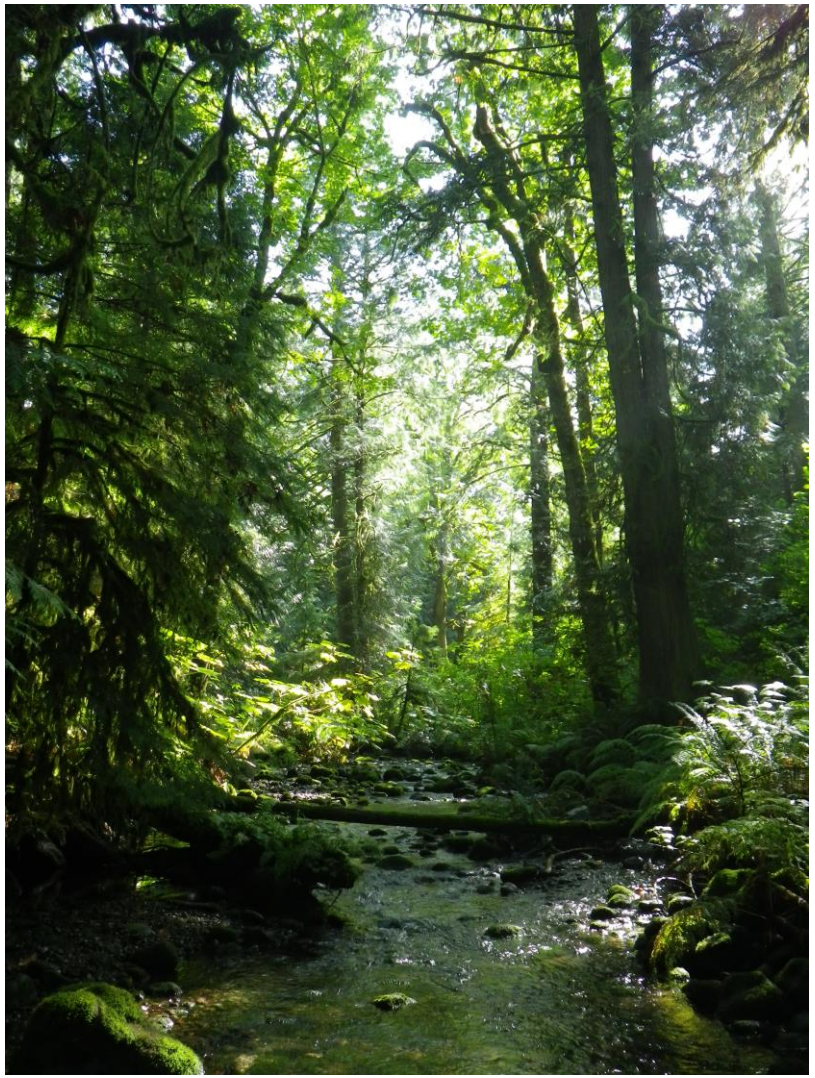

Using Bioassessment to Prioritize Puget Sound Basins for Restoration and Protection, Identify Stressors, and Monitor Restoration Effectiveness

Kate Macneale and Beth Sosik

King County – Department of Natural Resources and Parks

Water and Land Resources Division

King County

DEPARTMENT OF ECOLOGY State of Washington

Freshwater Qu

- **Protect all ‘ basins**
- **Restore 30 “fair” to “go**

Condition of Biotic Integrity
Excellent
Good
Fair
Poor
Very Poor

Restore and Protect B-IBI Basins Project

- Use B-IBI scores to prioritize restoration and protection basins
- Identify stressors and potential threats
- Develop restoration and protection plans
- Implement
- Monitor

Restore and Protect B-IBI Basins Project

- Use B-IBI scores to prioritize restoration and protection basins
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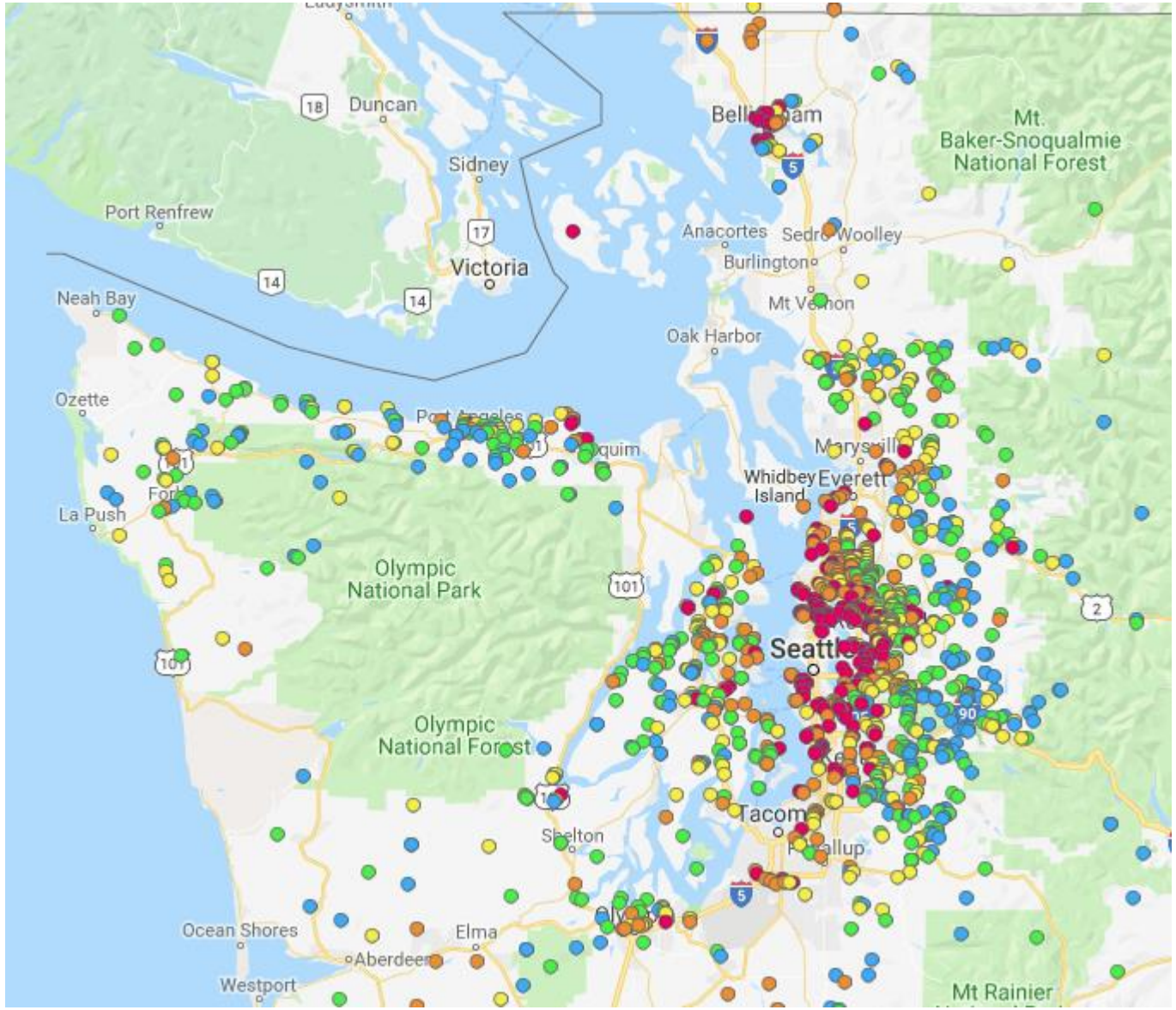
Data available for 1500+ sites



