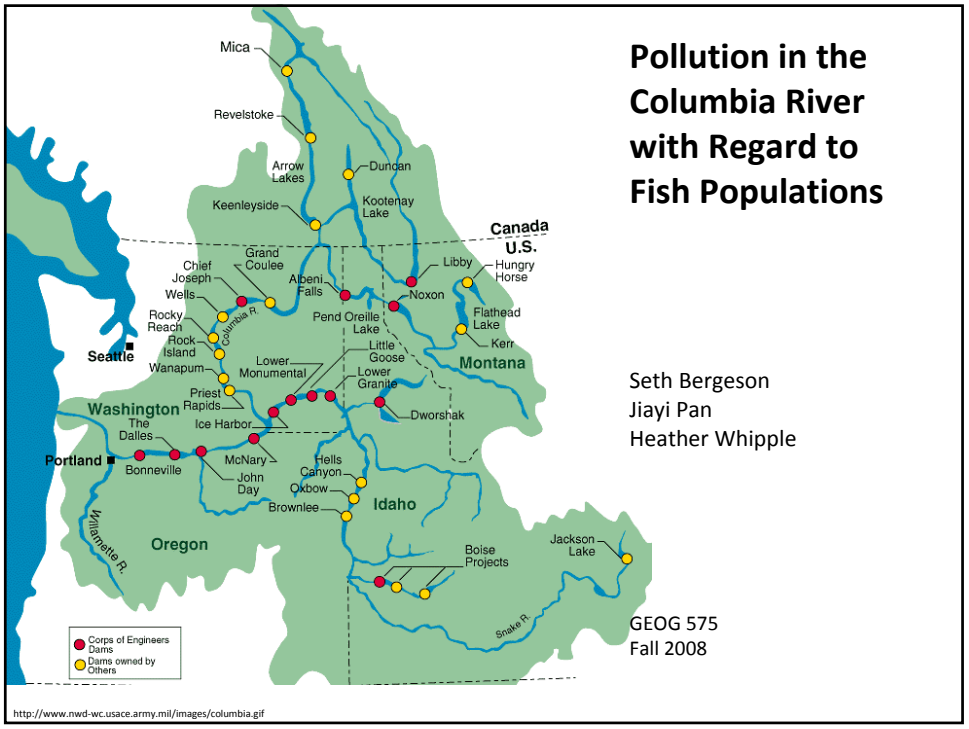

Pollution in the Columbia River with Regard to Fish Populations

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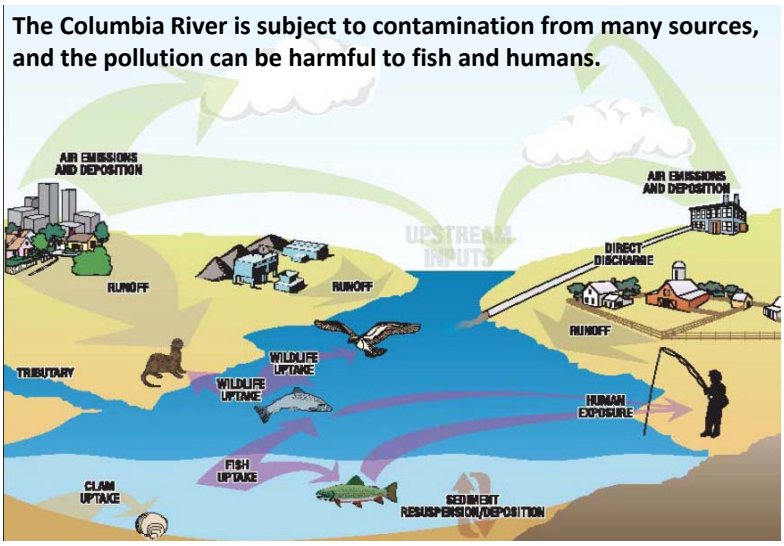
Background

- A recent study found that fish in the Columbia-Snake river system were able to migrate as (and in some cases faster) than fish in the undammed Thompon-Fraser river system.
- On the one hand, this shows that mitigation efforts to help fish pass dams may be working.
- On the other, questions remain about why fish in the undammed but more polluted river are not able to move faster.
- Fish in both systems have an extremely low return rate: less than half a percent of adults return to spawn.

