



**DEQ**

State of Oregon  
Department of  
Environmental  
Quality

# Willamette Basin Rivers & Streams Assessment:

## An Example of Using National, State and Local Surveys to Support an Integrated Basin Water Quality Assessment

Michael Mulvey  
Robin Leferink  
Aaron Borisenko

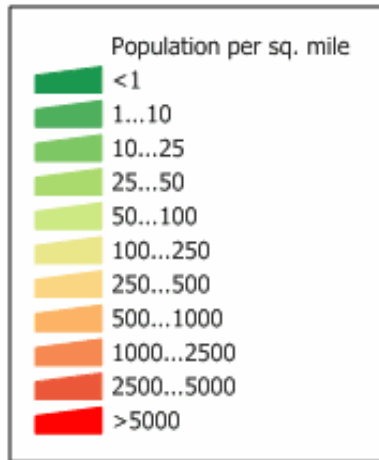
National Water Quality Monitoring Conference  
April 2012



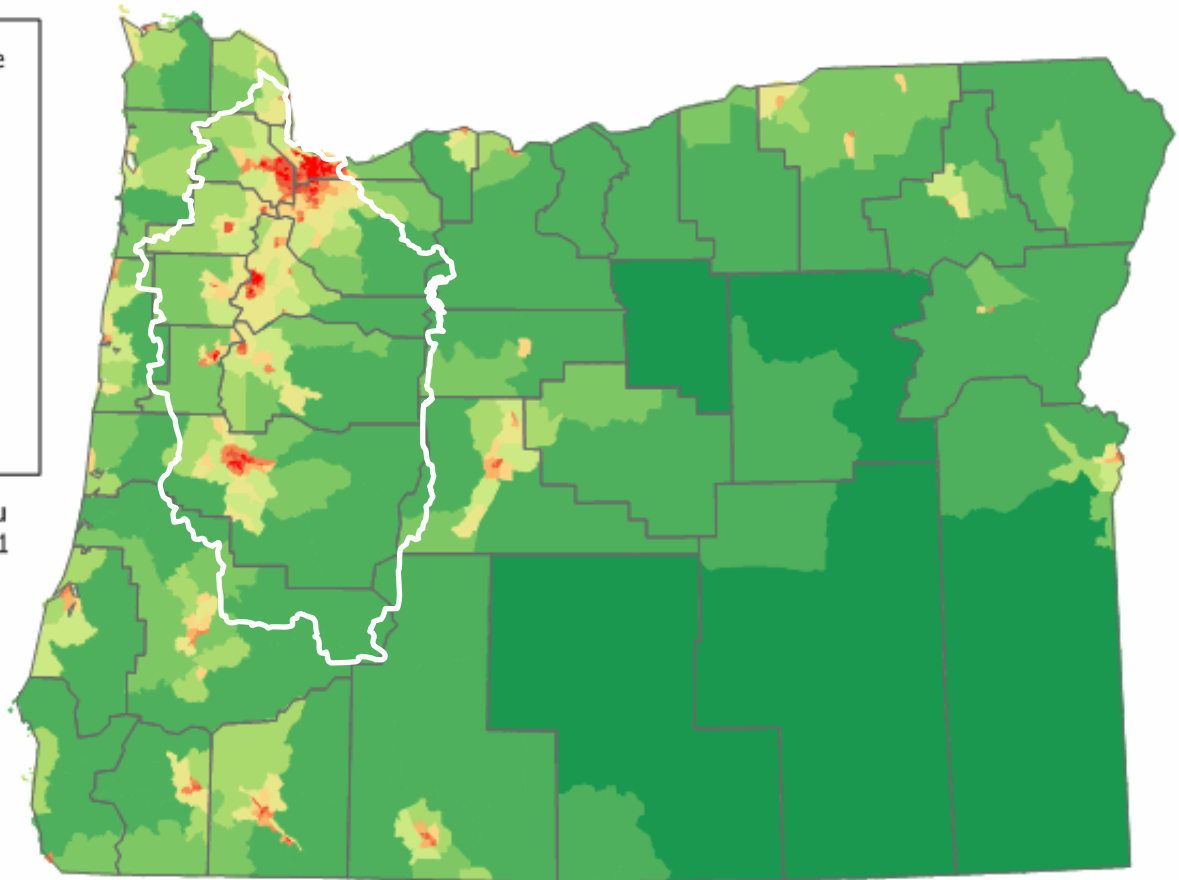
THE OREGON PLAN FOR  
*salmon & watersheds*

Photo by Sam Beebe/ECOTRUST

# Willamette Basin Rivers & Streams Assessment



Source: U. S. Census Bureau  
Census 2000 Summary File 1  
population by census tract.





