Receiving Water Findings Symposium

September 13, 2018

Tacoma, WA

SAM

Stormwater Action Monitoring

Symposium Agenda

- Context for regional monitoring
- Puget Lowland Streams
- Puget Nearshore Mussels
- Puget Nearshore Sediment
- Understanding spatial assessments
- Puget Shoreline Bacteria Compilation
- "Add-on" studies
- What's next for SAM status and trend projects

Context for Regional Monitoring

Brandi Lubliner, PE
SAM Coordinator
Washington State Department of Ecology

Stormwater Action Monitoring

ABOUT SAM

Stormwater Action Monitoring

SAM is

Collaborative

- Formal committee of stakeholders (Stormwater Work Group), caucuses, workshops, surveys, and polls.

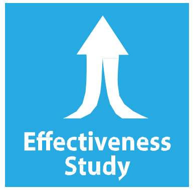
Regional

- Western Washington

Funded

- By permittees in Western Washington: 91 cities, towns, counties; 2 ports; & WSDOT
- By in-kind from Ecology, WSDA, USGS, Redmond, Penn Cove Shellfish, Cedar Grove, hundreds of mussel monitoring volunteers

SAM's Scientific Framework



How well are stormwater management practices working?

SAM effectiveness studies answer why or why not, and under what conditions.

What are the most common types of pollution in stormwater?

SAM source identification projects identify the most common problems and propose regional actions.

How do we know if water quality is getting better or worse?

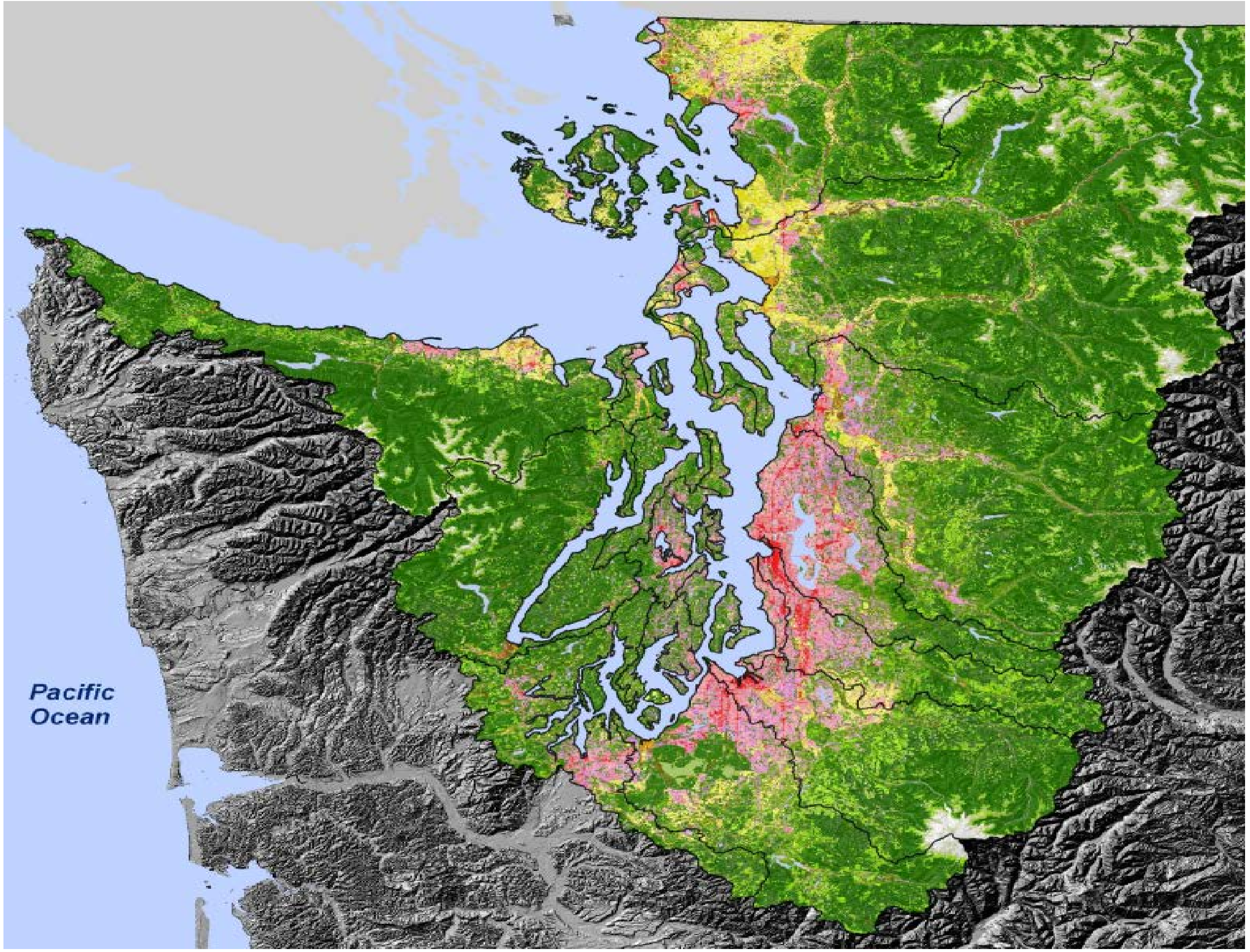
SAM receiving water monitoring evaluates conditions in the water bodies that we are trying to protect.

How do we know if water quality is getting better or worse?

SAM receiving water monitoring evaluates conditions in the water bodies that we are trying to protect. No other regional monitoring in the state gives feedback on permitted areas.

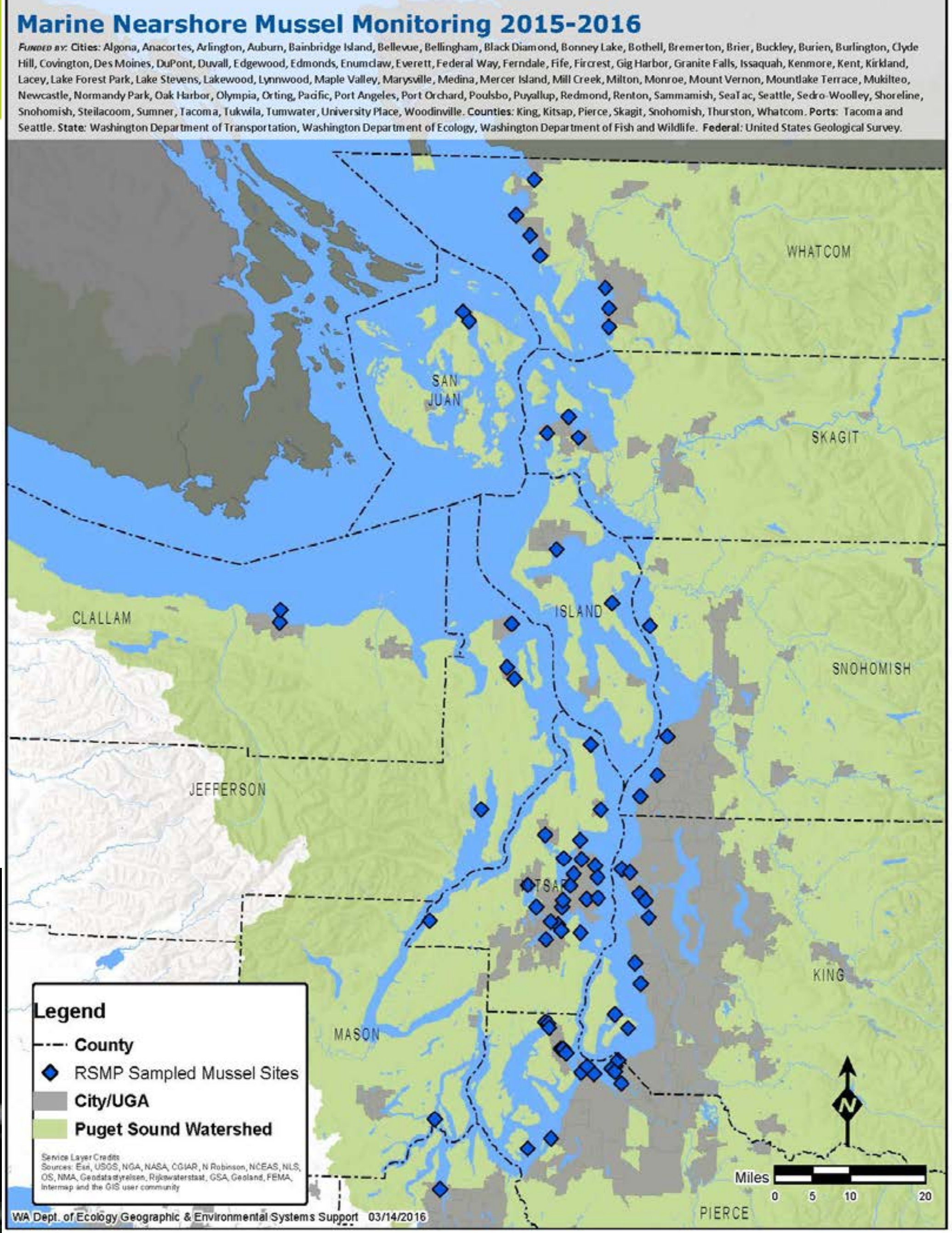
Puget Sound Regional Priorities

- Environments monitored:
  - Puget Lowland streams
  - Puget Sound nearshore
- What's measured:
  - Water quality
  - Sediment quality
  - Biotic endpoints
  - Habitat and watershed



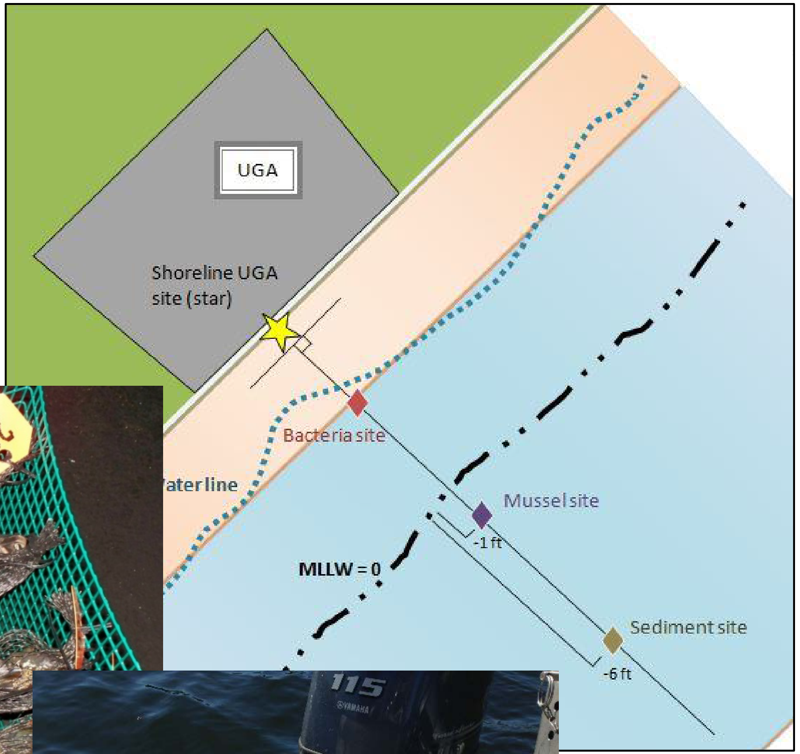
Urban nearshore

- Mussels (WDFW) sampled winter 15-16 and 17-18
- Sediment chemistry (USGS, WDNR, King Co), summer 2016
- Bacteria (Ecology, DOH)
  - No sampling, date compiled from 27 entities, 2010-15



Urban marine nearshore

- Bacteria data compiled from existing studies
  - Sound-wide sampling deemed too expensive
- Puget Sound nearshore sites
  - 40 UGA sites
  - Fine sediment – (USGS, WDNR, King Co), summer 2016
  - Mussel sampling (WDFW) – winter 2015-16



Puget Lowland Ecoregion Streams (PLES)

- EPA's randomized site design
  - 100 sites sampled year of 2015
- 20 agreements
  - 100s of parameters: chemistry, biology, habitat, watershed landuse
- Team: USGS, King Co, San Juan Island CD, Snohomish Co, Ecology-EAP, & 13 labs

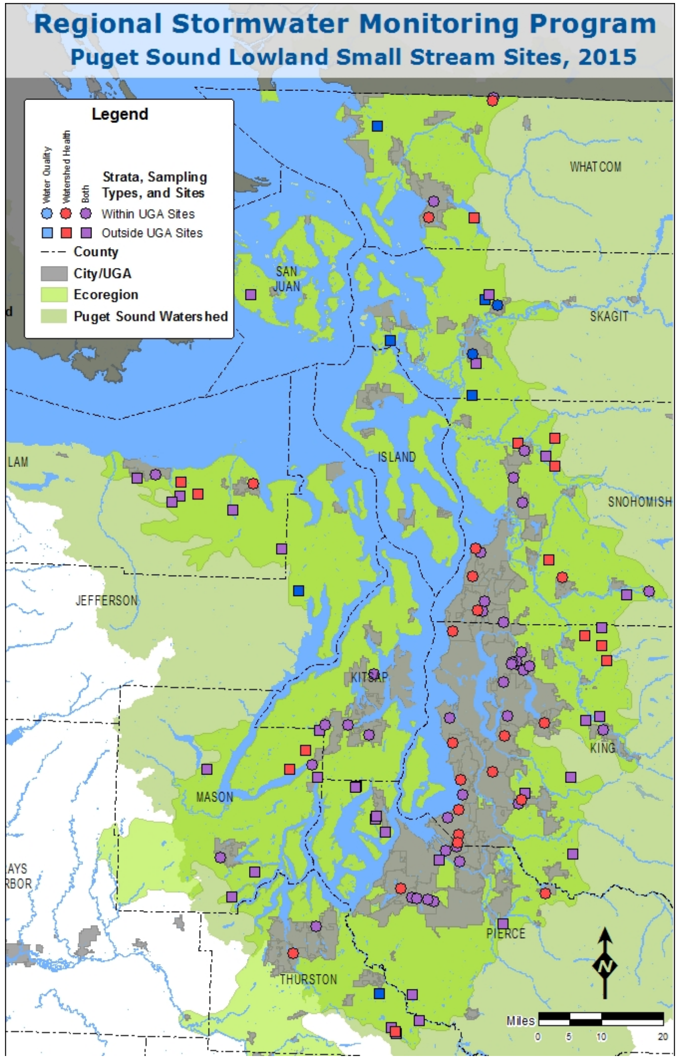
Puget Lowland Ecoregion Streams Status & Trends

Brandi Lubliner, SAM Coordinator; Rich Sheibley, USGS; Curtis DeGasperi, King County; Chad Larson and Keunyea Song, Ecology; Leska Fore, Puget Sound Partnership

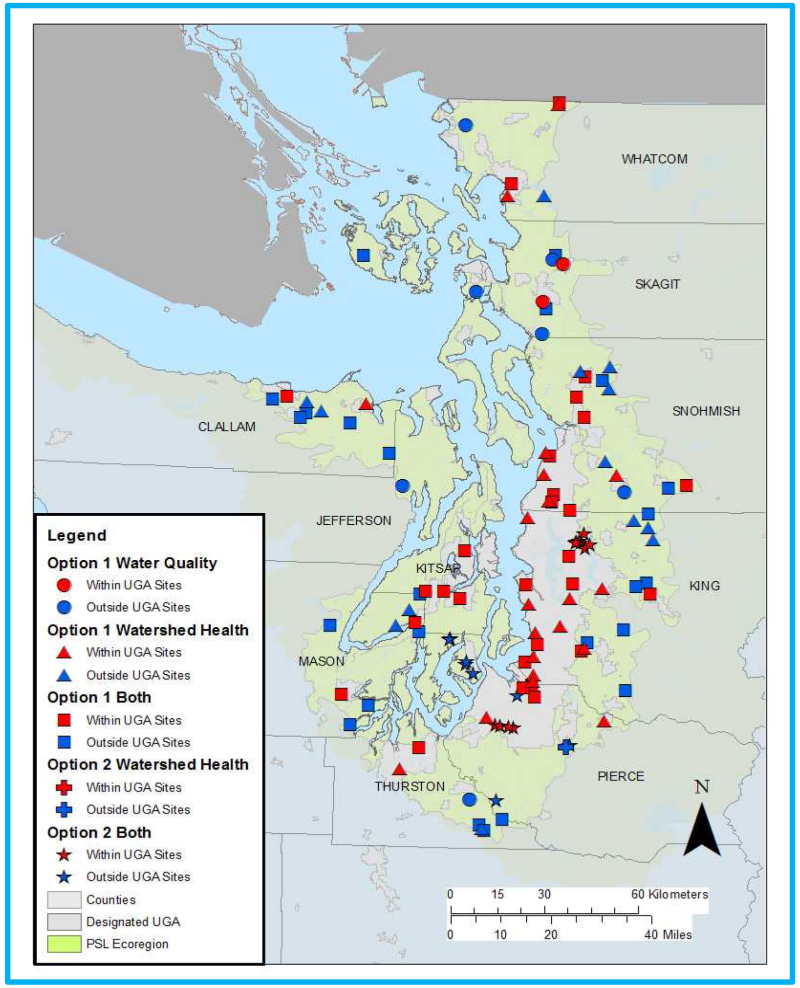
SAM Stormwater Action Monitoring

Sampled small Puget Lowland Streams within and outside urban growth areas (UGAs) for:

- Monthly water quality Jan-Dec 2015
  - Conventional parameters, metals, PAHs, stream flow
- Summer Watershed Health Monitoring
  - Water quality (conventional parameters)
  - Benthic macroinvertebrates
  - Periphyton
  - Sediment chemistry (TOC, metals, phthalates, PAHs, PCBs, PBDEs, common roadside-use pesticides)



Sites Within and Outside Urban Growth Areas



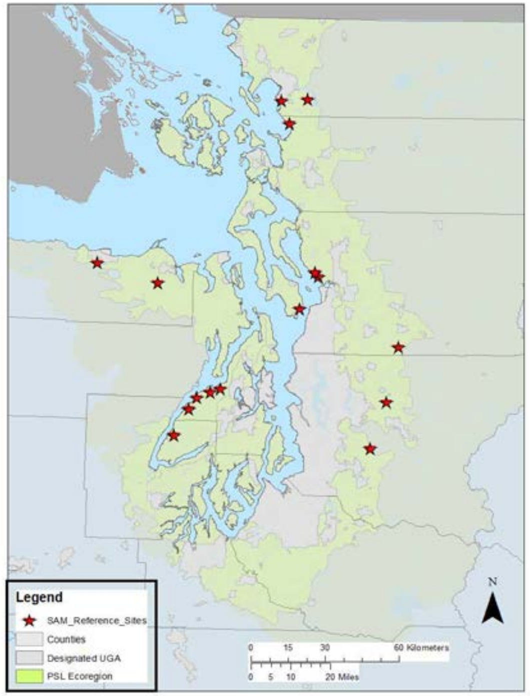
Sampling was probabilistic and spatially balanced

A total of 105 Watershed Health sites

Monthly water quality sampling attempted at 80 sites, but with mixed success due to unusually low flows in 2015

Followed EPA status assessment approach

- Need to set thresholds for good, fair, and poor
  - Fixed thresholds (e.g., literature, state standards)
  - Distribution based thresholds (from ‘least-disturbed’ reference sites)



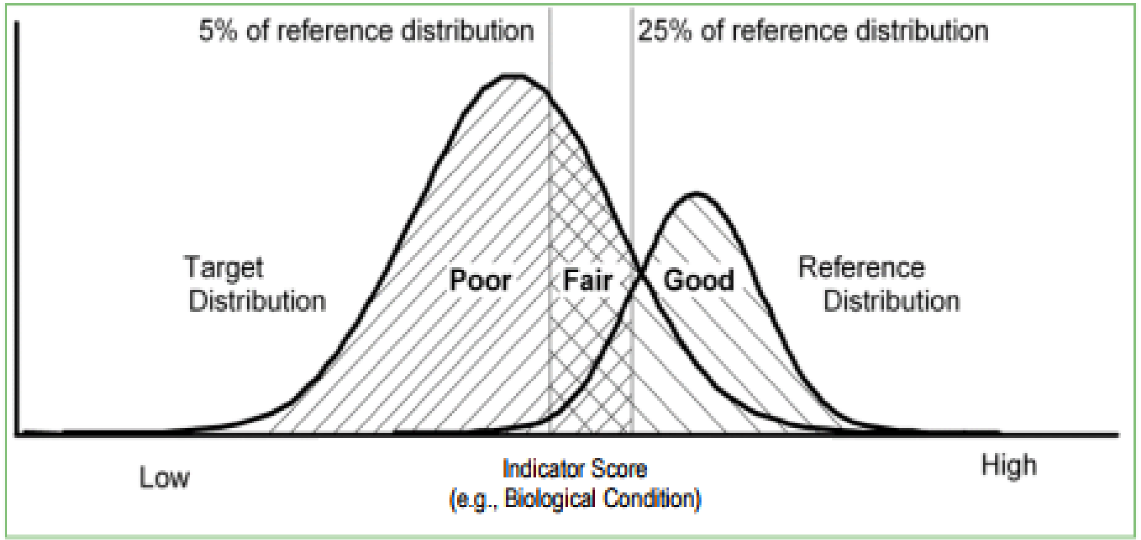
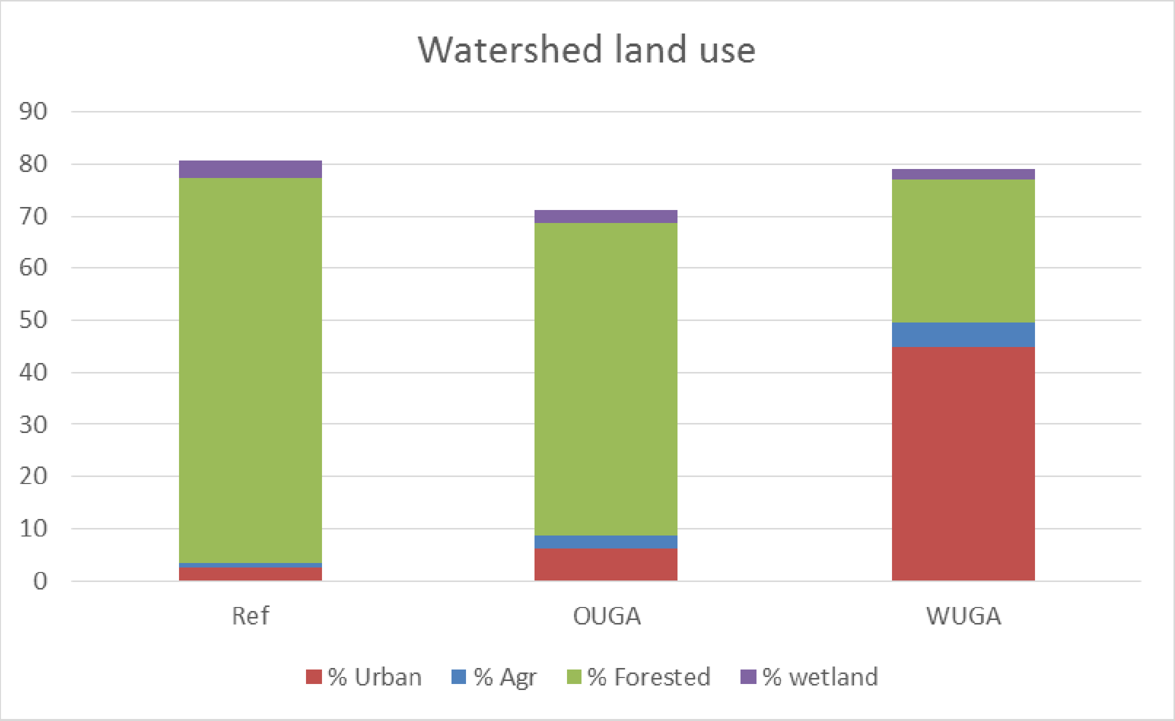


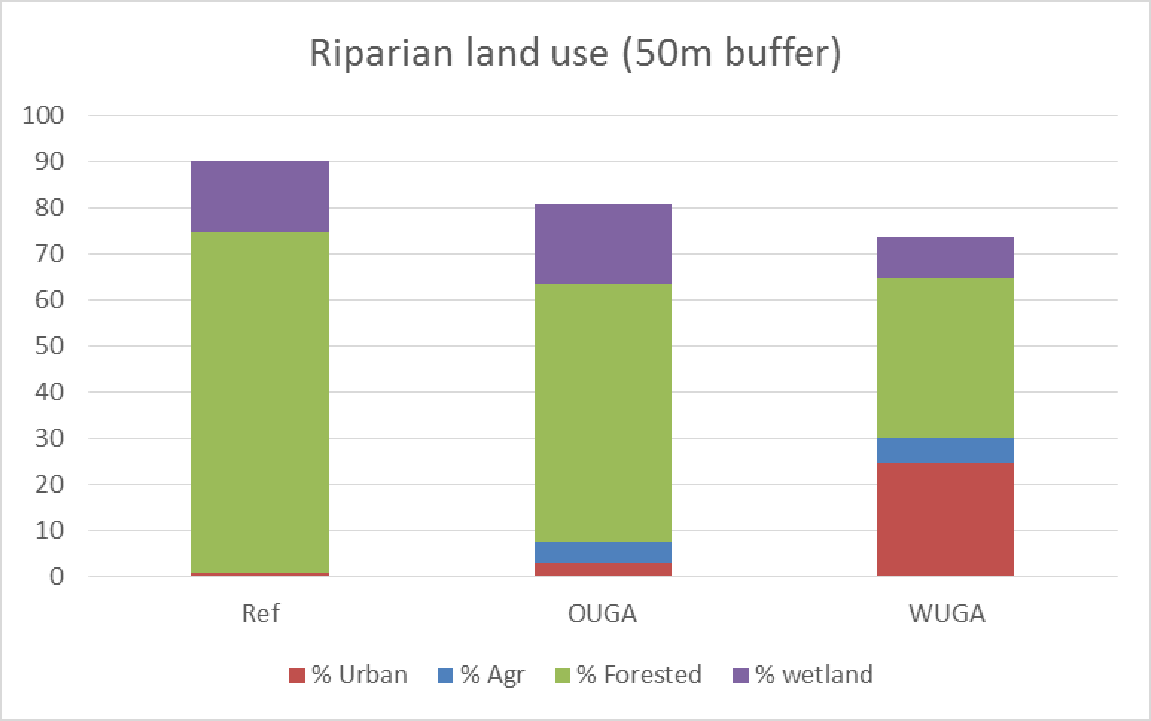
Figure 7. Reference condition thresholds used for good, fair and poor assessment (EPA/NRSA).

