# Monitoring for Adaptive Management

## Status and Trends Monitoring of Aquatic and Riparian Habitats in the Lake Washington/Cedar/ Sammamish Watershed

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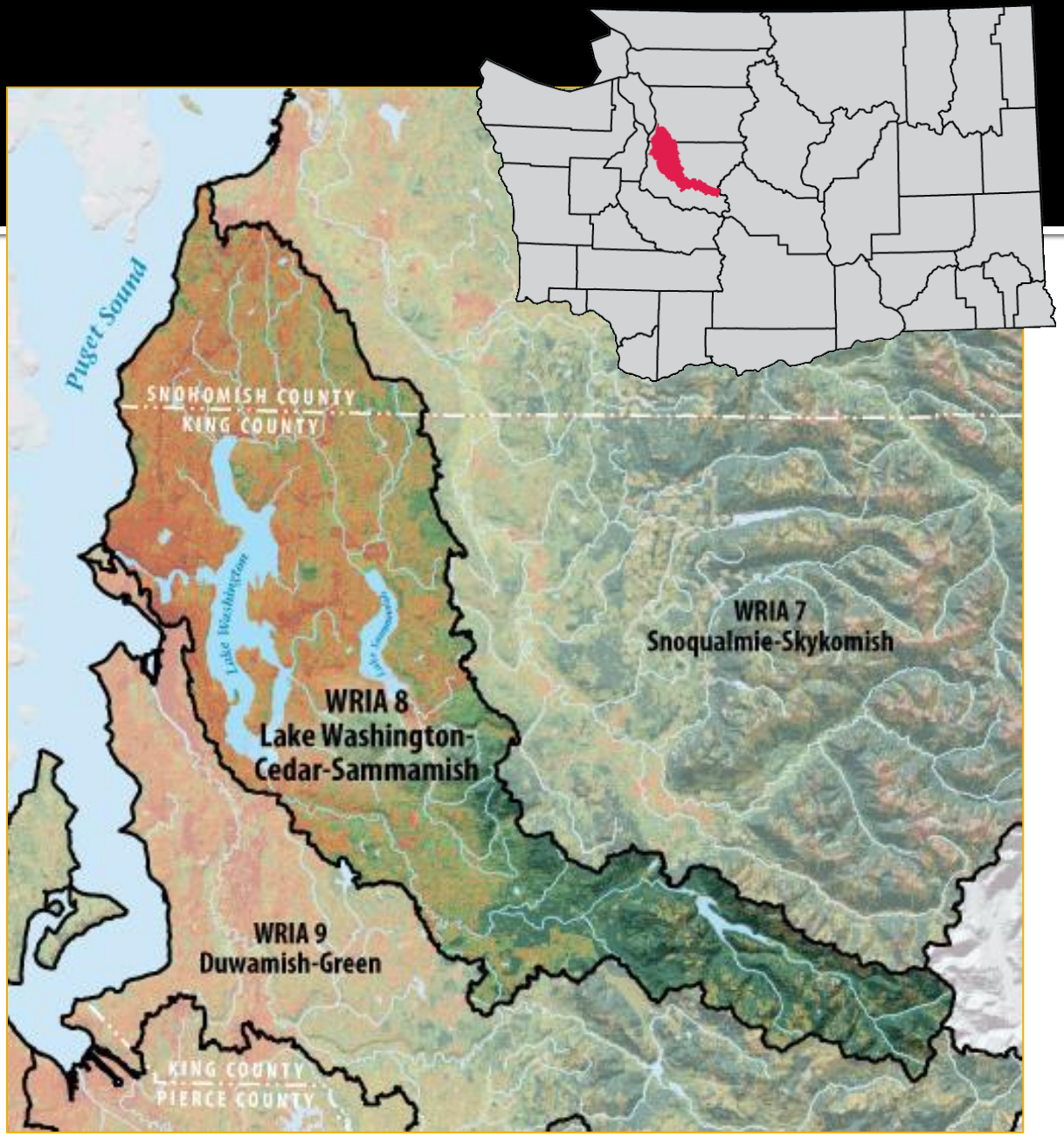
# Water Resource Inventory Area (WRIA) 8

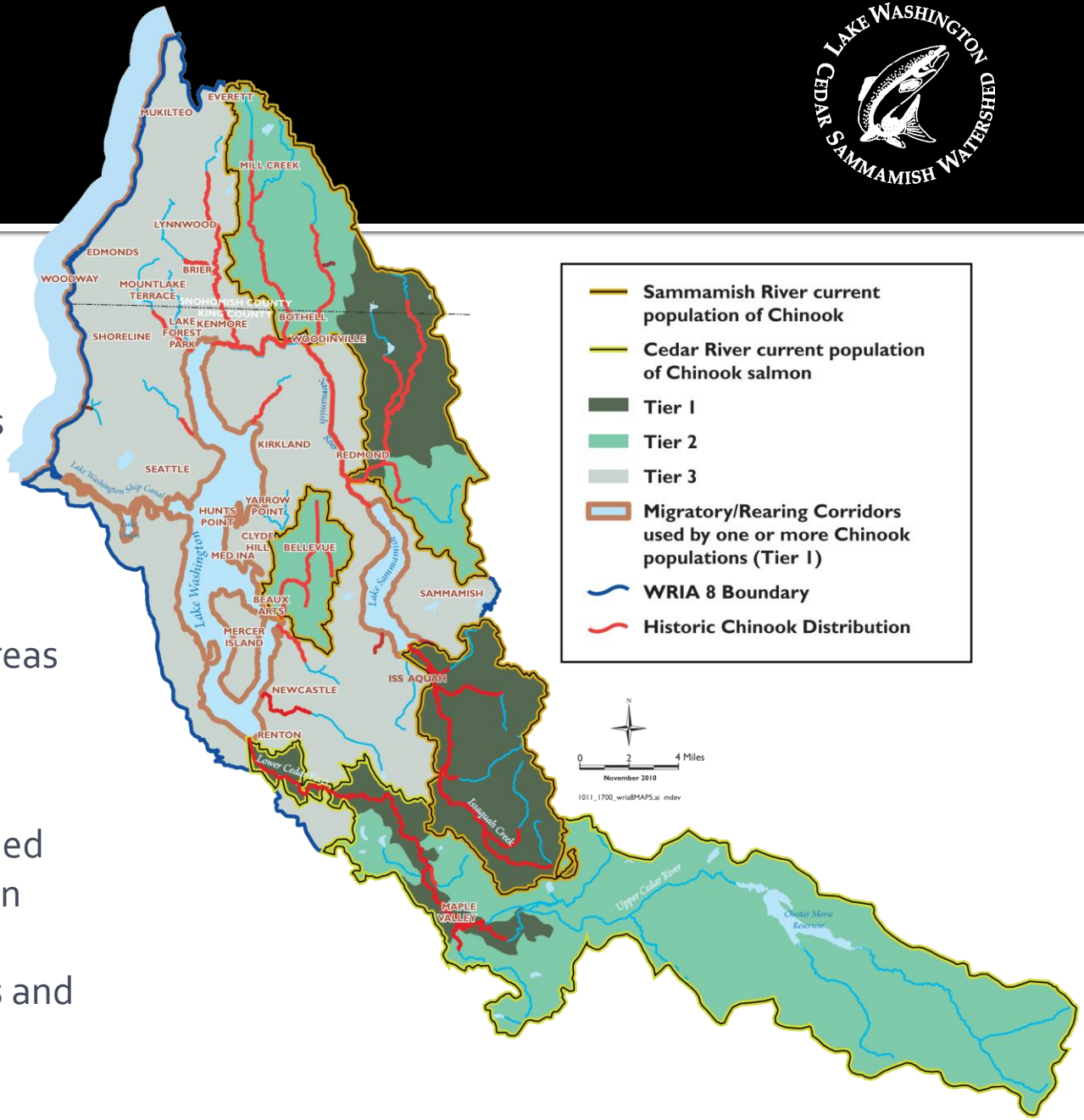
## Lake Washington/ Cedar/ Sammamish Watershed