## Willamette Basin

### Land Use

10%

Urban

30%

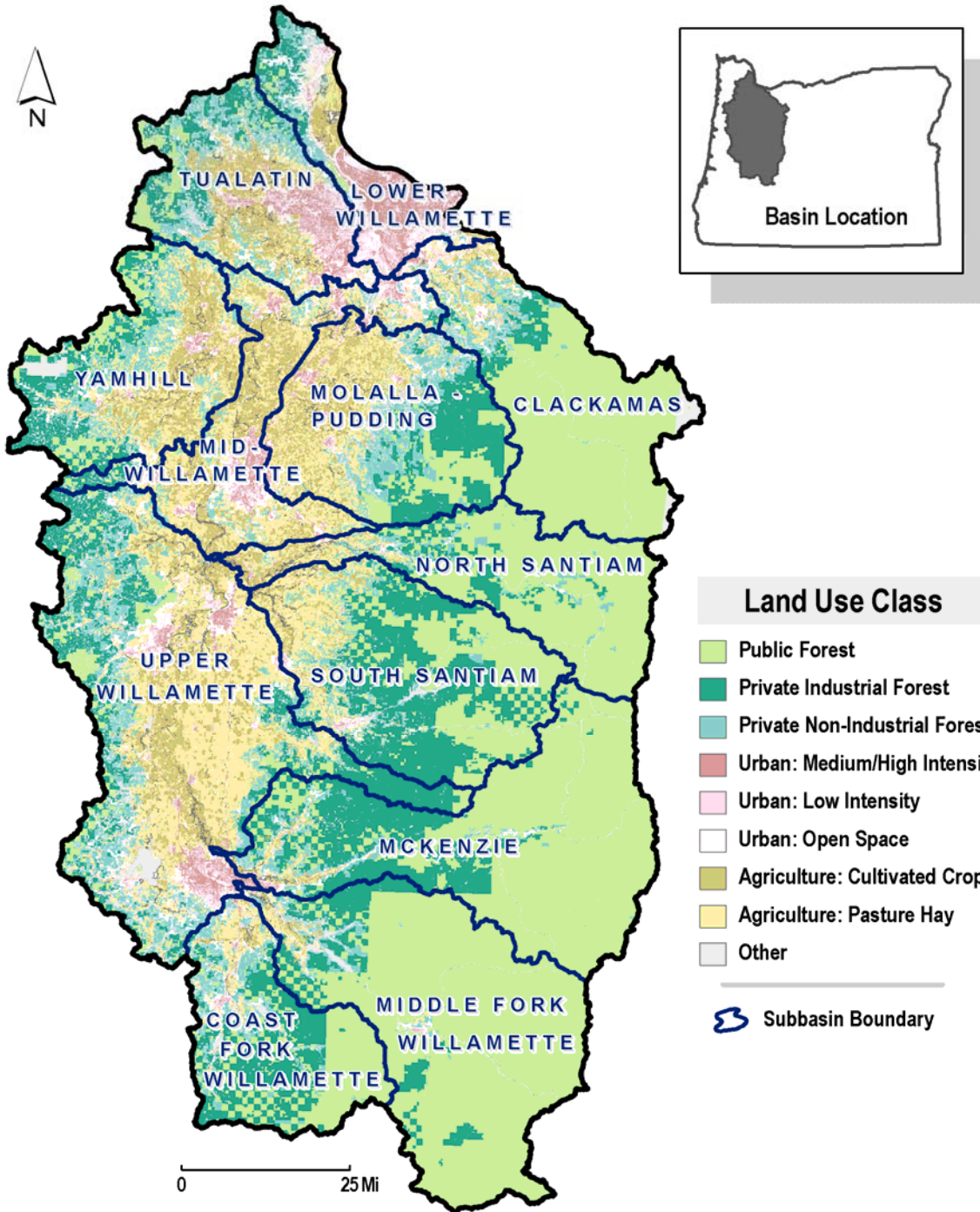
Agriculture

60%

Forest

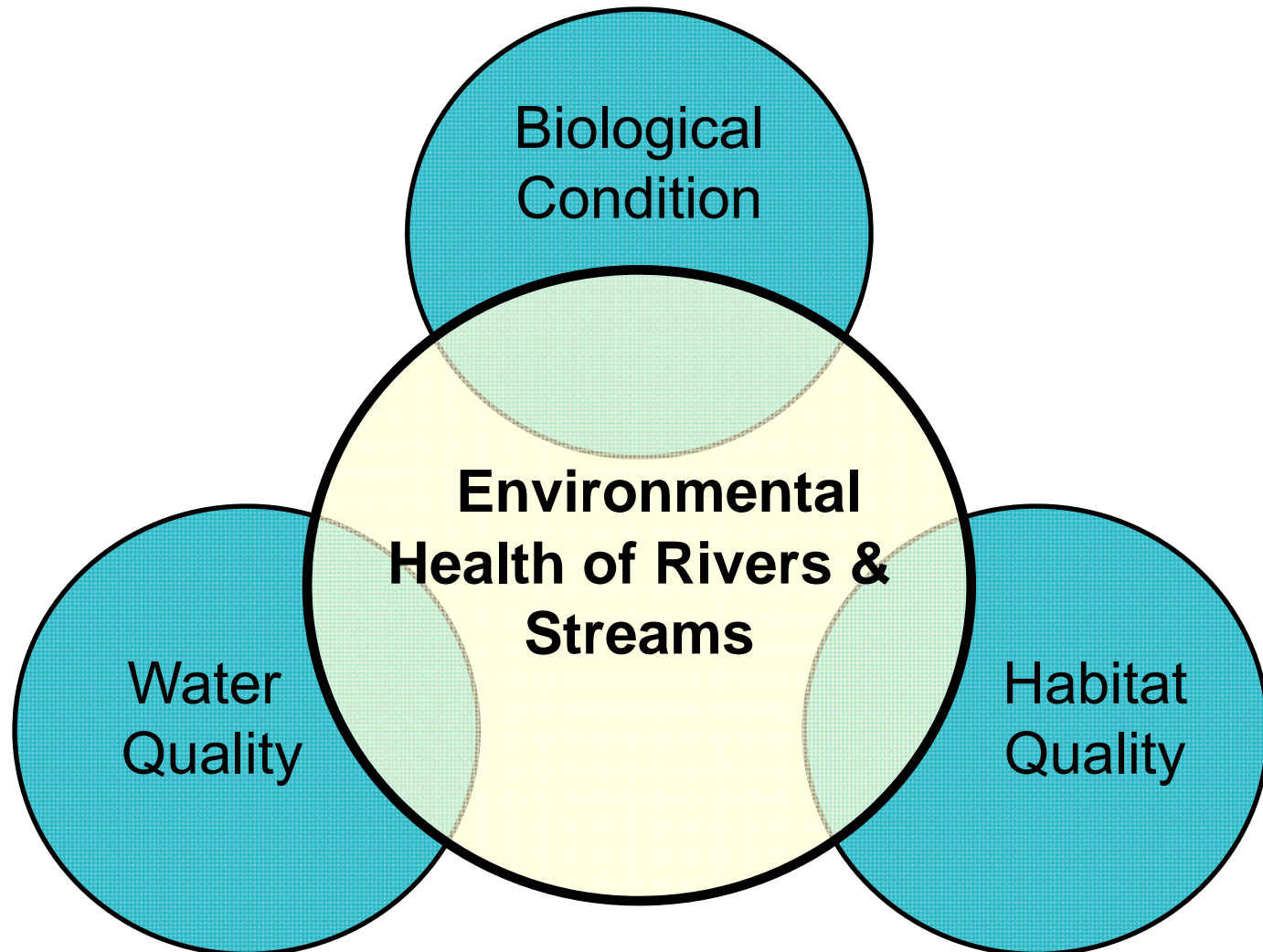
### Subbasins

(12)





## Components



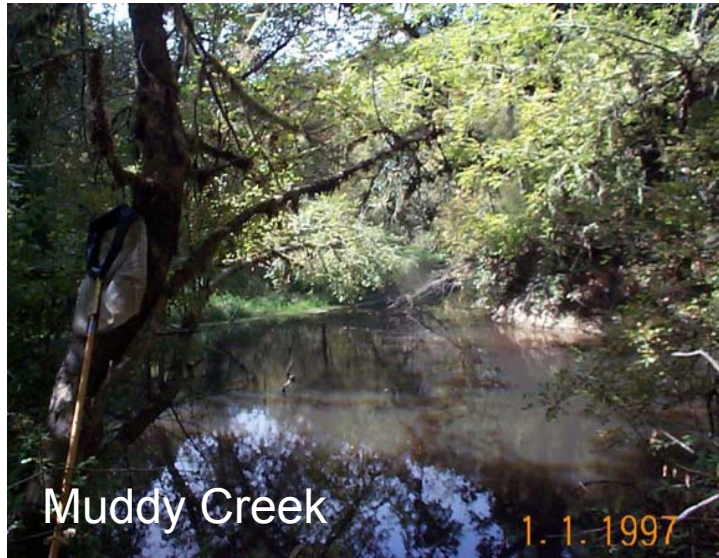