Background

The Columbia River is subject to contamination from many sources, and the pollution can be harmful to fish and humans.



Columbia River Toxics Reduction Working Group

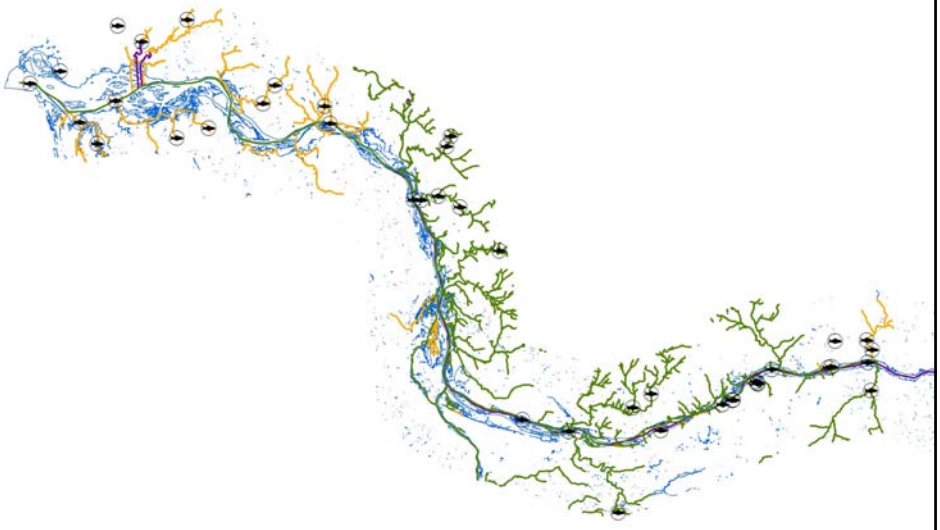
Data & Design

- Our database is designed to collect river pollution data from different sources in conjunction with data about fish habitat, hatchery locations, and life cycles.
- Having these data in one place will allow researchers to better understand the complex interactions between pollutants, water, and wildlife

Data & Design

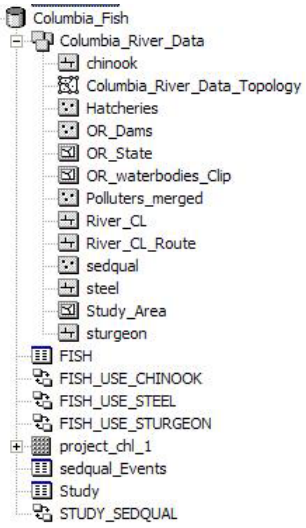
- Geographic data
  - Boundaries, dams, bodies of water, study area
- Fish data
  - Hatchery locations, habitat regions
- Satellite data
  - Chlorophyll-A concentrations
- Pollution data
  - Known polluter locations, PCB samples, study data

Data & Design



Data & Design

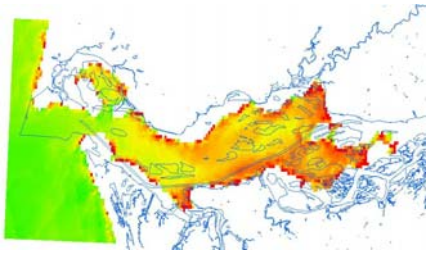
- Database normalization
  - Attribute domains
- Topology
  - Test points within waterbodies; polluter sites within study area
- Relationship classes
  - Fish feature data linked to qualitative values table; test points liked to study information table
- Routes & Events
  - Test points are events on the river route



Data & Design

Satellite chl-a (Chlorophyll-a) Data

- chl-a data are originally from NASA MODIS (Moderate Resolution Imaging Spectroradiometer) aboard the Terra (EOS AM) satellites
- The chl-a concentrations are indications of primary production at the base of the food chain. Less chl-a ultimately means less food for fish.



