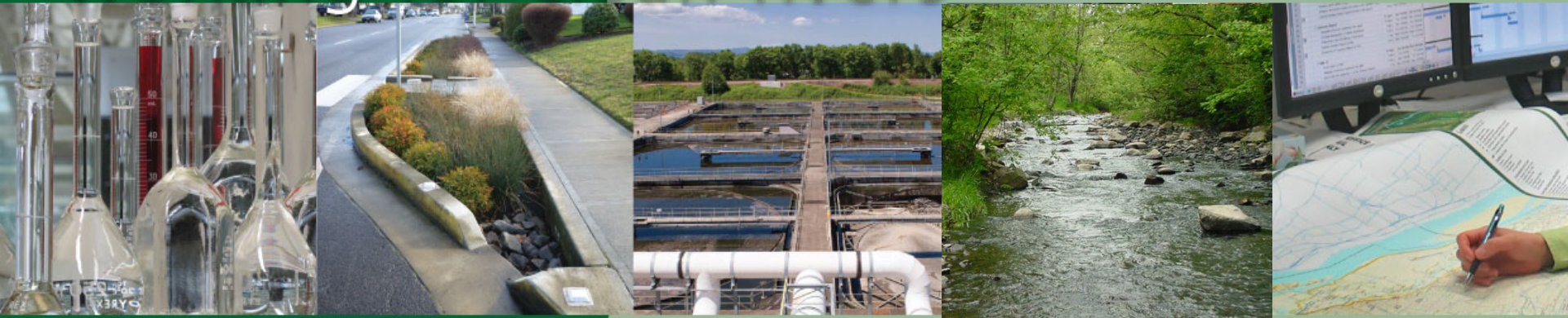


working for clean rivers



Urban Impacts on the Biological Health of Portland Streams



ENVIRONMENTAL SERVICES
CITY OF PORTLAND

NICK FISH, COMMISSIONER
MICHAEL JORDAN, DIRECTOR

Chris Prescott
Watershed Ecologist
City of Portland Bureau of Environmental Services

Diagnosing Stream Health

- Basic questions that inform ecosystem management:
 - How healthy is the ecosystem?
 - What are the greatest threats to its health?
- Describe city approach & challenges in finding answers for Portland streams