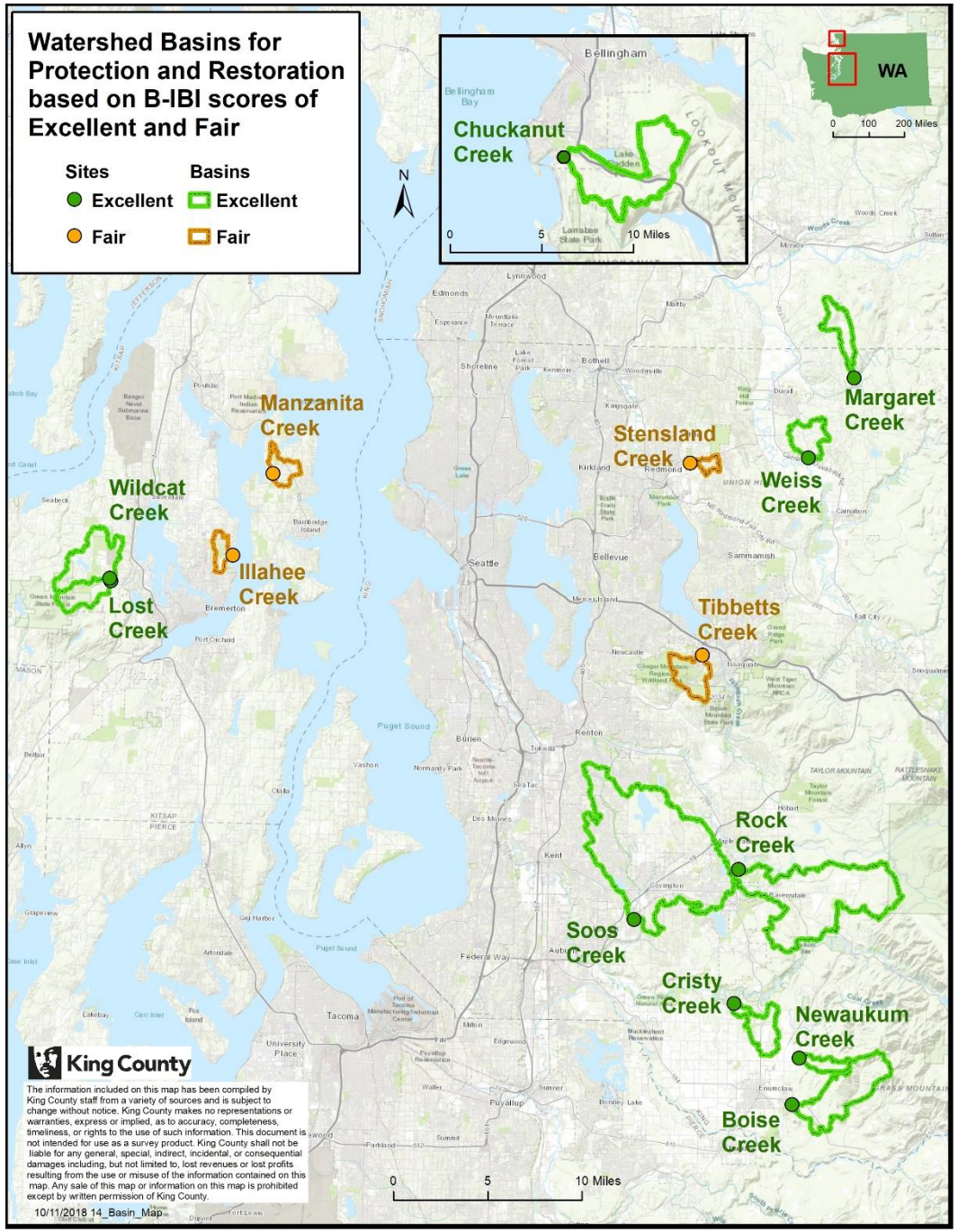
All data publically available on www.pugetsoundstreambenthos.org

Restore and Protect Project

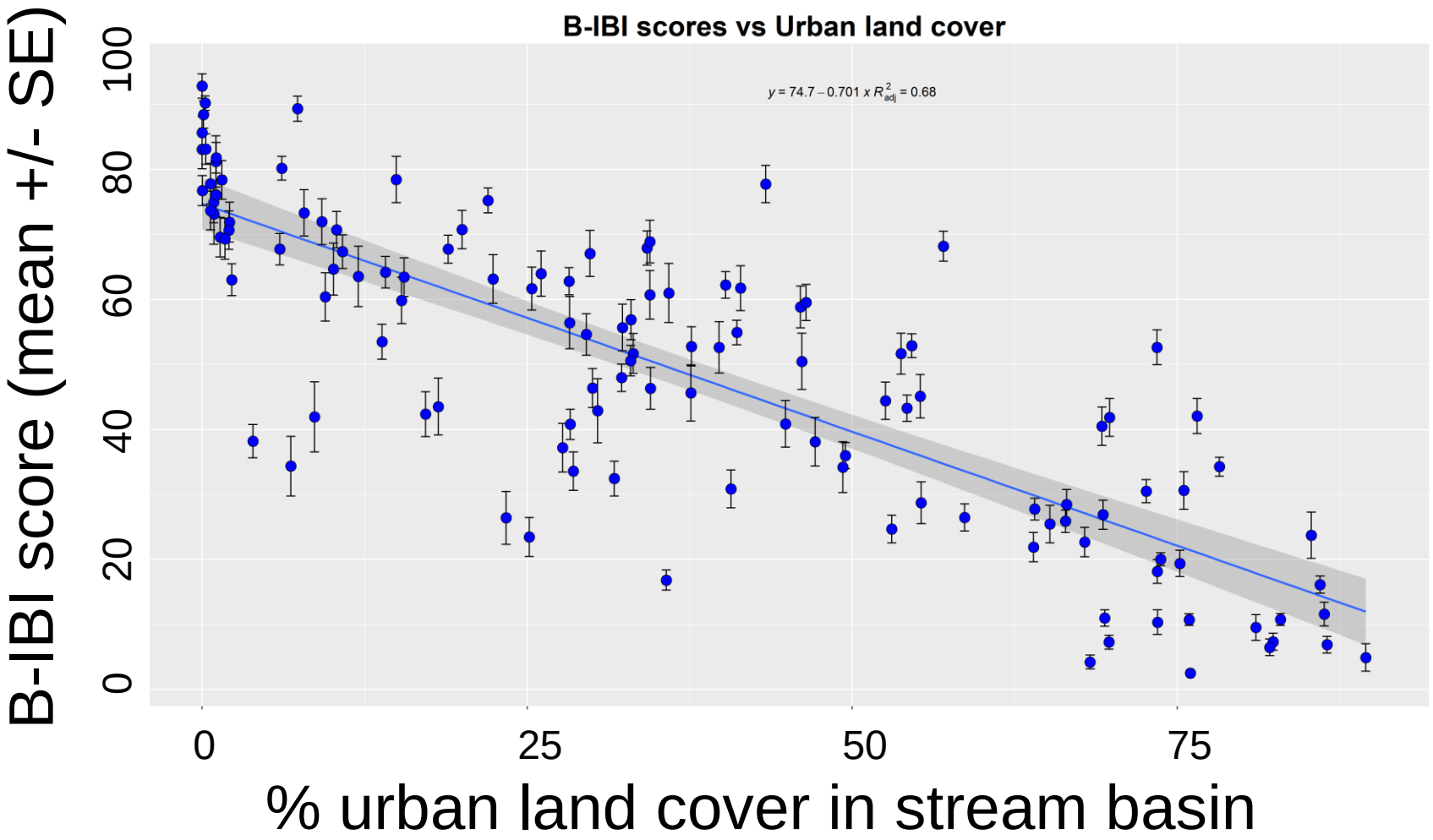
- 4 fair sites
- 10 excellent sites

Site selection criteria:

- Sampling history
- Basin size
- Prioritized by others
- Stressor information available
- Biological potential
- Accessible!