Included watershed and riparian GIS analysis

- Leveraged USGS NAWQA expertise (and USGS $) to derive land cover and other landscape parameters for all SAM PLES sites and 16 least-disturbed reference sites
- Why? Because local riparian and upstream land cover shown to be important factor for biological communities

Land cover summary within and outside UGAs





SAM Stormwater Action Monitoring

Detected >50% of time	A
Detected 20-50% of time	B
Detected <20% of time	C

Water Quality

Parameter	Detection Freqency	
	Outside UGA	Within UGA
Ammonia	B	A
Arsenic	A	A
Arsenic dissolved	A	A
Chloride	A	A
Chromium	A	A
Chromium dissolved	B	A
Copper	A	A
Copper dissolved	A	A
Dissolved Organic Carbon	A	A
Fecal coliform	A	A
Hardness as CaCO3	A	A
Nitrite-Nitrate	A	A
Ortho-phosphate	A	A
Total Nitrogen	A	A
Total Phosphorus	A	A
Total Suspended Solids	A	A
Lead	B	B

Parameter	Detection Freqency	
	Outside UGA	Within UGA
Naphthalene	C	B
Zinc	C	B
Zinc dissolved	C	B
1-Methylnaphthalene	C	C
2-Methylnaphthalene	C	C
Acenaphthene	C	C
Acenaphthylene	C	C
Anthracene	C	C
Benz(a)anthracene	C	C
Benzo(a)pyrene	C	C
Benzo(b)fluoranthene	C	C
Benzo(g,h,i)perylene	C	C
Benzo(k)fluoranthene	C	C
Cadmium	C	C
Cadmium dissolved	C	C
Carbazole	C	C
Chrysene	C	C
Dibenzo(a,h)anthracene	C	C
Dibenzofuran	C	C
Fluoranthene	C	C
Fluorene	C	C
Indeno(1,2,3-cd)pyrene	C	C
Lead dissolved	C	C
PCN-002	C	C
Phenanthrene	C	C
Pyrene	C	C
Retene	C	C
Silver	C	C
Silver dissolved	C	C
Total Benzofluoranthenes	C	C

Sediment Quality

Parameter	Detection Frequency	
	Outside UGA	Within UGA
Arsenic	A	A
Cadmium	A	A
Chromium	A	A
Copper	A	A
Dichlobenil	A	A
Lead	A	A
Retene	A	A
Total PBDE	A	A
Total PCB	A	A
Zinc	A	A
Bis(2-Ethylhexyl) Phthalate	B	A
Silver	B	A

Parameter	Detection Frequency	
	Outside UGA	Within UGA
1-Methylnaphthalene	C	C
2,4-D	C	C
2-Methylnaphthalene	C	C
Acenaphthene	C	C
Acenaphthylene	C	C
Anthracene	C	B
Benz(a)anthracene	C	B
Benzo(a)pyrene	C	B
Benzo(b)fluoranthene	C	B
Benzo(g,h,i)perylene	C	B
Benzo(k)fluoranthene	C	B
Butyl benzyl phthalate	C	C
Carbaryl	C	C
Carbazole	C	C
Chlorpyrifos	C	C
Chrysene	C	A
DCPMU	C	C
Dibenzo(a,h)anthracene	C	C
Dibenzofuran	C	C
Dibutyl phthalate	C	C
Diethyl phthalate	C	C
Dimethyl phthalate	C	C
Di-N-Octyl Phthalate	C	C
Diuron	C	C
Fluoranthene	C	A
Fluorene	C	C
Indeno(1,2,3-cd)pyrene	C	B
Naphthalene	C	C
PCN-002	C	C
Phenanthrene	C	B
Pyrene	C	A
Total Benzofluoranthenes	C	B
Total PAH	C	A
Triclopyr	C	C

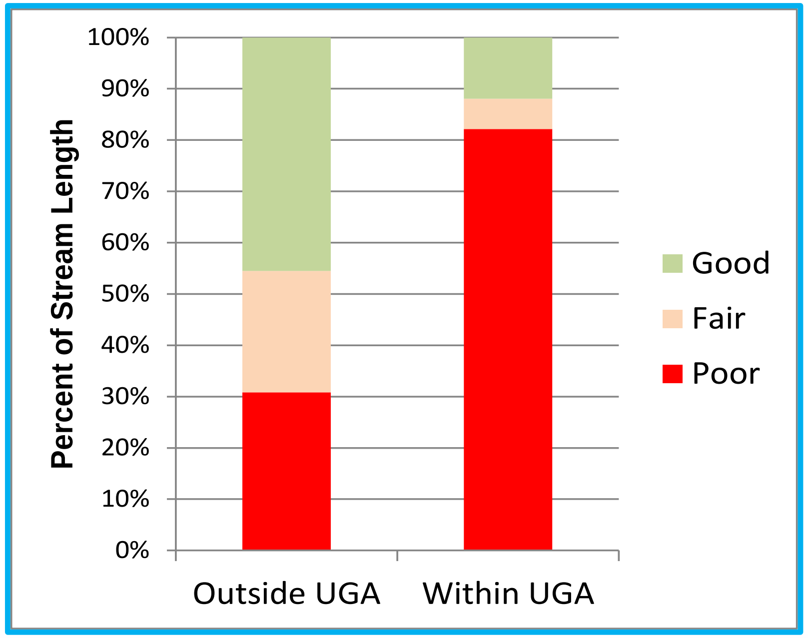
Big Questions

- Status: How bad is it?
- Trends: Are things getting better or worse?

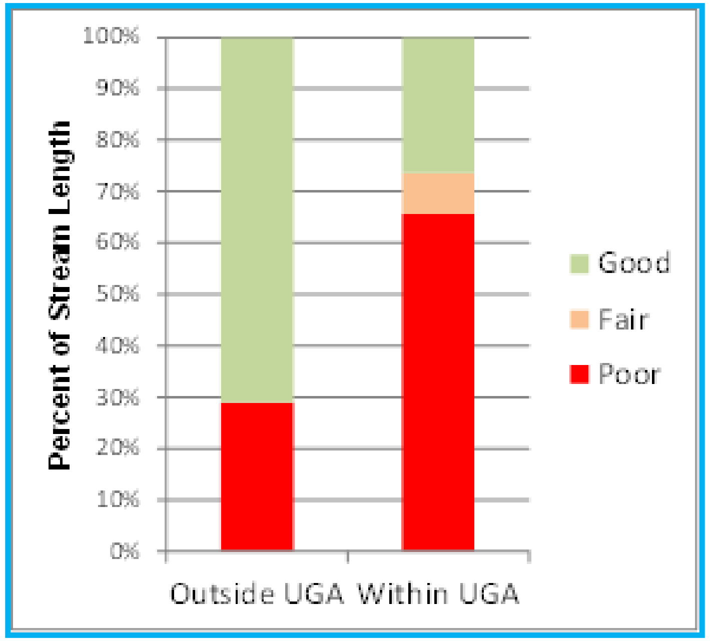
Biological Status

- Biological condition was generally worse in small streams within UGAs compared to streams outside UGAs

Benthic Index of Biotic Integrity



Trophic Diatom Index



Comparison to water quality standards

- Higher frequency of exceedance of fecal coliform standard at sites within UGAs
- Similar frequency of exceedance of temperature, pH, and dissolved oxygen standards at sites within and outside of UGAs
- Measured metals concentrations did not typically exceed relevant acute or chronic standards for the protection of aquatic life.

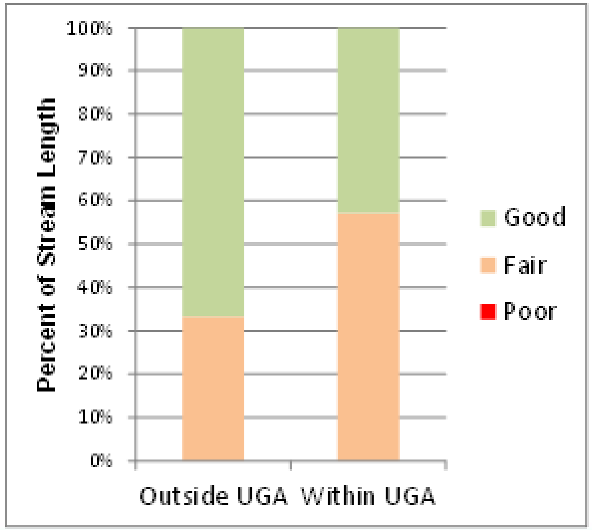
Comparison to sediment quality standards

- Measured sediment contaminant concentrations did not typically exceed sediment quality standards within or outside UGAs

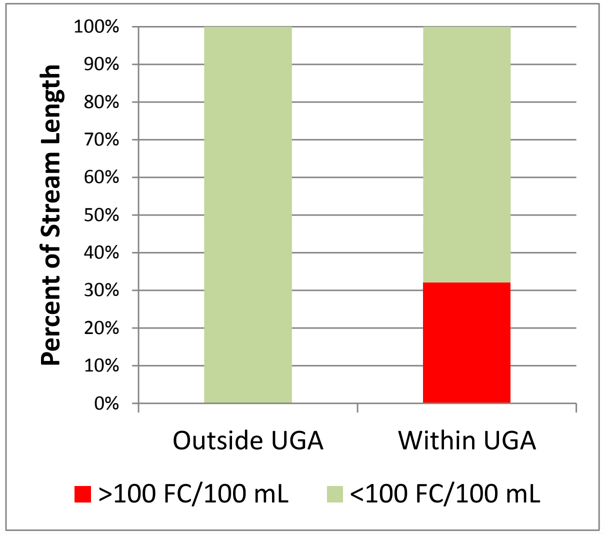
Water Quality Status

- Status based on WQI and temperature similar inside and outside UGAs
- Greater proportion of stream length within UGAs in poor condition based on Fecal Coliform bacteria and Total Phosphorus

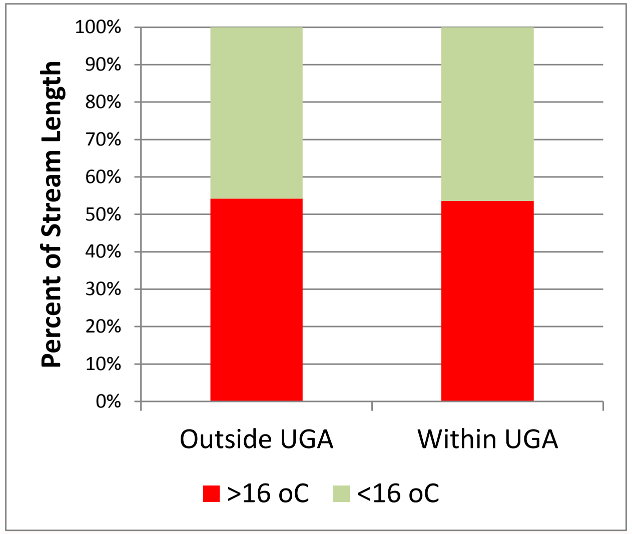
Annual Water Quality Index



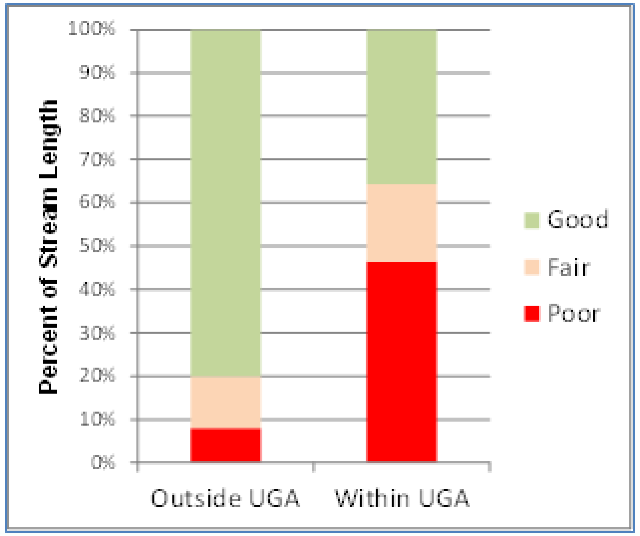
Fecal Coliform Bacteria



Temperature

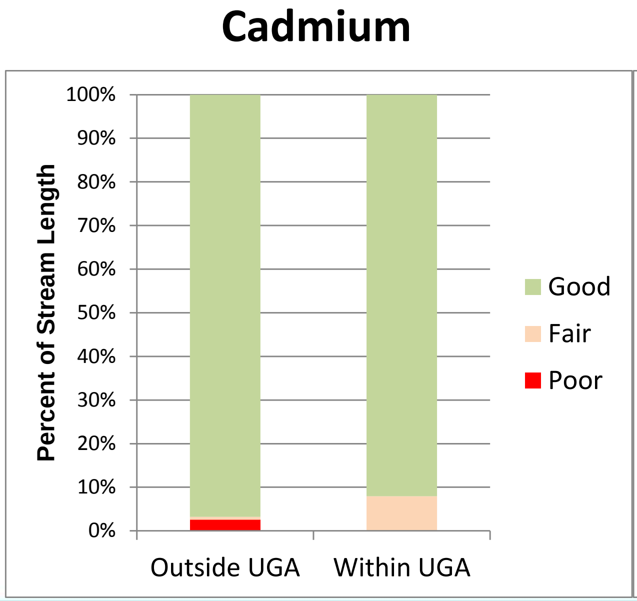


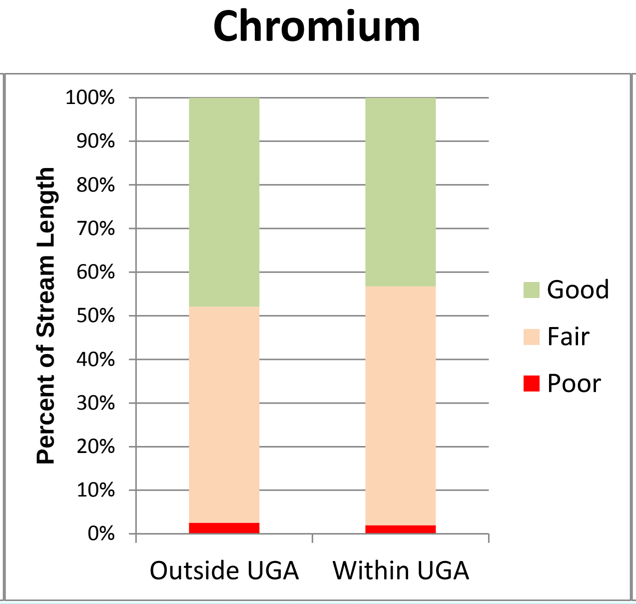
Total Phosphorus

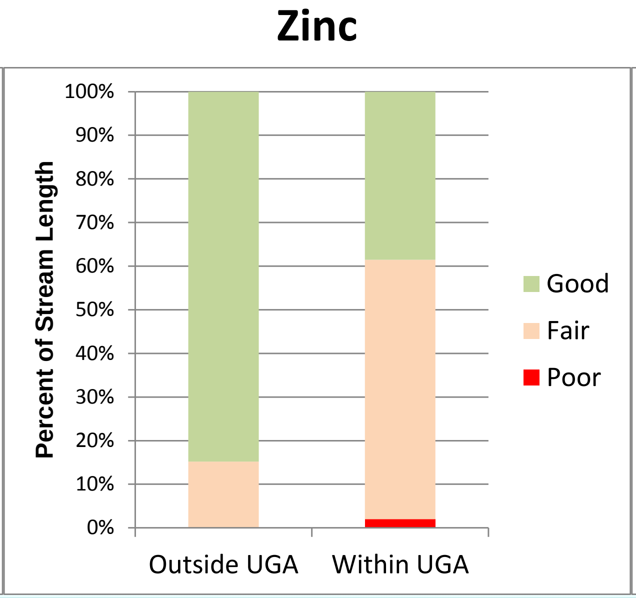


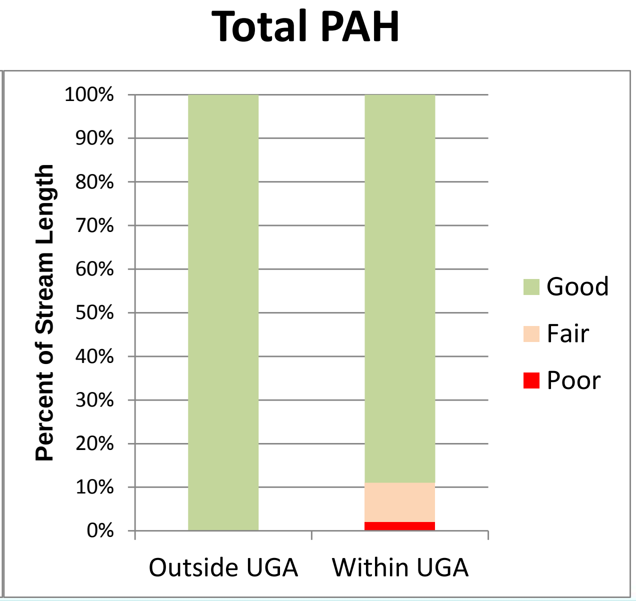
Sediment Quality Status

- Highest concentrations measured typically occurred within UGAs
- Zinc concentrations distinctly elevated within UGAs





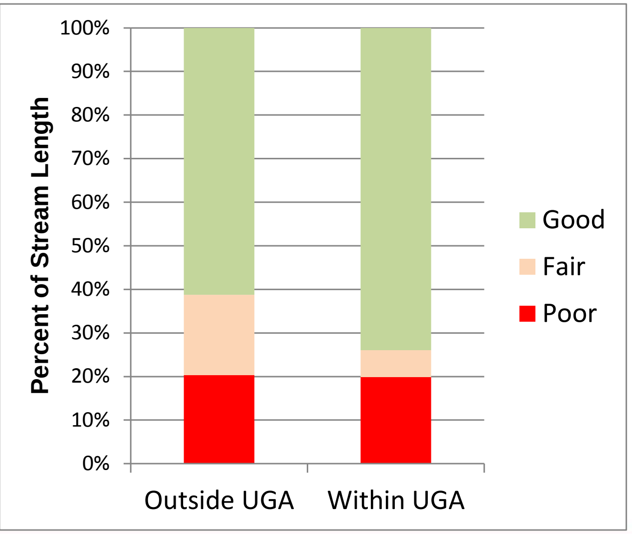




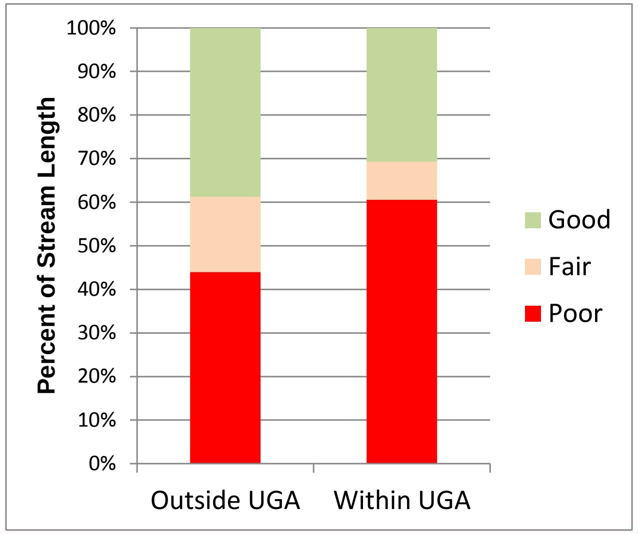
Habitat Status

- Habitat in poor condition similar within and outside UGAs except for wood volume and pool area
- Habitat poor + fair condition similar within and outside UGAs except for stream substrate status

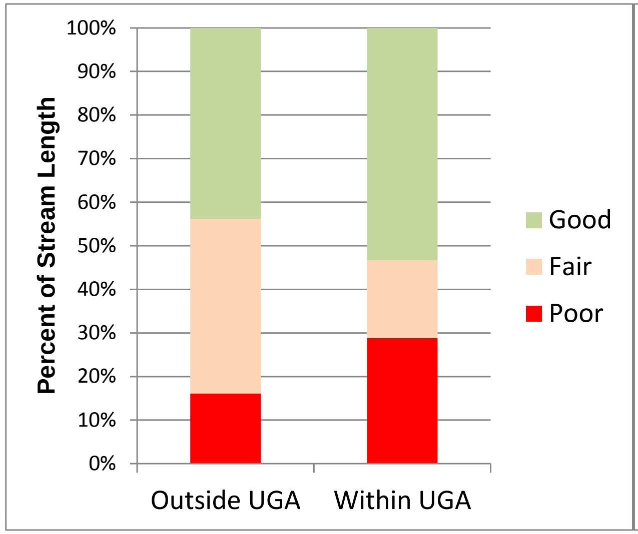
Riparian Canopy Closure



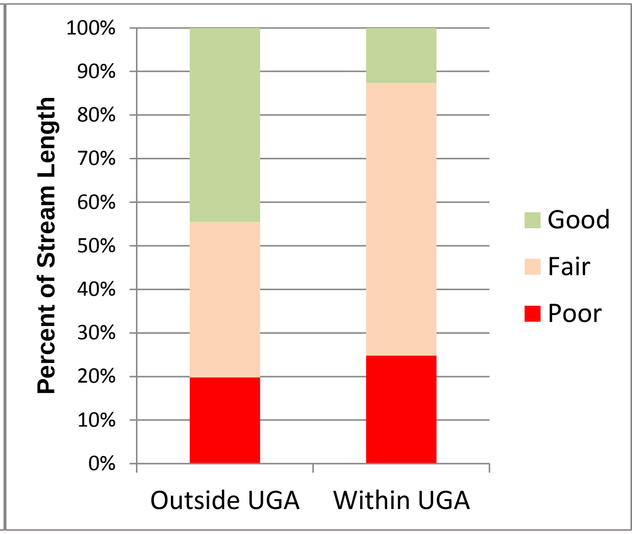
Large Wood Volume



Residual Pool Area



Median Particle Size (D50)