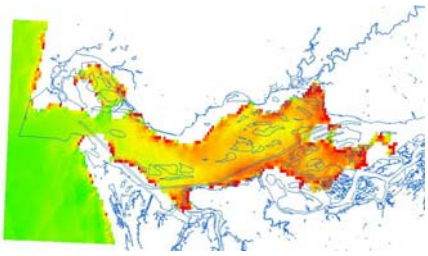
Data & Design

Creating a Raster

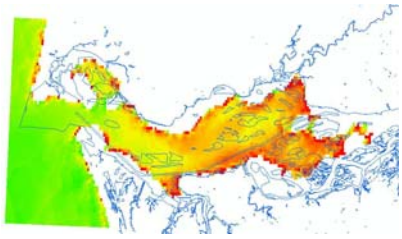
- Chl-a concentration data in the CRE (Columbia River Estuary) from

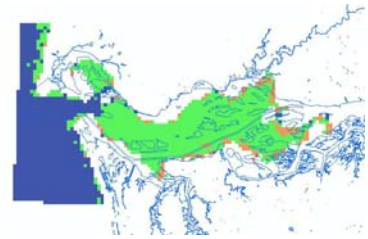
http://web.cecs.pdx.edu/~jaylab/project/ocean_color_web/Ocean_color_CR.html

- Remove the tidal effects. -- Long-term mean of the chl-a data in the CRE
- Build the geo-referenced raster layer
  - Change the data to raster format (ESRI asc)
  - Define projection

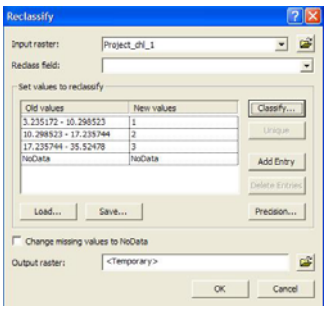


Analysis

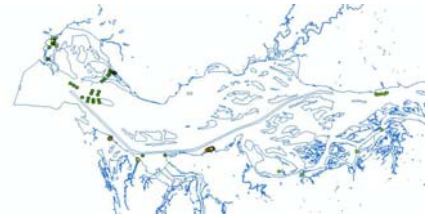


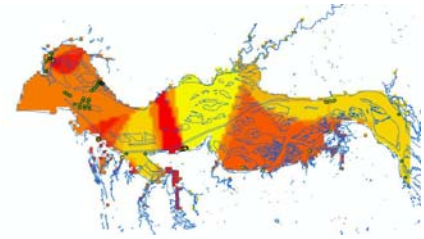


- Reclassified the raster for low, medium, and high levels of chlorophyll-a



Analysis





- A point layer of sediment samples tested for PCBs
- Generate a surface of PCB concentrations using Inverse Distance Weighting
- Reclassified surface into low, medium and high levels of contaminants

Analysis

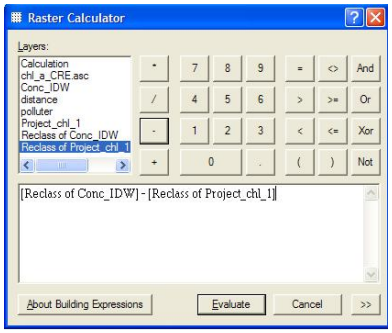
Combined two raster layers using raster calculator

