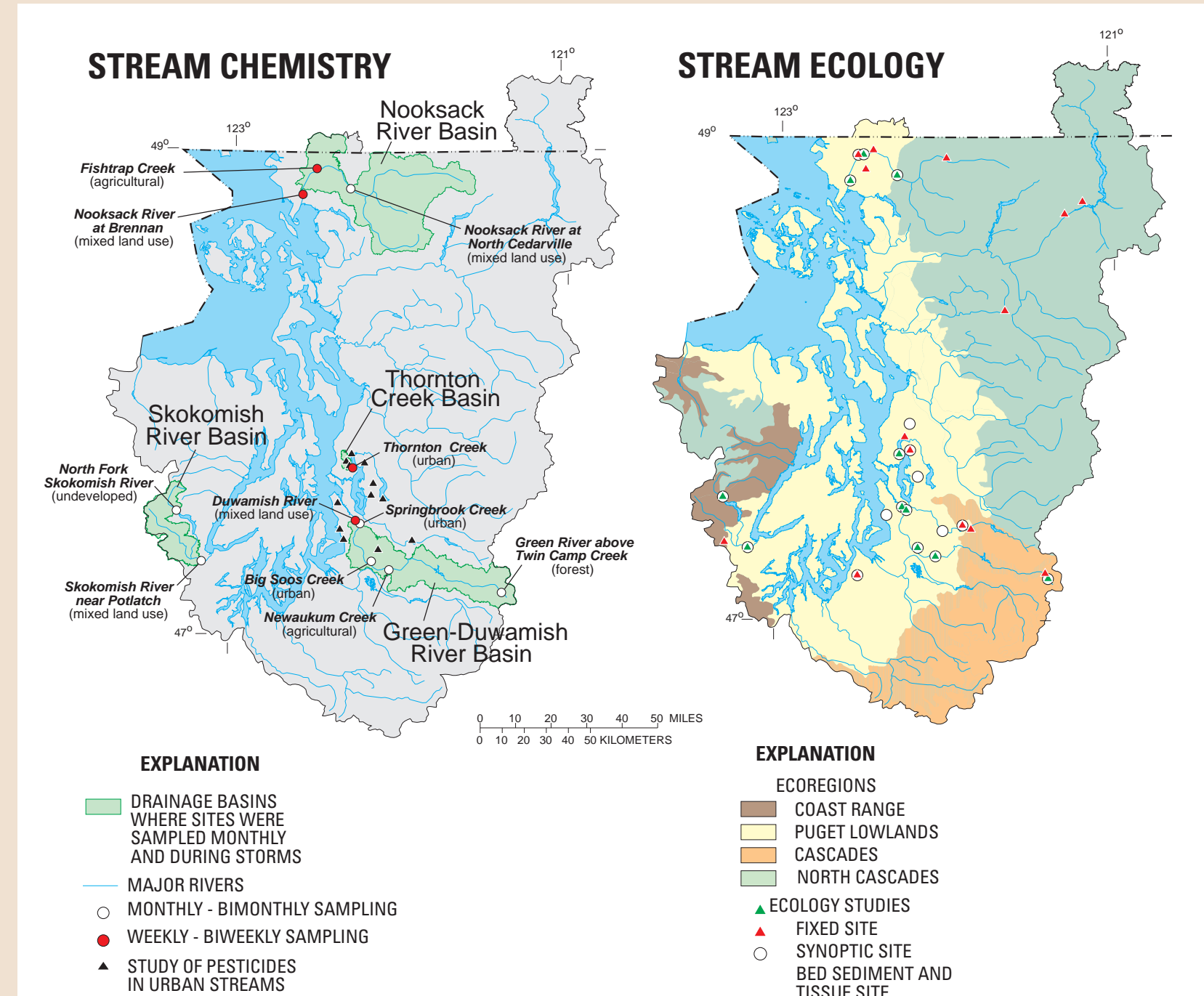


Quality of Streamwater in the Puget Sound Basin—A Decade of Study and Beyond