- 1.4 million inhabitants
- Most highly developed watershed in the state



# Water Resource Inventory Area (WRIA) 8

- Two listed Chinook salmon populations, plus steelhead, bull trout, kokanee, other salmonids
- Protected headwaters (Cedar Watershed)
- Spawning and rearing areas generally outside urban growth boundary
- Salmon recovery governed by a collaborative "Salmon Recovery Council" of 27 jurisdictions plus business and environmental groups



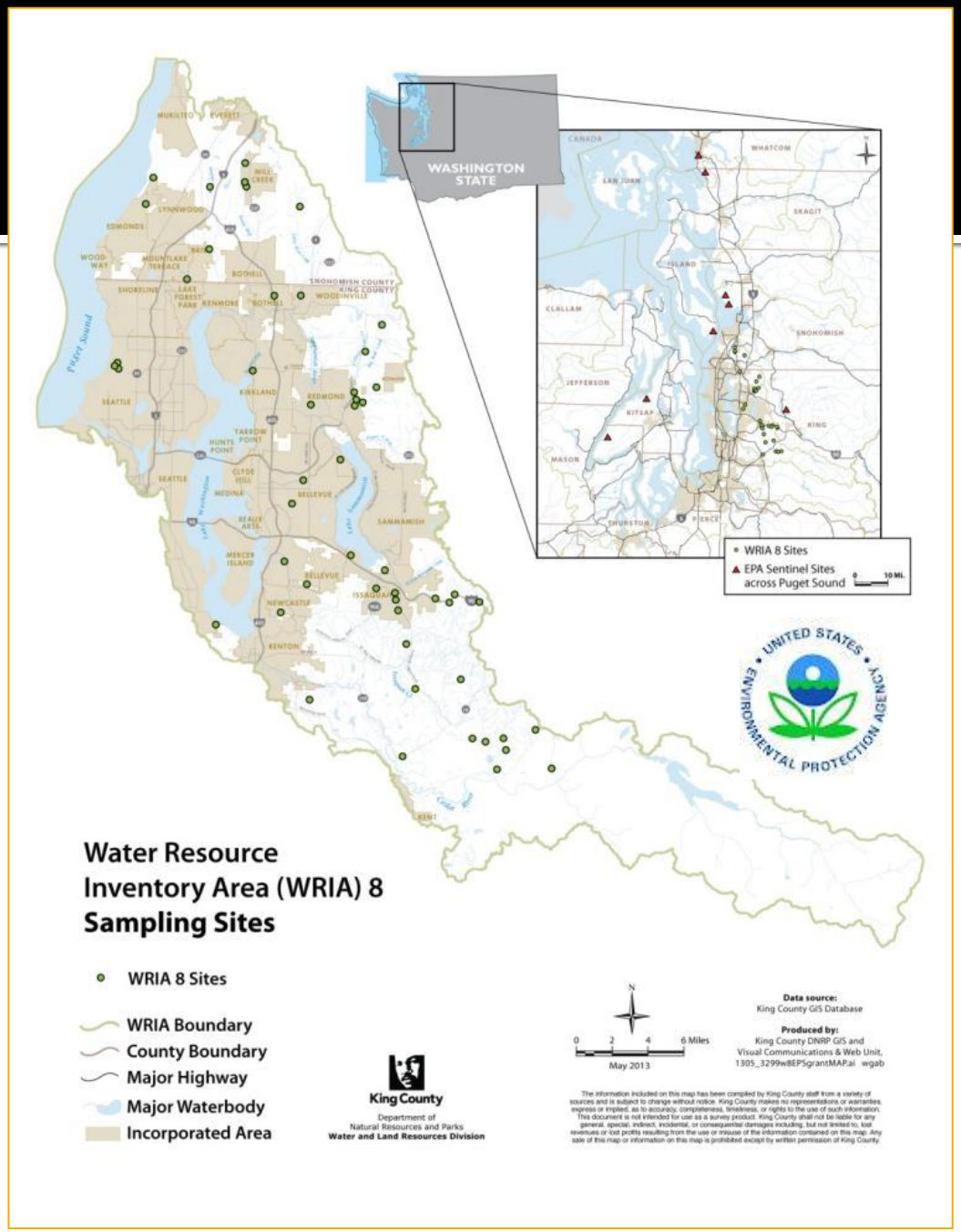
# Status and Trends Monitoring

- Chinook Salmon (VSP)
  - (Fish in/fish out monitoring)