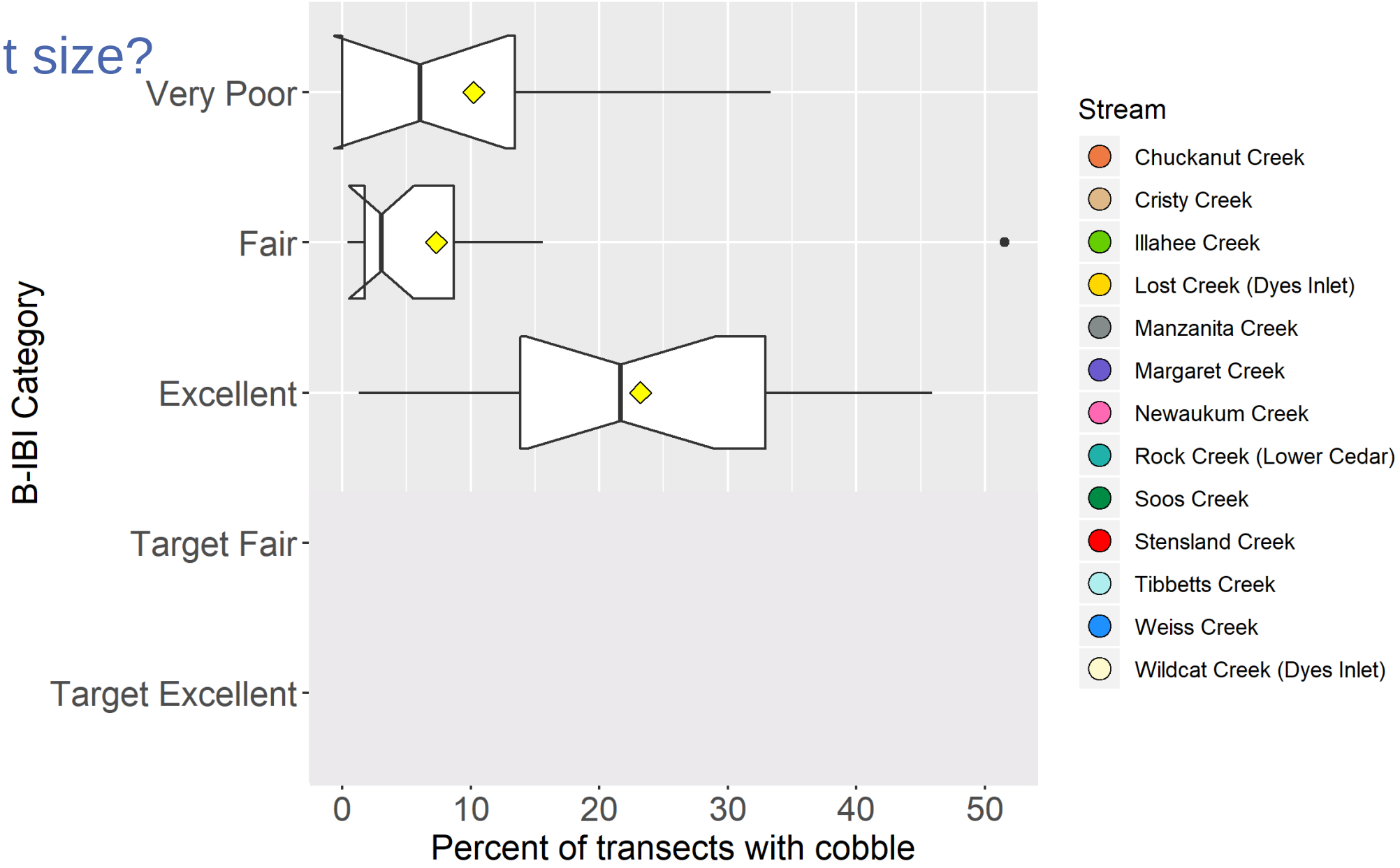
Identify stressors and potential threats



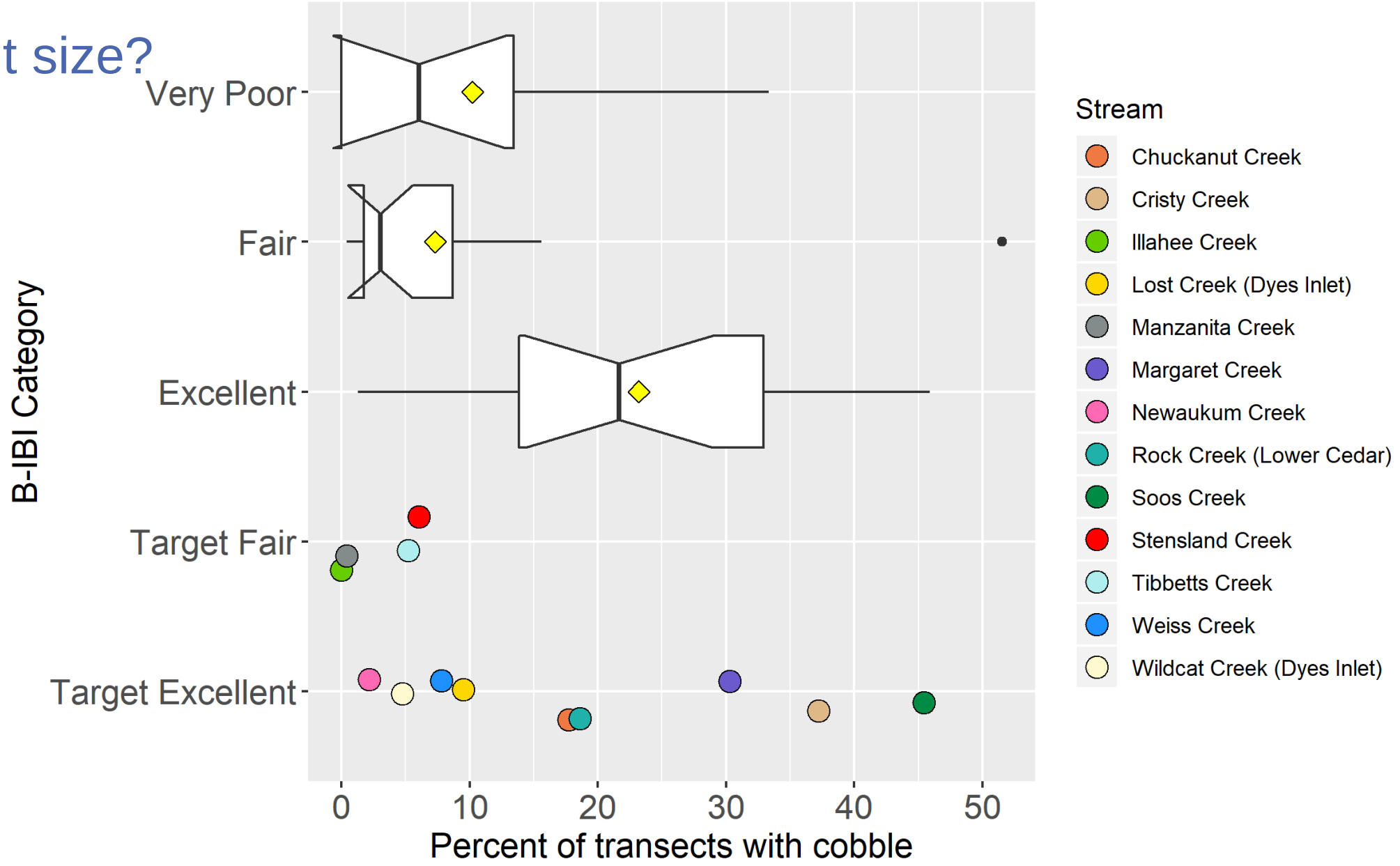
Stressors and potential threats to <u>these</u> communities?