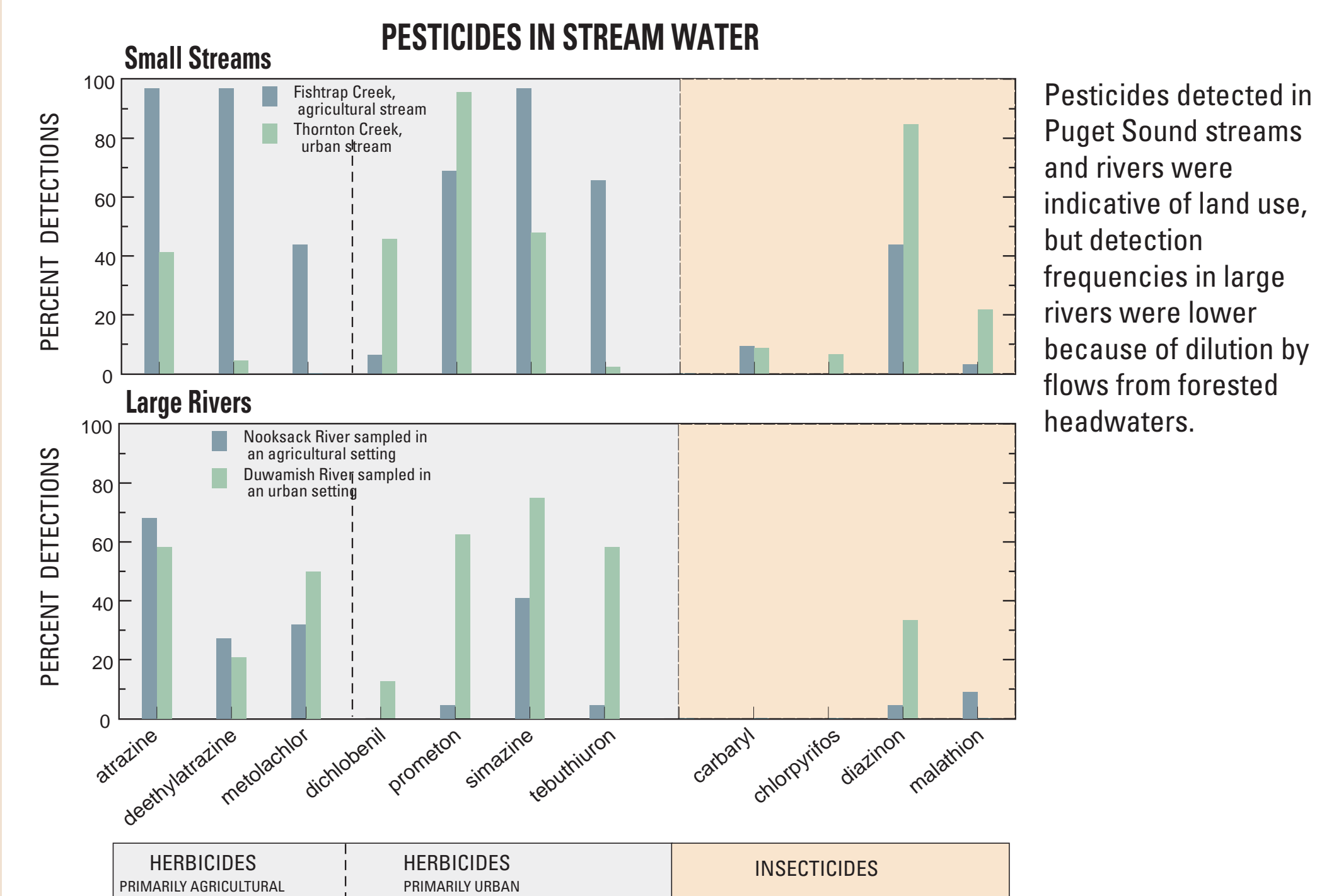
Sandra Embrey and Patrick Moran, Washington Water Science Center, Tacoma, WA