# Willamette Basin Rivers & Streams Assessment

Reference Condition

Not Reference Condition



Willamette  
Valley  
Ecoregion



Muddy Creek

1.1.1997



East Drew Creek

Coast Range  
Ecoregion



Roaring Creek

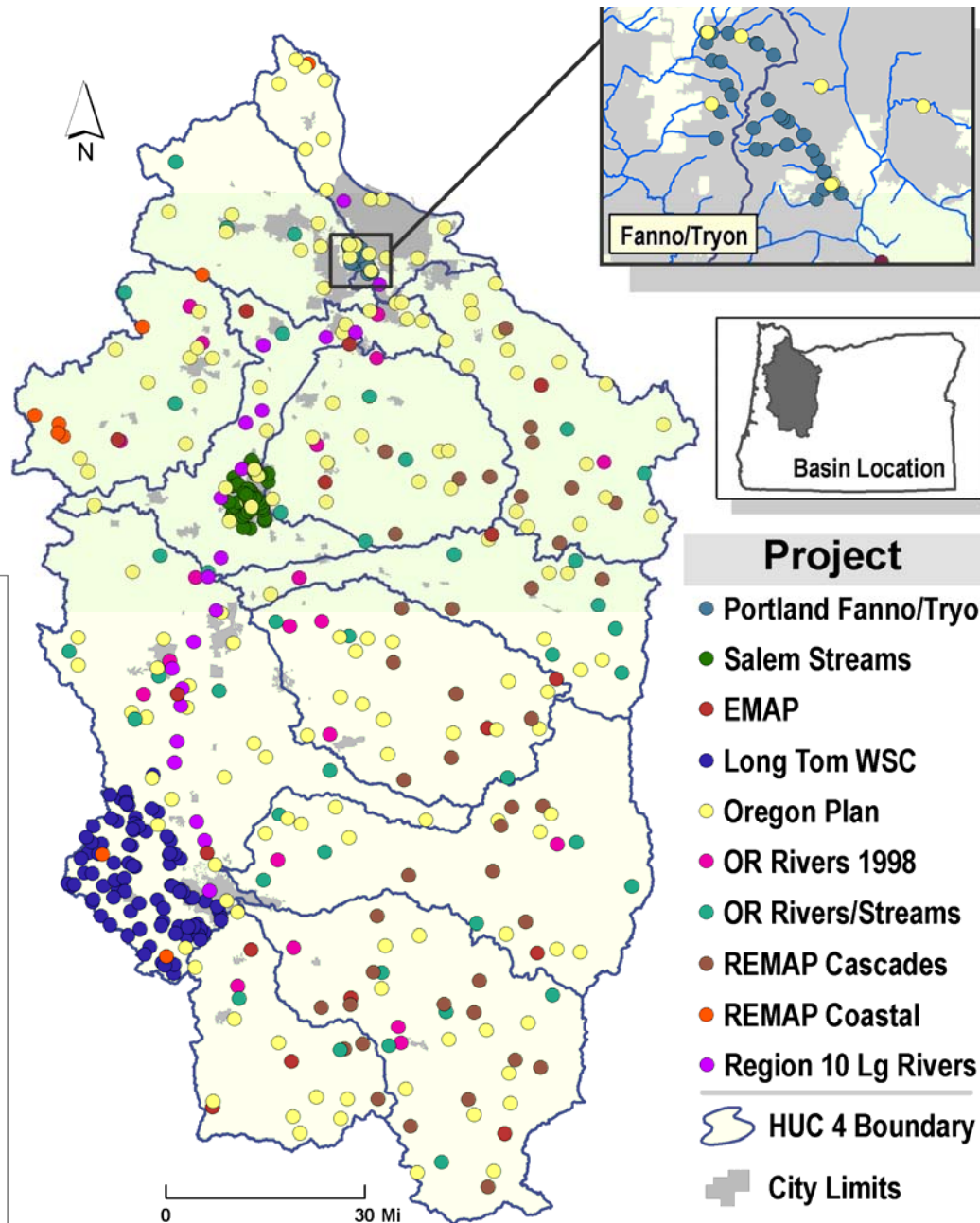
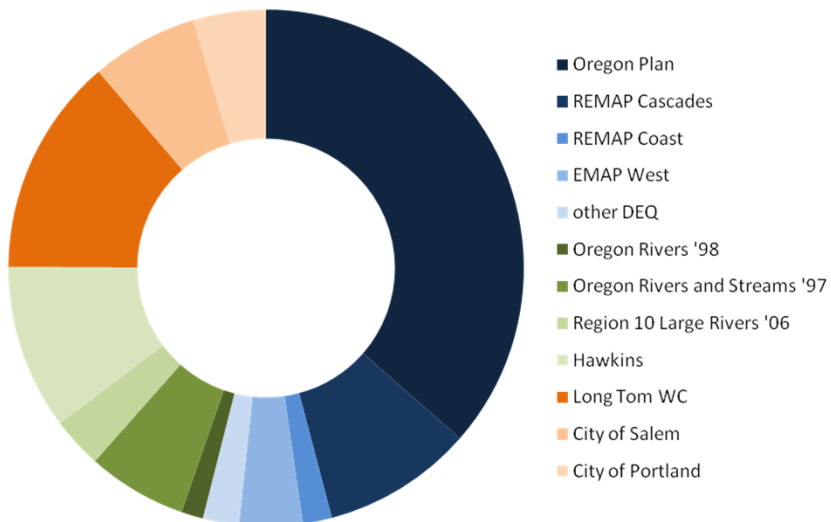