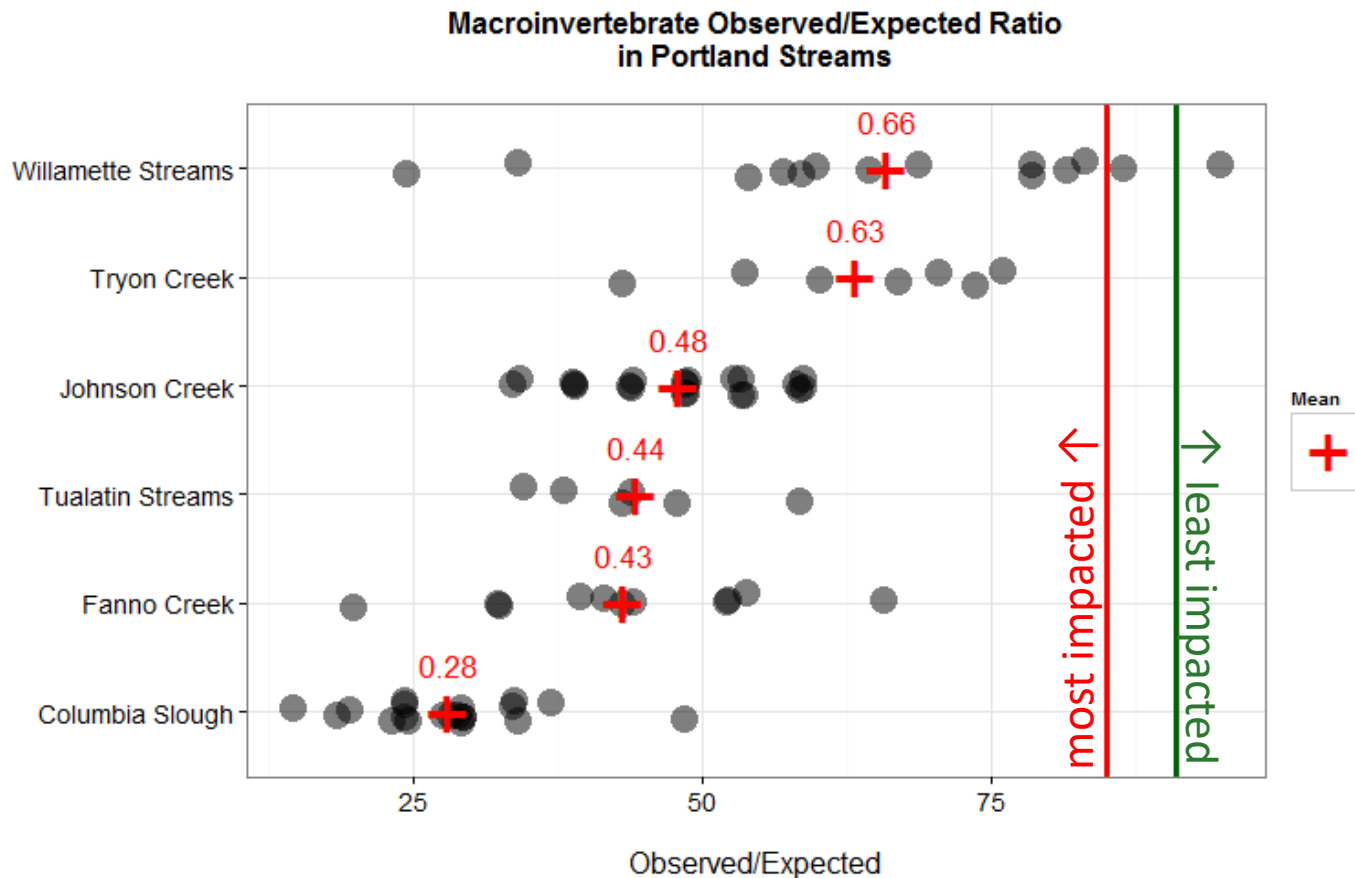


How healthy are Portland streams?

- Portland uses biological communities in streams as the ultimate measure of stream health
 - Established in CWA, ESA, Superfund
 - CWA: *“The objective of this Act is to restore and maintain the chemical, physical, and **biological** integrity of the Nation's waters.”*
 - Respond to a wide range of different stressors (e.g., water quality vs. habitat)
 - Most directly tied to city's objectives