THE FIRST CYCLE, 1995-1998--WHAT WAS LEARNED

STUDY UNIT DESIGN

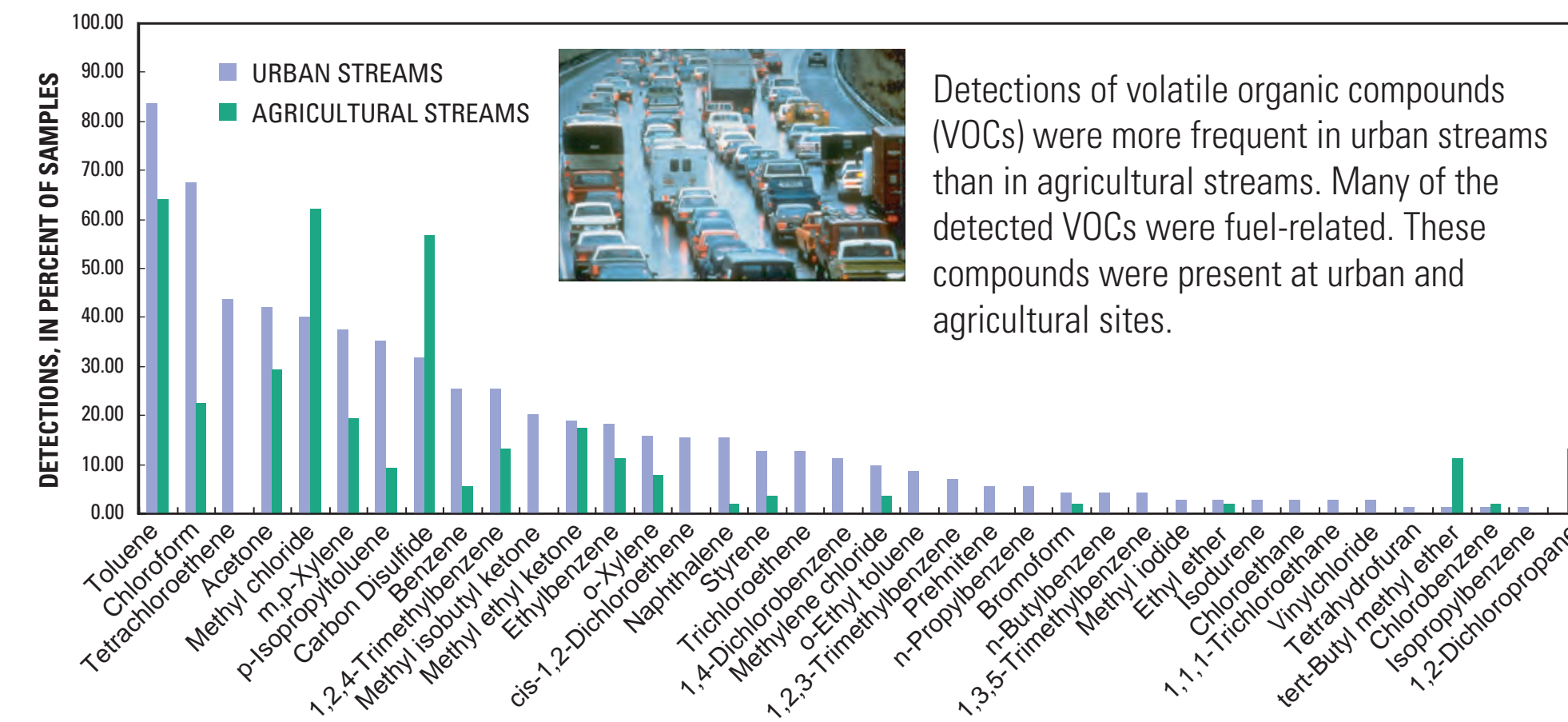


ORGANIC CHEMICALS AND LAND USE



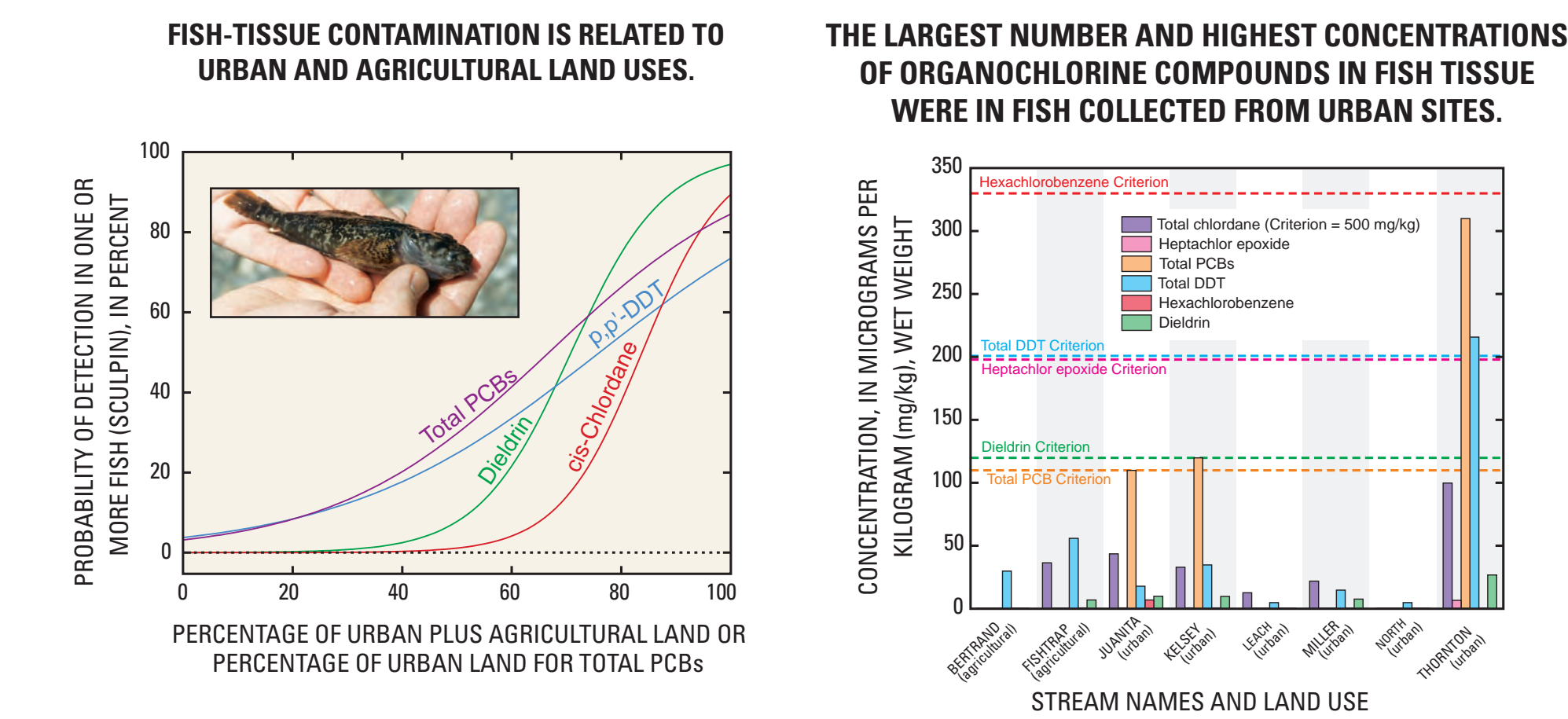
Pesticides detected in Puget Sound streams and rivers were indicative of land use, but detection frequencies in large rivers were lower because of dilution by flows from forested headwaters.