Gobel Creek

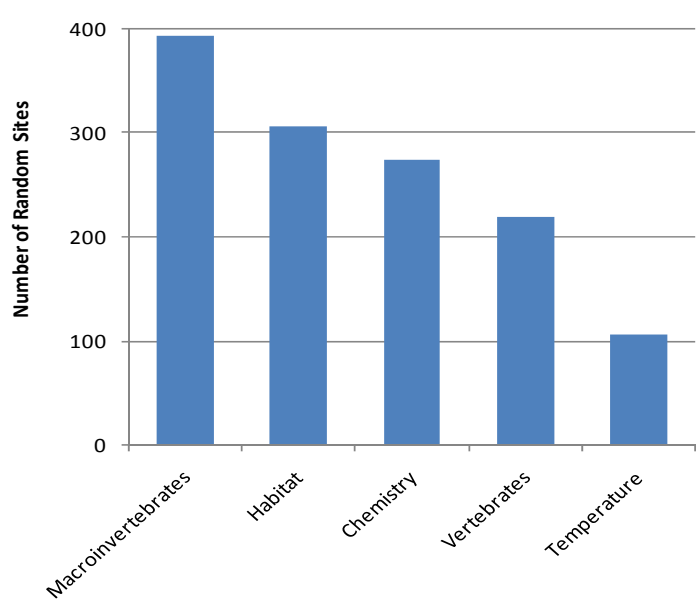
230  
Reference  
Sites

# 450 Random Sites, More Than 12 Different Sources

## Data Sources



## Random Sites Data Sets





## Combining Data

- Data from different sample surveys can be combined if certain design principles are followed
  1. Concordant target populations
  2. Consistent frame
  3. Randomization in site selection
  4. Common protocols (*and data quality*)

*From: Phil Larson, EPA Corvallis, Oregon, 2004*



## Design Principles for Combining Data:

# 1. Concordant Target Populations

- **Issues:**

- Target pop was natural, flowing, non tidal water for all surveys, *but* many different specific original target pops:
  - Stream size (Strahler stream order)
  - Subbasin
  - Land use
  - Ecoregion
  - Municipal/watershed council boundaries
  - Salmon/steelhead habitat

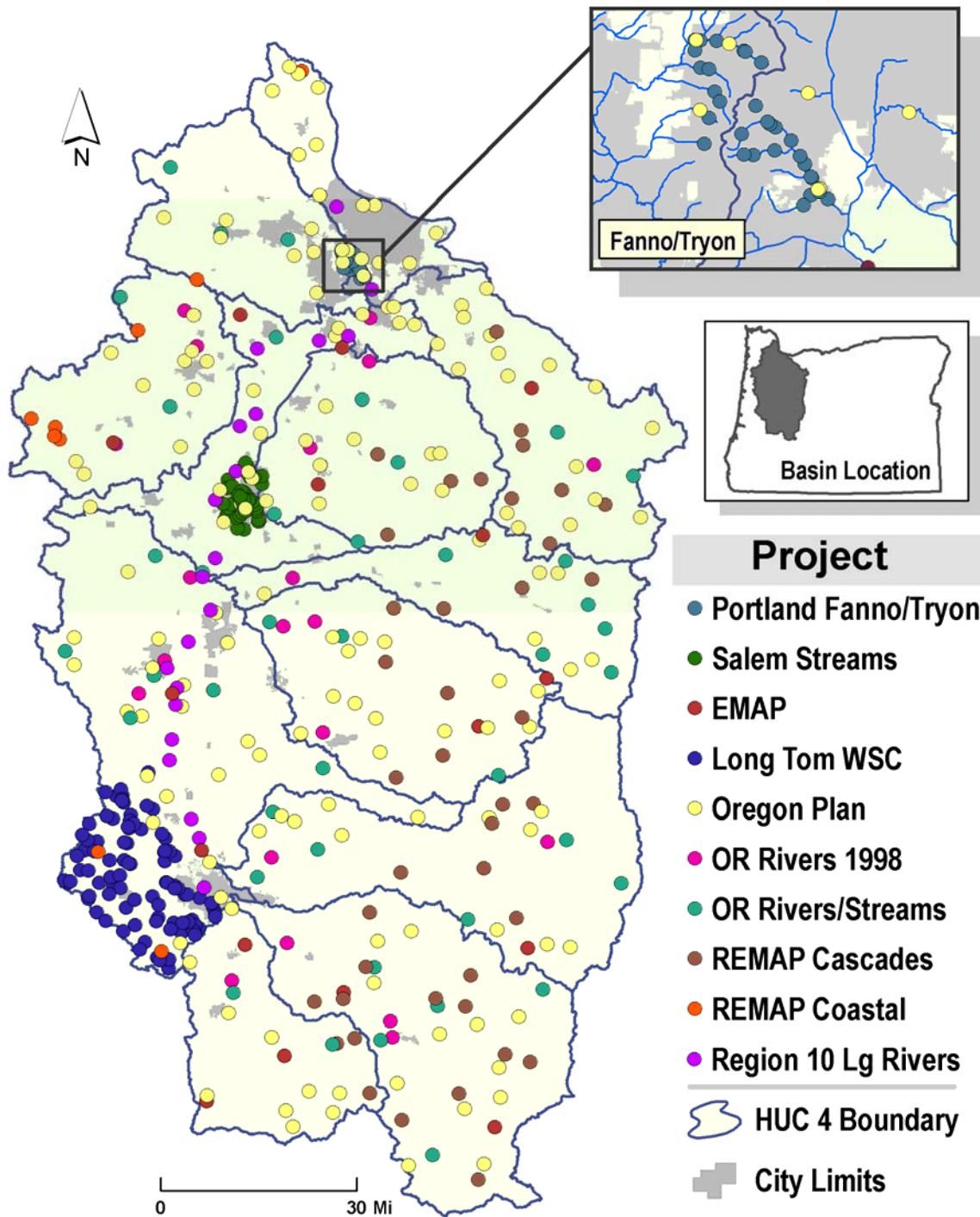
- **Resolution:**

- Create variable site weights:
  - % of total stream length each site is worth..
- Variable site weights based on land use, stream order, subbasin, municipal/watershed council boundary and data type.
- Variable site weights can be complicated but not difficult to do.