- Watershed Conditions
  - Stream Condition (habitat, biota)
  - Streamflow
  - Water Quality
  - Land Cover

# Approach: Status and Trends

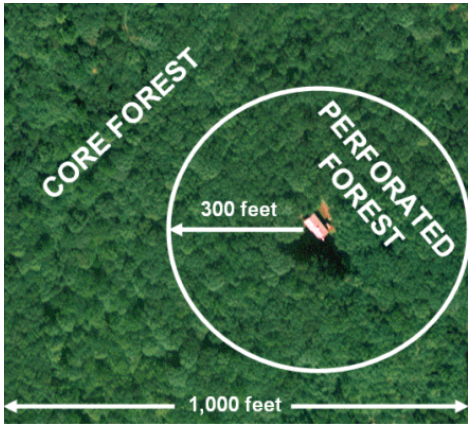
- 52 sites in WRIA 8
  - (Ecology/EMAP GRTS sample draw)
- 5y sampling window
  - (year 1: n = 29)
- +5 EPA "Sentinel" sites across Puget Sound
  - Chuckanut Creek
  - Glendale Creek
  - Griffin Creek
  - Dewatto River
  - Big Beef Creek

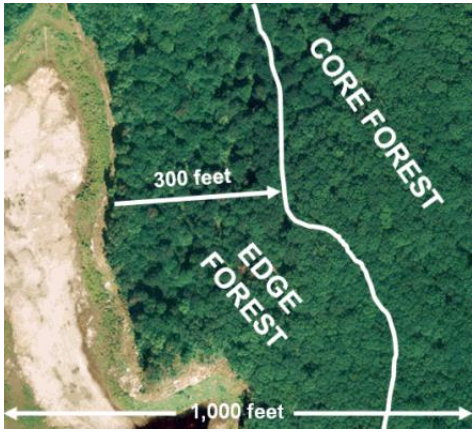


# Metrics:
# Baseline Information/Status & Trends

- Biology: BIBI, FIBI, diversity indices
- Habitat: normalized metrics vertical residual pool area, embeddedness, % fines, LWD count/volume, riparian cover, disturbance, etc. (ECY/EMAP protocols)
- Hydrology: Flashiness, high pulse count, low pulse count, TQ Mean, R-B Index, etc (subset of sites)
- Summer water temperature: 7DADM, days above critical thresholds, etc. (one year)
- Land cover: % urban, % impervious, % forest, population/$KM^2$, elevation, forest fragmentation, etc.

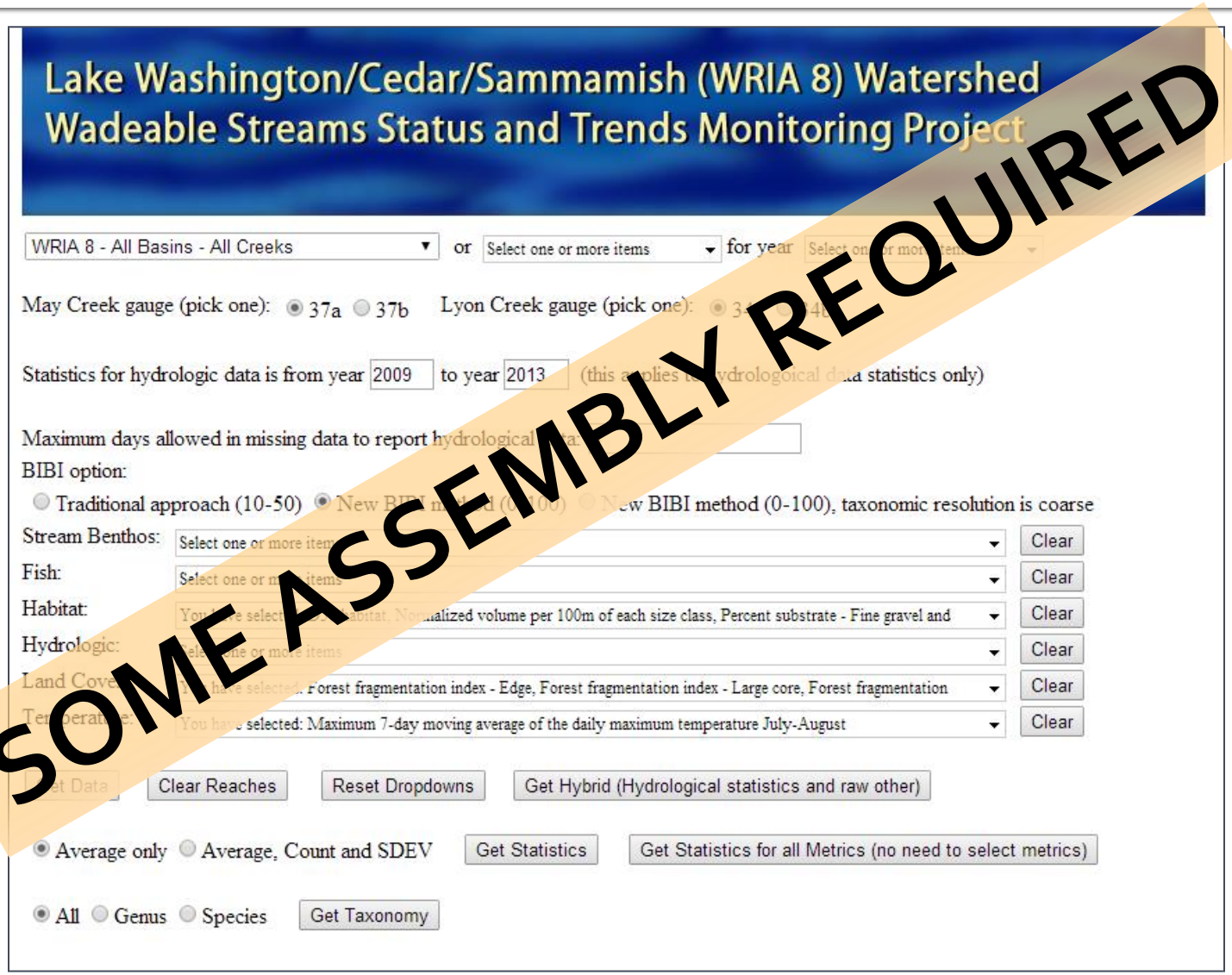
# Fragmentation Metrics






Derived from LandSat (30m) land cover product:
"300 feet" = 3 pixels and "1,000 feet" = 10 pixels