A logical question

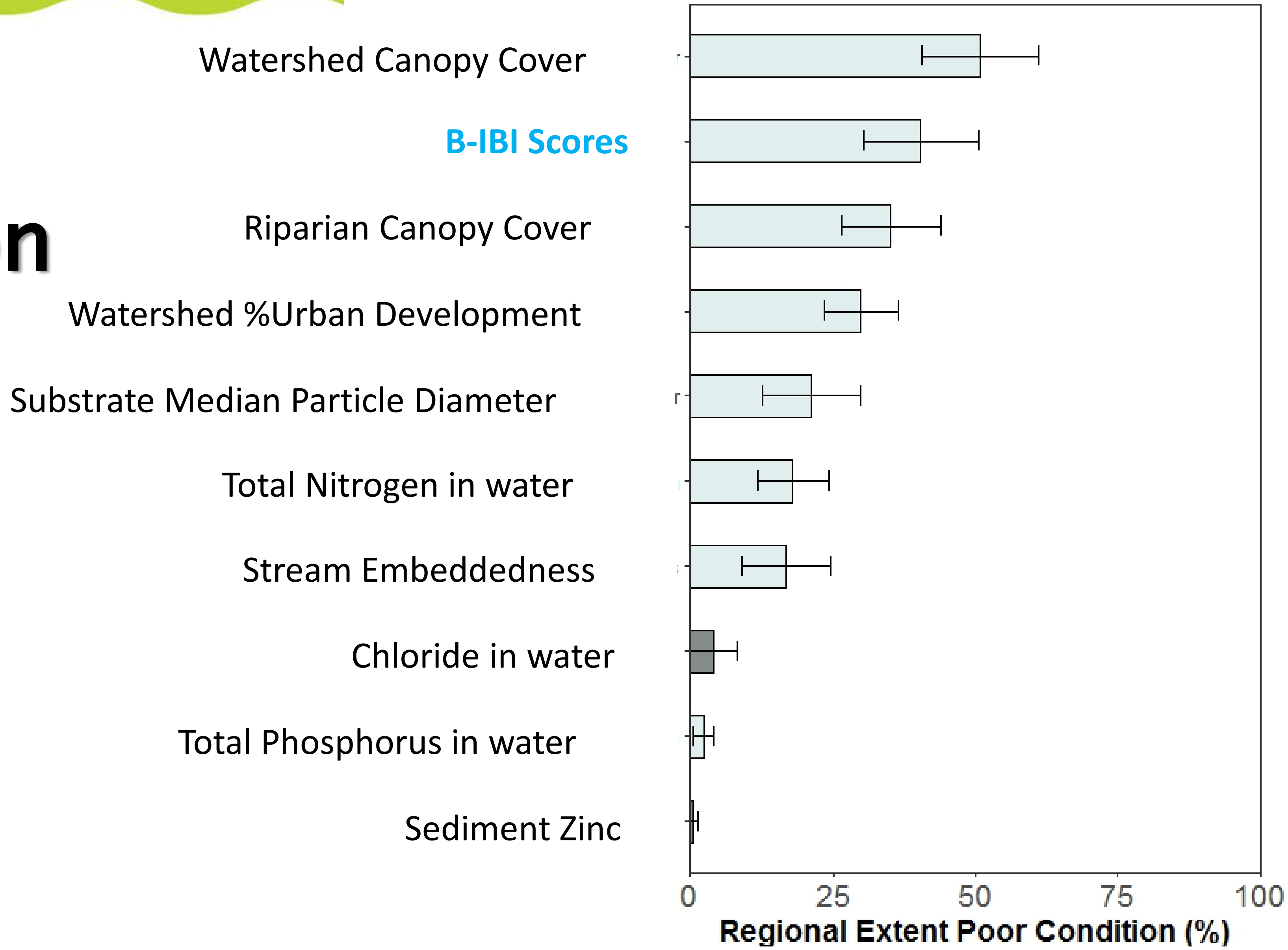
- What are the causes of poor biological condition?

Relative Risk and Attributable Risk (RR/AR)

- Assumes causal relationship between stressor and biological response
- Assumes stressor's effects would be completely reversed if stressor were eliminated
- Assumes the effects of multiple stressors are independent and act in isolation from other stressors

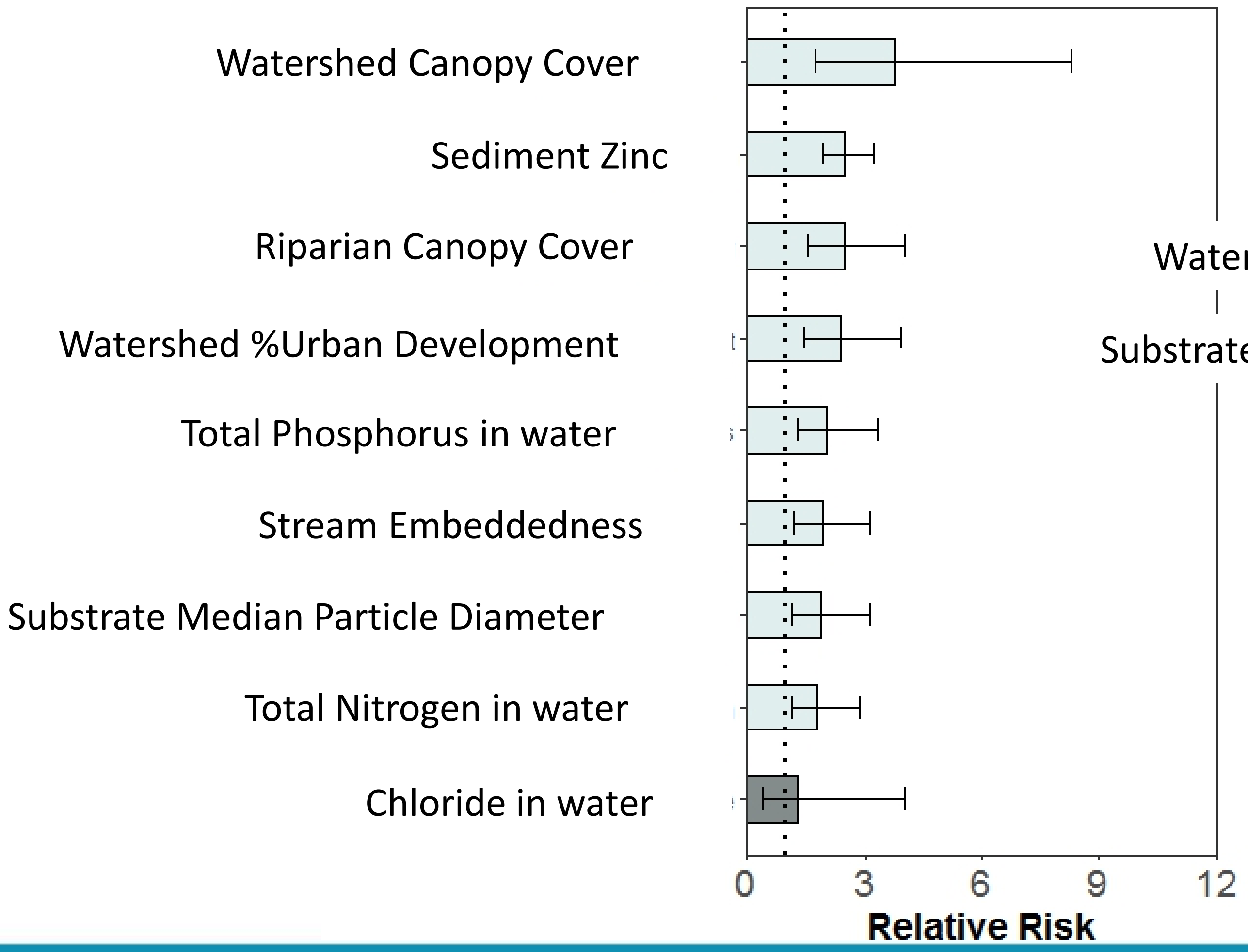
Stressor → Biological Response

Extent of poor condition

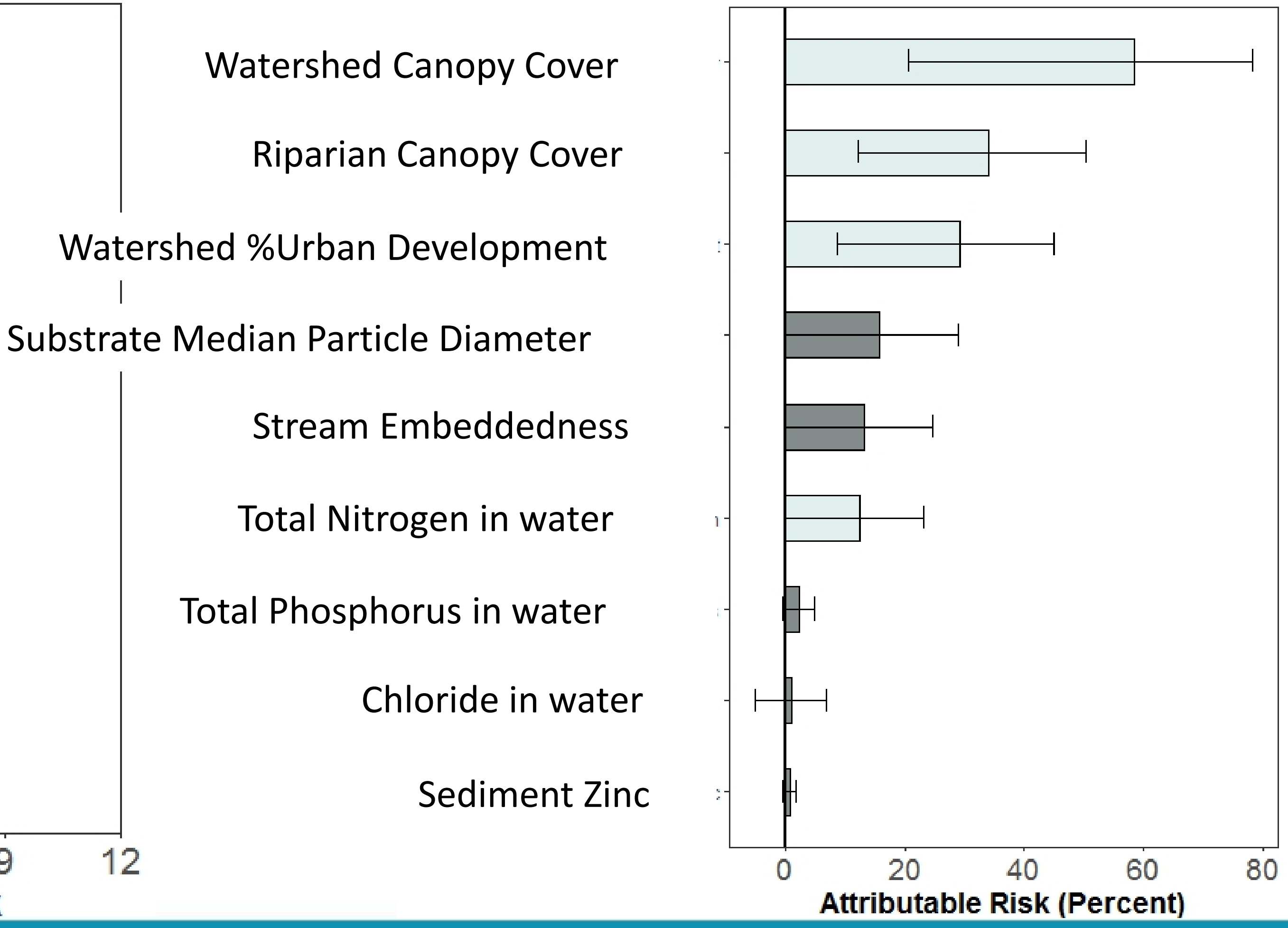


RR/AR for B-IBI scores

Relative Risk

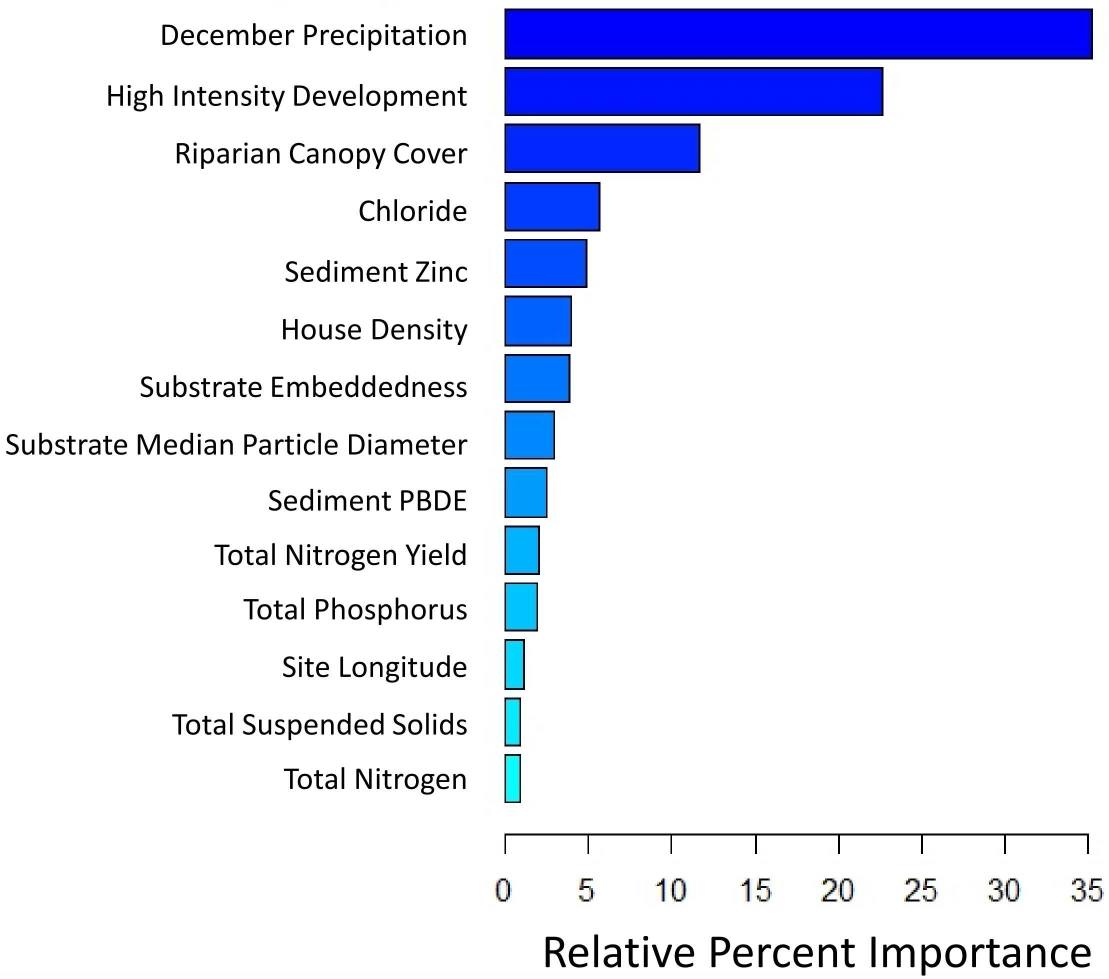


Attributable Risk



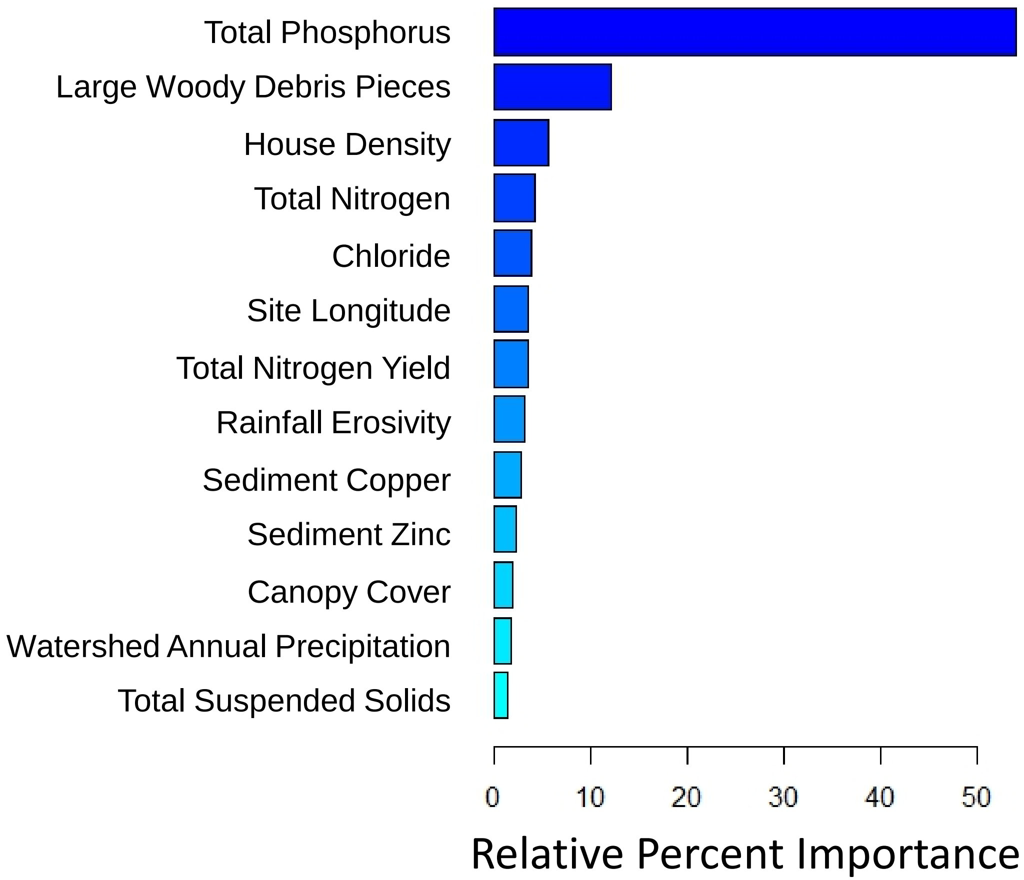
Boosted Regression Tree Model of BIBI scores

- Natural variables
  - Mean December precipitation
  - Longitude
- Human variables
  - High Intensity Development
  - Riparian Canopy Cover
  - Chloride in water
  - Zinc in sediment
  - House density
  - Stream embeddedness
  - Etc



Boosted Regression Tree model of Trophic Diatom Index

- Natural variables
  - Longitude
- Human variables
  - Total Phosphorus
  - Large Woody Debris
  - House Density
  - Total Nitrogen
  - Chloride
  - Watershed Total Nitrogen Yield
  - Etc



Most important stressors for B-IBI scores

Stream Health Category	Significant Stressors
Land cover	• Watershed Canopy Cover • Riparian Canopy Cover • Percent Urban Development
Water	• Total Nitrogen • Total Phosphorus
Sediment	• Total Zinc • Substrate Embeddedness • Substrate Particle Diameter

Key Findings

- Nearly all of the stream health indicators were negatively influenced by urban development
- Key stressors driving poor B-IBI scores were landscape-scale watershed characteristics
- Watershed and riparian canopy cover were found to be the most important stressors to B-IBI at the regional scale
- Regional scale probabilistic monitoring is a cost-effective way to provide unbiased estimates of stream health status and trends

Questions?

2015/16 Mussel Monitoring Survey

Jennifer Lanksbury, Laurie Niewolny, Andrea Carey, Mariko Langness,
Sandra O'Neill, James West

Toxics-focused Biological Observation System (TBiOS)
Washington Department of Fish and Wildlife

Stormwater Action Monitoring

Mussels are natural contaminant samplers

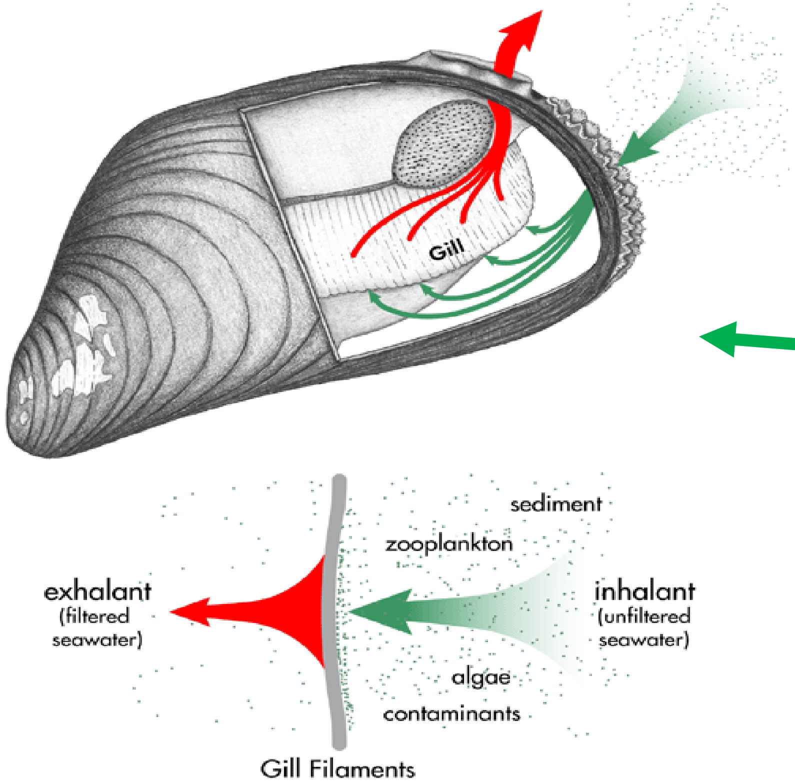
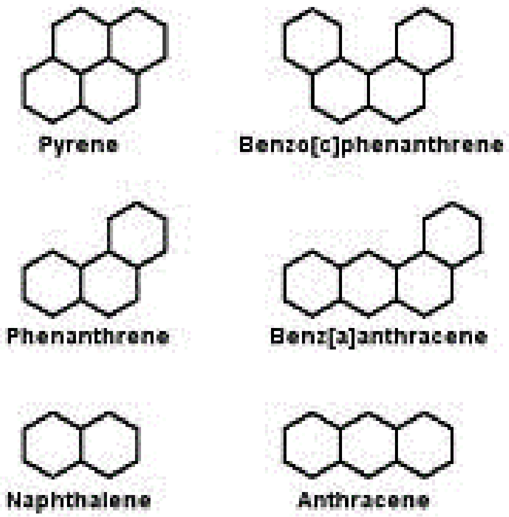