450  
Random  
Site  
Locations





## Design Principles for Combining Data: 2. Consistent frame

- **Issues:**
  - Not all surveys used the same map
  - Most surveys used 1:100K stream map but one used 1:24K map
- **Resolution:**
  - Not considered a big issue



## Design Principles for Combining Data: **3. Randomized site selection**

- **Issues:**
  - Not all studies used same site selection method
  - Most used EPA's GRTS method but one did not
- **Resolution:**
  - Not considered a big issue



## Design Principles for Combining Data: 4. Common protocols and data quality

- **Issues:**

- Metadata, metadata, metadata!!!
  - QA/QC documentation
- Staff changes
- Biological data sensitive to
  - Sampling effort
  - Taxonomic resolution
- Chemical units
- Errors
- Original data formats, storage and retrieval

- **Resolution:**

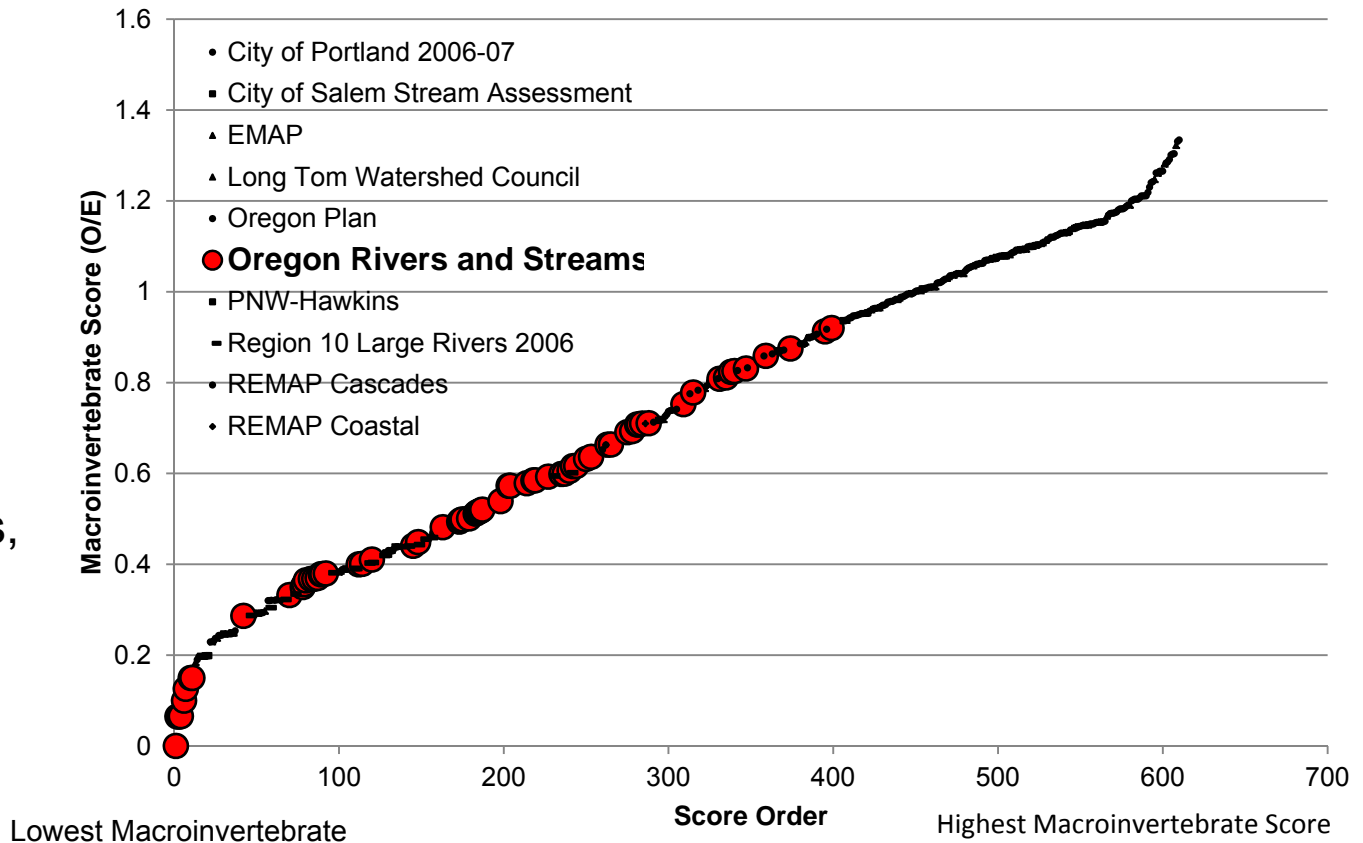
- Are data compatible?
- Look at the data graphically: Do the data make sense?
- ***“When in doubt: throw it out.”***

# Willamette Basin Rivers & Streams Assessment



*Look at the graphically data: Do the data make sense?*

## Macroinvertebrate Biological Condition Scores by Data Source



Low scores reflect difference in collection protocols, not in biological condition of the water bodies

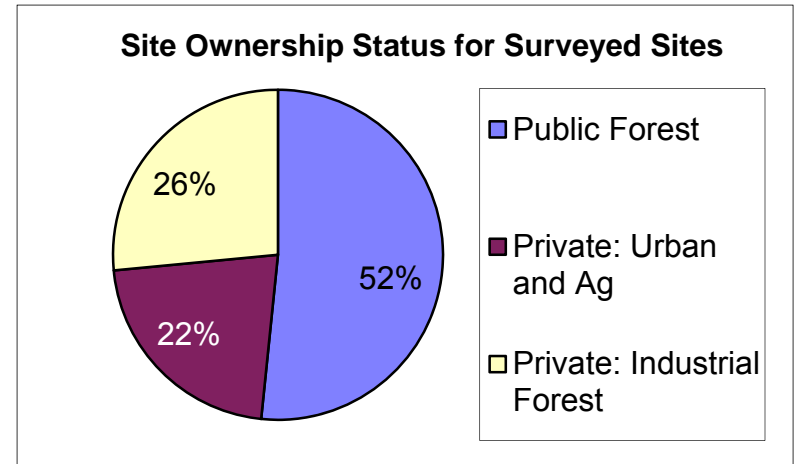
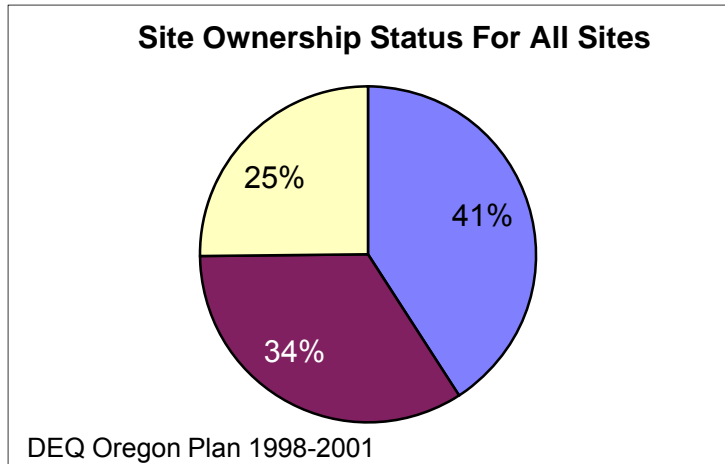
# Willamette Basin Rivers & Streams Assessment



# Willamette Basin Rivers & Streams Assessment



## Bias: the random sample is not representative of the population

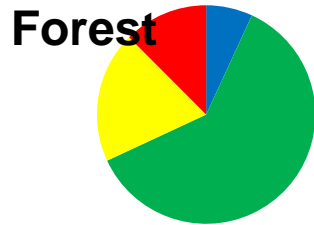


- Issue:
  - No access permission for 48% of agricultural and urban land owners.
  - No access permission for 21% of industrial forest land owners.
  - Privately owned sites make up about 60% of the original site list but less than 50% of the sites surveyed.
- Resolution:
  - Outreach to forest industry groups.
  - Replacement site selection based on land use and stream order.
  - Variable site weights based on land use corrects for sampling access bias.