Health of Portland streams is poor in comparison to regional benchmarks



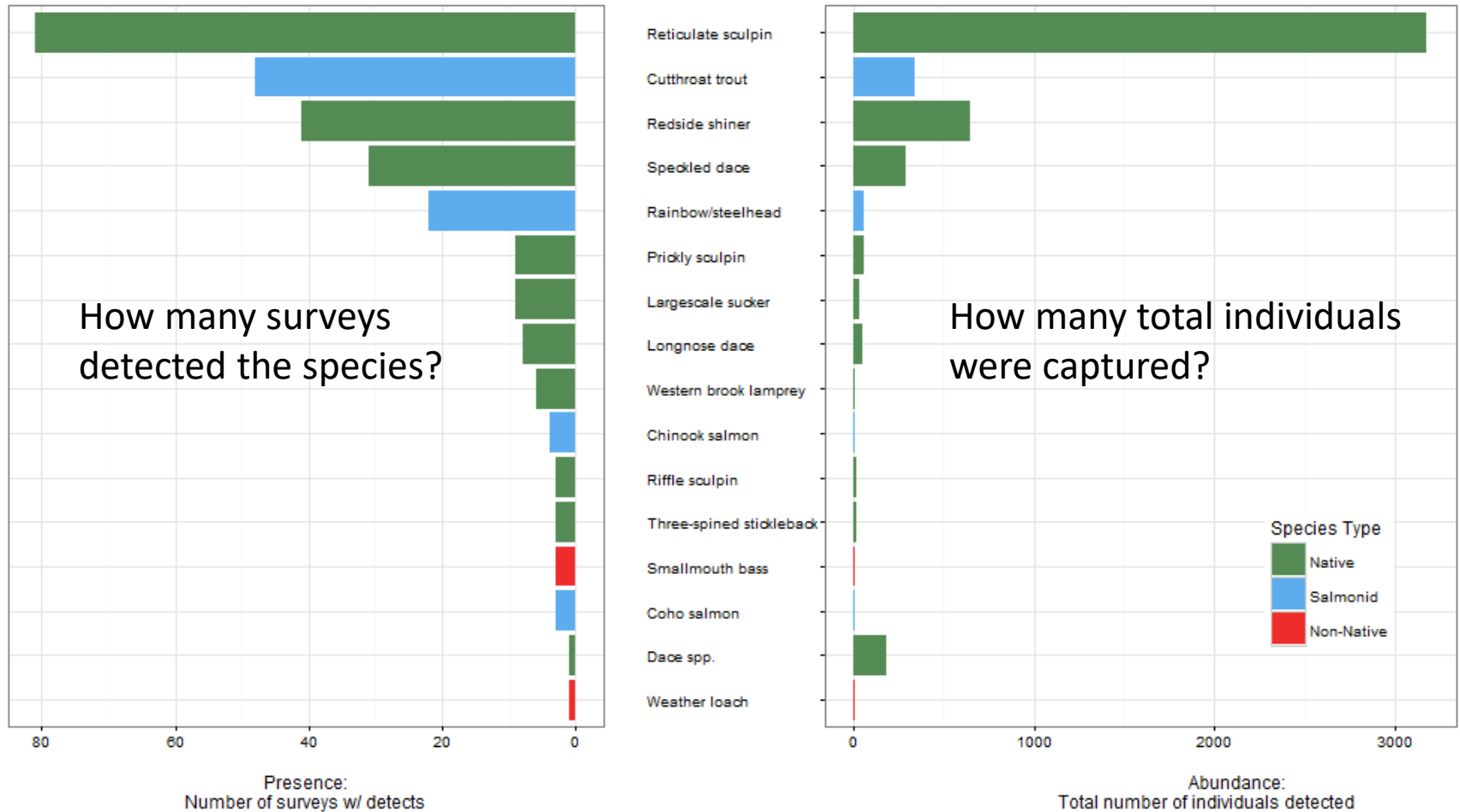
DEQ Observed/Expected ratio – proportion of species observed at the site that are expected at reference (“healthy”) streams



Biological signs of hope

“Seeds” of healthy fish communities present:

- Sensitive species persist; limited non-natives
- Reduce stressors so that numbers increase and species are thriving; not just hanging on



What causes poor biological health?

Difficult to answer in urban streams:

- Urban Stream Syndrome:
 - “everything is broken”
 - Flashy flows, too hot, pollutants, invasive species, hardened banks, altered channels & floodplains
- Stressors are highly correlated
 - Difficult to separate effects
 - Which is “most important”?



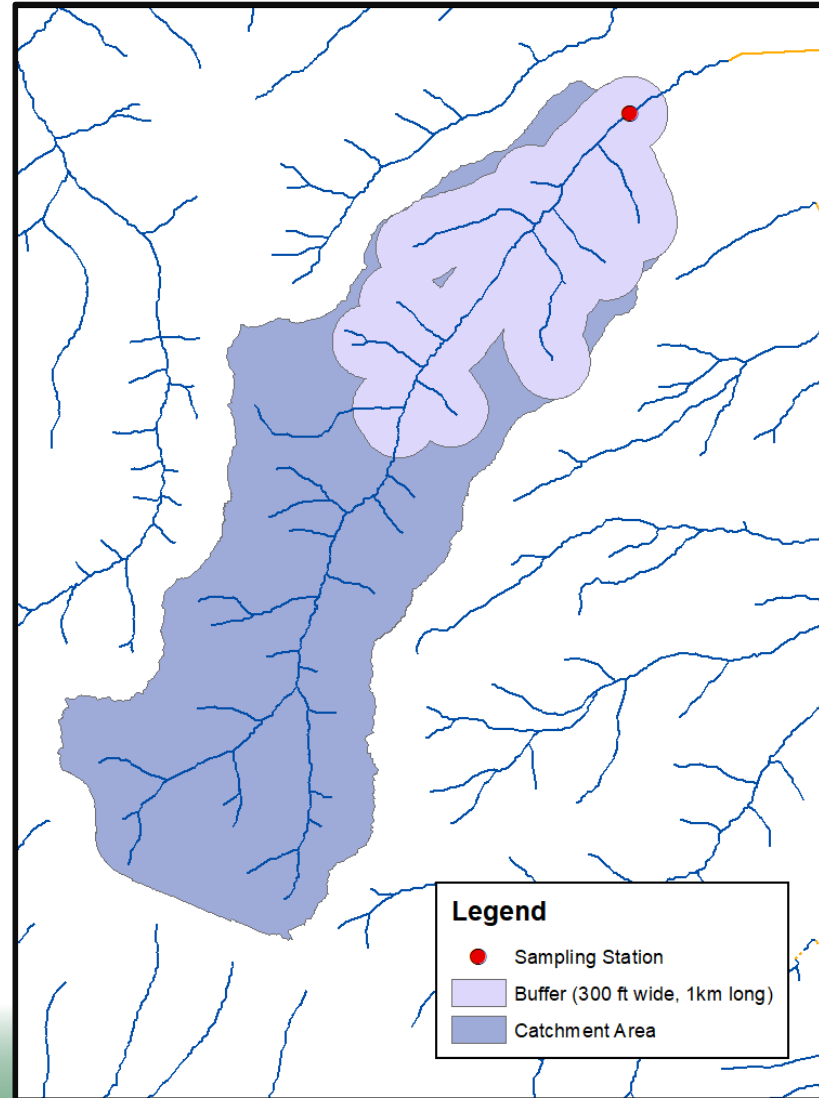
Evaluating land use impacts on stream health