Illustration by *Ethan Nedeau*



Contaminants in seawater and food

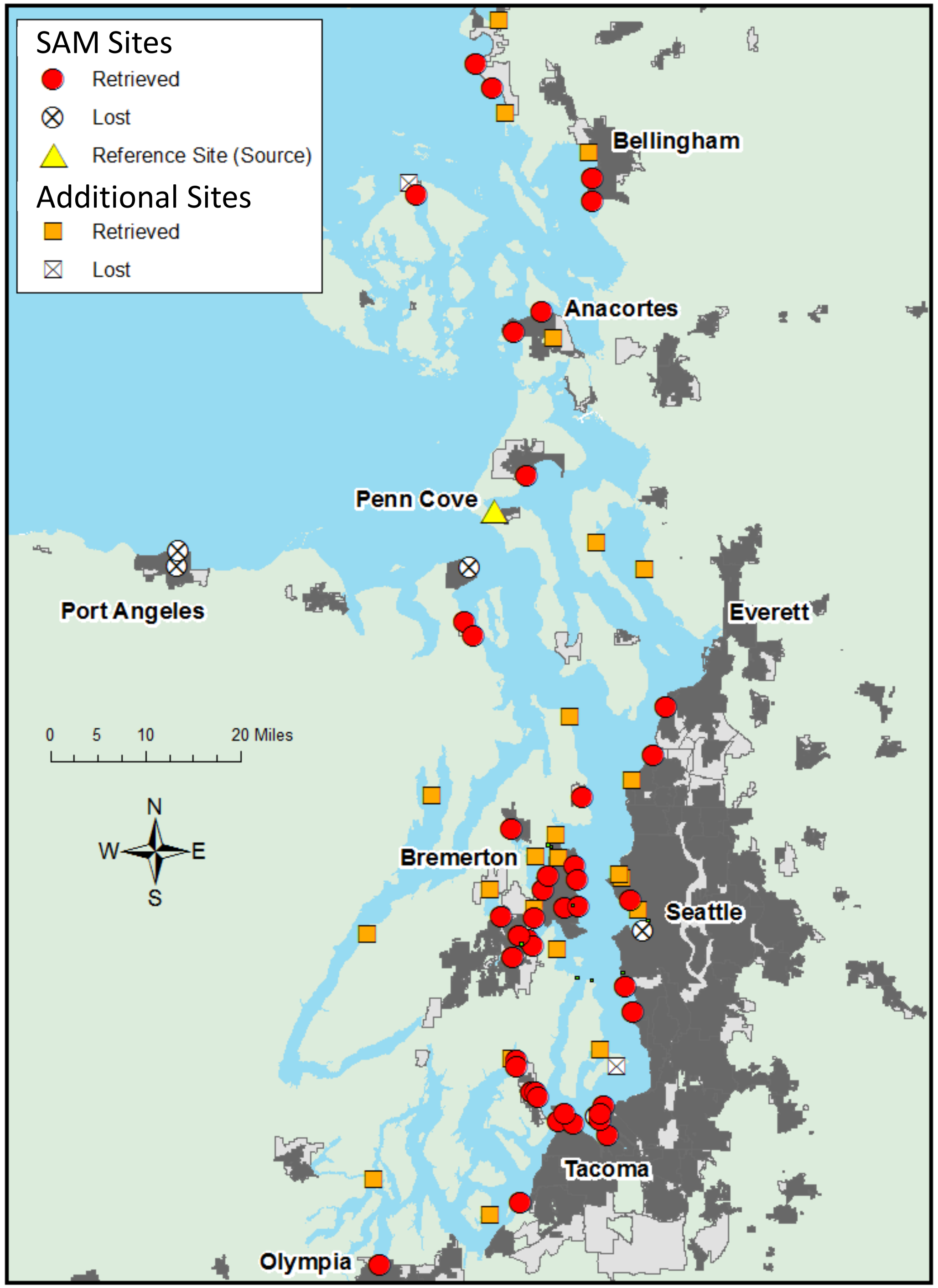
Mussel Monitoring
Status & Trends Questions:

1. Do mussel tissue contaminant levels correlate with urbanization indicators, such as land use and impervious surface, in adjacent shorelines and contributing watersheds? *(…answered each year)*

2. How do mussel tissue contaminant levels change over time in response to stormwater management and urban population growth in Puget Sound? *(answered over time…)*

2015/16 Mussel Monitoring Sites:

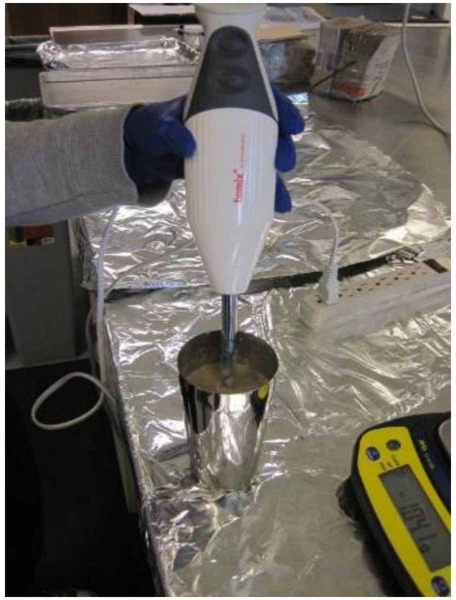
- 73 total sites = 40 SAM + 33 additional sponsored
- Native bay mussels (*Mytilus trossulus*)
- Transplanted in anti-predator cages to nearshore
- Winter exposure for 3 months

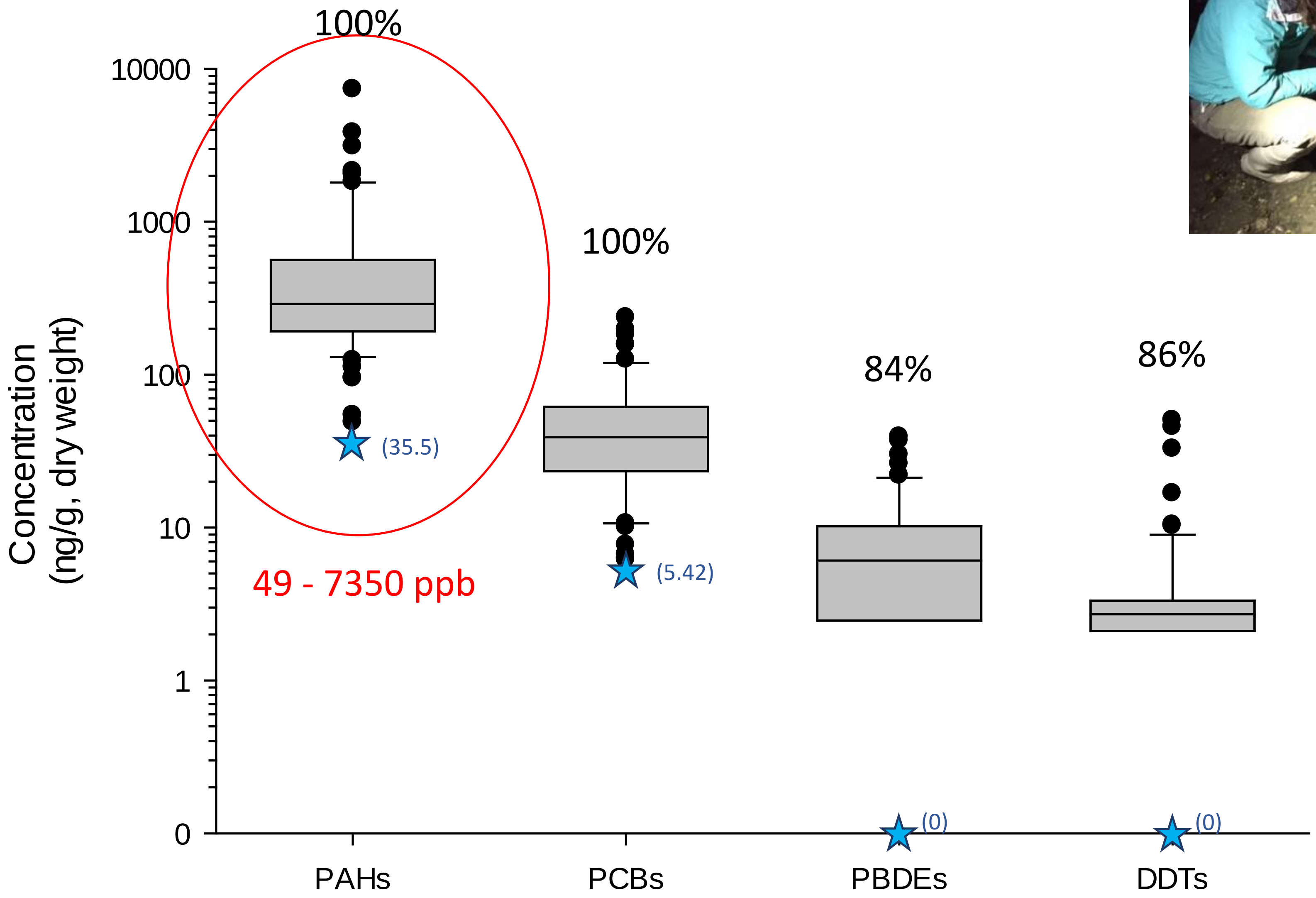


Mussel cages deployed & retrieved by 100+ volunteers

Chemical Analyses

- **Organic contaminants**:
  - **PAHs** - Polycyclic Aromatic Hydrocarbons
  - **PCBs** - Polychlorinated biphenyls
  - **PBDEs** - Polybrominated diphenylethers
  - **DDTs** - Dichloro-diphenyl-trichloroethanes
  - Other pesticides - chlordanes, HCB, aldrin, dieldrin, HCHs, endosulfan 1, Mirex
- **Metals**:
  - Zinc, Copper, Lead
  - Arsenic, Cadmium, Mercury





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100%
84%
86%
10000
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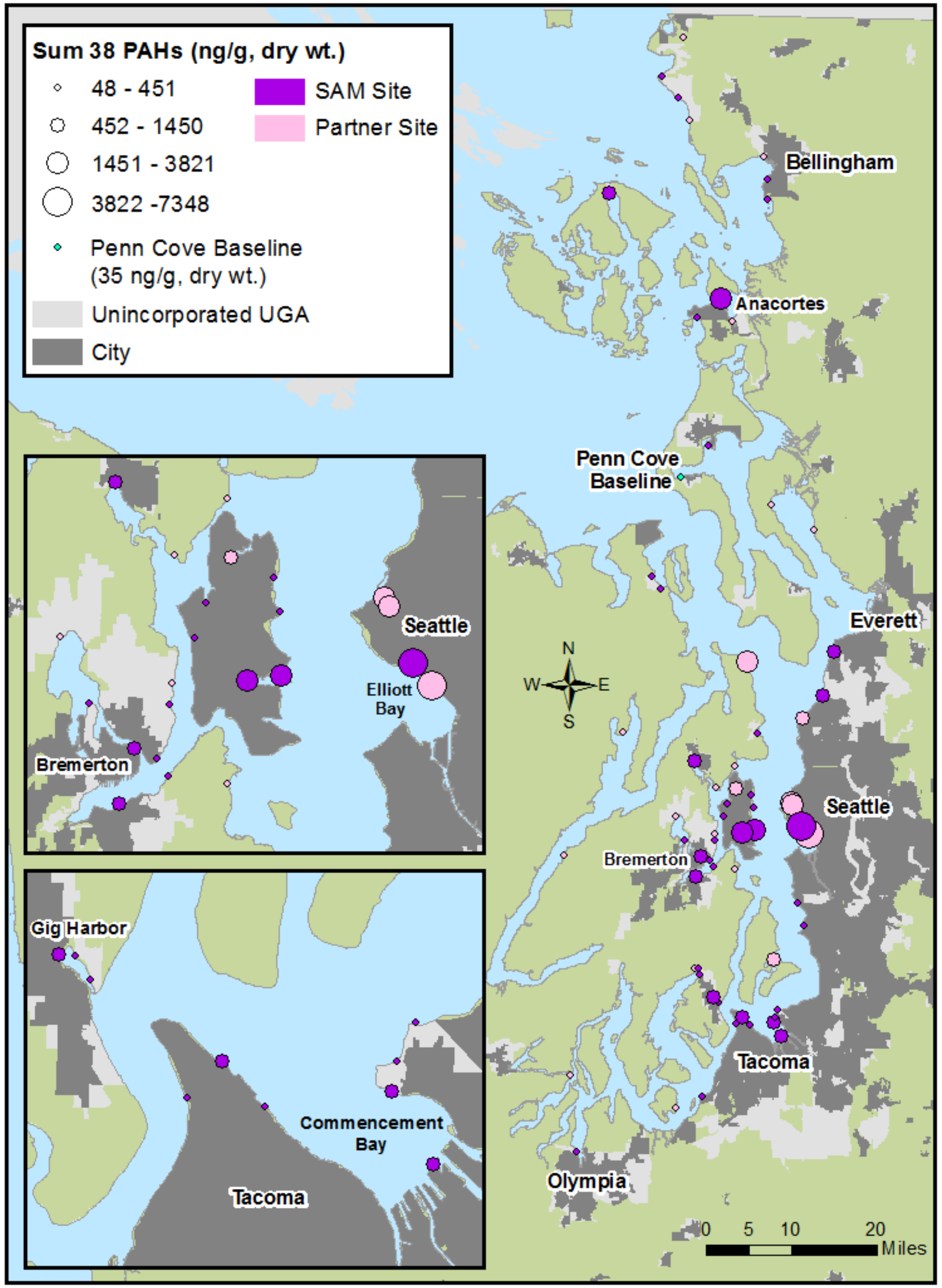
1
0
Concentration
(ng/g, dry weight)
(35.5)
(5.42)
(0)
(0)
49 - 7350 ppb
PAHs
PCBs
PBDEs
DDTs

PAHs

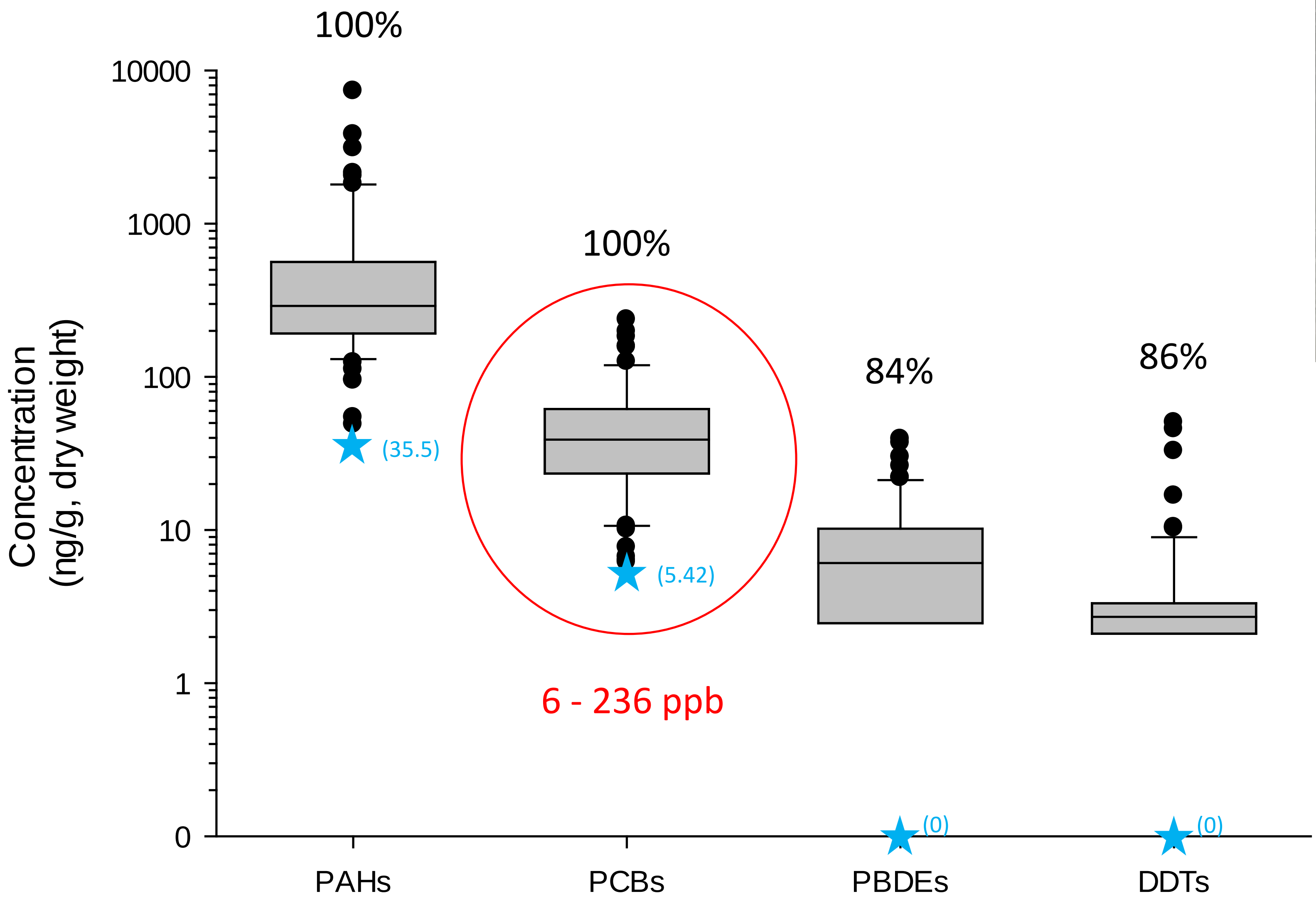
PAHs highest in highly urbanized Elliott Bay.

Also elevated in Eagle Harbor, Anacortes, Sinclair Inlet, and Commencement Bay.




THE PCB CHALLENGE
PCBs CAN BE FOUND IN EVERYDAY PRODUCTS
paint
printing inks
clothing pigments & dyes
pesticides
old fluorescent light ballasts
lubricants & hydraulic fluids


HI-PRESS. GAS
WATER JACKET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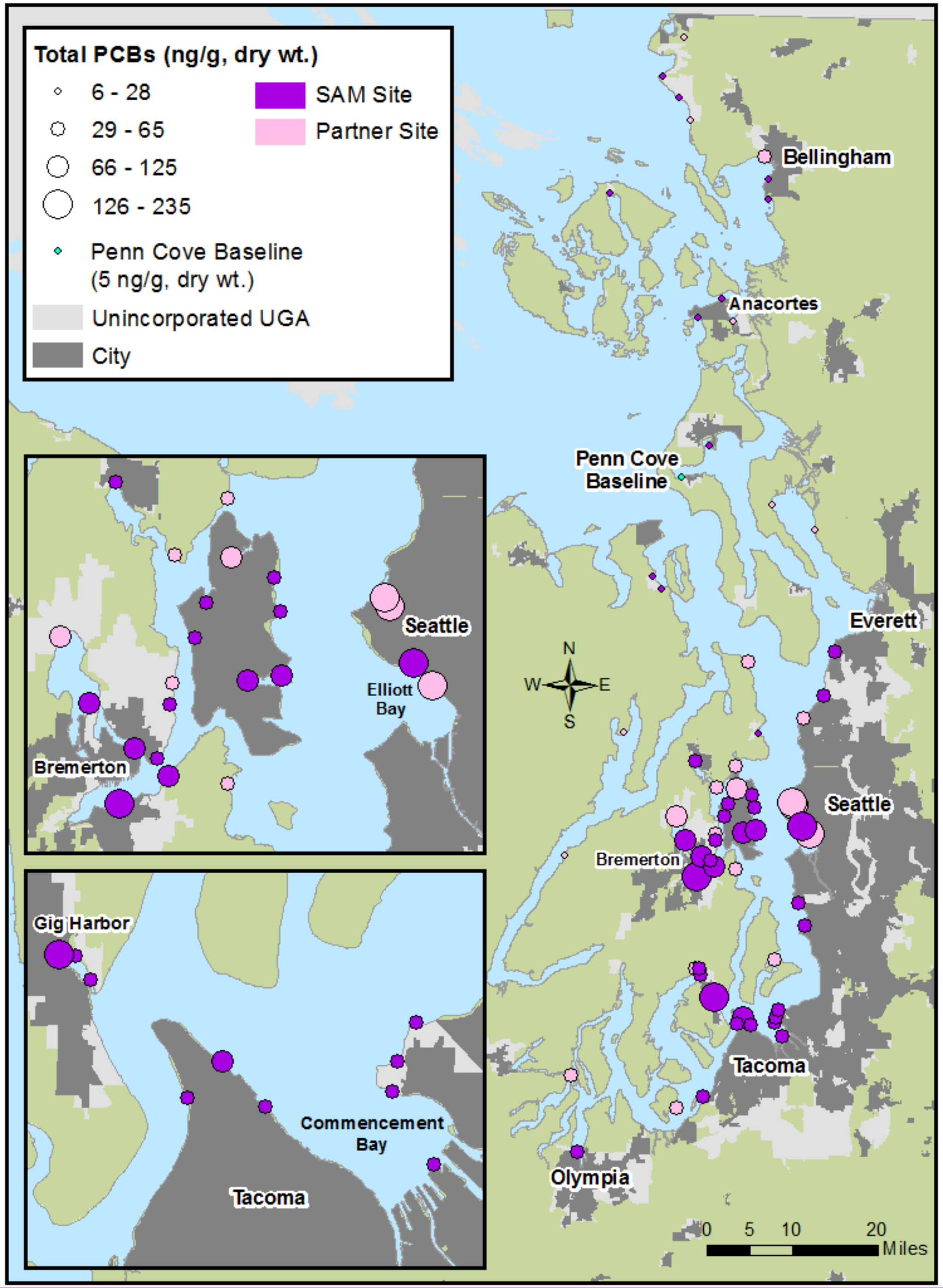
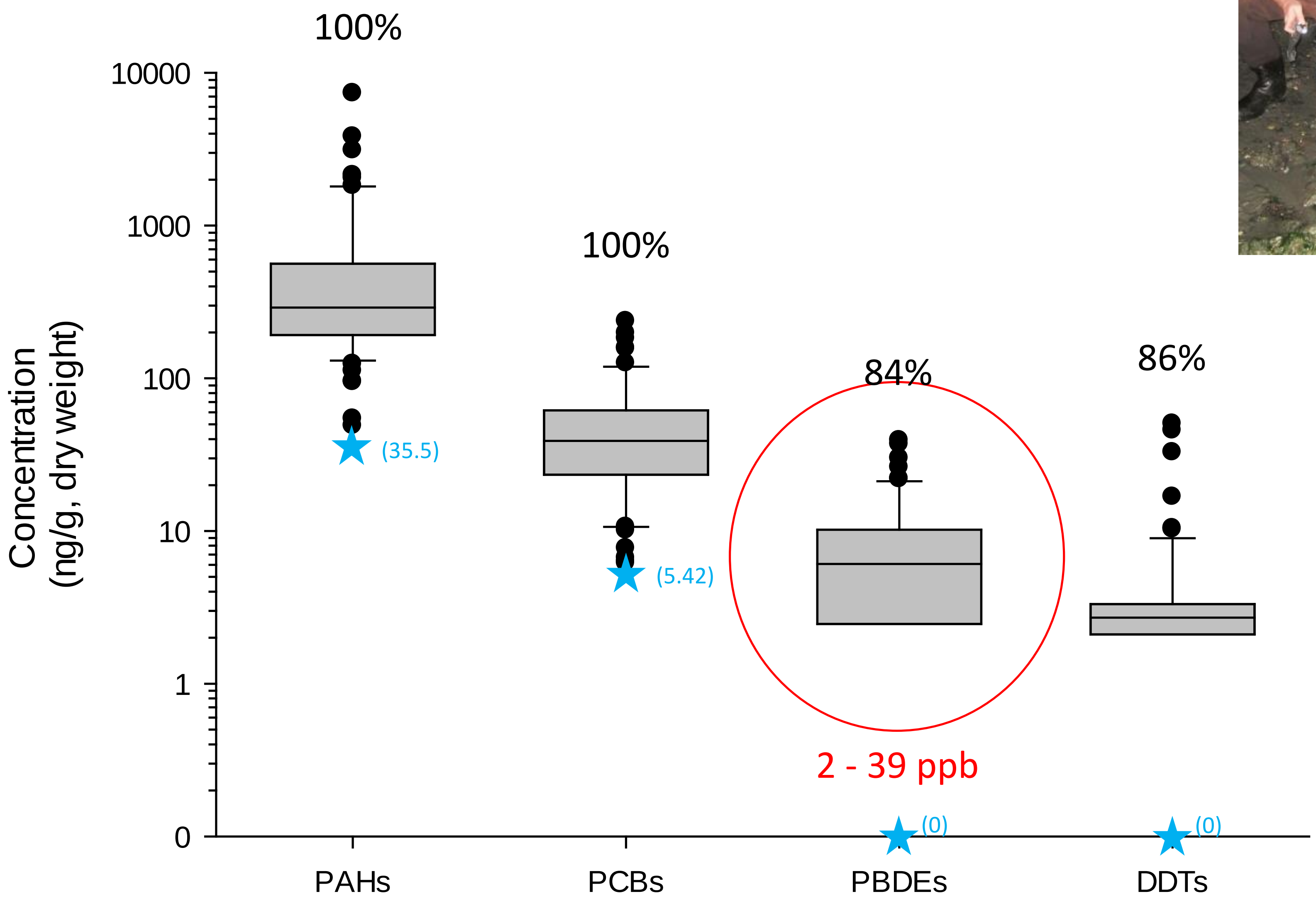
Concentration
(ng/g, dry weight)
(35.5)
(5.42)
(0)
(0)
6 - 236 ppb
PAHs
PCBs
PBDEs
DDTs

PCBs highest in highly urbanized Elliott Bay and Salmon Bay.