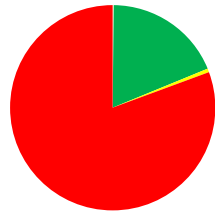
# Willamette Basin Rivers & Streams Assessment



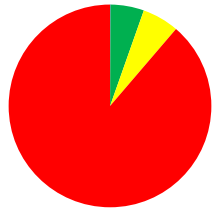
## Basin Land Use: Biological Condition



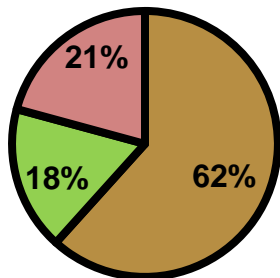
## Urban



## Agriculture



## Most Disturbed Stream Miles by Land Use



## Leading Stressors:

### •Forest

- Warm water temperature
- Large woody debris and fish cover

### •Urban

- Warm water temperature
- Excess fine sediment
- Poor riparian vegetation

### •Agriculture

- Warm water temperature
- Poor riparian vegetation
- Excess fine sediment

**Agriculture streams makes up about 30% of the stream miles but 62% of the most disturbed stream miles**

**Urban streams make up 10% of the stream miles but 21% of the most disturbed stream miles.**



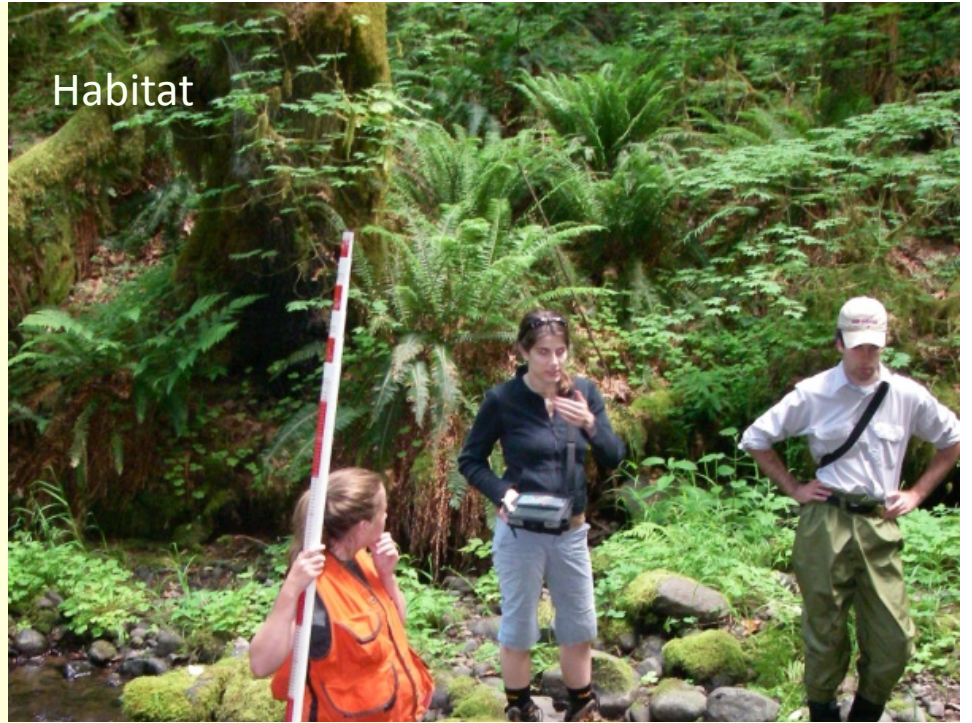


Photo by Sam Beebe/ECOTRUST





Fish and Amphibians



Habitat



Bugs



Chemistry



Tualatin River



An agricultural stream



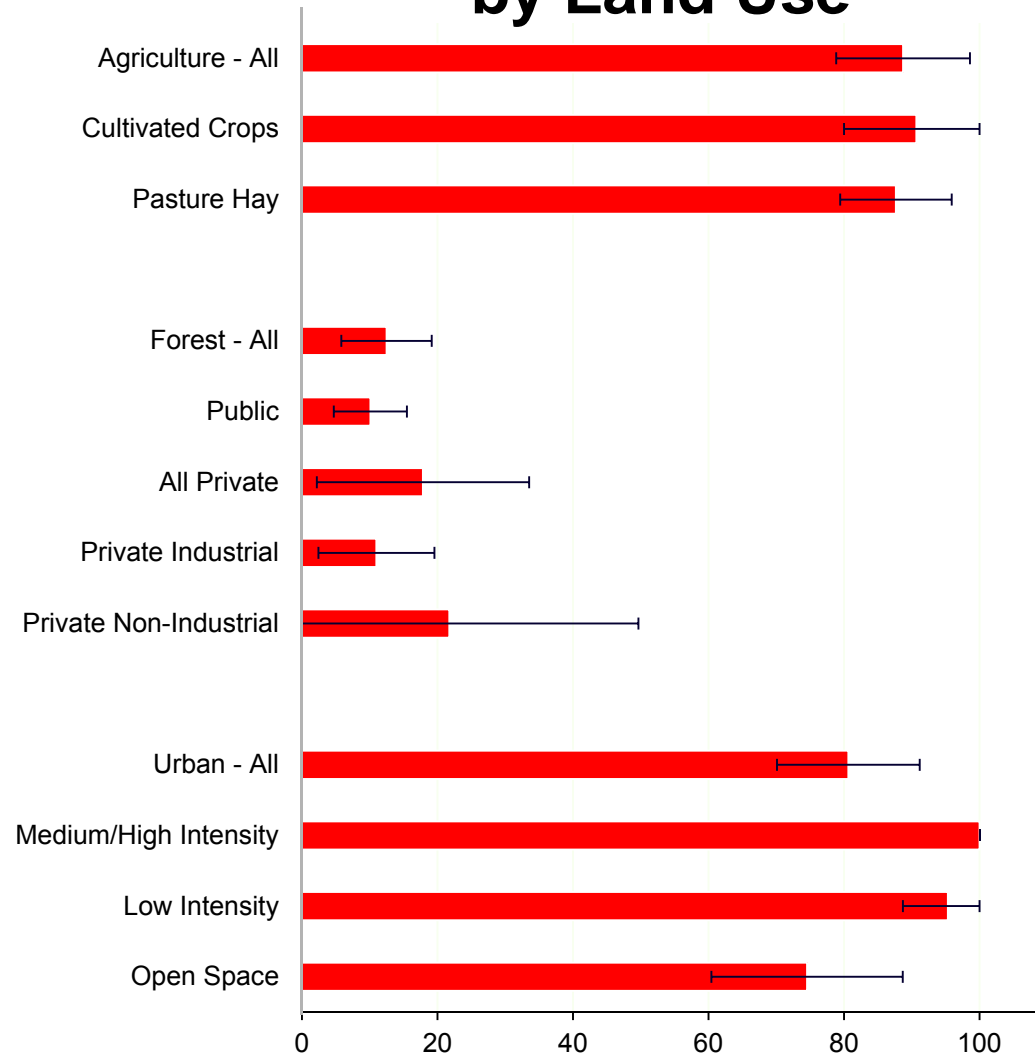
An urban stream



A forest stream

# Willamette Basin Rivers & Streams Assessment

## Highly Disturbed Biological Condition by Land Use

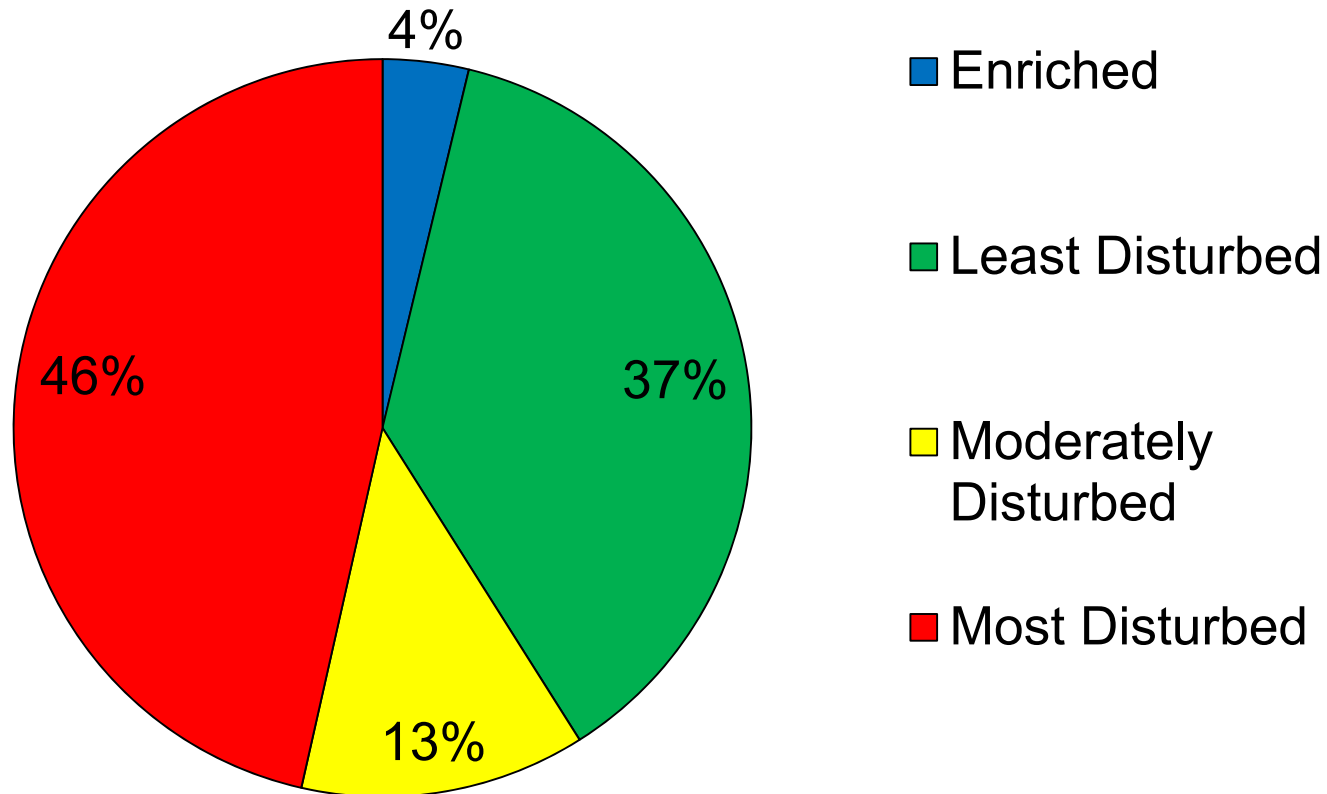


**% Stream Length Impaired**

# Willamette Basin Rivers & Streams Assessment



## Willamette Basin Biological Condition



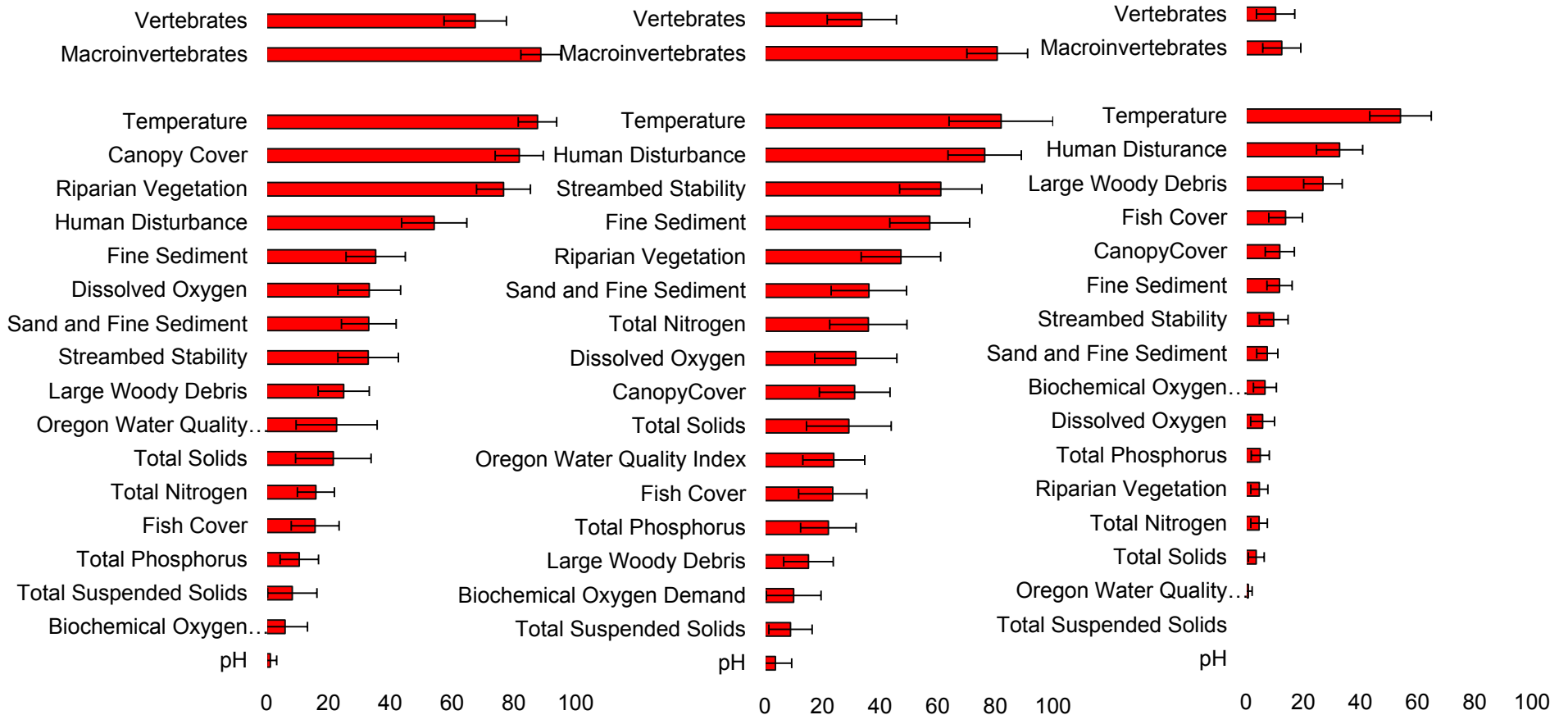
# Willamette Basin Rivers & Streams Assessment