Evaluated land use at 2 spatial scales:

- **Catchment:** all land draining to the station
- **Riparian zone of influence:** upstream buffers of varying lengths & widths

Indicators:

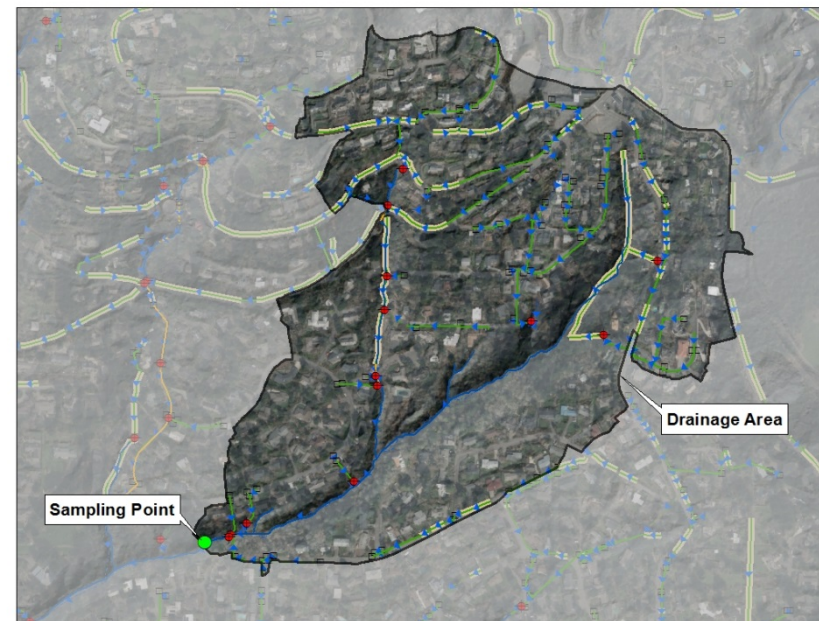
- **Upland land use:**
 - Impervious, tree canopy, road density, % piped stream
- **Stream condition:**
 - Water quality (e.g., temp., metals, nutrients, TSS)
 - Habitat (e.g., wood, substrate, bank condition)