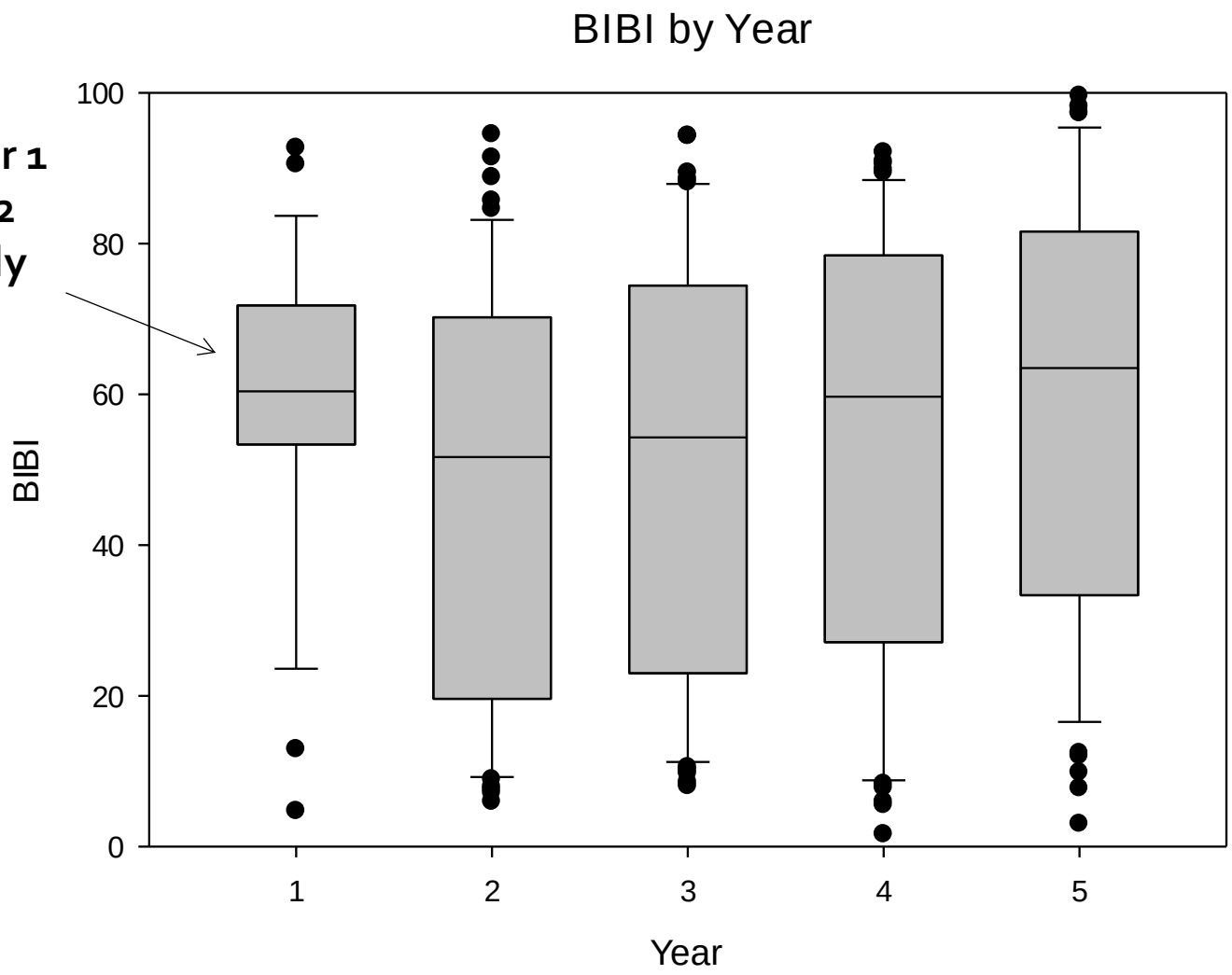
# Database



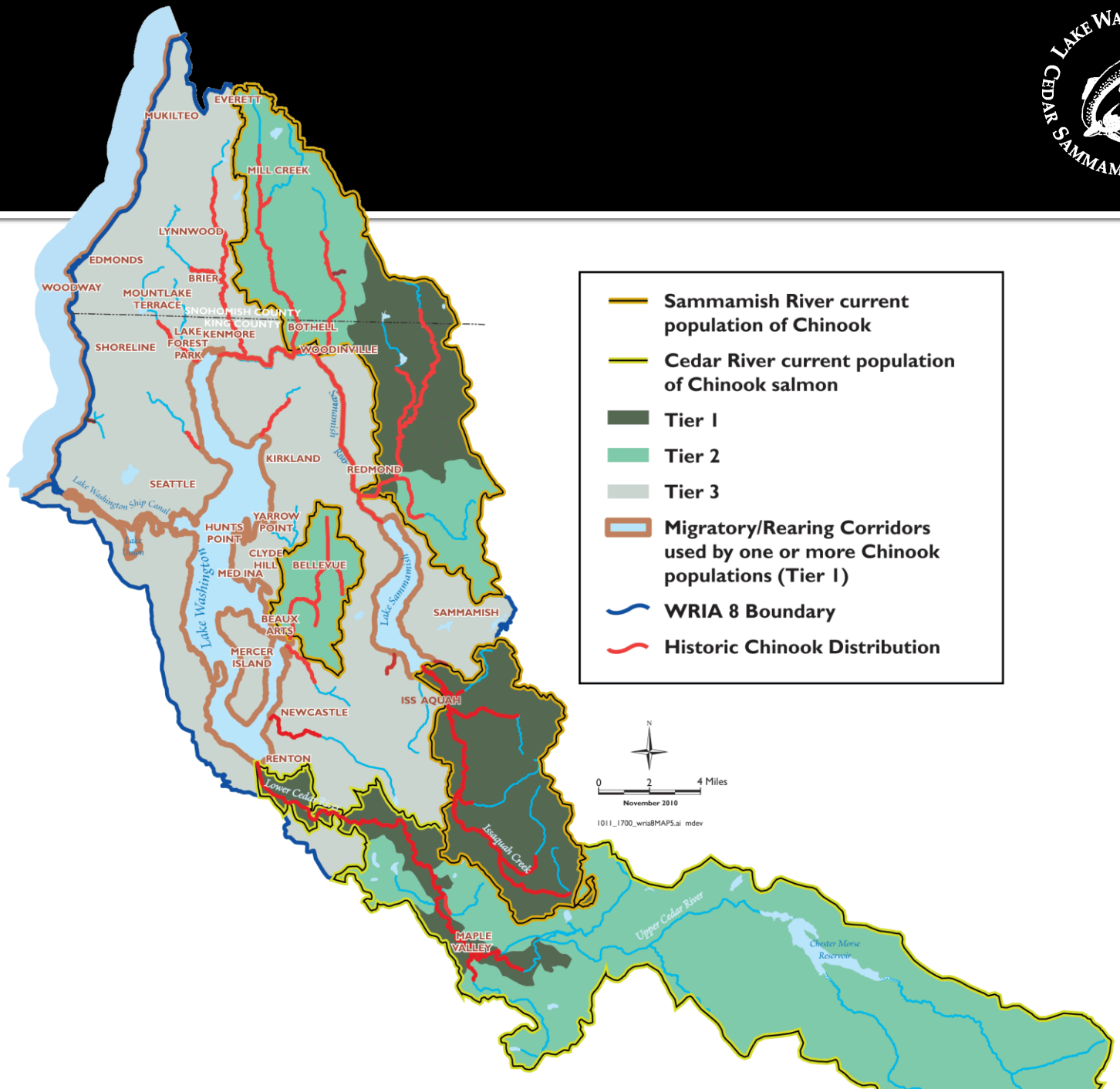

SOME ASSEMBLY REQUIRED

# Descriptive Statistics

2009: Tier 1 and Tier 2 areas only (n = 29)

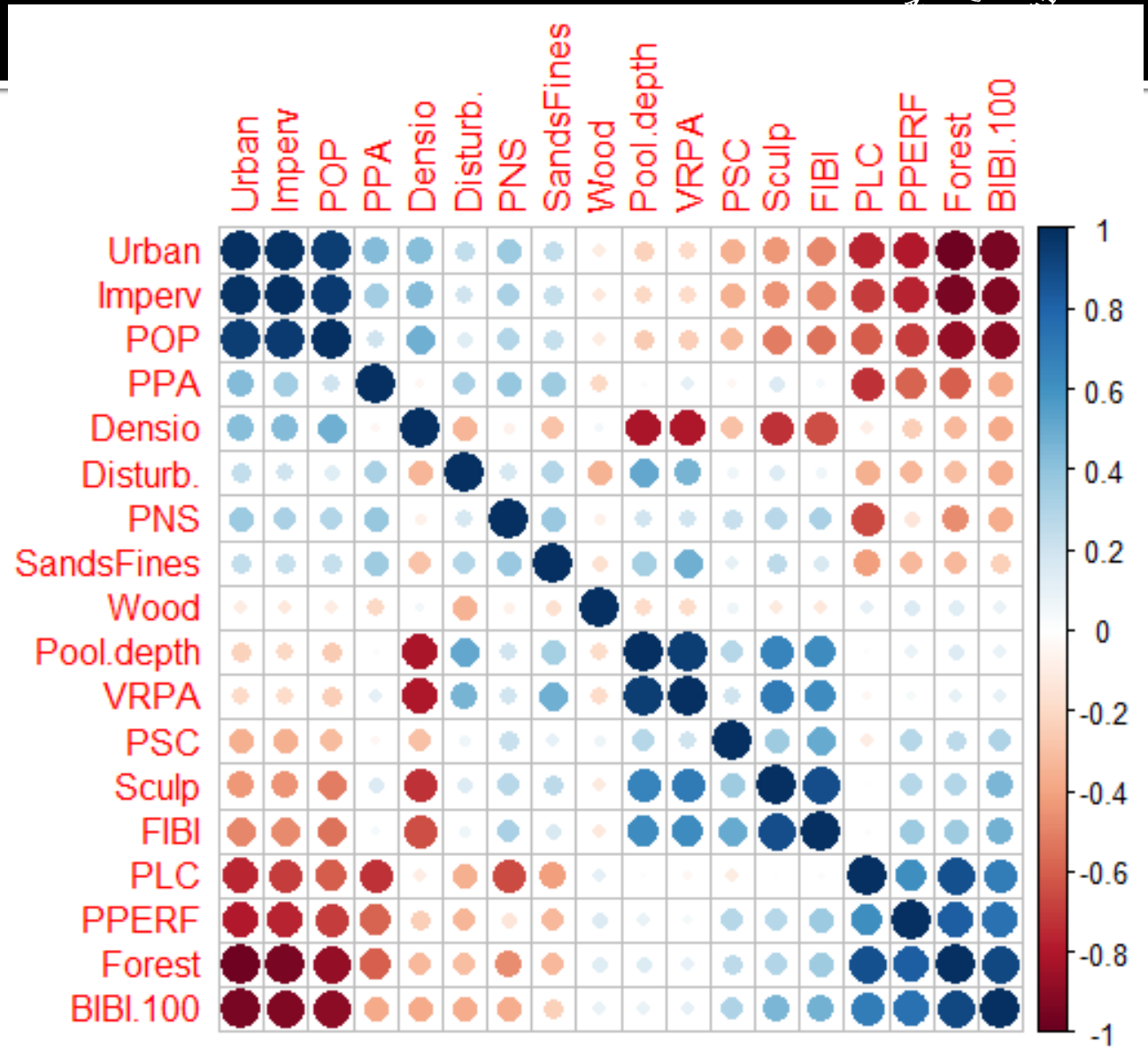



2010-2013: All Tiers (n = 52)