VOLATILE ORGANIC COMPOUNDS IN STREAM WATER



Detections of volatile organic compounds (VOCs) were more frequent in urban streams than in agricultural streams. Many of the detected VOCs were fuel-related. These compounds were present at urban and agricultural sites.

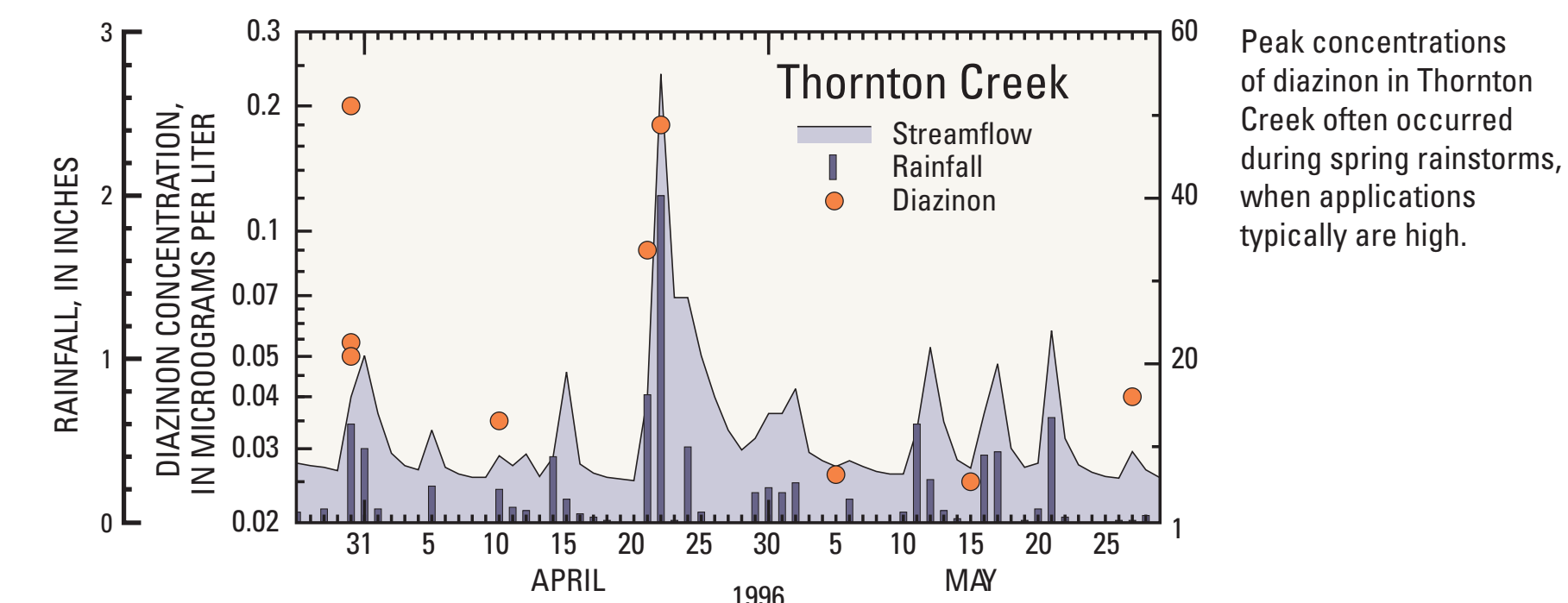
ORGANOCHLORINE COMPOUNDS IN FISH TISSUE AND STREAMBED SEDIMENT



FISH-TISSUE CONTAMINATION IS RELATED TO URBAN AND AGRICULTURAL LAND USES.

THE LARGEST NUMBER AND HIGHEST CONCENTRATIONS OF ORGANOCHLORINE COMPOUNDS IN FISH TISSUE WERE IN FISH COLLECTED FROM URBAN SITES.