- Multiple lines of evidence
  - Compare local and basin-scale conditions to other sites
    - Sediment size, embeddedness
    - Hydrologic stress
    - Riparian conditions
    - Age of development
    - Forest cover and stand age
    - Zoning
    - Temperature
    - Forest harvest plan
    - Many more
  - Index of Catchment (ICI) and Index of Watershed (IWI) Integrity
  - Biological Condition Gradient (BCG)
  - TITAN analysis, what specific taxa may indicate
  - Stare at photos, explore, talk with people

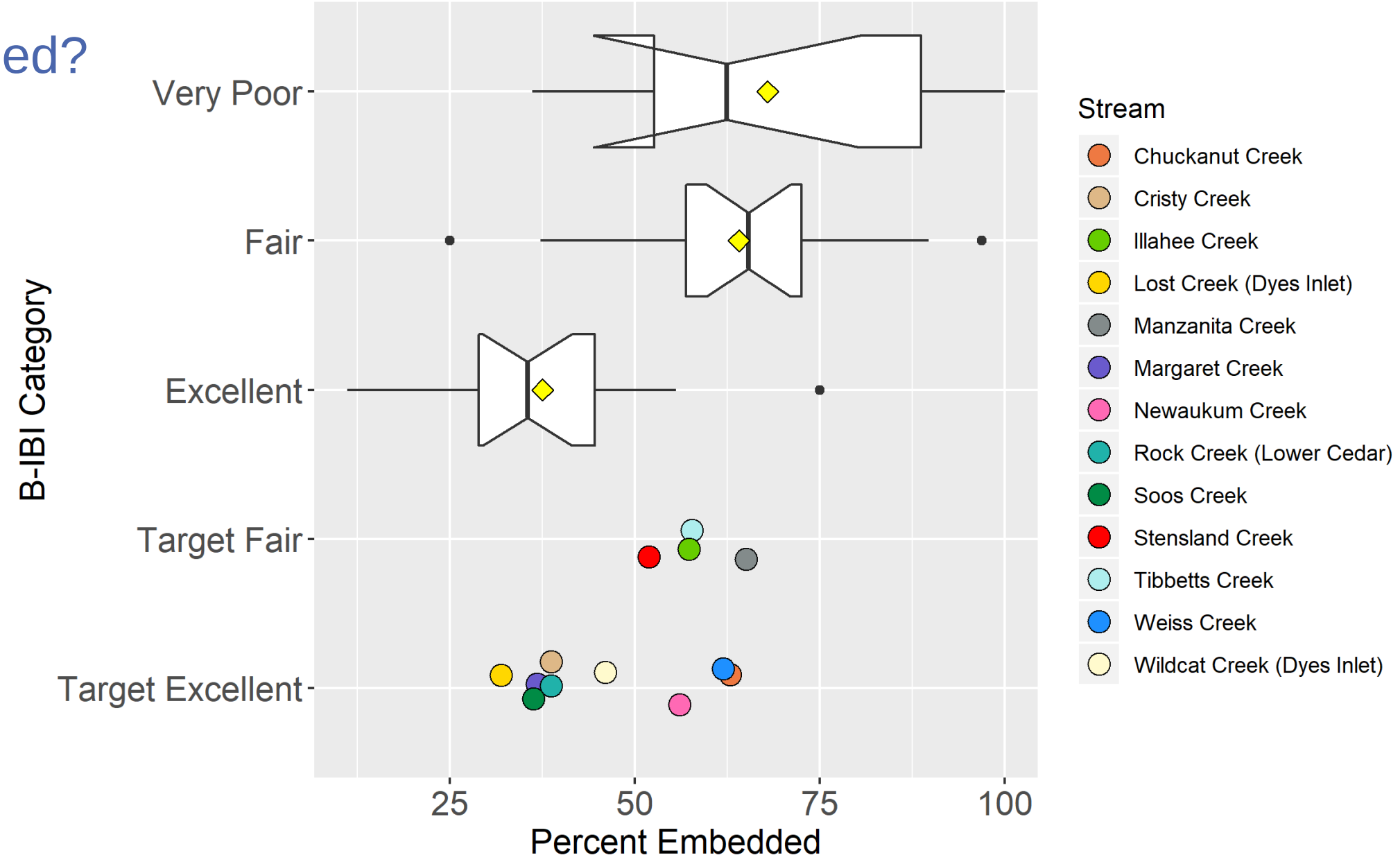
Sediment size?



Sediment size?



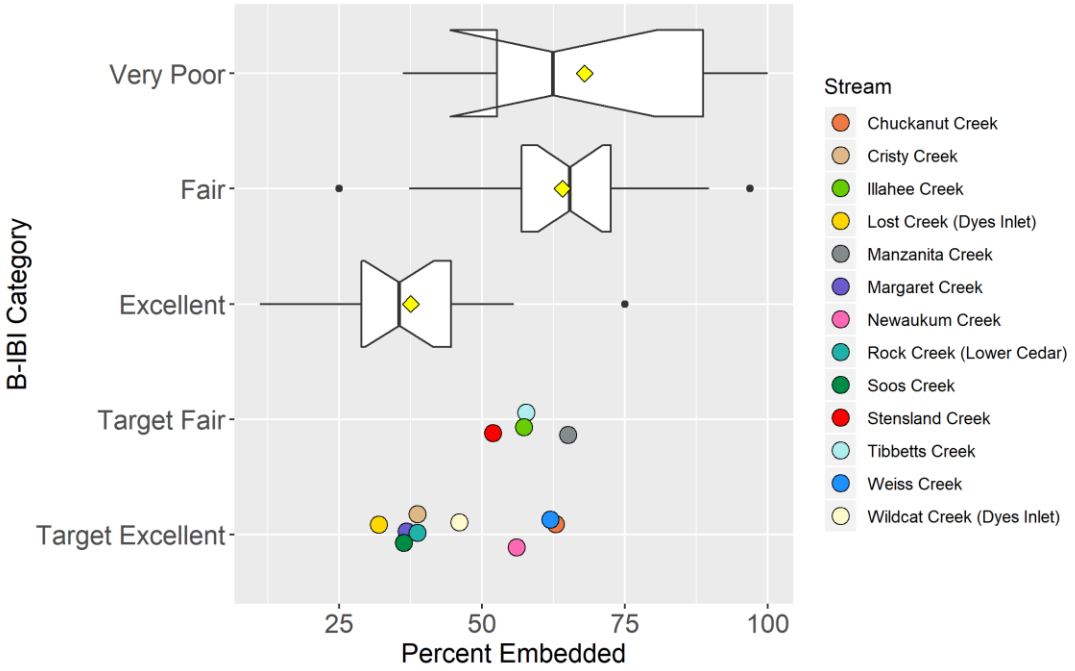
Embedded?