Sammamish River current population of Chinook
Cedar River current population of Chinook salmon
Tier 1
Tier 2
Tier 3
Migratory/Rearing Corridors used by one or more Chinook populations (Tier 1)
WRIA 8 Boundary
Historic Chinook Distribution
N
0
2
4 Miles
November 2010
1011_1700_wria8MAP5.ai mdev
EVERETT
MUKILTEO
MILL CREEK
LYNNWOOD
EDMONDS
BRIER
WOODWAY
MOUNTLAKE TERRACE
SNOHOMISH COUNTY
KING COUNTY
BOTHELL
KENMORE
LAKE FOREST PARK
SHORELINE
WOODINVILLE
Sammamish River
KIRKLAND
REDMOND
SEATTLE
Lake Washington Ship Canal
YARROW POINT
HUNTS POINT
CLYDE HILL
BELLEVUE
MEDINA
Lake Washington
Lake Sammamish
SAMMAMISH
BEAUX ARTS
MERCER ISLAND
ISSAQUAH
NEWCASTLE
RENTON
Lower Cedar River
Issaquah Creek
MAPLE VALLEY
Upper Cedar River
Chester Morse Reservoir

# Correlations Matrix

% Urban
% Impervious
Population/km^2
% Patch (PPA)
Densiometer
% Human Disturb.
% Native Fish spp. (PNS)
% Sands+Fines
Wood count
Avg pool depth
**V**ertical **R**esidual **P**ool **A**rea
% Small core (PSC)
Sculpin count
Fish IBI
% Large Core (PLC)
% Perforated
% Forest
BIBI (100 scale)