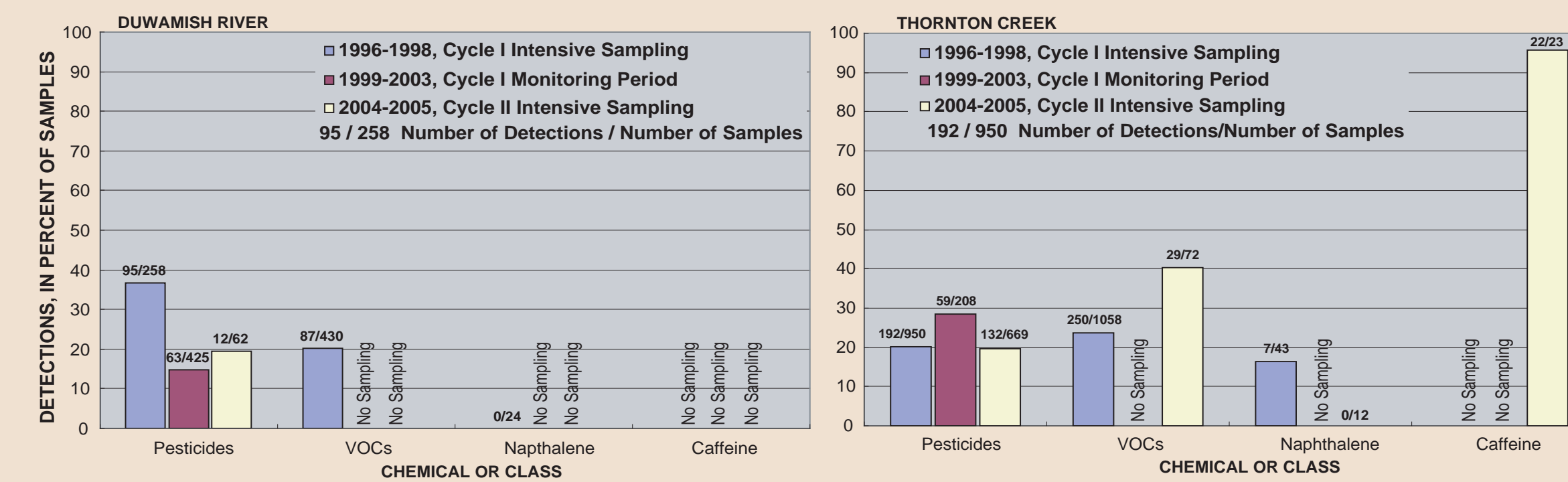
WASHOFF OF PESTICIDES DURING RAINSTORMS INTO STREAMS CAUSED VARIATIONS IN CONCENTRATIONS.



Peak concentrations of diazinon in Thornton Creek often occurred during spring rainstorms, when applications typically are high.

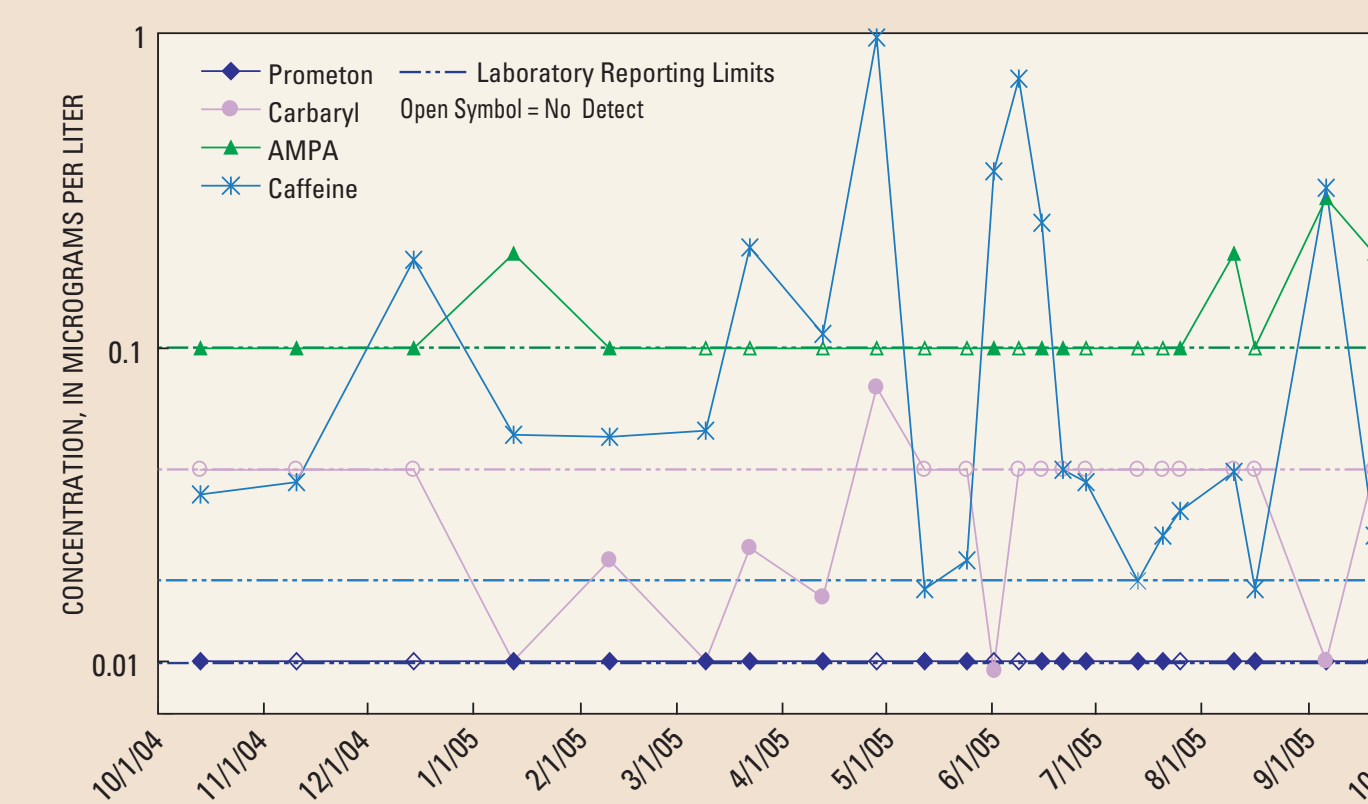
MONITORING YEARS, 1998-2003, AND THE SECOND CYCLE, 2004---