Also elevated in Sinclair Inlet, and Gig Harbor.



PBDEs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100%
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86%
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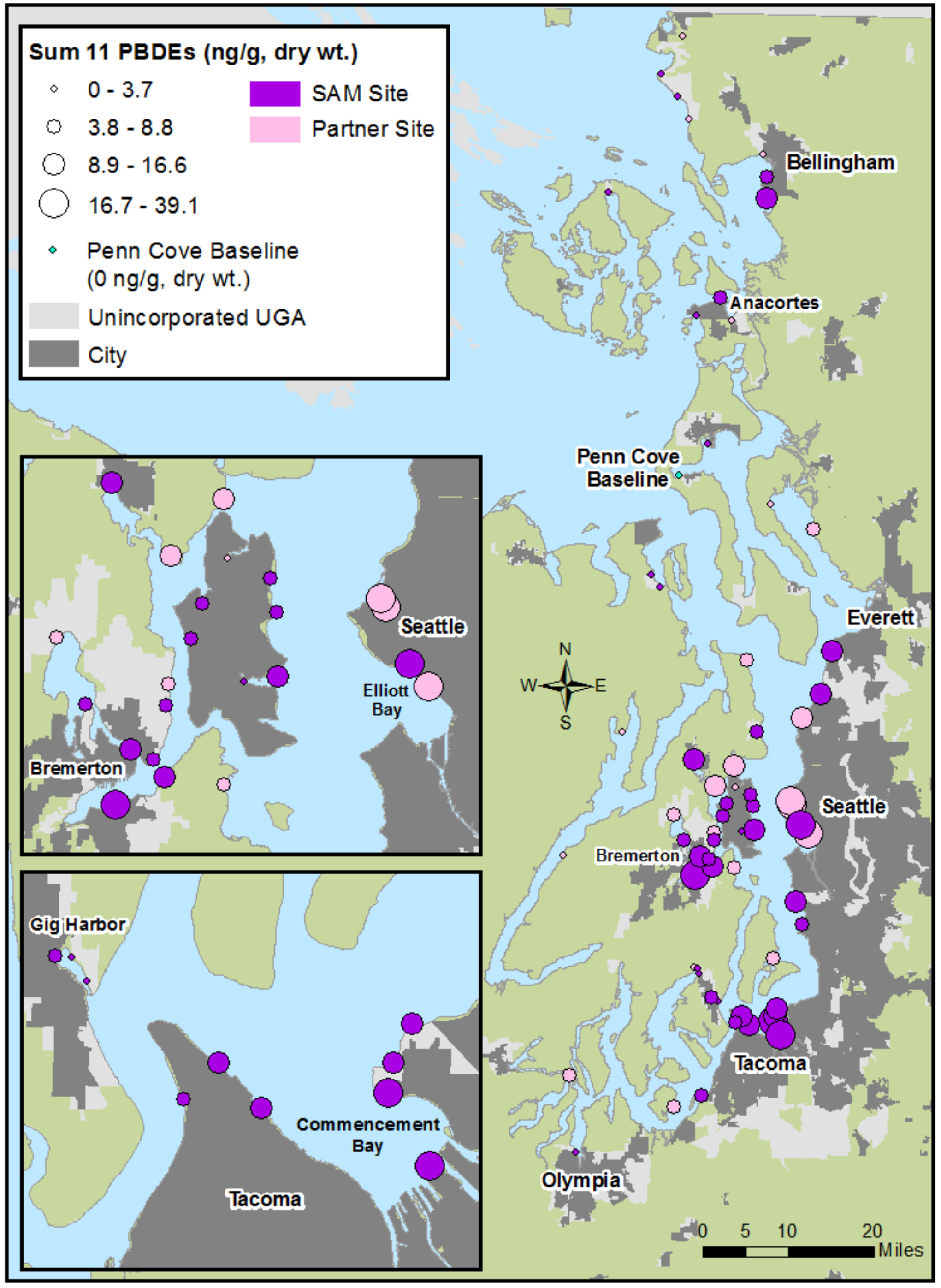
1
0
Concentration
(ng/g, dry weight)
(35.5)
(5.42)
(0)
(0)
2 - 39 ppb
PAHs
PCBs
PBDEs
DDTs

PBDEs highest in highly urbanized Elliott, Salmon, and Commencement Bays.

Also elevated in Sinclair Inlet.



Factors Related to Mussel Contamination

1. Municipal land-use designation

2. Degree of impervious surface in nearshore-adjacent watersheds

- ➢ Both describe urban development in slightly different ways.
- ➢ Each accounted for 20-50% of the variability in PAHs, PCBs, PBDEs, and DDTs in nearshore mussels.

Type	Test	Significant Results (α <0.05) Organic Contaminants	Metals
Municipal land-use planning designations	UGA vs. Reference	PAHs, PCBs, PBDEs, DDTs	NS
	UGA class (city vs. unincorporated-UGA)	PAHs, PCBs, PBDEs, DDTs	Zinc
Largescale upland variables* measured in adjacent watersheds with an average area 8.8 km^2 (3.4 $miles^2$)	mean % Impervious Surface	PAHs, PCBs, PBDEs, DDTs	NS
	% Urban area	PBDEs, DDTs	NS
	% Forested area	NS	NS
	% Agricultural area	PCBs, PBDEs, DDTs	Lead
	% Wetland area	NT	NT
Small-scale upland variables† measured within 200 meters (656 ft) inland from shoreline	% Urban area	NS	NS
	% Forested area	NS	NS
	% Agricultural area	NS	NS
In-water or onshore point sources	Marina/ferry terminal presence	PAHs, PCBs, DDTs	Lead
	Railroad presence	PAHs, PBDEs, DDTs	NS
	Creosote observed	NS	NS
Natural geographical/geological features	Shoreline form (bay vs. open)	NS	Lead
	Substrate (depositional vs. coarse)	NS	Lead

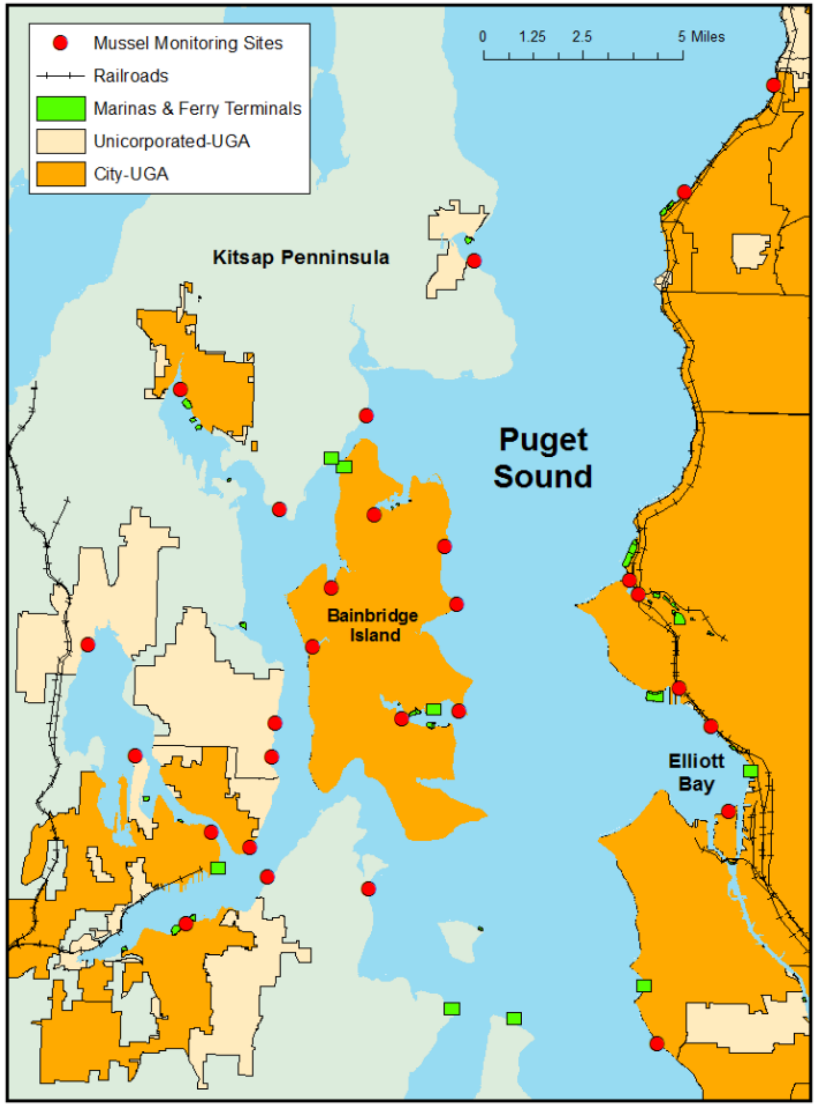
NS = not siginificant, NT = not tested due to lack of replicates

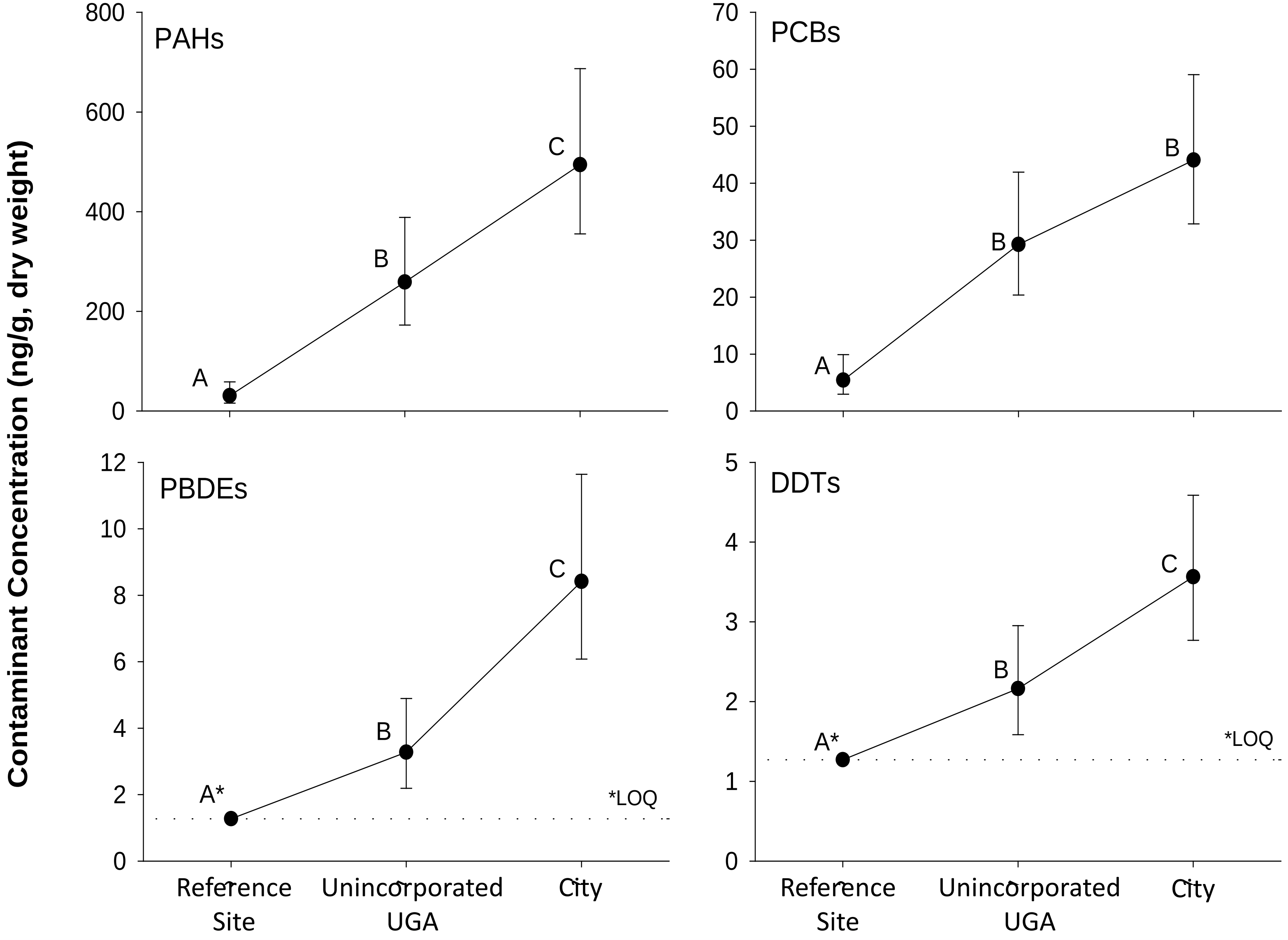
* Data from National Land Cover Dataset (NLCD) 2011

† Data from NOAA's C-CAP Land Cover Atlas shoreline characterization

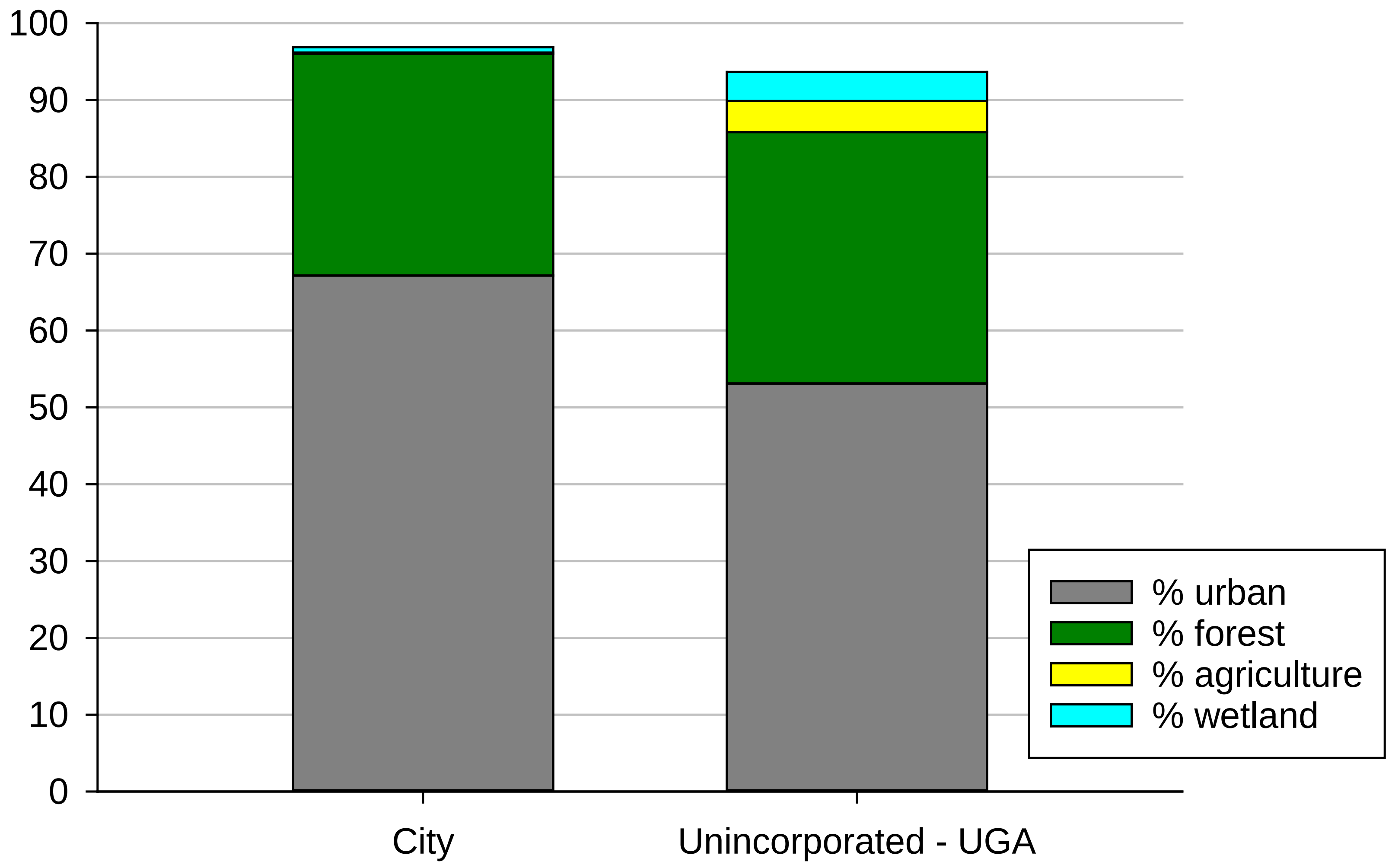
Municipal Land-Use Designations break the urban growth areas (UGAs) into:

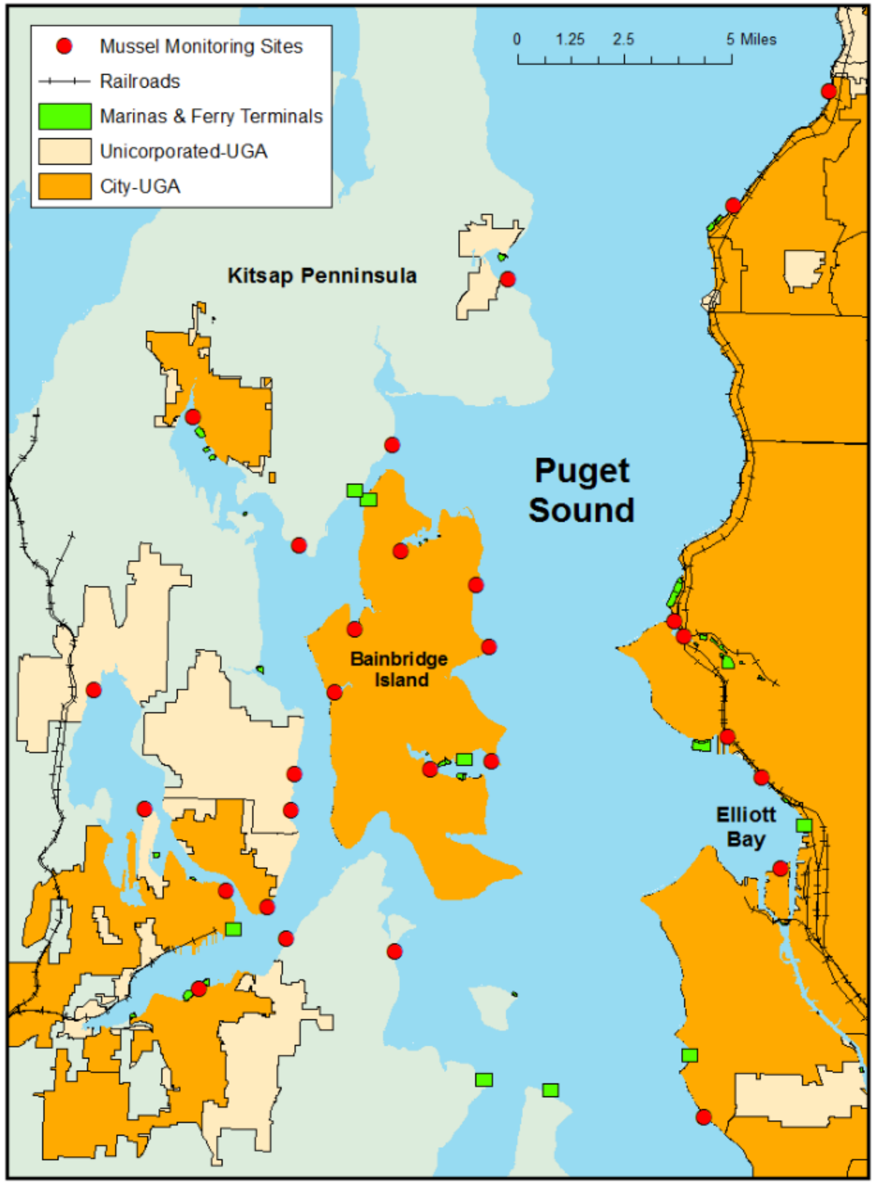
- **Cities**
- **Unincorporated-UGAs**



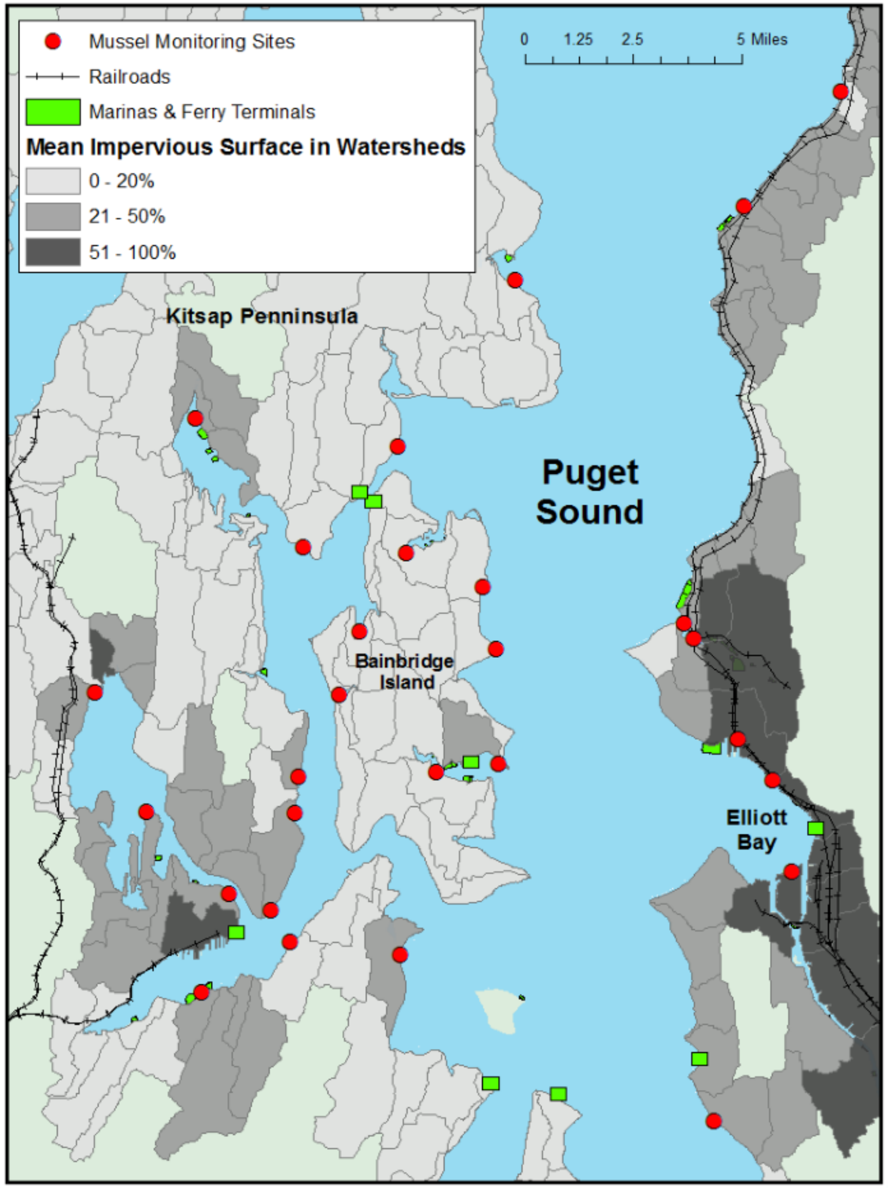


Level	Replicates
Reference	6
Unincorp.	17
City	26

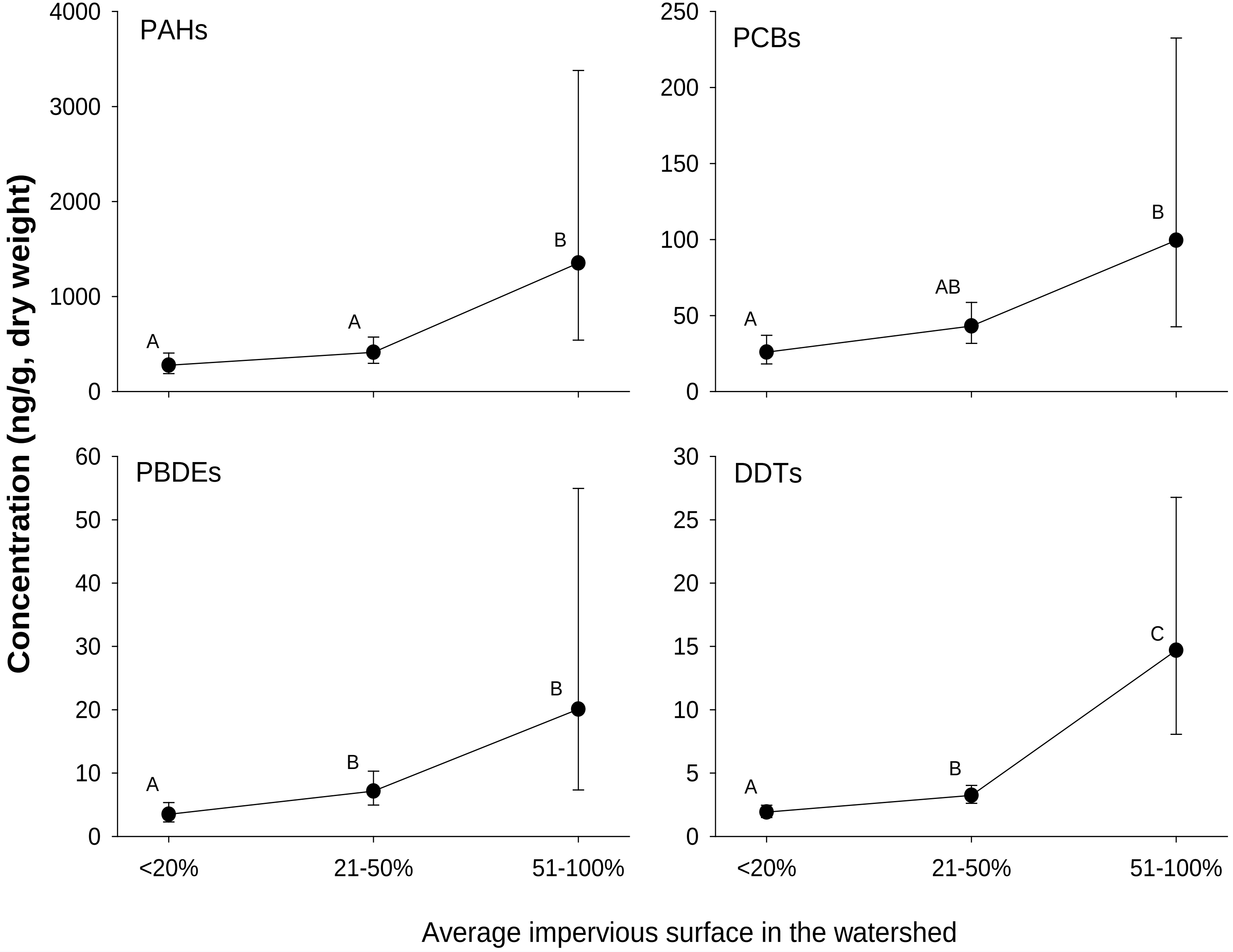

100
90
80
70
60
50
40
30
20
10
0
City
Unincorporated - UGA
% urban
% forest
% agriculture
% wetland