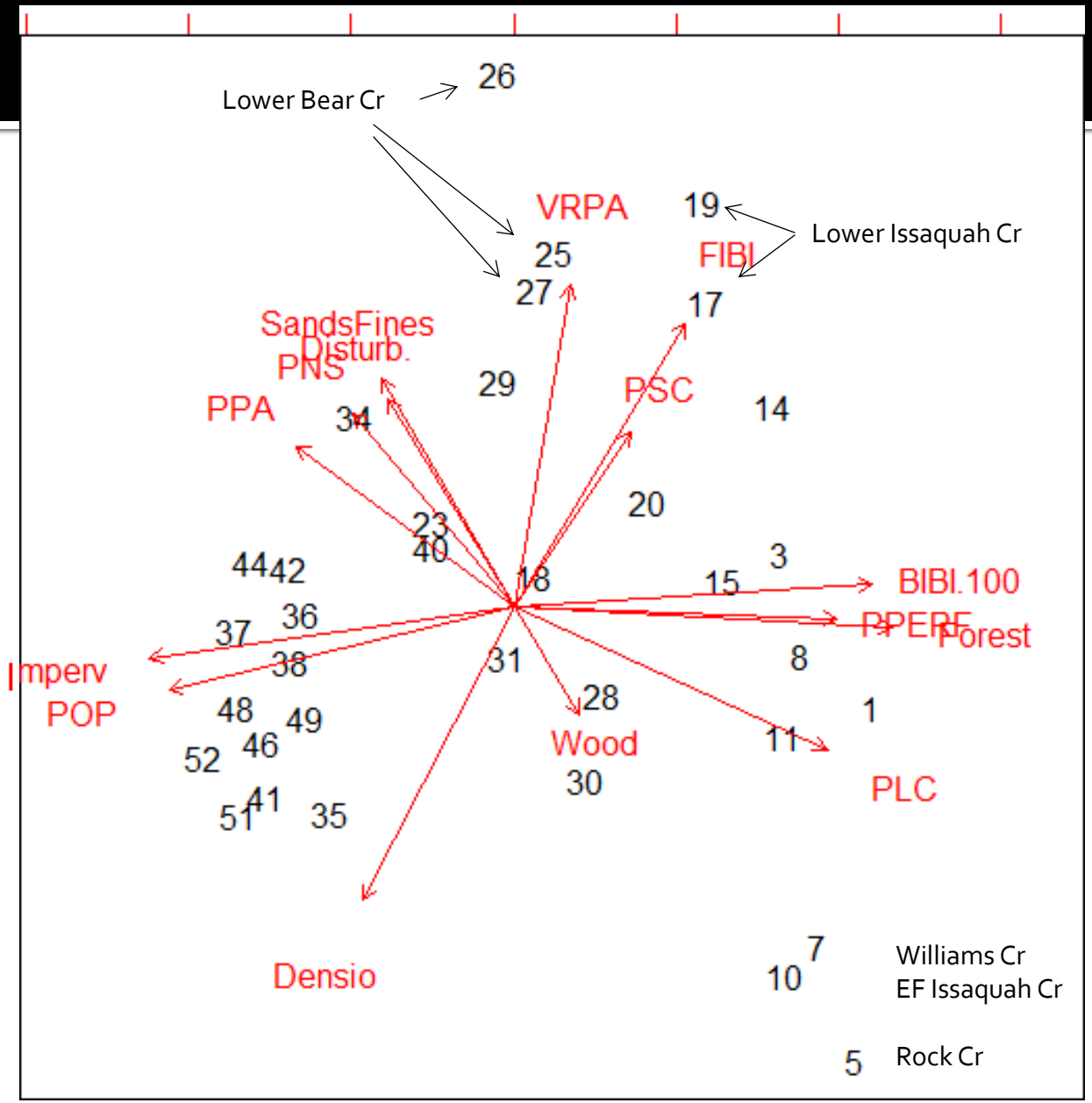
# Multivariate Approaches

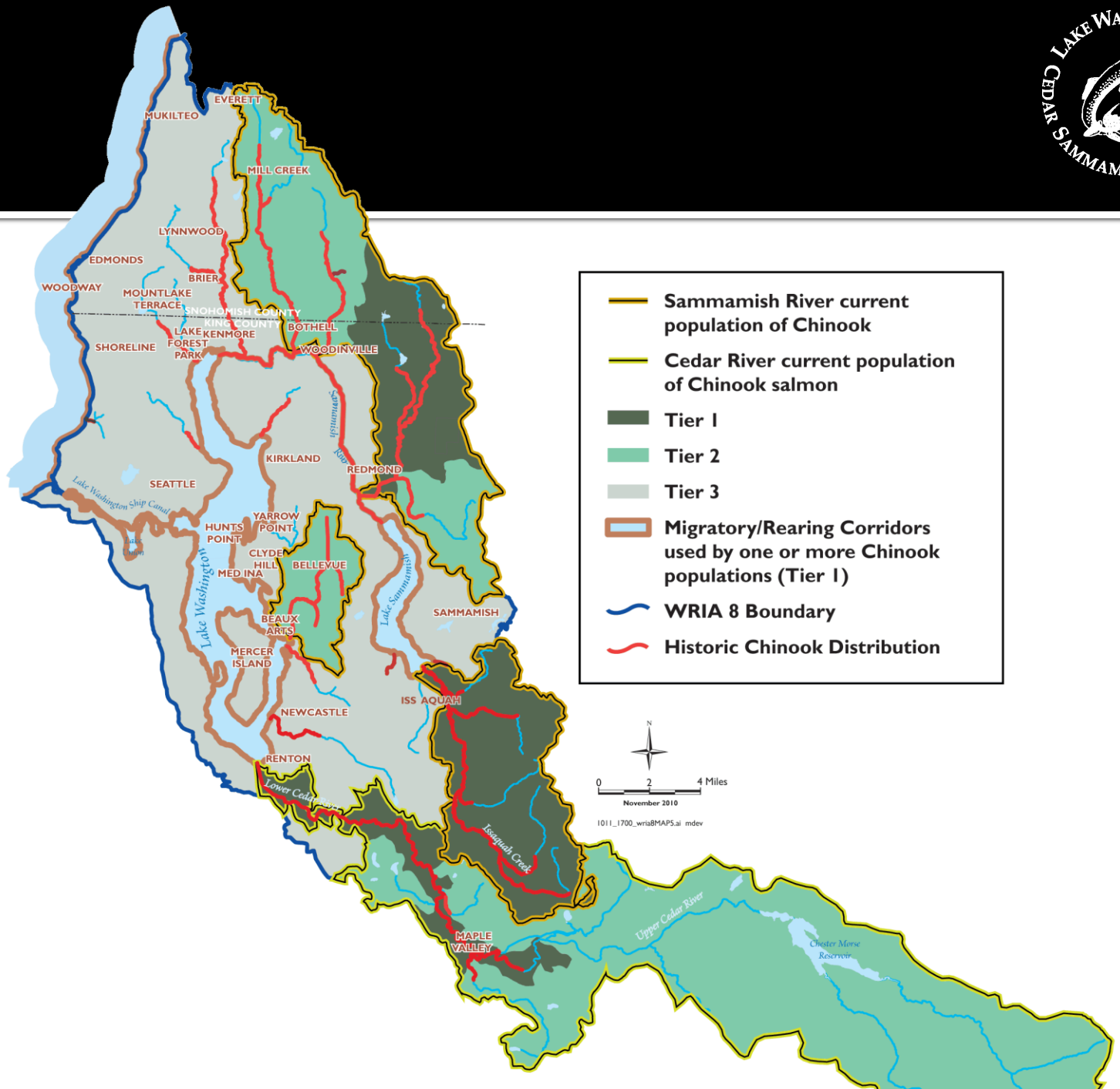
- Principal Components Analysis
- Nonmetric Multidimensional Scaling
- Logistic Regression

# Principal Components Analysis

% Impervious
Population/km^2
% Patch (**PPA**)
**Densio**meter
% Human **Disturb**.
% Native Fish spp. (**PNS**)