ORGANIC CHEMICALS IN THE DUWAMISH RIVER AND THORNTON CREEK



Sampling for organic compounds in the urban index stream has occurred in three intervals—1995 to 1998 intensive studies of the first cycle; 1999 to 2003 low-level monitoring of the first cycle; and 2004-2005 intensive studies of the second cycle. The proportion of samples with detections of pesticides remained relatively constant between the two intensive-study periods. In Thornton Creek, a greater percentage of samples tested positive for VOCs during the second cycle than during the first. However, the polycyclic aromatic compound naphthalene, which was detected in about 15 percent of samples during 1996-98, was not detected in any of the 23 samples collected in 2004-05. Caffeine, which was not monitored during the first cycle, was detected in more than 90 percent of the samples collected during the second cycle.

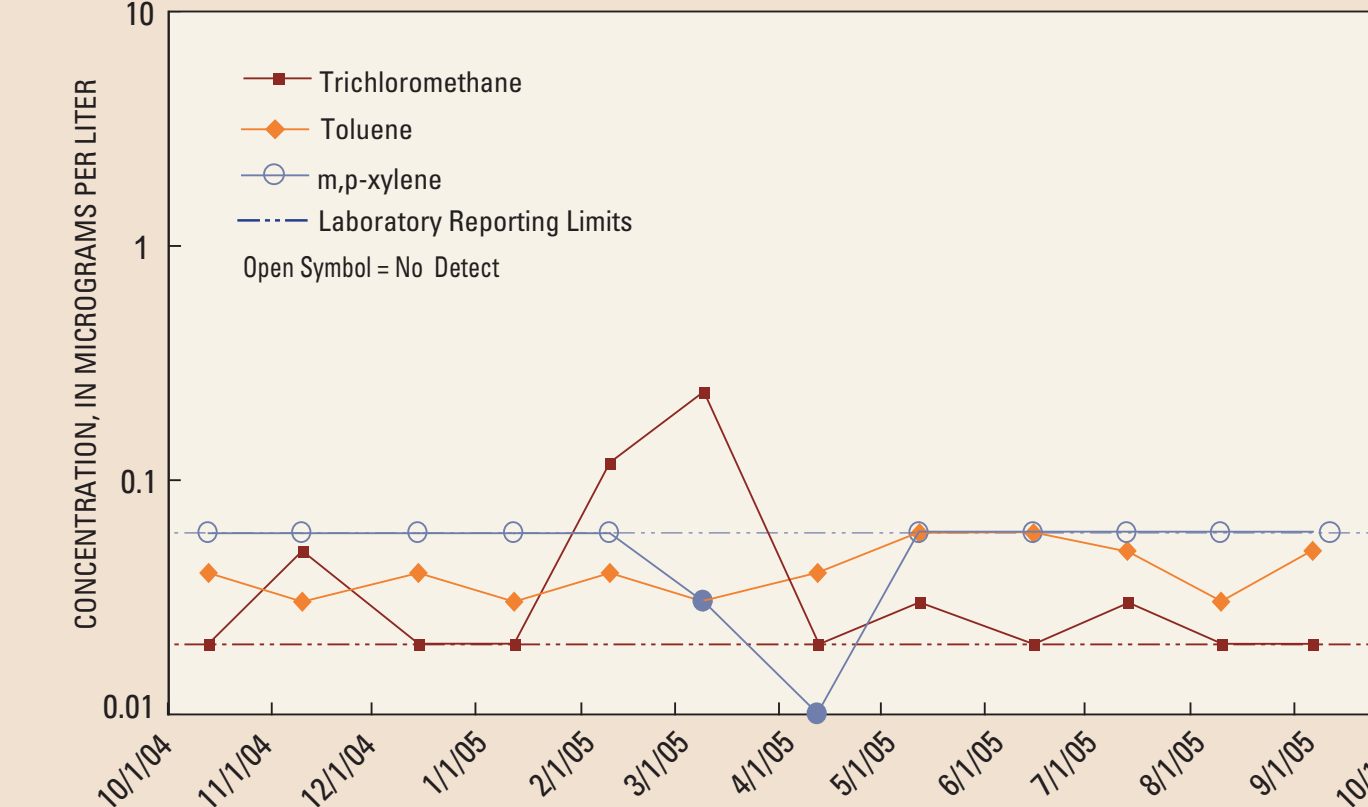
PESTICIDES, DEGRADATES, AND CAFFEINE IN THORNTON CREEK, WATER YEAR 2005



In the second cycle, the three most frequently detected pesticide compounds were the herbicide prometon, the insecticide carbaryl, and the glyphosate degradation compound, amino-methylphosphonic acid (AMPA). In the first cycle, prometon was the most frequently detected herbicide, where as diazinon was the most frequently detected insecticide.