Mussel Monitoring Sites
Railroads
Marinas & Ferry Terminals
Unicorporated-UGA
City-UGA
0 1.25 2.5 5 Miles
Kitsap Penninsula
Puget Sound
Bainbridge Island
Elliott Bay



Mussel Monitoring Sites
Railroads
Marinas & Ferry Terminals
Mean Impervious Surface in Watersheds
0 - 20%
21 - 50%
51 - 100%
0 1.25 2.5 5 Miles
Kitsap Penninsula
Puget Sound
Bainbridge Island
Elliott Bay



Level	Replicates
<20%	20
21-50%	23
51-100%	3

Conclusions

Toxic contaminants enter Puget Sound nearshore food web, especially along shorelines adjacent to highly urbanized areas:

- PAHs, PCBs, PBDEs, and DDTs were the most abundant organic contaminants
- Concentrations significantly higher in urbanized areas as measured by -
  - Municipal Land-Use Classification (City vs. Unincorporated-UGA)
  - Impervious Surface in Adjacent Watersheds
- Concentrations of metals were relatively low

What does mussel monitoring do for you?

- Compare nearshore contaminants on local and regional scales in UGA to whole Puget Sound.

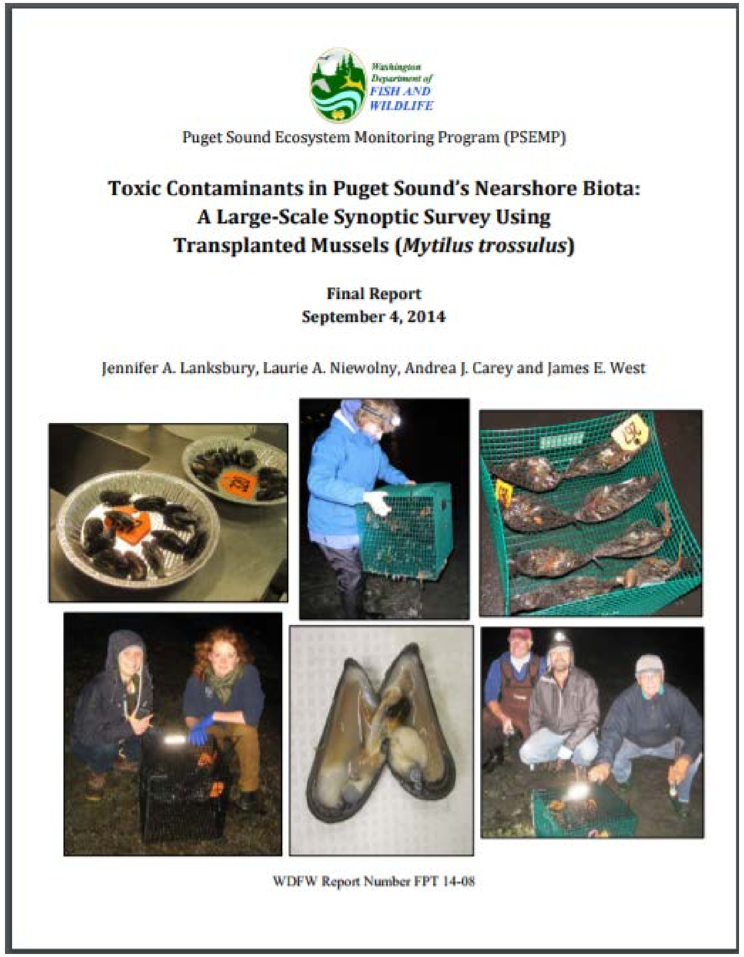
- Tracking mussel contamination over time shows decision-makers where contaminants are coming into our nearshore environments.

- Contributes information about effectiveness of stormwater management programs…

  - Can we see differences in the Puget Sound UGA nearshore related to differential implementation of BMPs? Does remediation work? Other questions?

Stormwater Action Monitoring

Reports now available online:



Washington Department of FISH AND WILDLIFE

Puget Sound Ecosystem Monitoring Program (PSEMP)

Toxic Contaminants in Puget Sound's Nearshore Biota: A Large-Scale Synoptic Survey Using Transplanted Mussels (*Mytilus trossulus*)

Final Report
September 4, 2014

Jennifer A. Lanksbury, Laurie A. Niewolny, Andrea J. Carey and James E. West

WDFW Report Number FPT 14-08


Thank you

Puget Sound Nearshore Sediment Monitoring: The Importance of Drift Cells

September 13, 2018

Robert W. Black[1], Abby Barnes[2], Colin Elliot[3] and Jennifer Lanksbury[4]

[1]Washington Water Science Center, U.S. Geological Survey, Tacoma, WA.

[2]Washington State Department of Natural Resources, Olympia, WA.

[3]King County Environmental Lab, Seattle WA.

[4]Washington State Department of Fish and Wildlife, Olympia, WA

Stormwater Action Monitoring

science for a changing world

Why Nearshore Sediment

- Stormwater is implicated as main pollution source to Puget Sound and gaining attention for salmon and orca recovery.
- Stormwater chemicals are often attached or become attached to sediment until aquatic plants and animals come in contact within them.

Study Goal

-Status, spatial extent and quality of Puget Sound sediment chemical quality in nearshore urban areas, defined as areas parallel to Urban Growth Areas (UGAs), using spatially balanced probabilistic Generalized Random Tessellation Stratified (GRTS) sampling design.

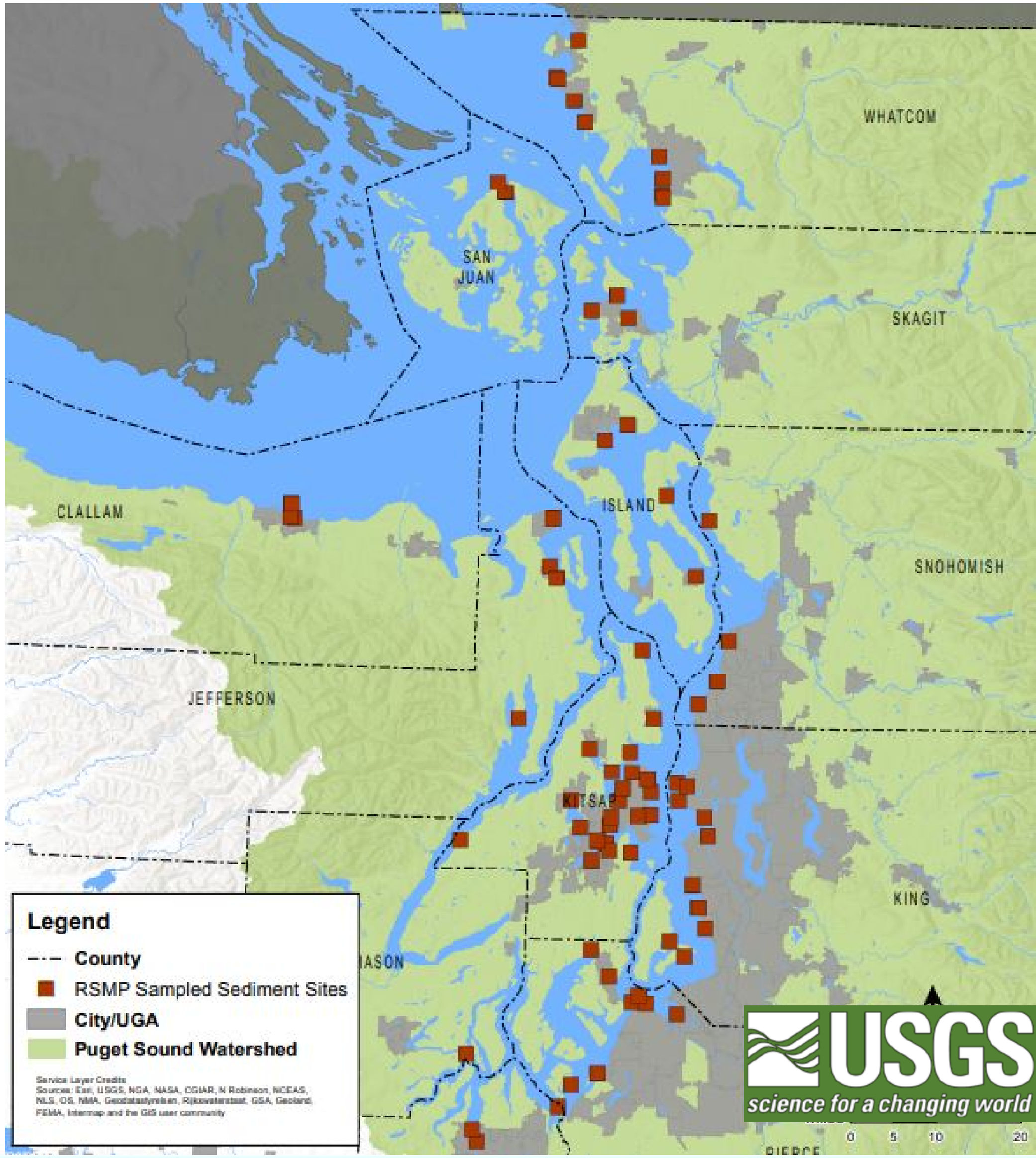
GRTS sampling design: efficiently extrapolate from small number of sites to entire nearshore within the UGA boundaries of the Puget Sound.

-Identify anthropogenic and natural factors that influence sediment quality.

Stormwater Action Monitoring

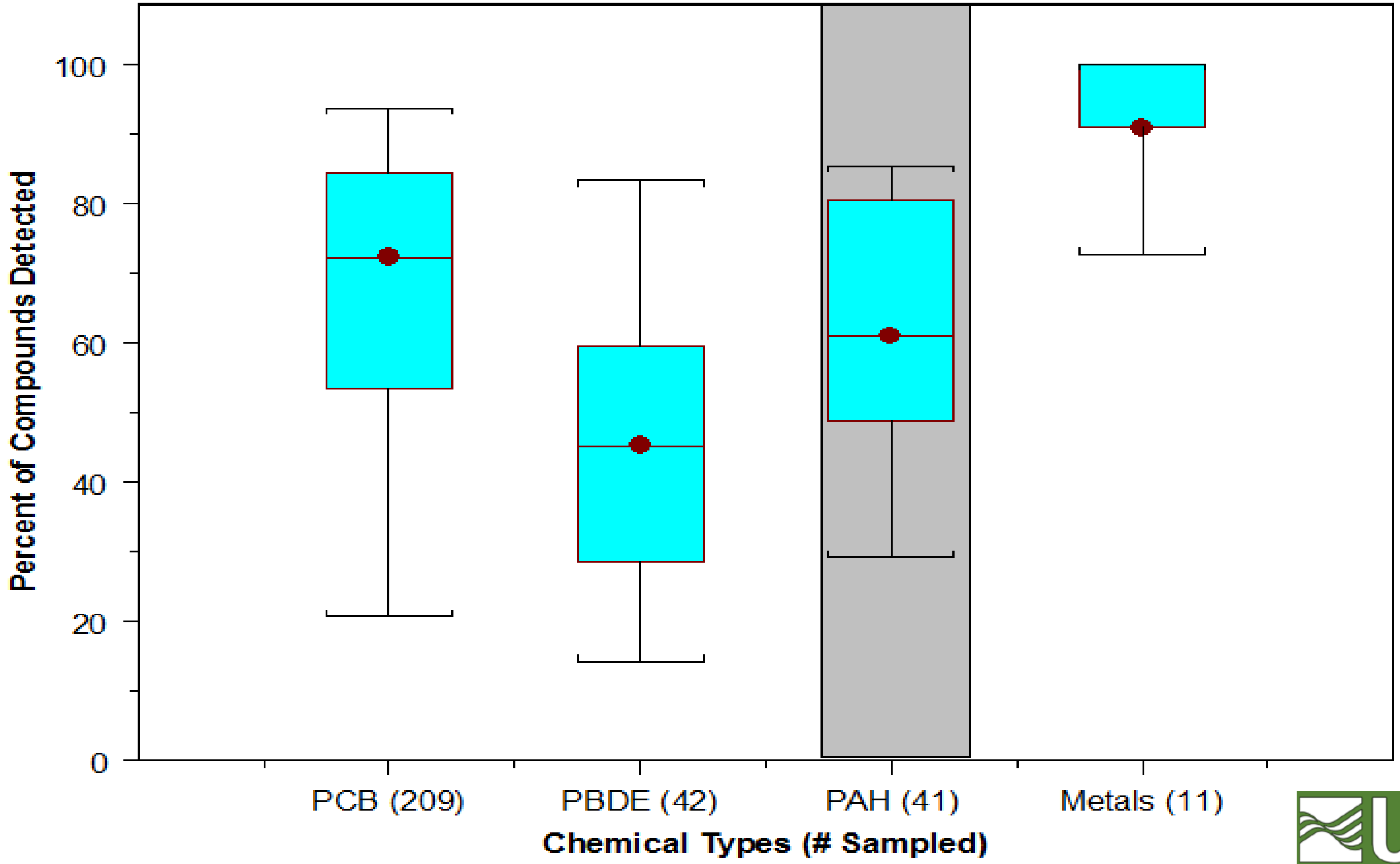
Study Design and Methods

- 41 (SAM-Option 1) 8 (Option 2) represents 1,357 km adjacent to UGA
- Sediment (top 2-3cm) collected from 6 feet below mean low low water.
- Sieved to <2mm
- PCB (polychlorinated biphenyl) , PBDE (polybrominated diphenyl ethers), PAH (polycyclic aromatic hydrocarbons) , Metals, Organic Carbon



Percent Chemical Detection at 41 Sites

Every site had at least 1 PCB, PBDE, PAH or metal compound detected.



Percent of ~1,300km Nearshore Sediment Below Criteria or Standards Based on 41 SAM Sites.

Compound	% of Sites Below Criteria or Standard	Compound	% of Sites Below Criteria or Standard
Total PCB	98	Metals	
PBDE	No Standards	Arsenic	100
PAH		Cadmium	100
Anthracene	99	Chromium	100
Benz[a]anthracene	99	Copper	100
Benzo(a)pyrene	99	Lead	100
Benzo(ghi)perylene	98	Mercury	100
Chrysene	98	Zinc	100
Dibenzo(a,h)anthracene	99		
Fluoranthene	97		
Indeno(1,2,3-cd)pyrene	98		
Phenanthrene	97		
Pyrene	96		

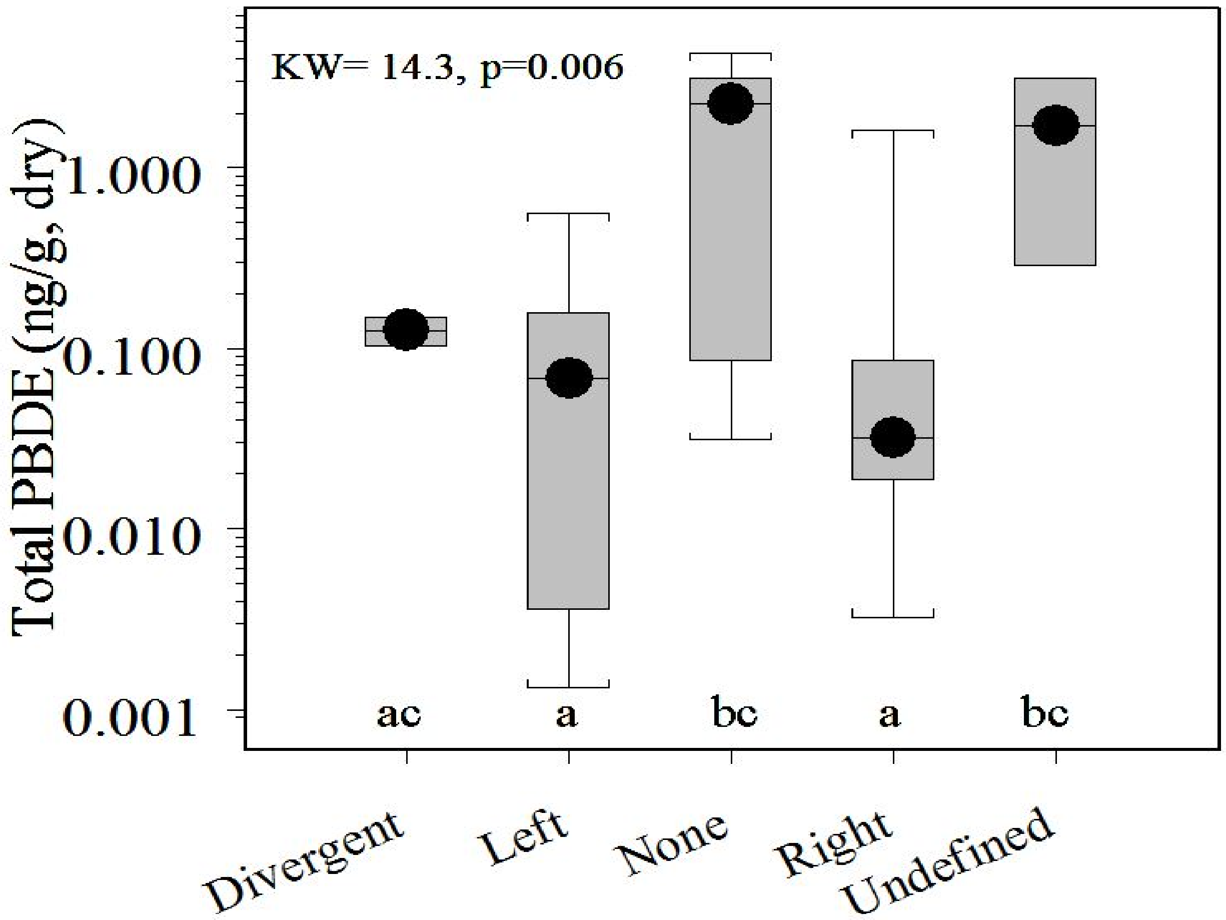
Are nearshore sediment chemicals concentrations related to adjacent watershed features (impervious area, land use, etc.)?

Statistical tests say VERY weakly.

If anthropogenic chemical concentrations in nearshore sediment are not related to adjacent land cover, what are they related to?

Puget Sound Shoreline Drift Cells: Ecology's Coastal Atlas

Chemical Concentrations By Drift Cells



Observations

- Sediment chemical concentrations are generally low and below current State criteria.
  - Organic chemicals slightly lower in unincorporated UGA.
  - Copper and lead higher in incorporated UGA.
- Sediment chemical concentrations not related to land cover.
  - Land cover metrics used may be wrong?
  - Concentrations appear to be driven by drift cells.
- Current randomized probabilistic design appropriate for Puget Sound status and trends as a whole, but future sampling of nearshore sediment will need to take into consideration the effects of drift cells to examine specific stormwater management actions.

Questions

Robert Black
WA Water Science Center
rwblack@usgs.gov
253-552-1687

Report on SAM web site

Using the spatial assessment to better understand the regional findings

Keunyea Song, PhD.
SAM Scientist, Ecology

Stormwater Action Monitoring

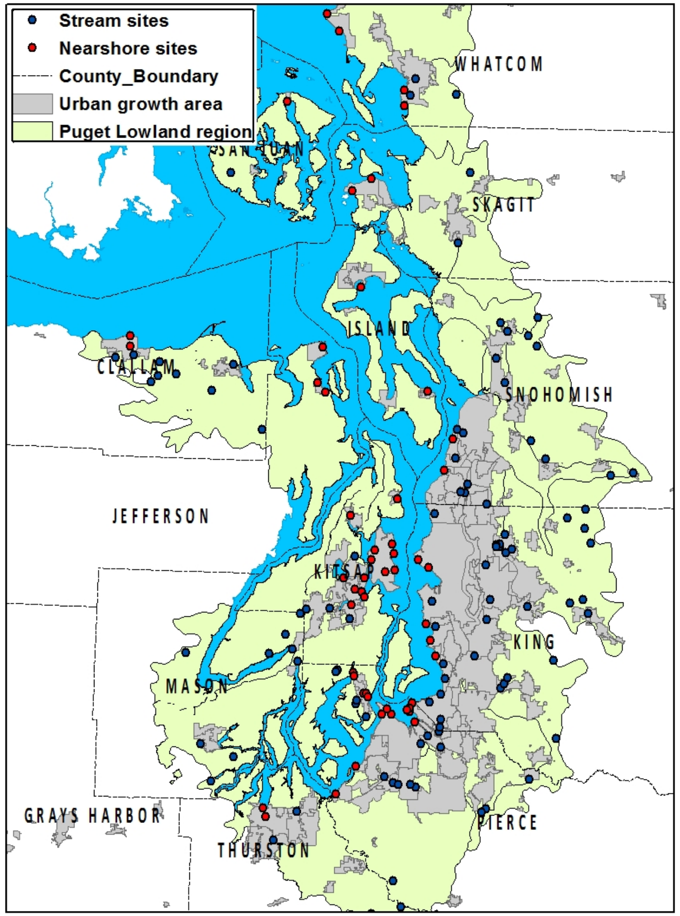
SAM receiving water key questions

- Q1: What is the current condition of receiving waters in Puget Sound?