Catchment Delineation

Delineation: Identifying all land areas draining to a sampling point

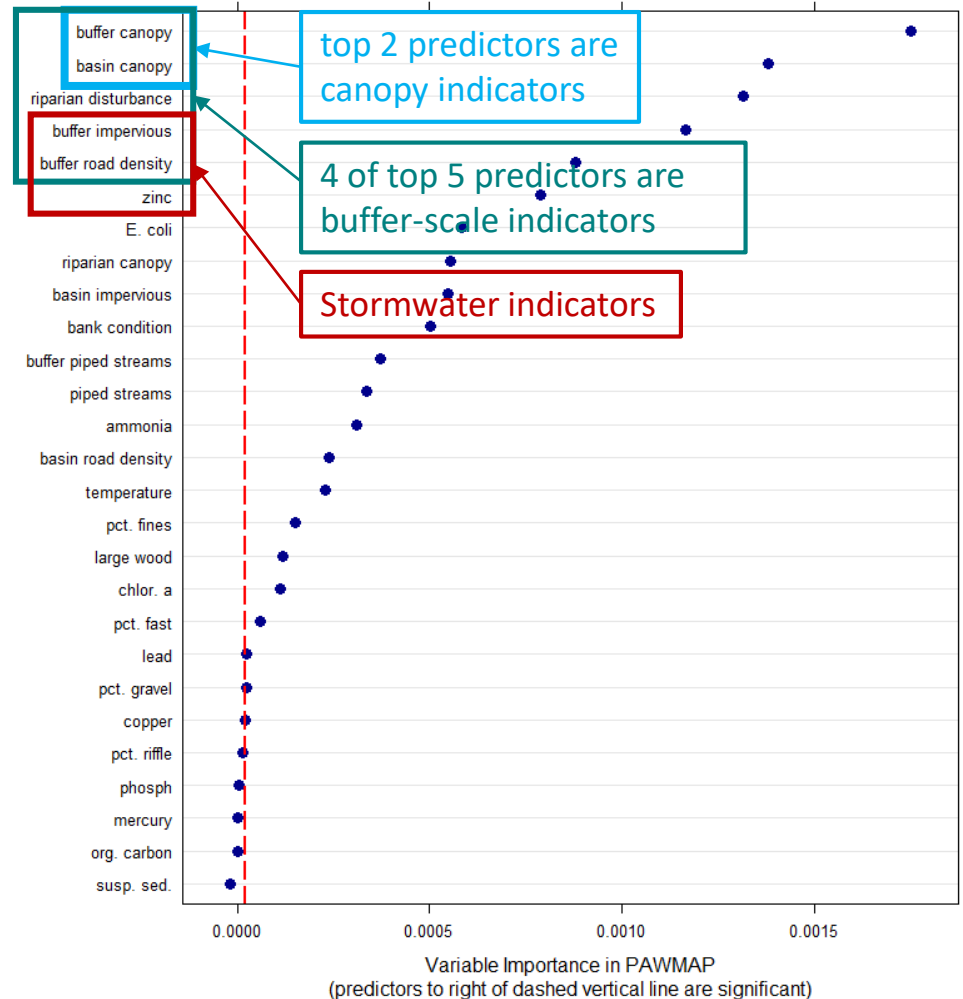
- **Natural landscapes:** straightforward process that uses standard GIS tools
- **Urban areas:** drainage patterns are extensively altered; delineation more difficult
 - SW, sewer, roads, buildings & other infrastructure alter drainage
- **Key tools:**
 - Stormwater System Plan
 - Urban drainage models
 - City GIS data
 - Drainage infrastructure
 - MS4 drainage basins