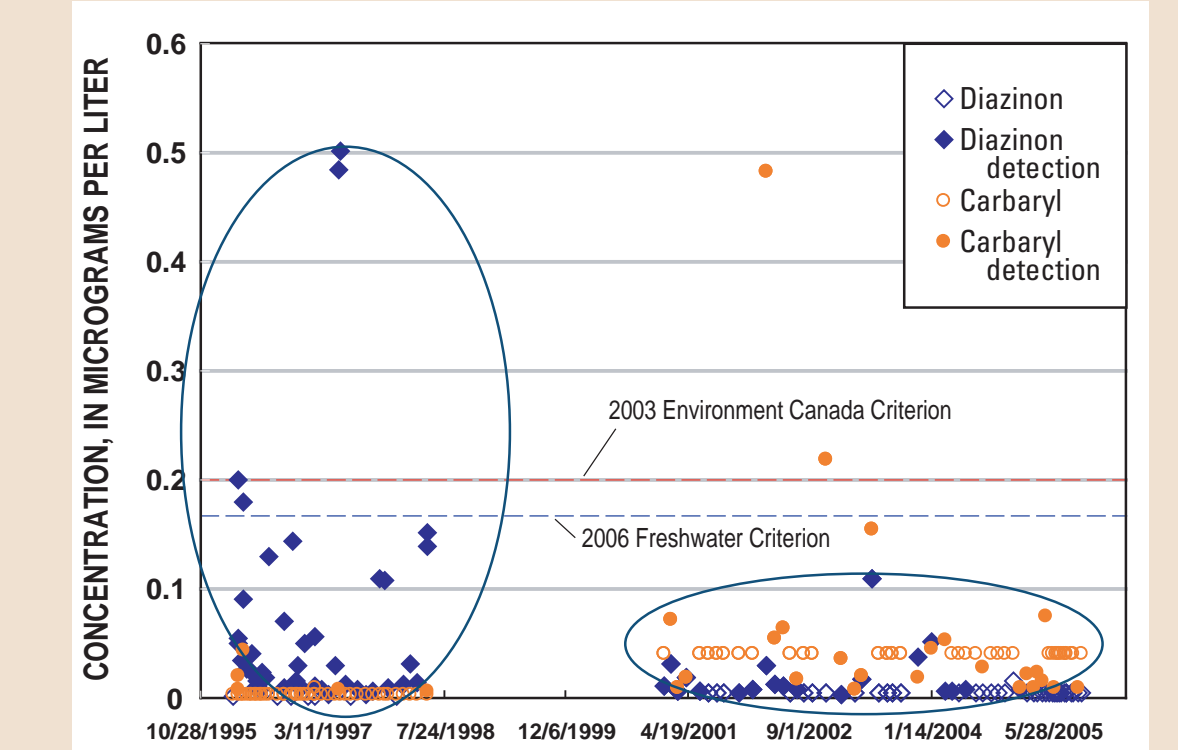
Caffeine, a chemical often found in waste water, was detected in all but one sample.

VOCs IN THORNTON CREEK, WATER YEAR 2005



All 12 samples collected for volatile organic compounds during this second cycle tested positive for trichloromethane (chloroform) and the solvent toluene. Trichloromethane is a byproduct of the chlorination of water supplies, but also is an industrial solvent. The solvent m,p-Xylene was the third most frequently detected VOC.