## Major Land Uses

### Agricultural Impairment

### Urban Impairment

### Forest Impairment

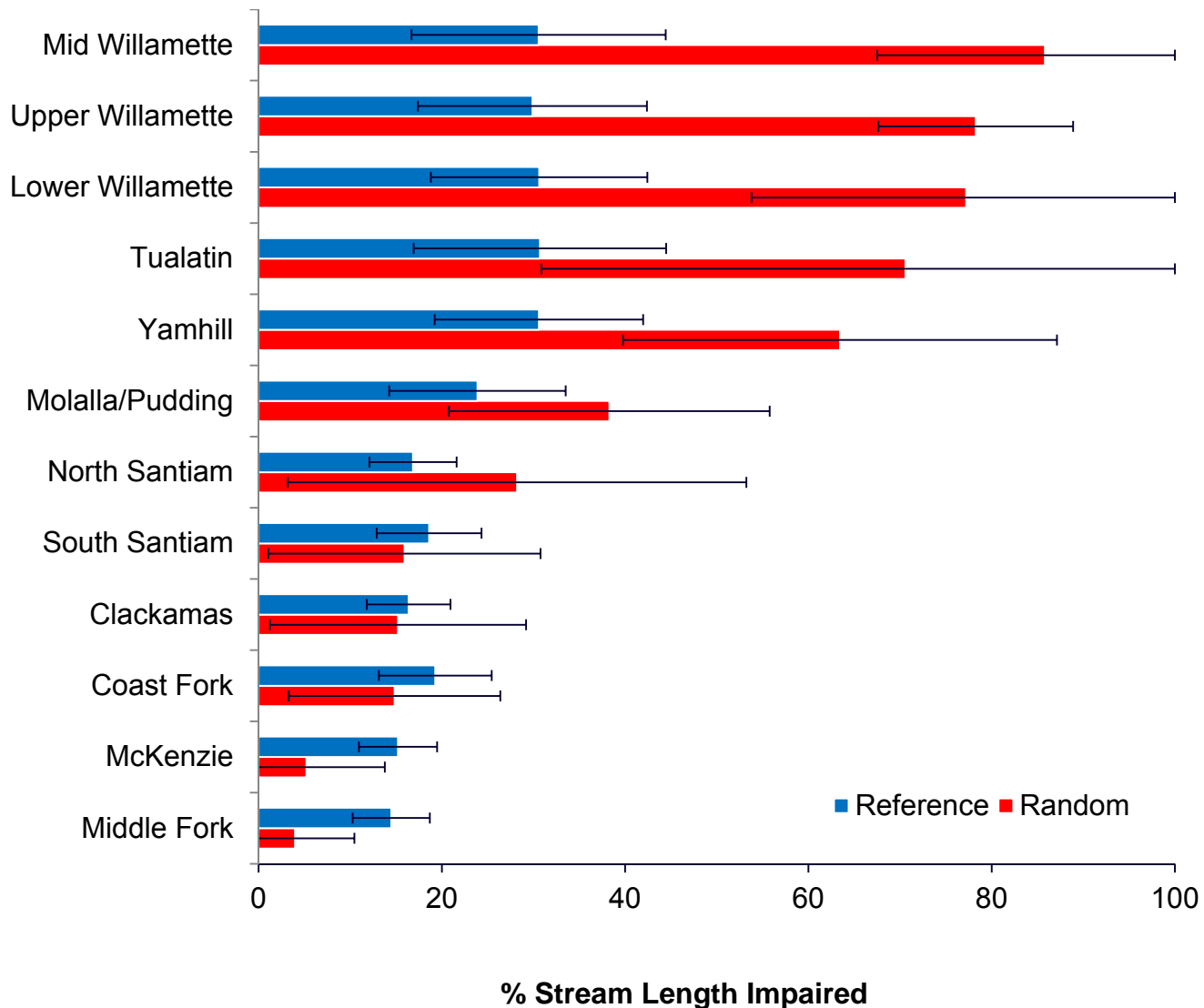


% of Stream Length

# Willamette Basin Rivers & Streams Assessment

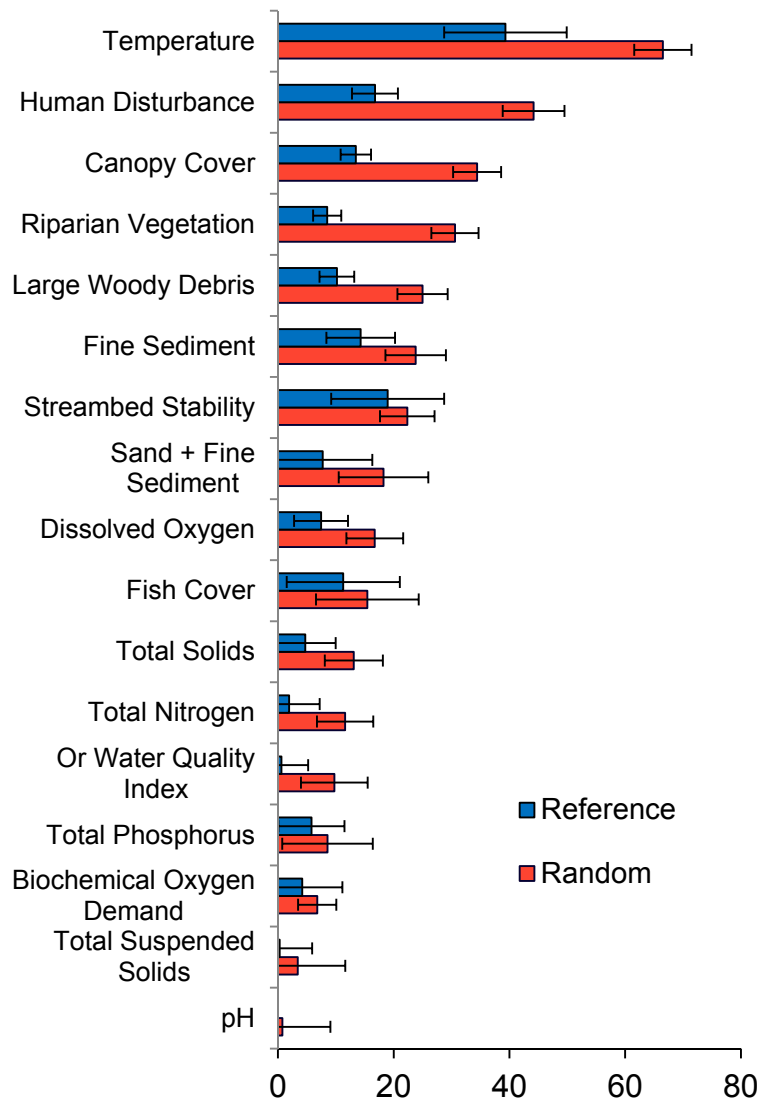


## Subbasins biological impairment





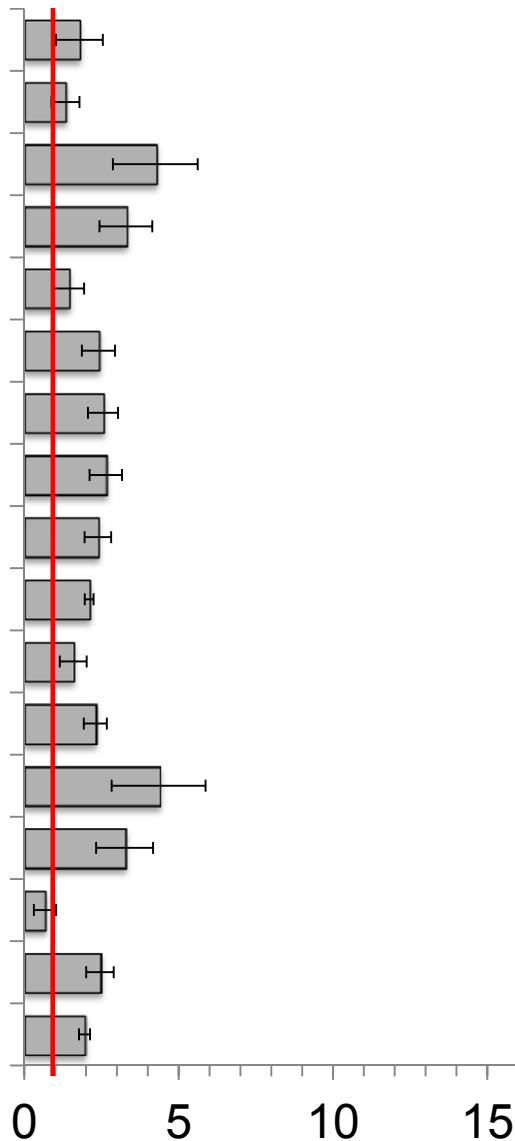
# Basin: Stressor Extent



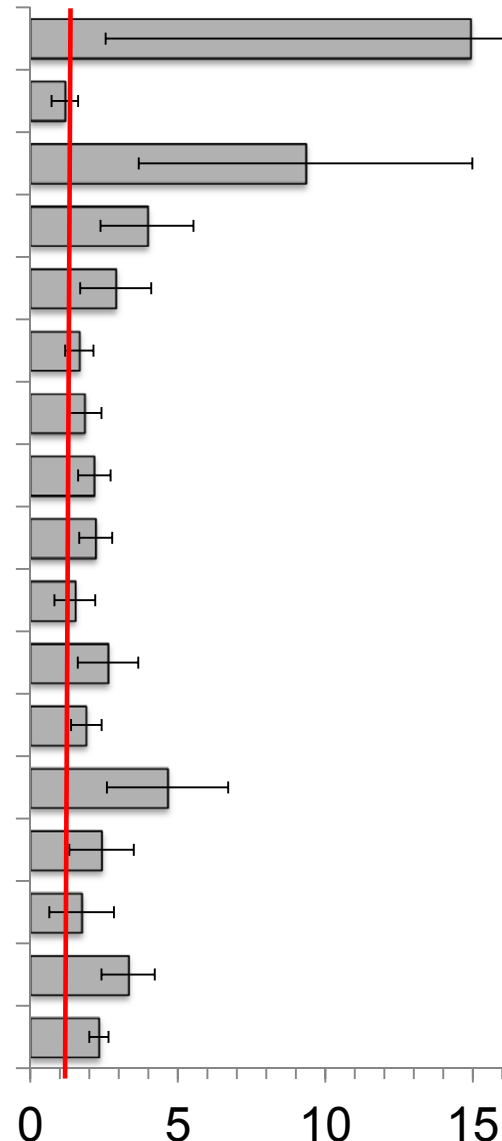
% Stream Length Impaired

# Relative Risk

## Macroinvertebrates



## Vertebrates



Risk Factor

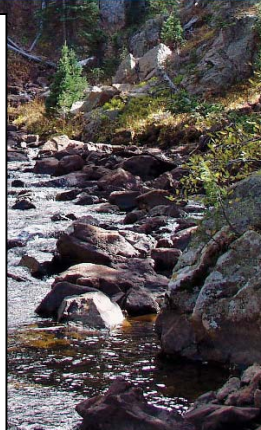
# Willamette Basin Rivers & Streams Assessment

[www.deq.state.or.us/lab/wqm/assessment.htm](http://www.deq.state.or.us/lab/wqm/assessment.htm)



## Related Reports

available on DEQ and EPA web sites



# Willamette Basin Rivers & Streams Assessment

## *Thank You*



### **Survey Design**

- Don Stevens, OSU
- Tony Olson, EPA
- Phil Larsen, EPA

### **Training & Equipment**

- Bob Hughes, OSU
- Phil Kaufmann, OSU
- David Peck, EPA

### **Data Sources**

- Bob Hughes, OSU
- Allen Herlihy, OSU
- Dave Peck, EPA
- Marlys Cappaert, SRA
- Curt Seeliger, SRA
- Chuck Hawkins, USU
- Ken Roley, City of Salem
- Chris Prescott, City of Portland
- Cindy Theiman, Long Tom Watershed Council

### **Data Analysis**

- Don Stevens, OSU
- John Van Sickle, EPA
- Thom Whittier, OSU
- Bill Gaeuman, OSU
- Shannon Hubler, DEQ