Potential causes of poor aquatic insect communities

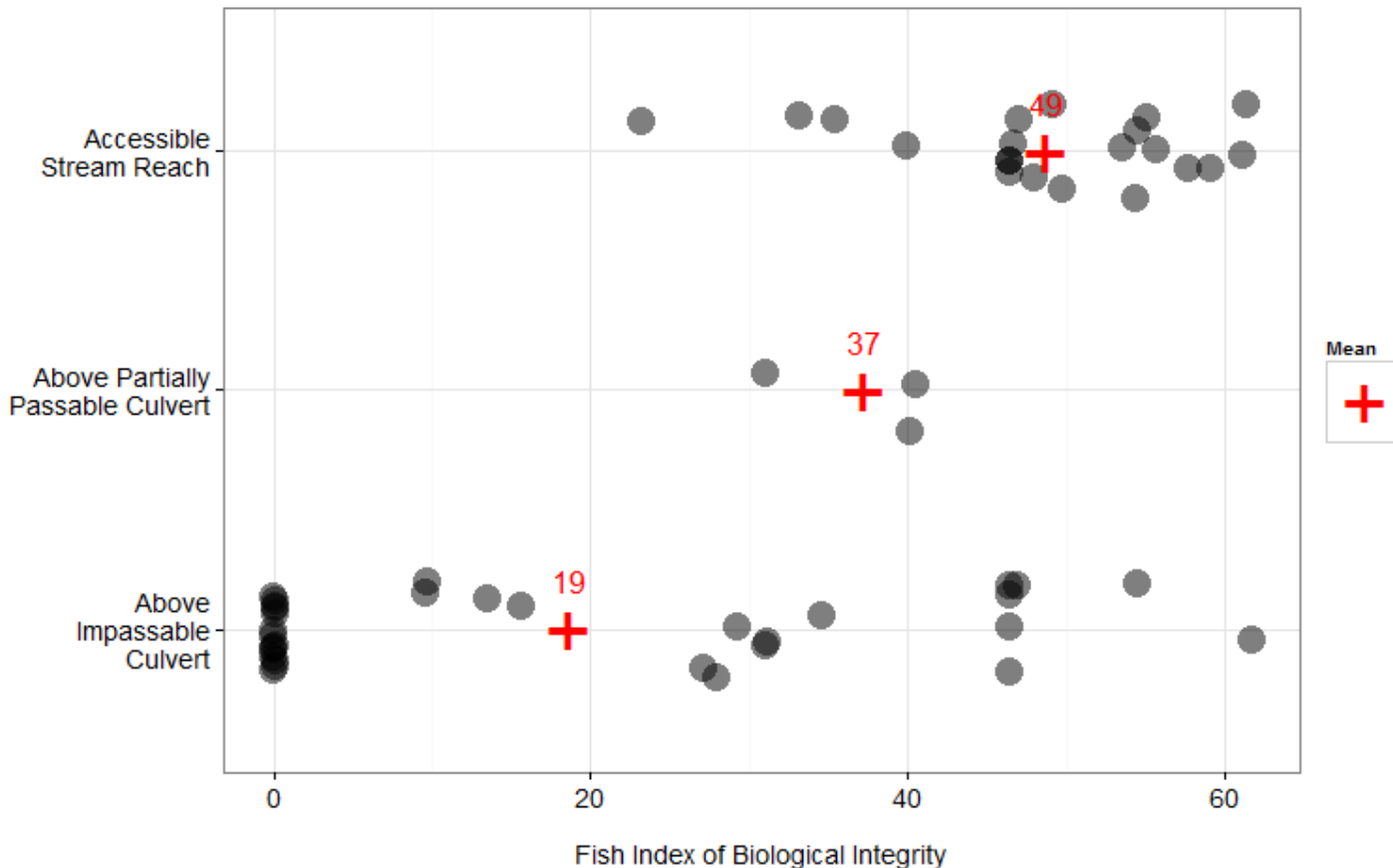
- Buffers are critical to bugs
 - 4 of top 5 indicators related to buffer
 - For given indicator, buffer scale better predictor than catchment
- Impervious, road density & zinc suggest important stormwater effects