Very Poor
Fair
Excellent
Target Fair
Target Excellent
B-IBI Category
25
50
75
100
Percent Embedded
Stream
Chuckanut Creek
Cristy Creek
Illahee Creek
Lost Creek (Dyes Inlet)
Manzanita Creek
Margaret Creek
Newaukum Creek
Rock Creek (Lower Cedar)
Soos Creek
Stensland Creek
Tibbetts Creek
Weiss Creek
Wildcat Creek (Dyes Inlet)

Sediment size? Embedded?

- In-stream restoration may include amending substrate

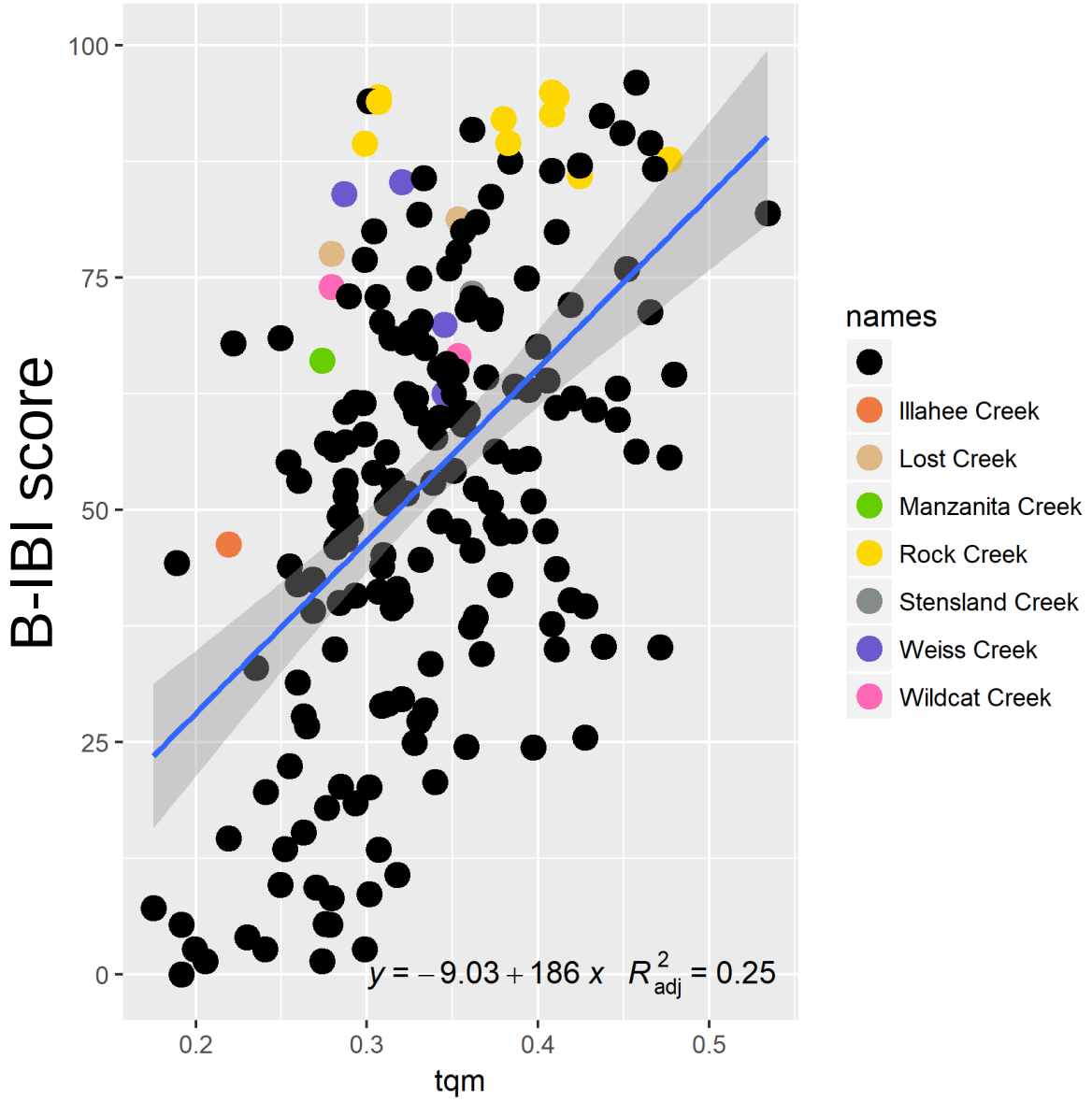
- Stormwater controls and riparian improvements may be needed to address embeddedness



Flashy?

- Relationships not as strong as expected
  - High pulse count
  - High pulse duration
  - RB Index
  - TQmean