Muddy Creek in the Finley National Wildlife Refuge

[www.deq.state.or.us/lab/wqm/assessment.htm](http://www.deq.state.or.us/lab/wqm/assessment.htm)

# Willamette Basin Rivers & Streams Assessment



Reference

Biological Response

Moderately Disturbed

Severely Disturbed

Pristine

Slightly impaired

Moderately impaired

Highly impaired

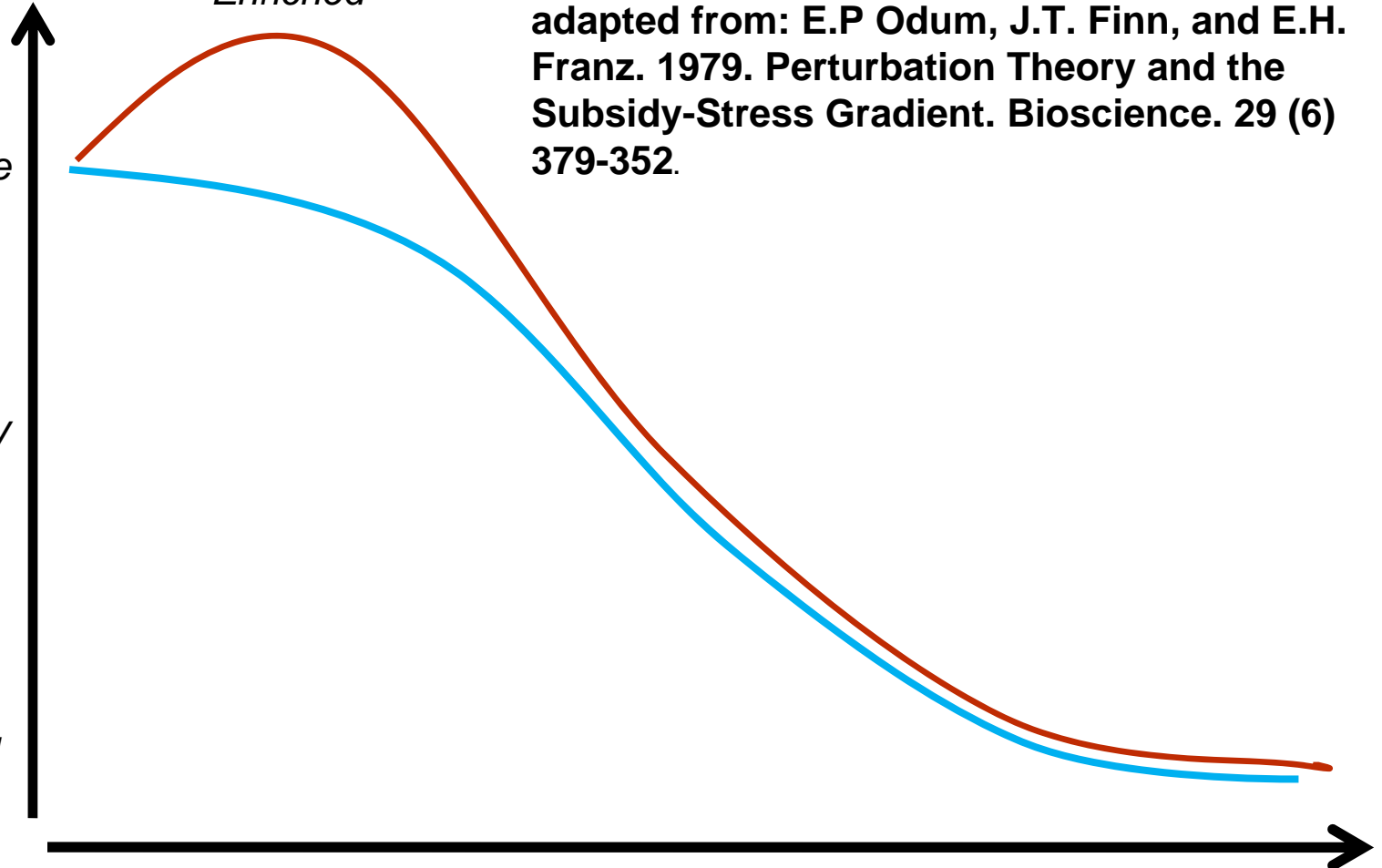
Lethal

Environmental Disturbance/Impairment Gradient

## Hypothetical biological response for a disturbed ecosystem

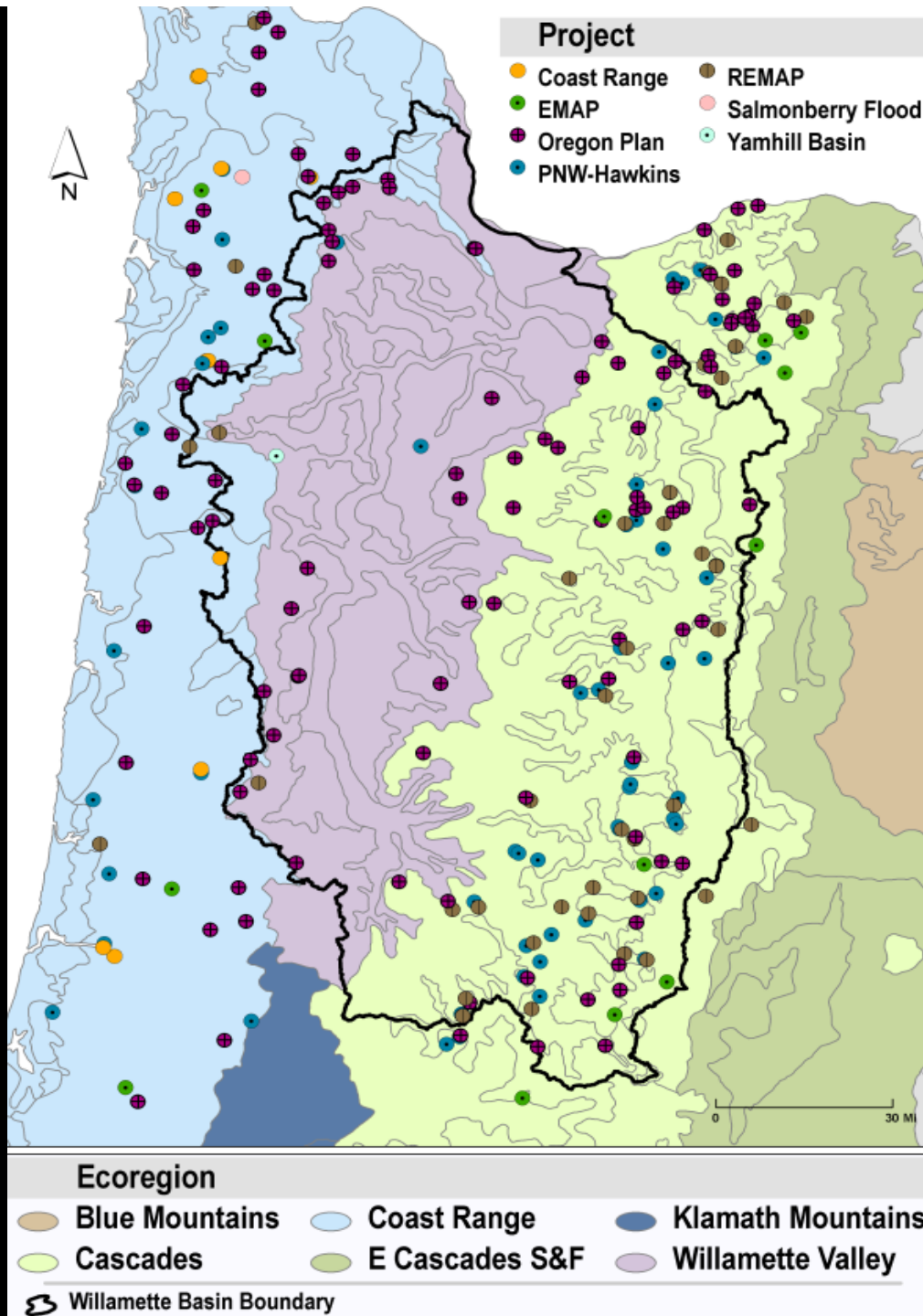
adapted from: E.P Odum, J.T. Finn, and E.H. Franz. 1979. Perturbation Theory and the Subsidy-Stress Gradient. *Bioscience*. 29 (6) 379-352.

*Enriched*





# 230 Reference Site Locations





## Site Ownership and Survey DEQ Oregon Plan Stream Surveys 1998-2001