Variable Importance to Macroinvertebrates

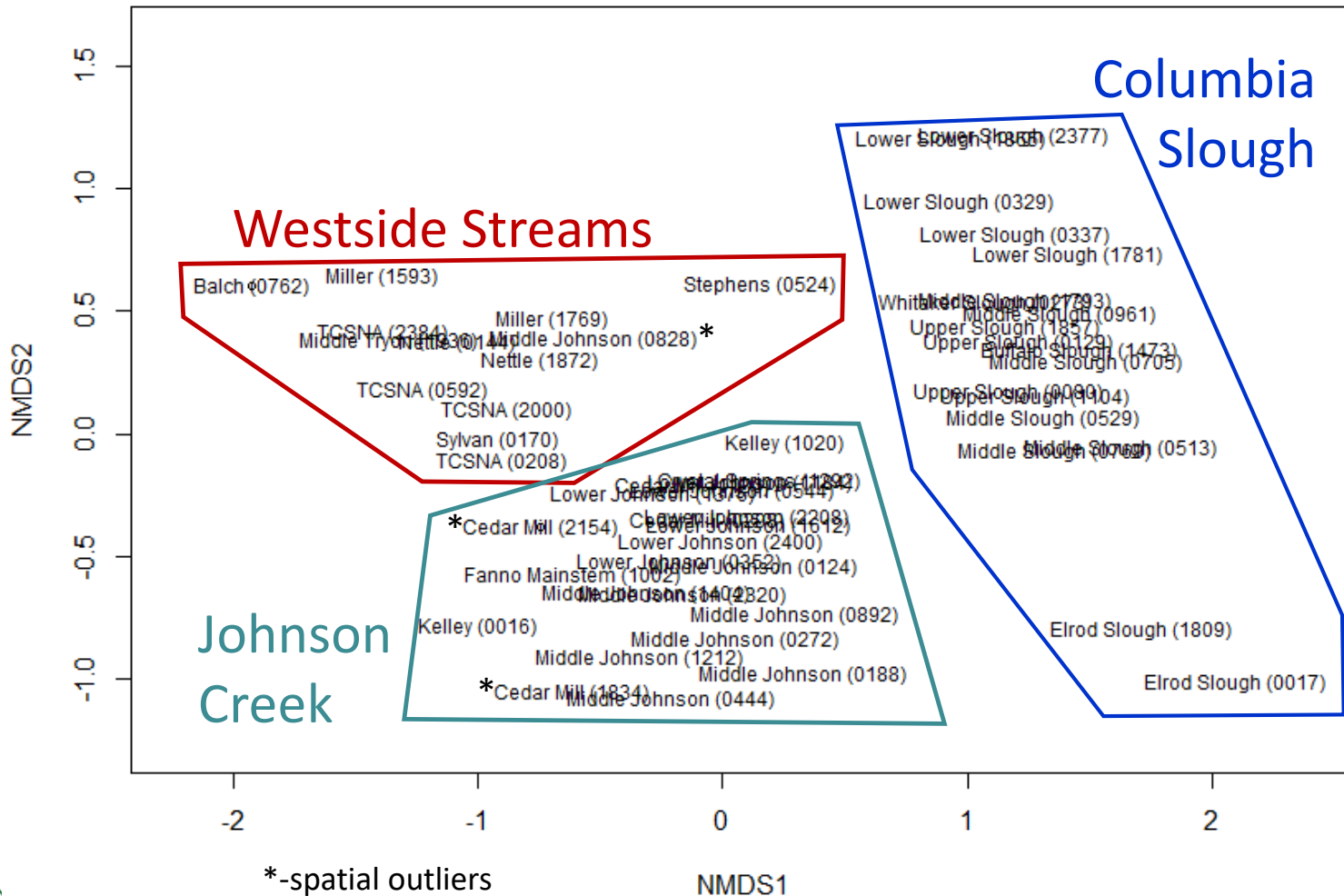


Potential causes of poor fish communities: Culvert Impacts

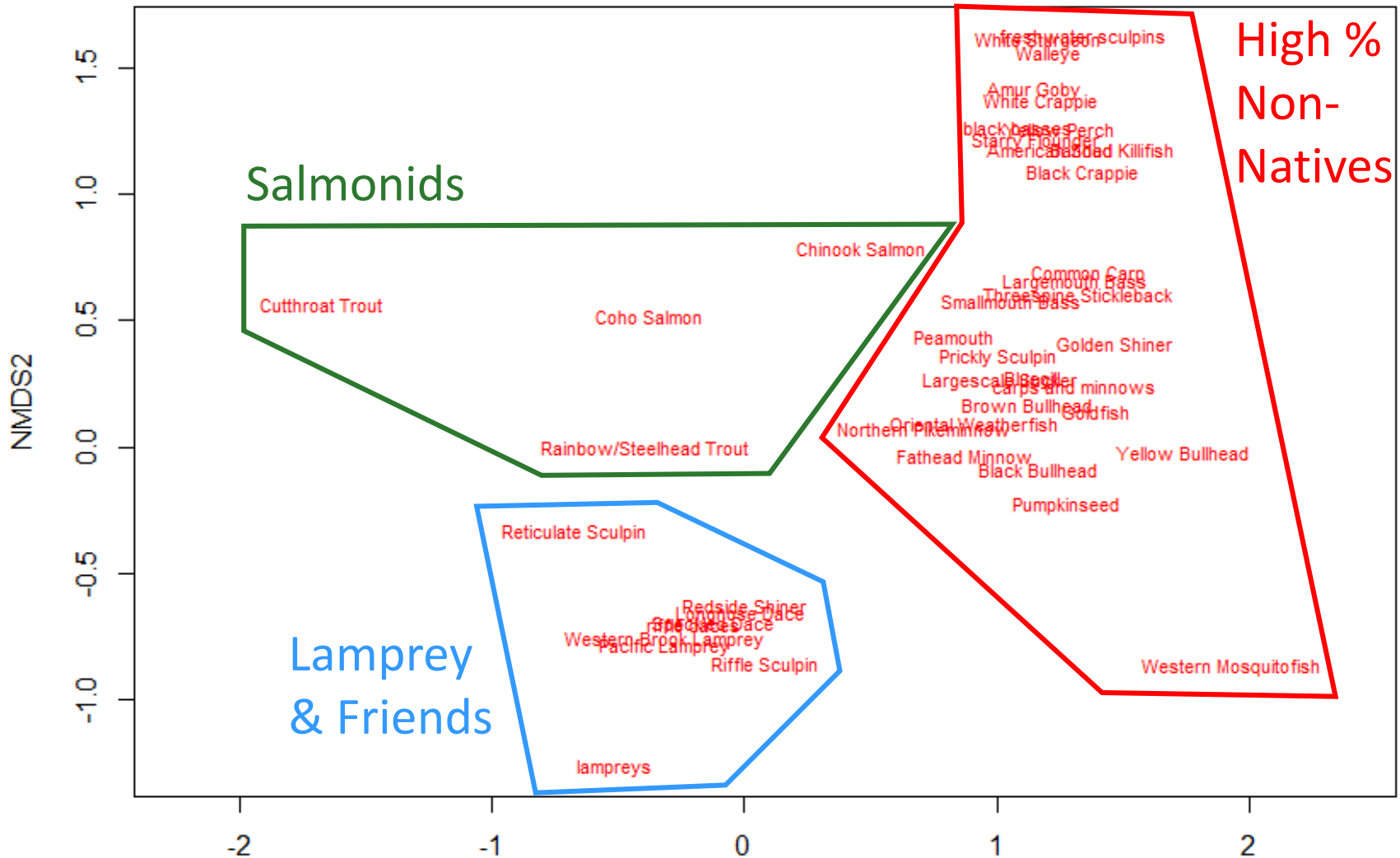
- 45% of reaches above impassable culverts had zero fish
- No sites above passable culverts ever had zero fish
- Not just anadromous – resident fish (e.g., sculpin) also absent
- Not due to stream size



Fish Communities: Geographic Patterns



Fish Communities: Species Associations



Difficult to detect land use effects across fundamentally different communities

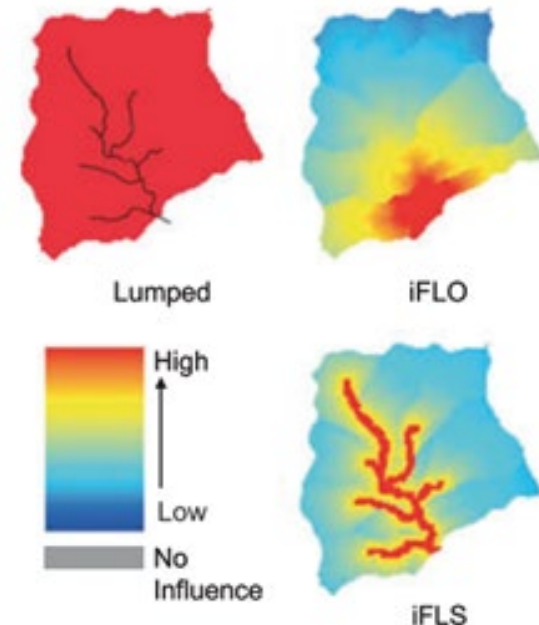
Next Steps

▪ Account for spatial autocorrelation

- independence of observations: critical assumption in most statistical analyses
 - Strong watershed pattern in fish communities → samples are not independent
- Building ***Spatial Stream Networks*** to account for this
 - urban drainage difficult to model

▪ Use inverse distance weighting

- current analyses weight all land use features equally
- IDW measures:
 - *Overland flow distance*
 - *Instream flow distance*
 - **Weights features by how close they are to the sampling point**



A number of people & programs are critical to these efforts

- Environmental Services
 - Pollution Prevention Services
 - Field Operations
 - Investigation & Monitoring Services
 - Water Pollution Control Laboratory
 - Stormwater/Regulatory Compliance
 - Watershed Services
 - Stormwater System Division
 - Watershed Programs Division
 - Science Integration Division
 - Mapping, Data & Applications
 - Asset Systems Management
- Portland Bureau of Parks & Recreation
- Oregon Dept. of Environmental Quality