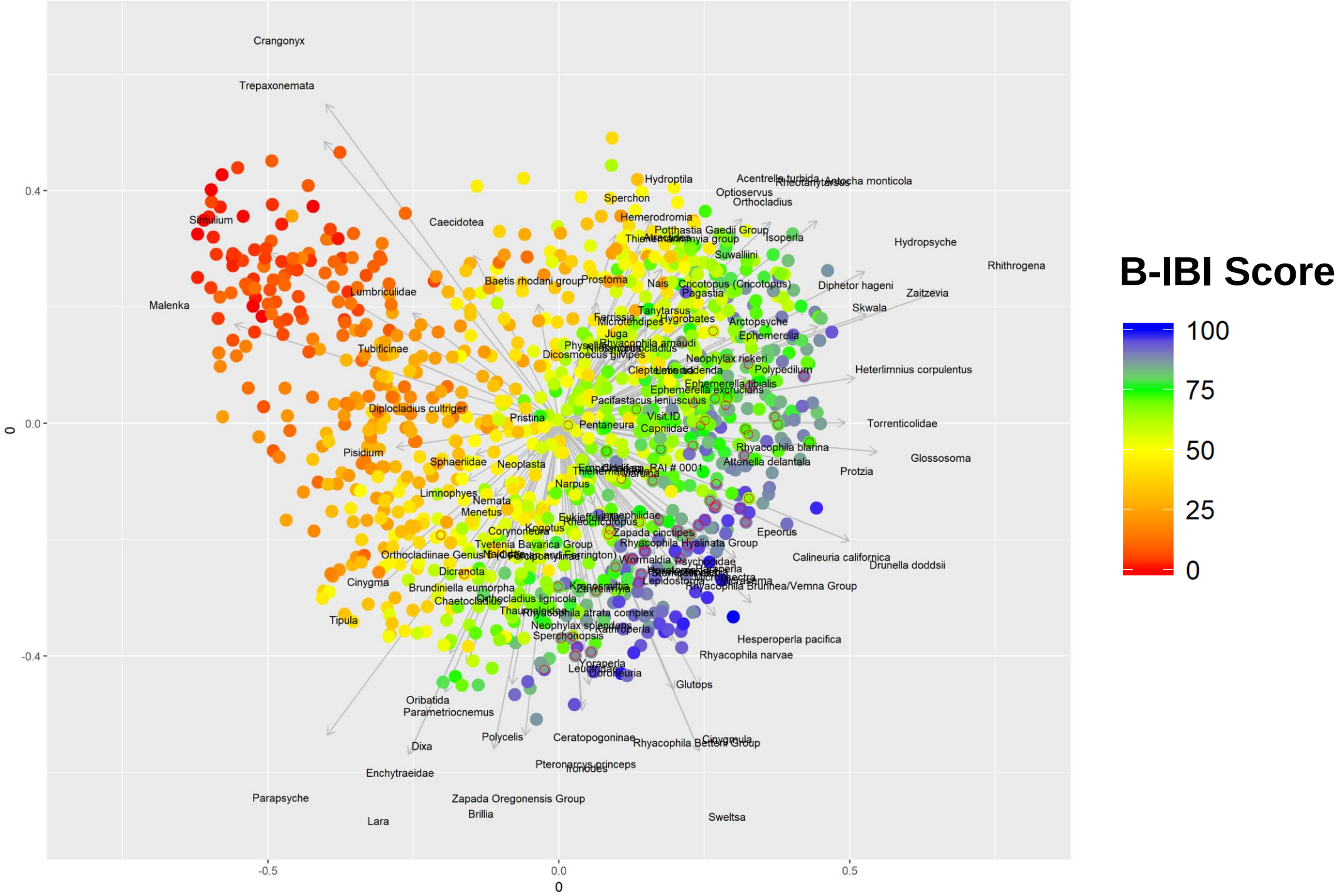
- But informative for some sites



Flashy ← Stable

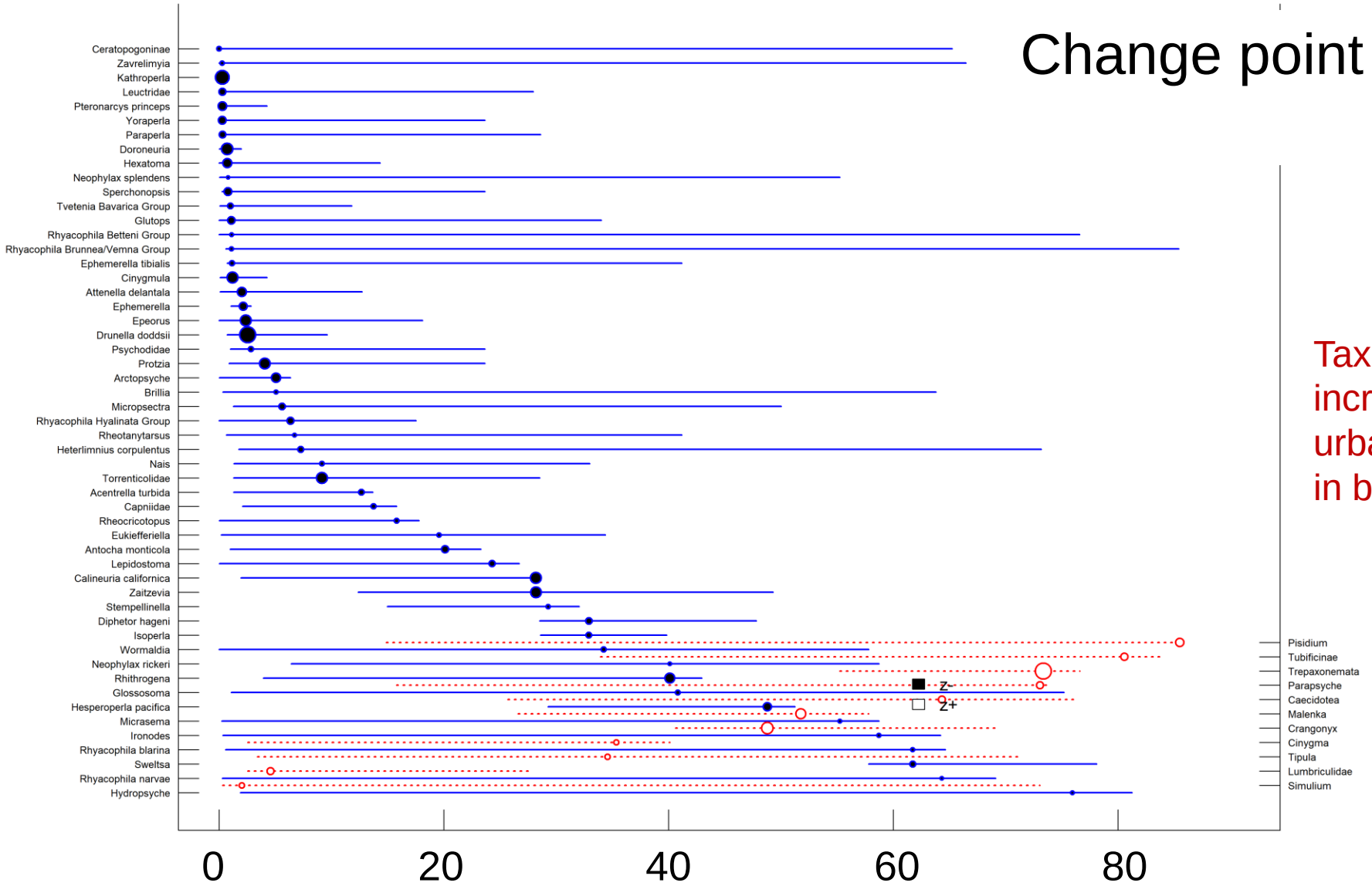
TITAN Analysis

- Measure of community sensitivity
- Change points – are target site conditions better or worse?


B-IBI Score
100
75
50
25
0
0.4
0.0
-0.4
-0.5
0.0
0.5
0
Crangonyx
Trepaxonemata
Simulium
Malenka
Caecidotea
Lumbriculidae
Tubificinae
Diplocladius cultriger
Pisidium
Sphaeriidae
Neoplasta
Limnophyes
Nemata
Menetus
Cinygma
Tipula
Dicranota
Brundiniella eumorpha
Chaetocladius
Orthocladius lignicola
Rhyacophila atrata complex
Neophylax splendens
Sperchonopsis
Oribatida
Parametriocnemus
Dixa
Enchytraeidae
Parapsyche
Lara
Polycelis
Zapada Oregonensis Group
Brillia
Ceratopogoninae
Pteronarcys princeps
Ironodes
Rhyacophila Betteni Group
Cinygmula
Glutops
Hesperoperla pacifica
Rhyacophila narvae
Sweltsa
Calineuria californica
Drunella doddsii
Epeorus
Rhyacophila Hyalinata Group
Zapada cinctipes
Rheocricotopus
Kogotus
Corynoneura
Tvetenia Bavarica Group
Orthocladiinae Genus
Wormaldia
Psychodidae
Lepidostoma
Rhyacophila Brunnea/Vemna Group
Rhyacophila Betteni Group
Rhyacophila blarina
Attenella delantala
Protzia
Glossosoma
Torrenticolidae
Heterlimnius corpulentus
Polypedilum
Neophylax rickeri
Ephemerella excrucians
Ephemerella tibialis
Pacifastacus leniusculus
Visit.ID
Capniidae
Pentaneura
Pristina
Narpus
RAI # 0001
Dicosmoecus gilvipes
Juga
Ferrissia
Microtendipes
Hygrobates
Tanytarsus
Arctopsyche
Ephemerella
Pagastia
Cricotopus (Cricotopus)
Nais
Prostoma
Baetis rhodani group
Hemerodromia
Sperchon
Hydroptila
Potthastia Gaedii Group
Isoperla
Suwalliini
Optioservus
Orthocladius
Acentrella turbida
Antocha monticola
Hydropsyche
Rhithrogena
Diphetor hageni
Zaitzevia
Skwala
Rhyacophila arnaudi
Rheotanytarsus