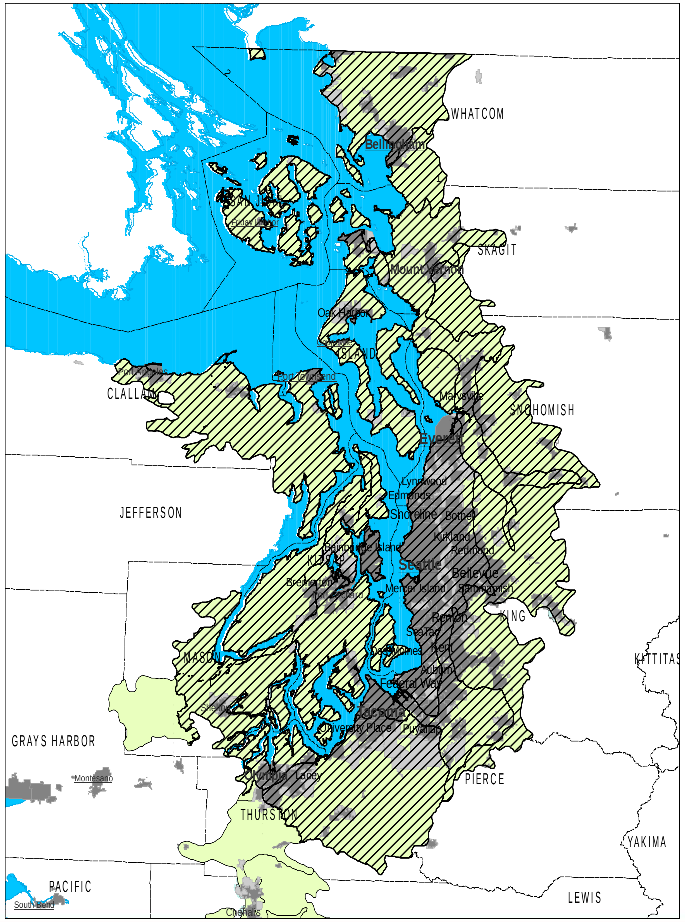
- Q2: How does the condition change over time in relation to urban growth and stormwater management efforts in the region?

Study Design

Site selection



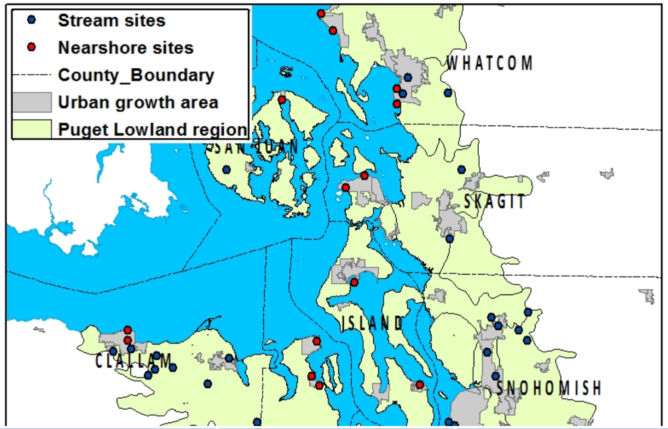
Whole study area



Generalized Random Tessellation Stratified Design (GRTS)

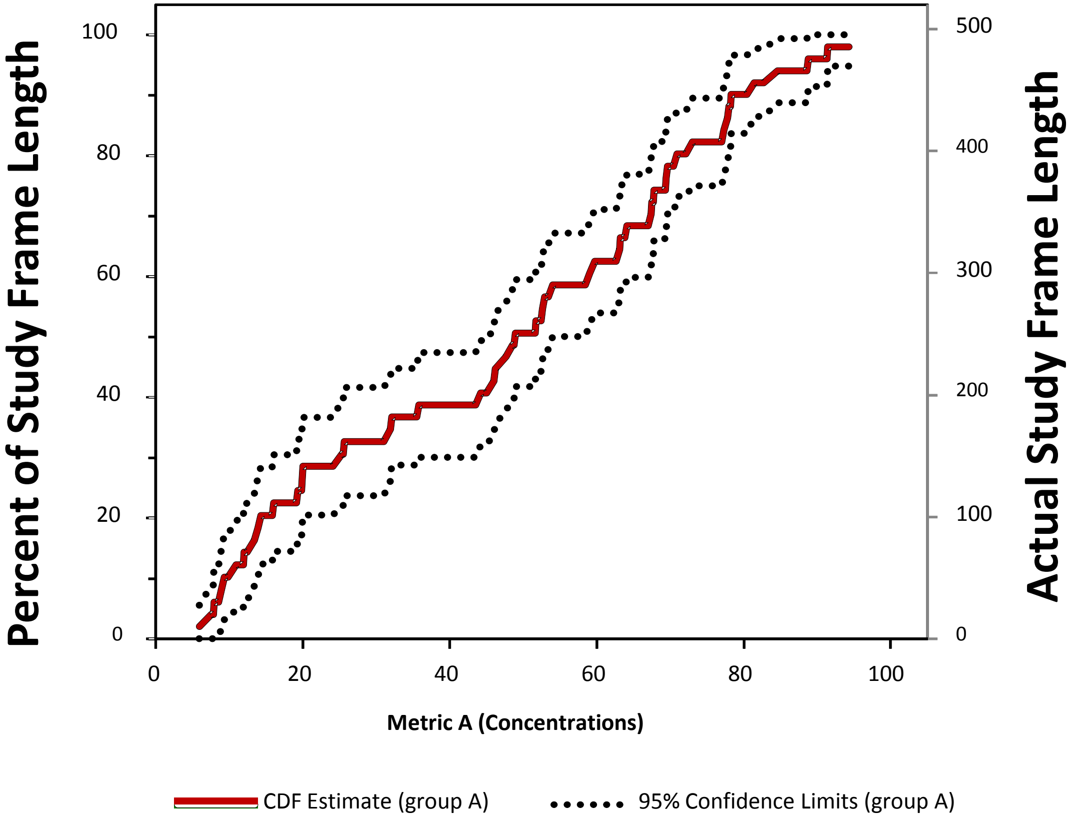
Regional assessment

Site-specific assessment



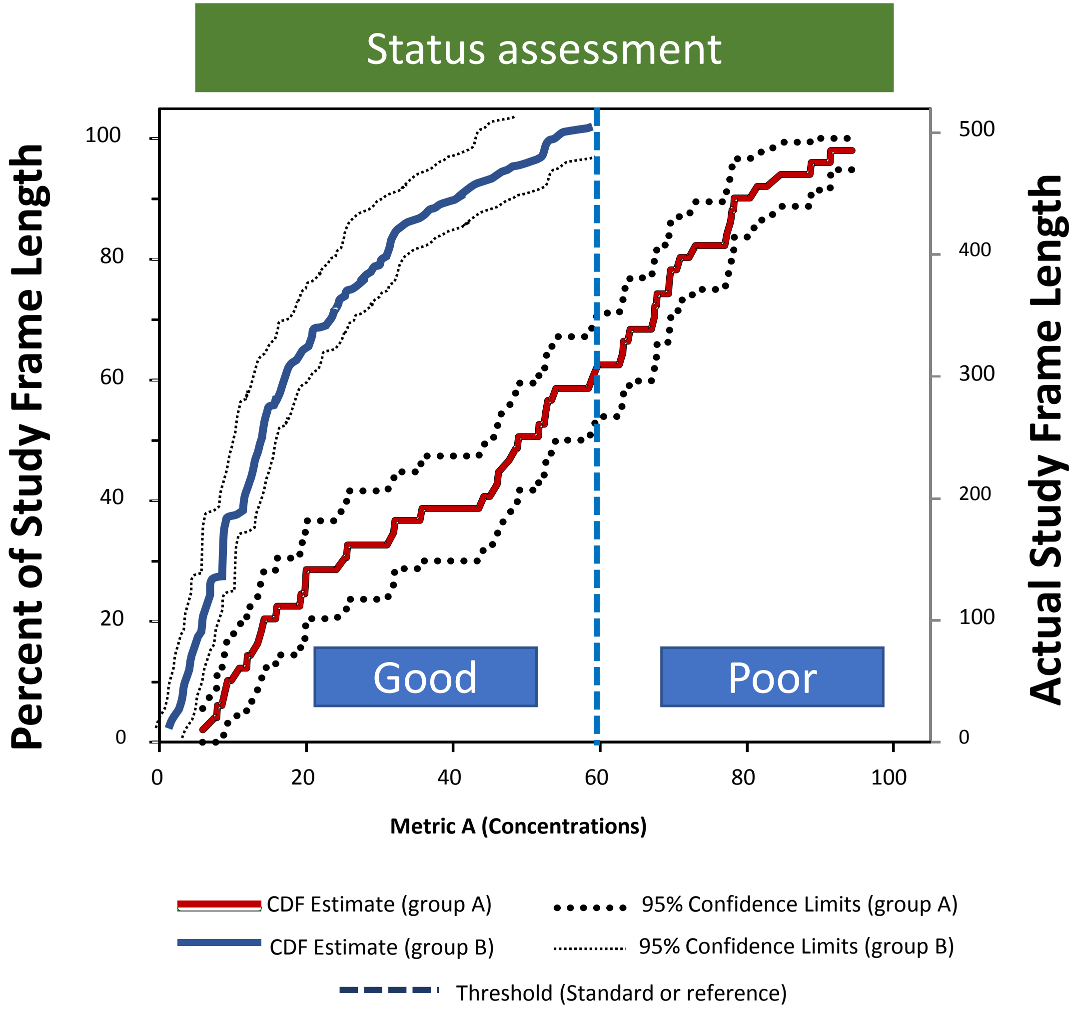
Sites	Length	Region
Mussel site	33 km	1200 km
Sediment	33 km	1300 km
Streams WUGA	11 km	550 km
Streams OUGA	53 km	1980 km

Whole study area assessment



Cumulative Distribution Function (CDF) plot

How to read CDF plots?



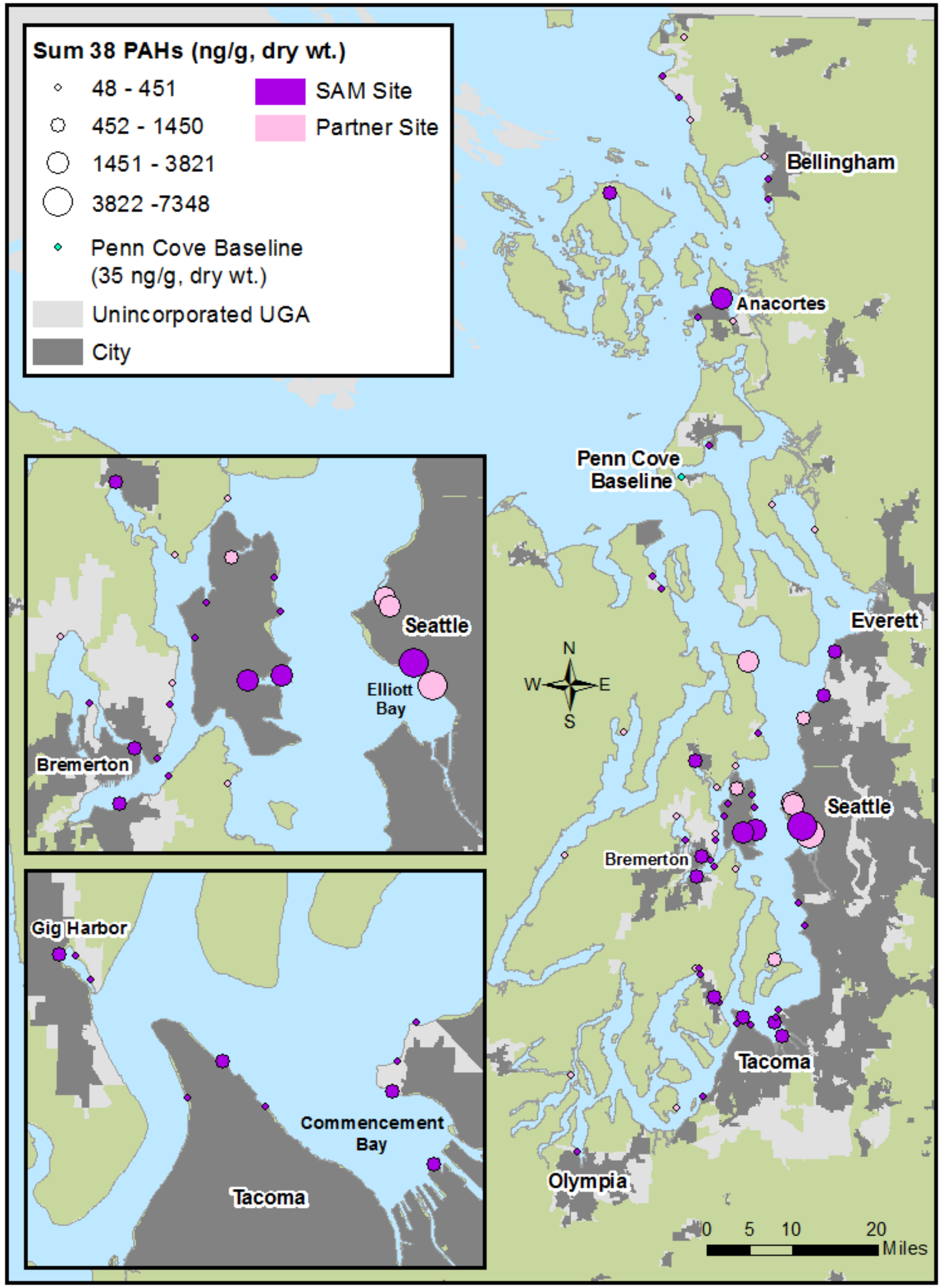
SAM
Stormwater Action Monitoring

Puget Sound status assessment using CDF plots

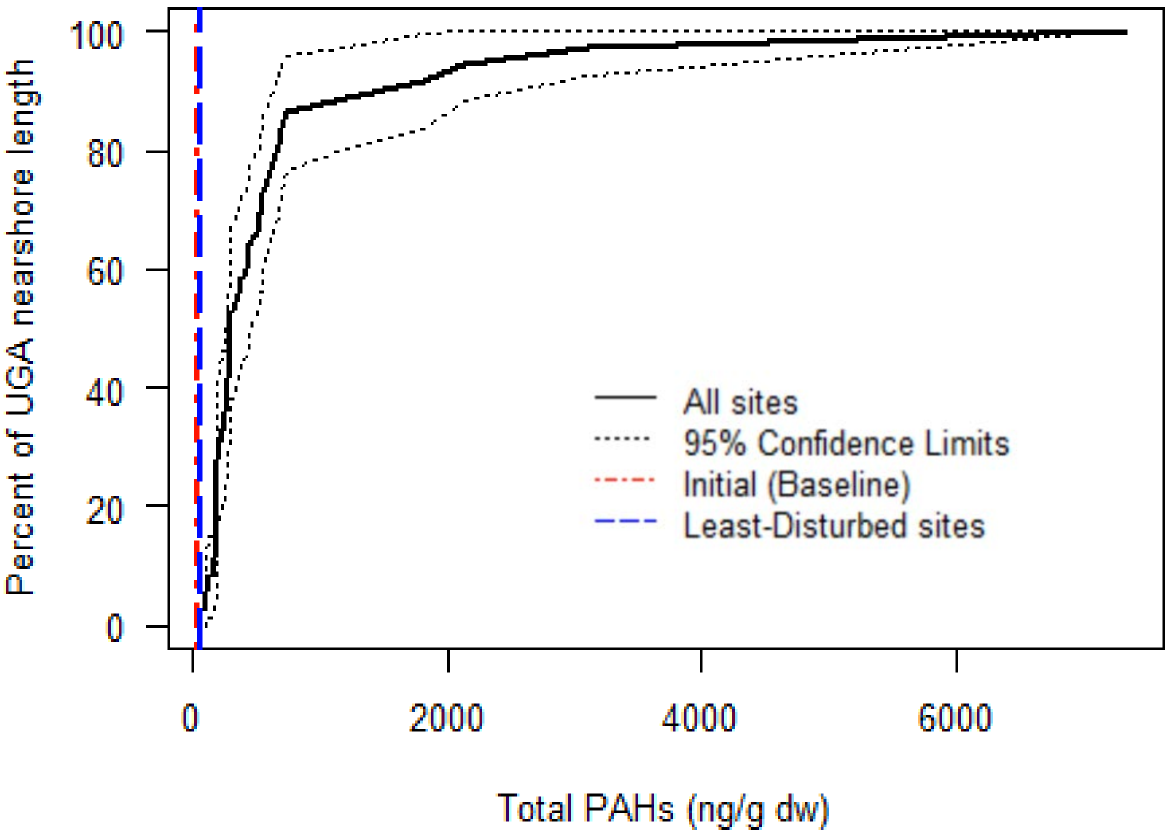
Nearshore Mussel Bioaccumulation

Nearshore Sediment Chemistry

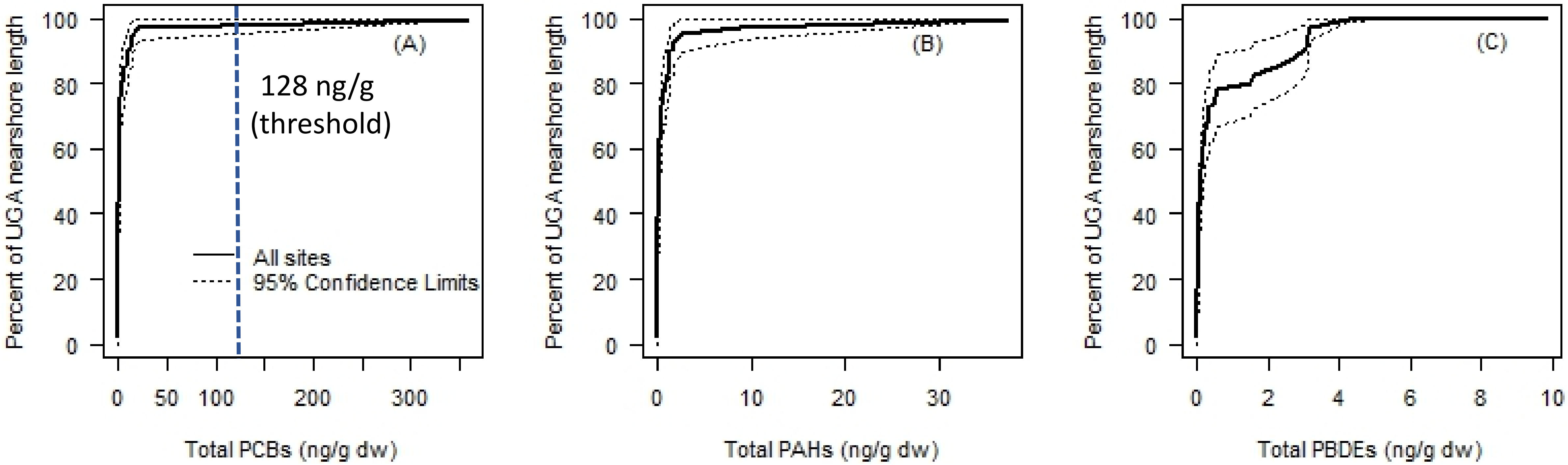
Puget Lowland Stream Health



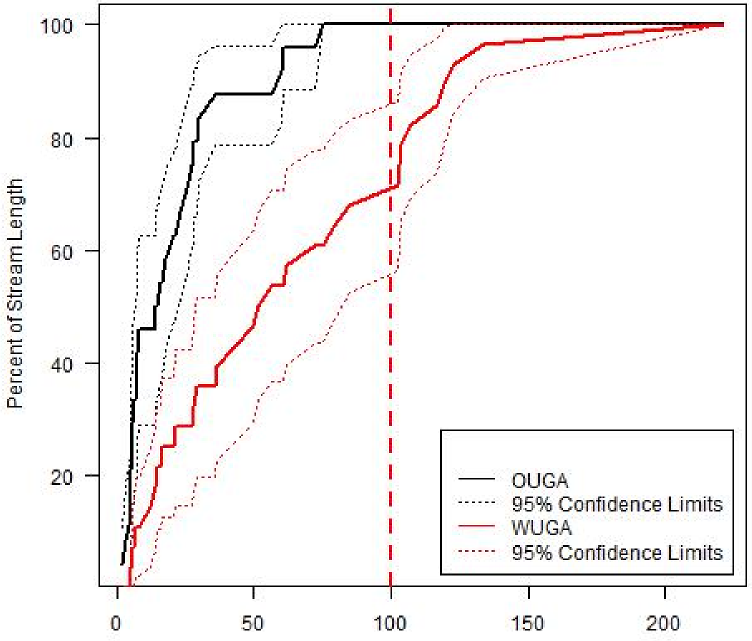
Urban Nearshore Mussel Bioaccumulation



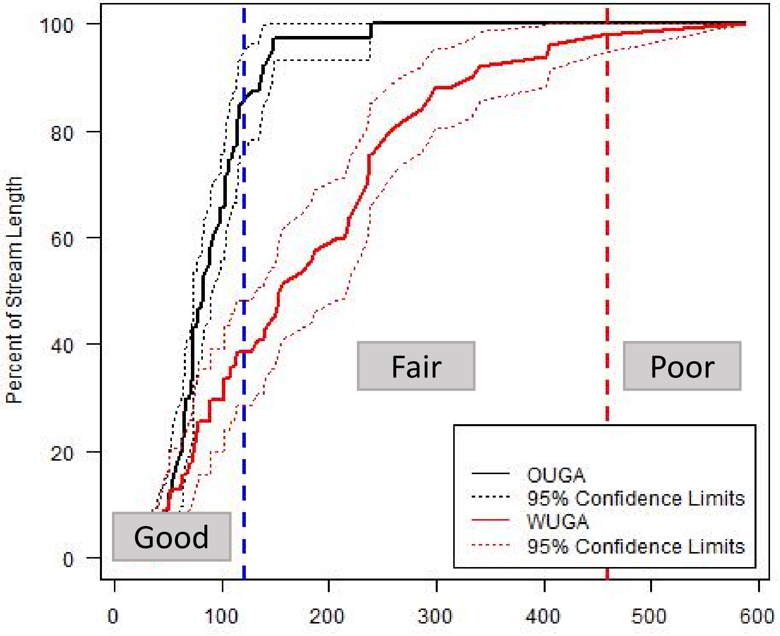
Urban Nearshore Sediment Chemistry



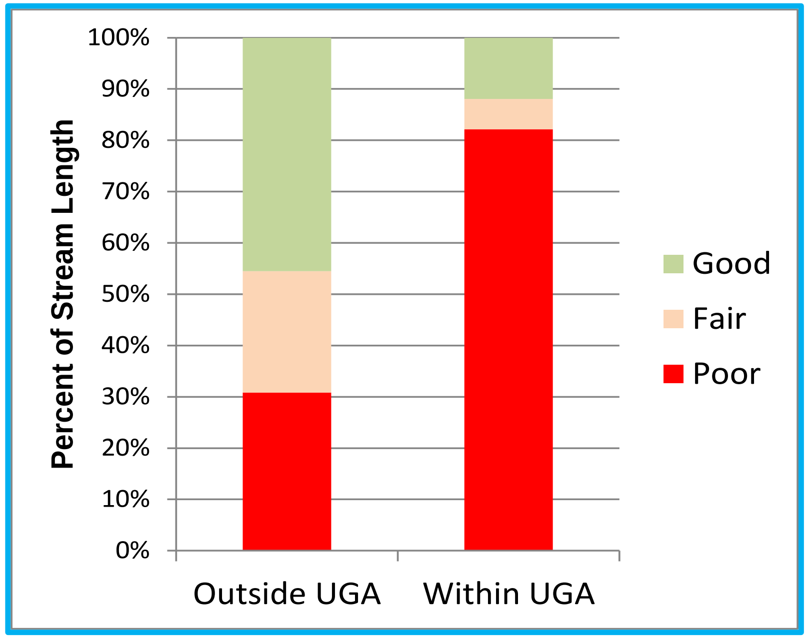
Puget Lowland Stream Health



Fecal coliform



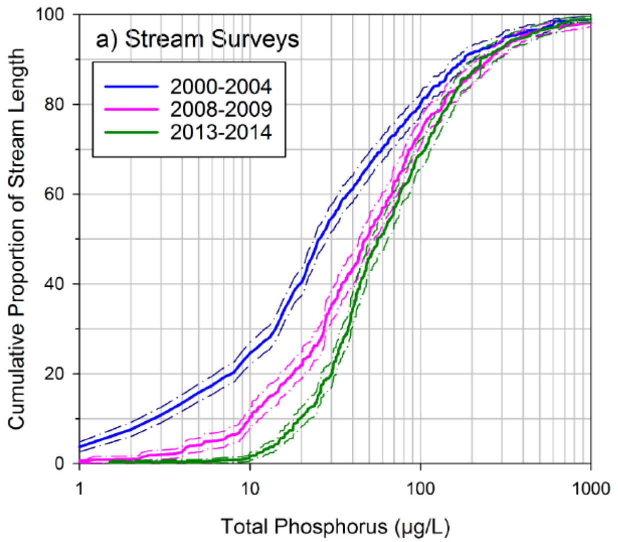
Sediment zinc



B-IBI

How we show what we learned

- Q1: What is the current condition of receiving waters in Puget Sound?
  - Cumulative Distribution Function (CDF) plots with probabilistic framework
  - Known standards or monitoring of reference (least-disturbed) conditions
  - Compare among strata
- Q2: How does the condition change over time in relation to urban growth and stormwater management efforts in the region?
  - Compare CDF plots over time