% Sands+Fines
**Wood** count
**V**ertical **R**esidual **P**ool **A**rea
% Small core (**PSC**)
Fish IBI
% Large Core (**PLC**)
% **Perf**orated
% Forest
BIBI (100 scale)

Plot numbers = increasing order (population per km^2)

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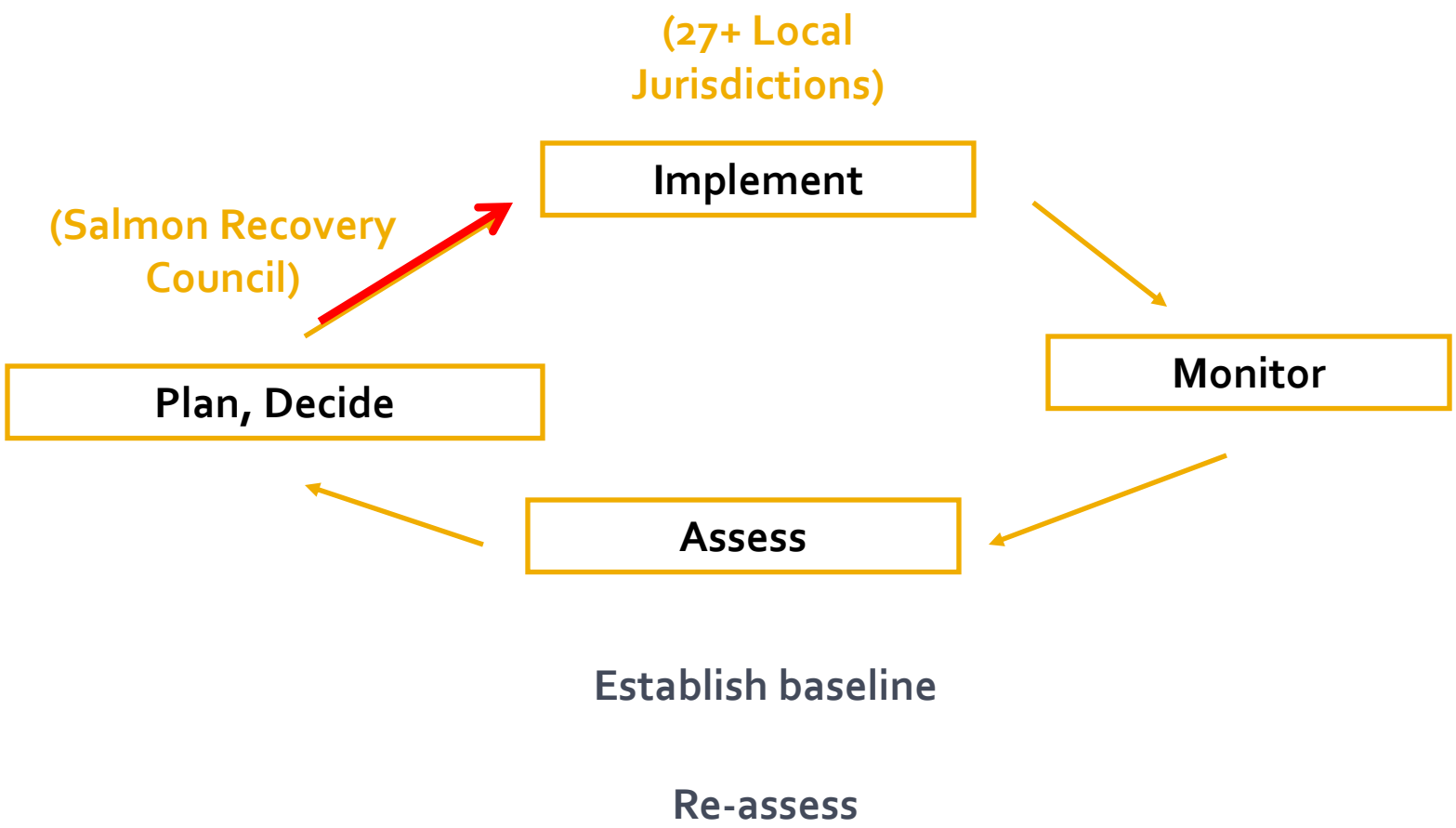
# Adaptive Management