Change point 2.6%

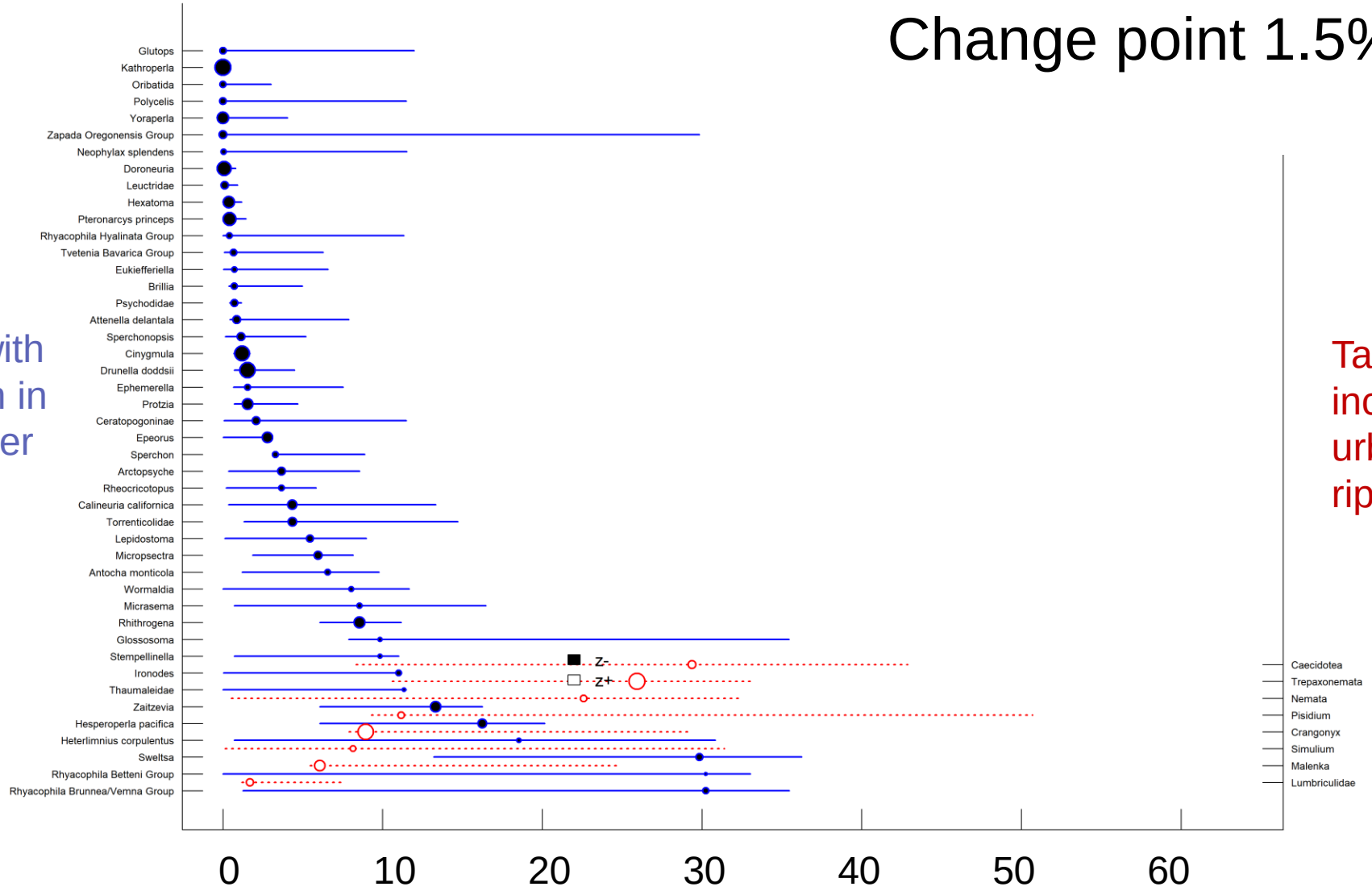
Taxa that disappear with urbanization in basin



Taxa that increase with urbanization in basin

Change point 1.5%

Taxa that disappear with urbanization in riparian buffer



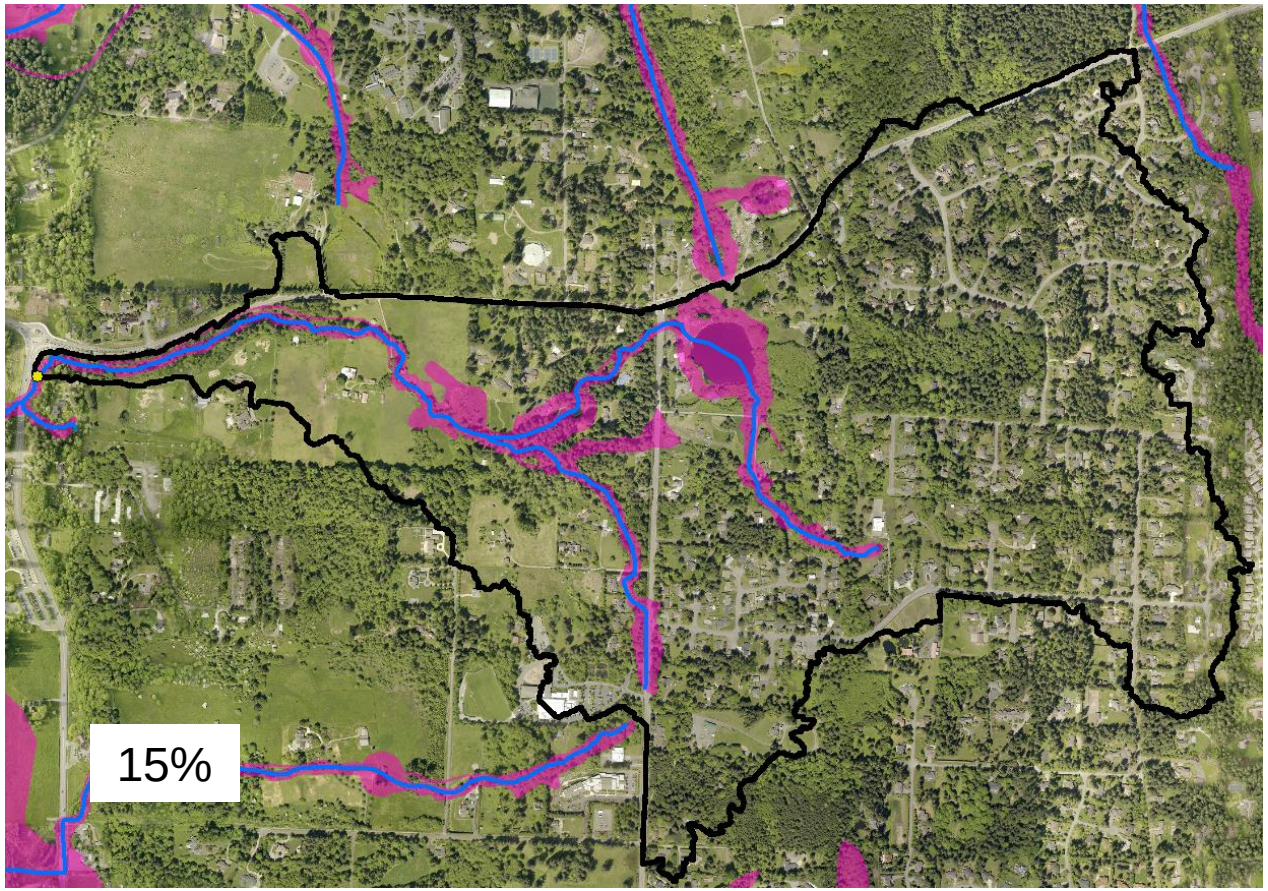
Taxa that increase with urbanization in riparian buffer

0 10 20 30 40 50 60

% urban, riparian buffer

Riparian buffer

- All 4 Fair sites >1.5% urban
- Excellent sites 0 – 7.8%



Abood and Maclean 2012

Informative taxa?

- High hopes that certain taxa would be highly informative
- Some of the most sensitive taxa at excellent sites, but patchy
- Suggestions?