Nearshore bacterial data compilation 2010-2015

Presented by Brandi Lubliner, SAM Coordinator
Project lead Deb Sargeant – (then) BEACH Coordinator

Receiving Waters Symposium 13Sept2018

Stormwater Action Monitoring

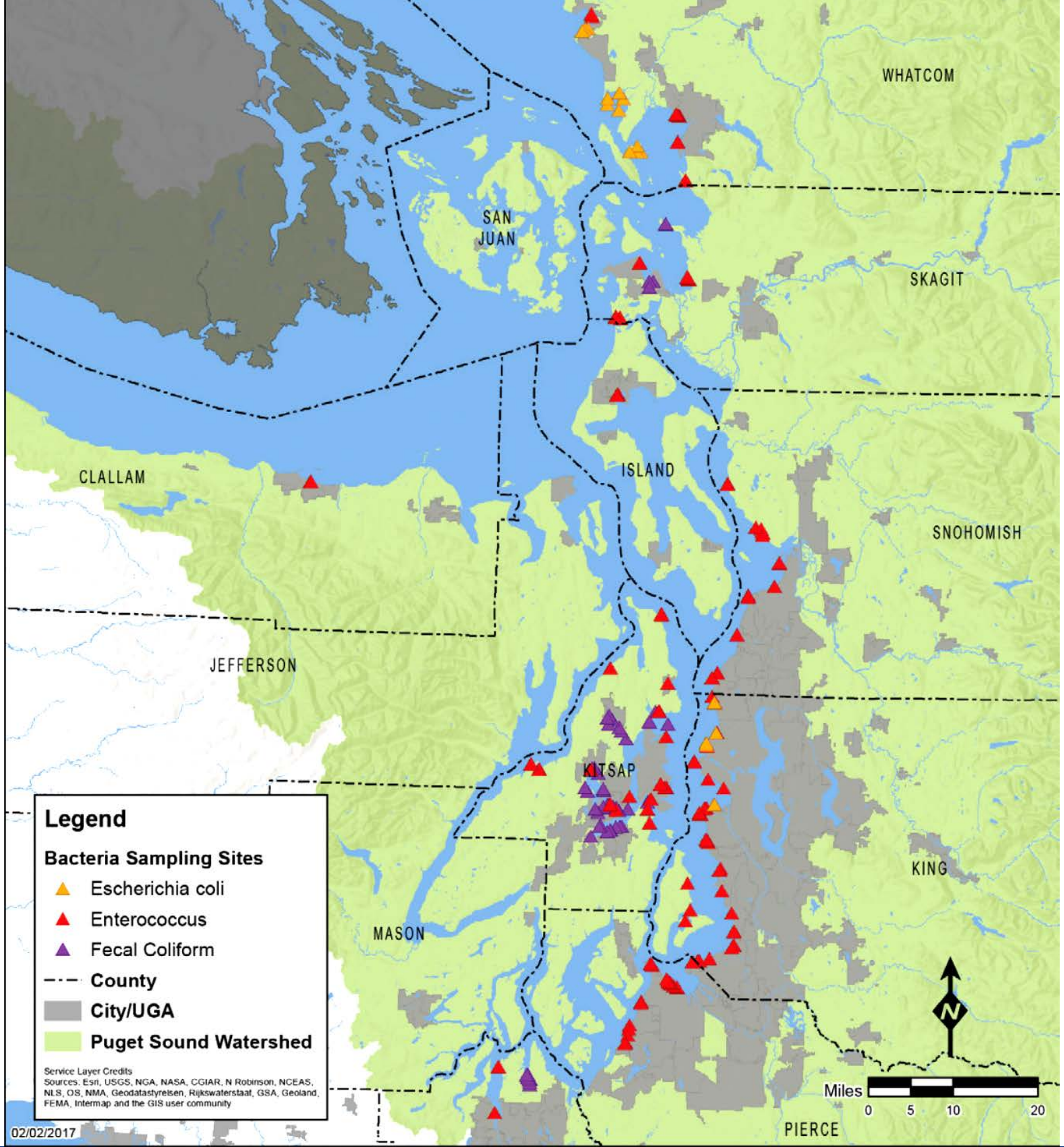

CLOSED
關閉 ¡Playa Cerrada! Cấm Vào 폐쇄함
NO SWIMMING
禁止游泳 ¡Se prohibe nadar!
Cấm Bơi Lội 수영 금지
NO WADING
禁止戲水 ¡Se prohibe bañarse!
Cấm Vào Nước 물놀이 금지
WATER POLLUTED!
水質污染 ¡Agua Contaminada! Nước Bị Ô Nhiễm 오염된물
STAY OUT OF THE WATER!
¡Quédese fuera del agua! Tránh vào nước 물에는 들어가지 말것
Health Jurisdiction
Contact Phone
Contact the BEACH Program at (360) 480-4868
or at: www.ecy.wa.gov/programs/eap/beach/
For shellfish safety information at this beach:
www.doh.wa.gov/shellfishsafety.htm
or call 1-800-562-5632.
Beach Environmental Assessment
Communication and Health (BEACH) Program
DEPARTMENT OF ECOLOGY State of Washington
Health

Study Design

Conduct a data and gap analysis of programs conducting bacterial nearshore marine monitoring in Puget Sound from 2010-2015.

- **Contacted 78 entities**: Tribal, federal, state, county, city, health departments, WWTPs, conservation districts, Surfriders and Beach Watchers.
- **Compiled data from 27 entities**
  - Reviewed the data for quality. Most were high level of quality such as they had a study plan and comparative sampling techniques.
    - fecal coliform (26,354 data points)
    - Enterococcus (14,750 data points)
    - Escherichia coli (848 data points)

Bacteria Data Locations



Entity	Fecal Coliform	Enterococci	*E-coli*
Department of Health - Shellfish	73.6%	0.0%	0.0%
Department of Ecology - BEACH	0.6%	84.5%	0.0%
Counties	21.6%	8.7%	0.0%
Tribes	3.5%	6.8%	100.0%
Cities	0.4%	0.0%	0.0%
Marine Resource Committees	0.3%	0.0%	0.0%
Waste Water Treatment Plants	0.0%	0.0%	0.0%
Conservation Districts	0.0%	0.0%	0.0%

Data Analysis

General summary statistics were computed overall and sub-regionally.

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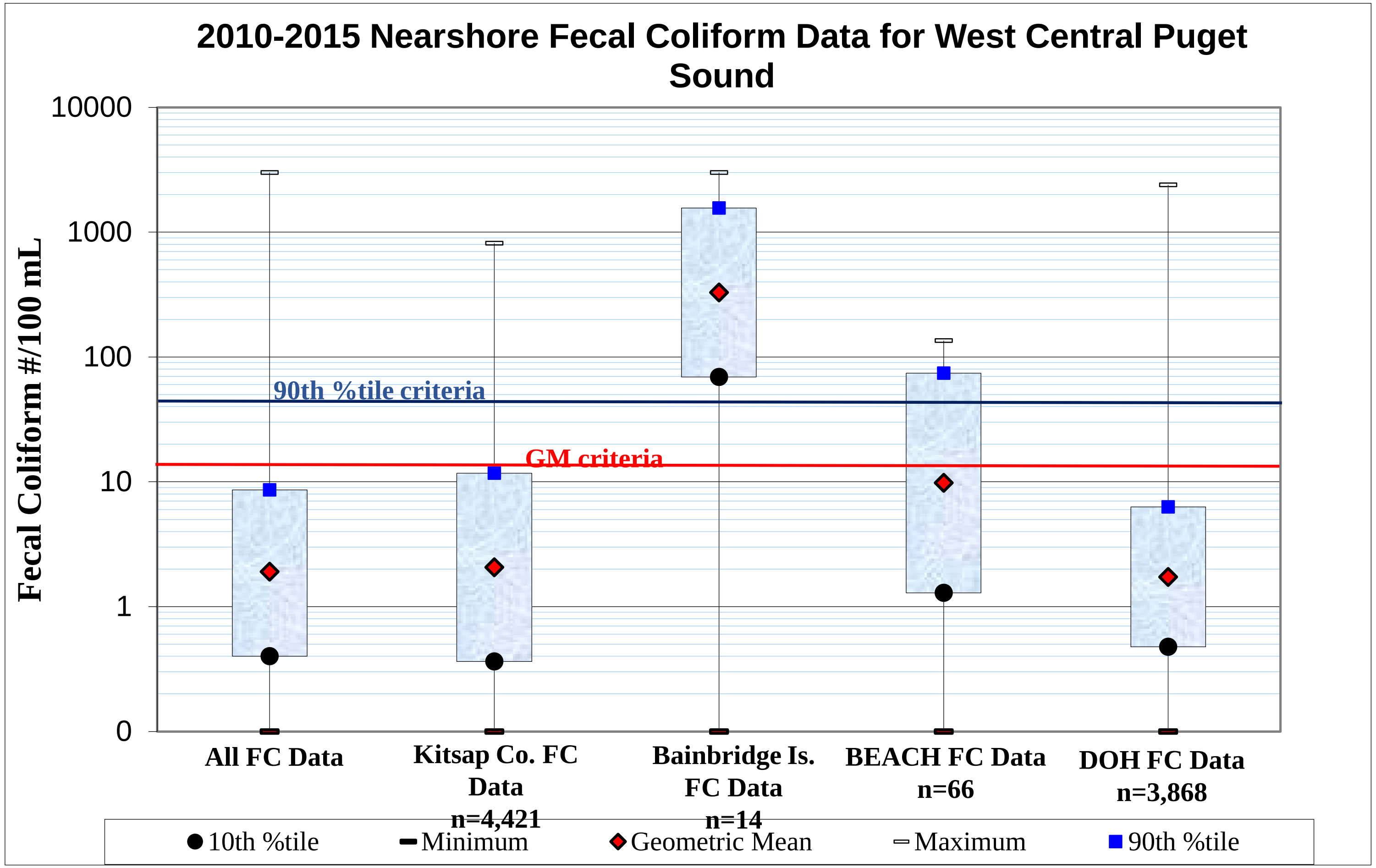
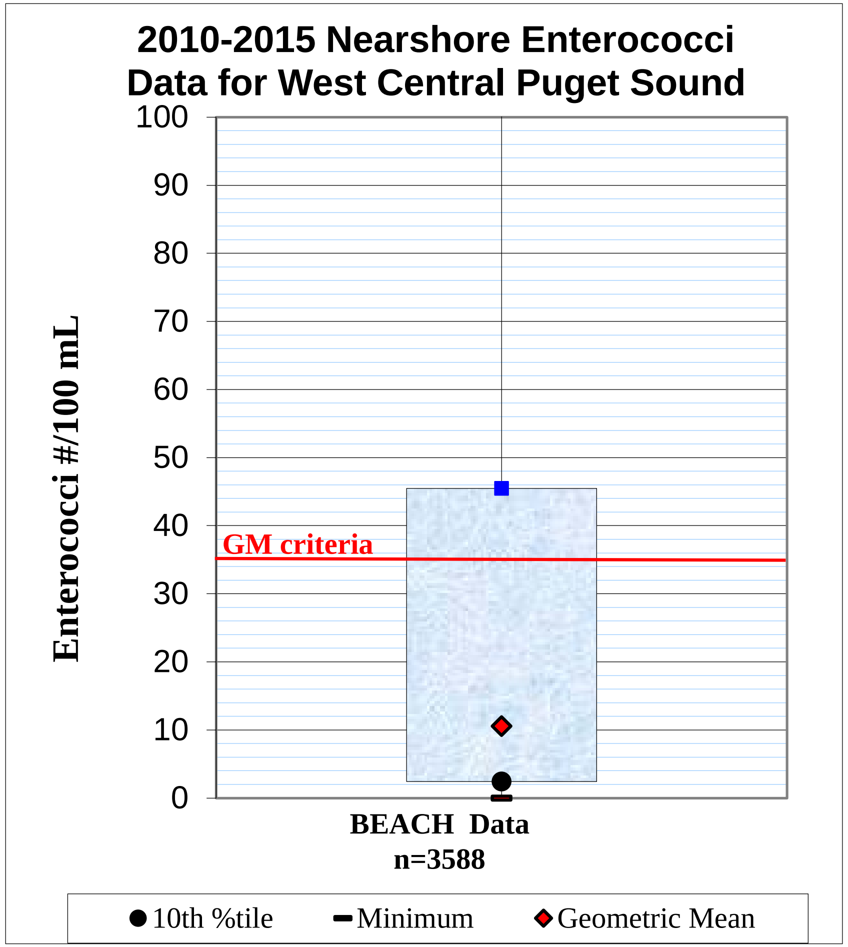
West Central Sound Fecal Coliform and Enterococci Data, 2010 - 2015





Findings

- Only one known stormwater focused data set was found.
- Compilation resulted in a large data set, numerous non-detects
- Data coverage isn’t well balanced but the extent of the sound is being monitored.
- When averaged sound-wide the summary statistics show decent water quality.
    - Some seasonal differences, especially where more data is available for fecal coliform.
- Evidence that the two sampling methods (wade-in vs boat grab) yield different results.

Recommendations to SWG

- A new regional sampling program does not appear to be needed.
  - The Puget Sound is too large for a storm season focused study.
  - Between BEACH and DOH Shellfish there is good coverage across Puget Sound for tracking ambient bacteria levels.
- IF a new program was pursued with a stormwater focus, then:
  - Find sites co-located with outfalls or mouths of rivers and streams that drain densely populated urban areas.
  - Methods of collection should be similar to BEACH or DOH Shellfish (they differ – boat vs wade in)
  - Consider effectiveness study objectives where changes may be measured due to source control and treatment activities in draining watershed. Need more specific questions.

“Add-on” to SAM studies

Leveraging the SAM sites is cost effective - ideal for exploratory work.

Streams (WSDA)

- pesticides in stream sediments

Nearshore (USGS & WDFW)

- micro plastics in sediments and mussels
- pharmaceuticals in mussels

WSDA's Pilot Study of Pesticides in Stream Sediments

- Field crews for SAM PLES collected an extra jar of sieved sediment for WSDA at 86 of 100 PLES sites.
- First time same 120+ pesticides screened in sediments

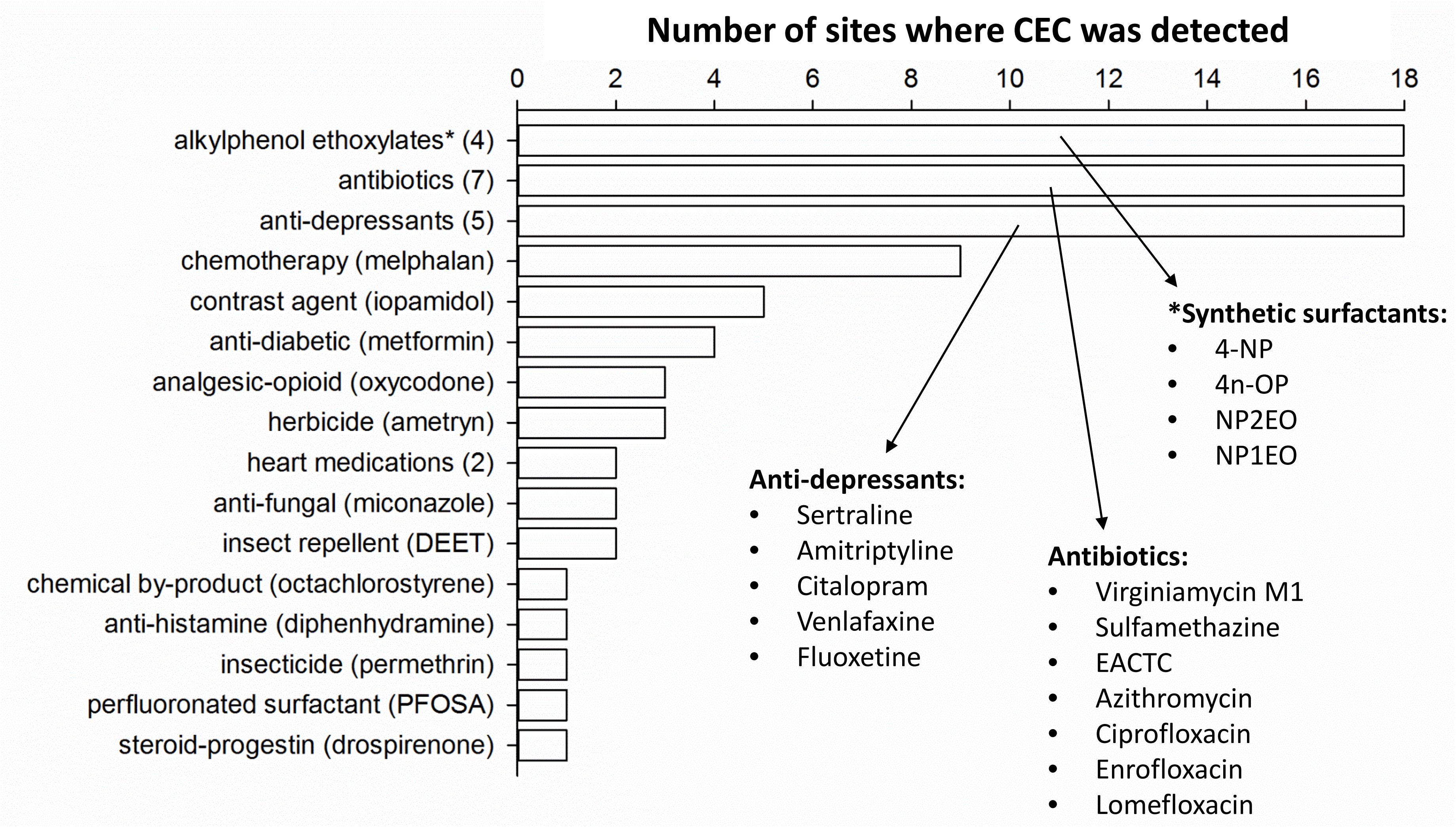
Washington State Department of Agriculture

Abigail Nickelson, WSDA

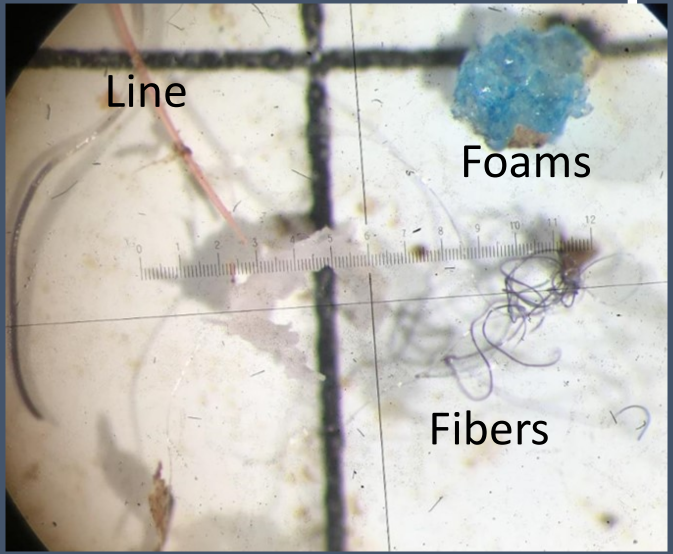
WSDA's Pesticides in Sediments Results

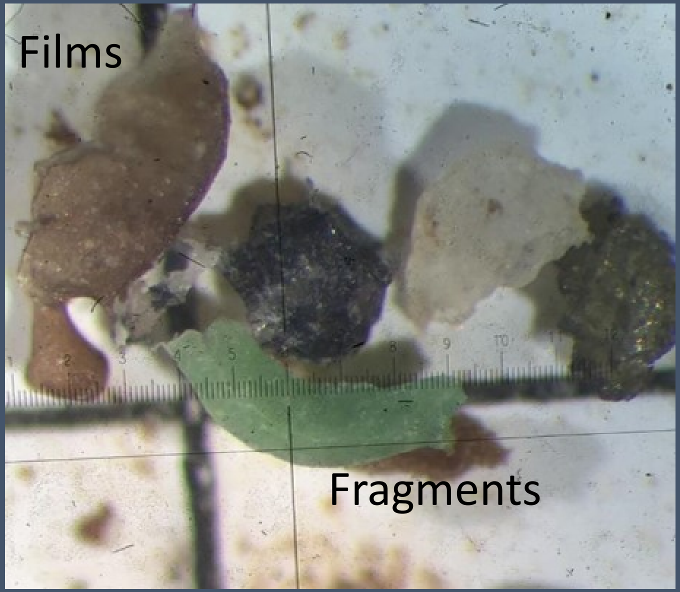
- Many pesticide non-detections at the 81 SAM stream samples. Reporting limits higher in sediment matrix than water.
- 12 unique compounds detected in only 28 samples. 8 samples had multiple compounds.
- Bifenthrin (pyrethroid) most commonly detected and almost always above toxic thresholds.
- Second most common was DDT and degradates, often contributing relatively small amount of toxicity.

Pilot Study - Contaminants of Emerging Concern (CECs) in Mussels



Microplastics in Nearshore Sediment





- >80% of microplastics were fibers
- 76% very small (355-1000 um)
- Concentration ~Great Lakes sediment (20-27,000/kg)
- Microplastic particles throughout Puget Sound sediment
- No clear pattern
- More variation in fibers in actively moving drift cells.
- Range of non-fibers higher in non-moving drift cells.

-Currently identifying the types of plastics (tire rubber)
-Developing new quantification methods
-Started biological effects studies on fibers on salmon

USGS

Questions?

How do I use SAM results?

- Transferable findings across jurisdictions
  - Stakeholders (you all) now have a regional status to compare a smaller local stream health to for context of your stream or waterfront as part of the larger regional health.
  - Can use the comparison to set local priorities and inform councils.
  - From the reports use status assessment as a local baseline if there isn't a local monitoring program
  - In the future, we hope to build tools for a more refined local prediction
- The regional trend program will tell us how stormwater management is working

SAM
Stormwater Action Monitoring

Up Next Receiving water findings

Upcoming SAM Workshop February 27, 2019
Renton Community Center
- come shape SAM studies

Upcoming SAM Receiving water video underway

Find these projects’ factsheets & final reports

ecology.wa.gov/SAM