# Adaptive Management

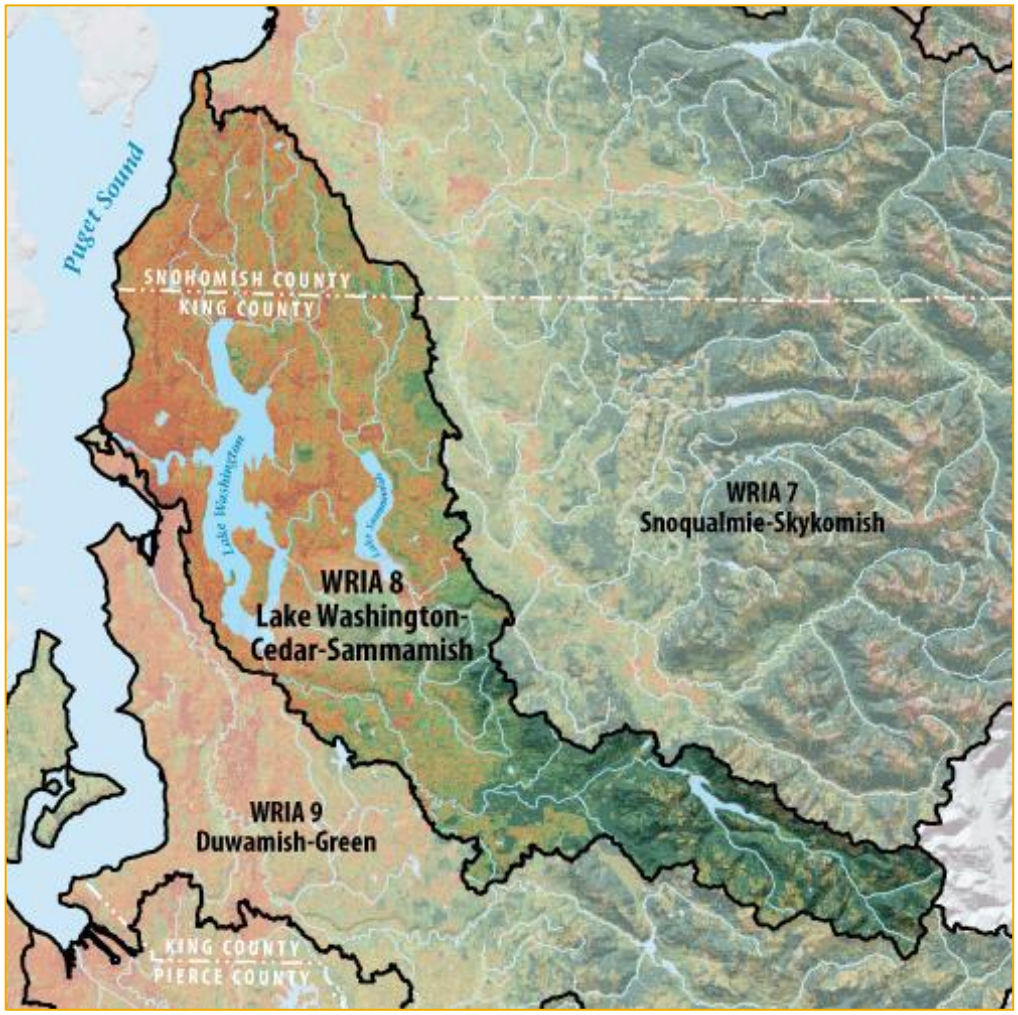
## 10 -Year Review (2015)

- Are we doing what we said we'd do?
- Are actions having the predicted effects?
- Interlocal Agreement renewal
- Recovery Plan update
- Recommendations to leadership
- Corrective actions

# Adaptive Management:
## Special challenges and caveats

Each jurisdiction has its own local priorities and schedules concerning…

- Land use and critical areas planning
- Shoreline planning updates
- Capital improvement programs
- Local needs (urban, rural)
- Election cycles
- Special interests
- Etc…



# Thank You

- U.S. Environmental Protection Agency
- WRIA 8 Salmon Recovery Council & Partners
- King County Dept. of Natural Resources and Parks
- Washington Department of Fish and Wildlife
- Washington Department of Ecology

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Lake Washington Cedar Sammamish Watershed

King County

Department of Ecology State of Washington

United States Environmental Protection Agency

U.S. Fish & Wildlife Service