Recommended Actions?

Restoration and Management Actions		Recommended Action
In-stream	amend substrate	low priority
	replace culverts	medium priority
	stabilize stream banks	High priority
	reconnect to floodplain	High priority
Riparian	stabilize slopes	High priority
	plant native trees	High priority
	plant native shrubs	High priority
	extend buffer	High priority

Recommended Actions?

Restoration and Management Actions		Recommended Action
Agricultural BMPs	exclude livestock from stream/riparian buffer	medium priority
	manage soil loss	medium priority
Forest BMPs	maintain or decommission roads	NA
	minimize clearcutting	NA
	replant	NA
Mining BMPs	enforce mining BMPs	NA

Recommended Actions?

Restoration and Management Actions		Recommended Action
Stormwater BMPs	increase flow control: build new facilities	High priority
	increase flow control: retrofit facilities	medium priority
	increase flow control: private residences	High priority
	maintain storage and treatment facilities	medium priority
	sweep streets	low priority
Other Approaches and Actions	conduct education campaign	High priority
	create incentives to follow BMPs	High priority
	purchase and protect property	High priority
	seed invertebrates	low priority

What, Where and When

- Specify actions
- Identify where
  - Public land
  - Connectivity
  - Must be feasible
- Sequence actions

Take aways

- Many indicators of stress, most correlated
- Difficult to identify specific stressors in most urban basins
  - Implications of messing up vary
- Understanding risks and subtle indicators key for protecting and monitoring excellent basins

Thank You!

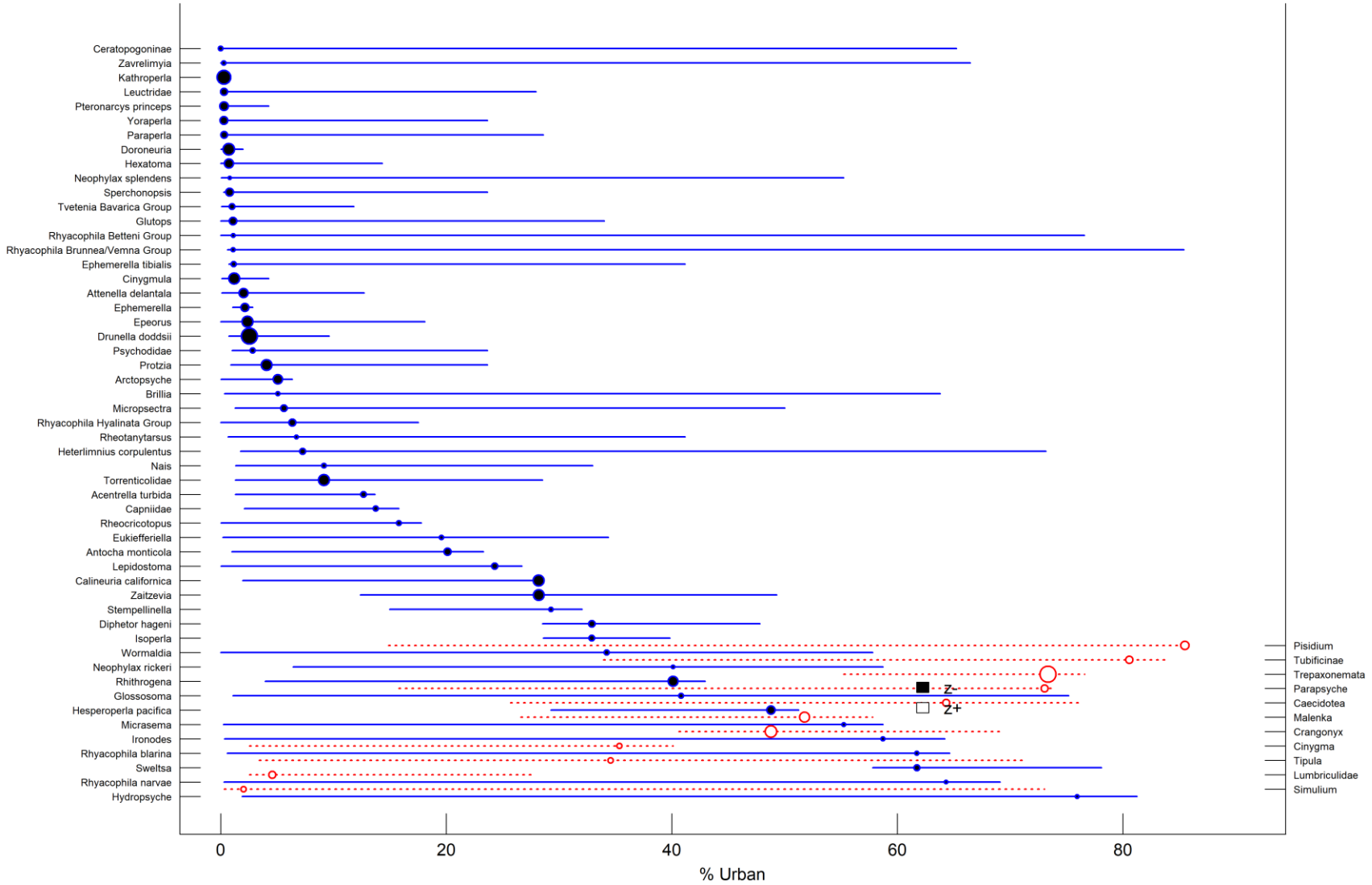
- Liora Llewellyn, Houston Flores, Dan Lantz, Andrew Miller, Brendan Grant, Mimi Reed, Stephanie Eckard, KayLani Siplin, Jessica Andrade, Paige Morris, Mark Quick, Jo Wilhelm, King County
- Jill Lemmon, Chad Larson, Lola Flores, WA Department of Ecology
- Kitsap County
- City of Bainbridge Island
- Whatcom County
- City of Bellingham
- City of Issaquah

- “This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement PC01J18101 to the Washington Department of Ecology. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.”

Freshwater Quality

- **Protect all "excellent" basins**
- **Restore 30 basins from "fair" to "good"**

Condition of Biotic Integrity	B-IBI score
Excellent	80 – 100
Good	60 – 80
Fair	40 - 60
Poor	20 - 40
Very Poor	0 – 20


Ceratopogoninae
Zavrelimyia
Kathroperla
Leuctridae
Pteronarcys princeps
Yoraperla
Paraperla
Doroneuria
Hexatoma
Neophylax splendens
Sperchonopsis
Tvetenia Bavarica Group
Glutops
Rhyacophila Betteni Group
Rhyacophila Brunnea/Vemna Group
Ephemerella tibialis
Cinygmula
Attenella delantala
Ephemerella
Epeorus
Drunella doddsii
Psychodidae
Protzia
Arctopsyche
Brillia
Micropsectra
Rhyacophila Hyalinata Group
Rheotanytarsus
Heterlimnius corpulentus
Nais
Torrenticolidae
Acentrella turbida
Capniidae
Rheocricotopus
Eukiefferiella
Antocha monticola
Lepidostoma
Calineuria californica
Zaitzevia
Stempellinella
Diphetor hageni
Isoperla
Wormaldia
Neophylax rickeri
Rhithrogena
Glossosoma
Hesperoperla pacifica
Micrasema
Ironodes
Rhyacophila blarina
Sweltsa
Rhyacophila narvae
Hydropsyche
Pisidium
Tubificinae
Trepaxonemata
Parapsyche
Caecidotea
Malenka
Crangonyx
Cinygma
Tipula
Lumbriculidae
Simulium
Z-
Z+
0
20
40
60
80
% Urban