PCB Concentrations - Chlorophyll-a = final output raster

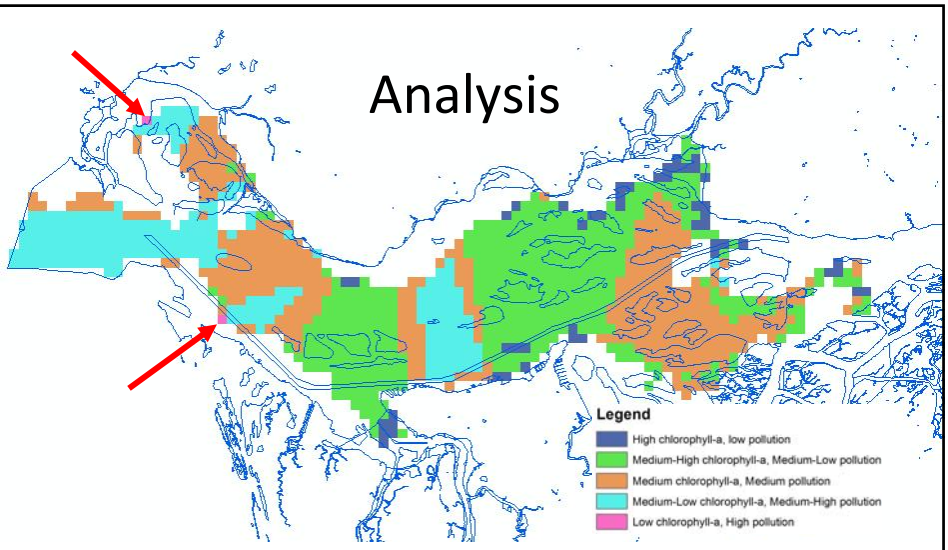
1 (low) - 3 (high) = -2 (more food/low contaminants)

2 (medium) – 2 (medium) = 0 (some food/some contaminants)

3 (high) – 1 (low) = 2 (less food/more contaminants)



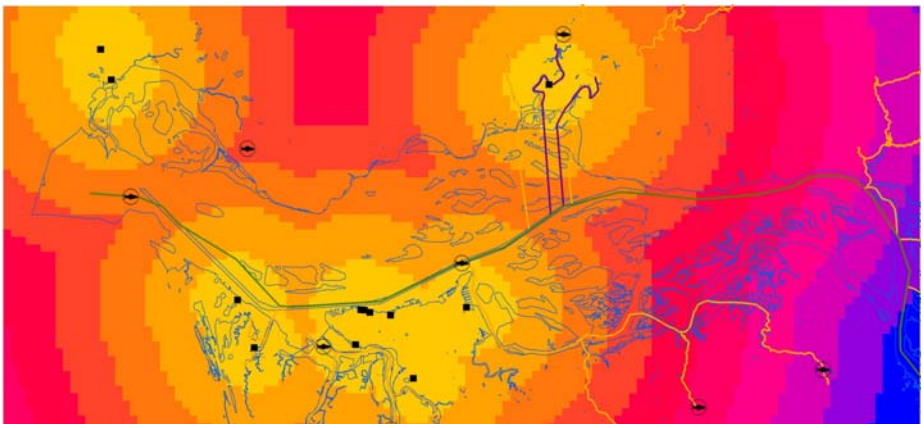
Analysis



- Raster calculator used to identify cells that have both the lowest chlorophyll-a and highest PCB concentration as locations least hospitable to fish.

Analysis

- Distance from polluter with hatcheries and fish habitat overlay.



Limitations

- Availability of data
  - Pollution data
  - Fish data
  - Satellite imagery
- Uneven distribution of data points
  - Uncertainty of spatial interpolation
- Not all polluters registered or identified
- Pollution sources from atmosphere, runoff
- Causal link between pollution, chlorophyll-a and overall river health

Limitations

Finding out where fish are going and where they have been is quite difficult outside of hatcheries and counting stations at dams.

This image shows acoustic tags that were surgically implanted in a steelhead smolt. Unlike shortwave radio tags that must pass close to a receiver to be read, these can be used on fish in undammed rivers. The tags are used to track fish migrating from spawning grounds to the North Pacific.

http://biology.plosjournals.org/perlserv/?request=slideshow&type=figure&doi=10.1371/journal.pbio.0060279&id=102243

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