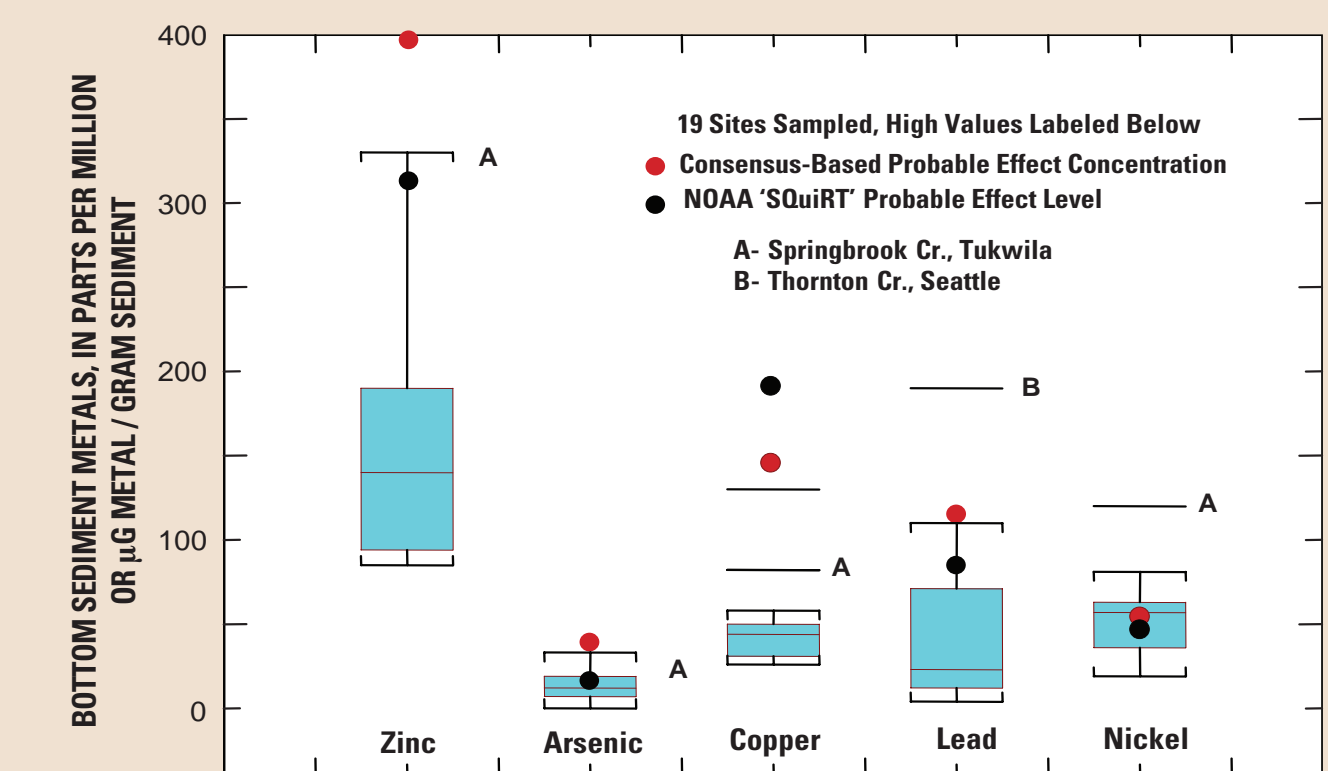
DIAZINON AND CARBARYL TRENDS IN THORNTON CREEK



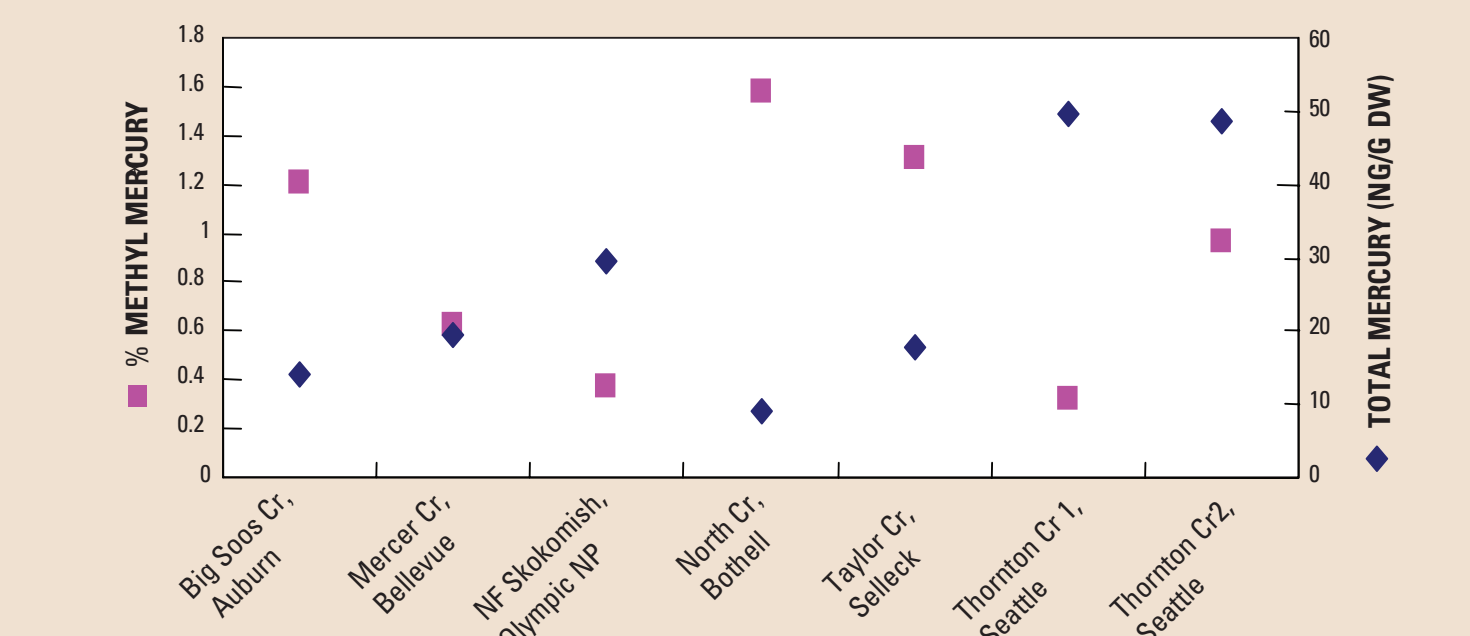
During the first cycle, the insecticide diazinon was often detected in samples from Thornton Creek and occasionally in concentrations that did not meet criteria for the protection of freshwater organisms. Monitoring shows the marked decrease in diazinon concentration and a concurrent rise in carbaryl detections and concentrations following the announcement in 2001 on restricting sales of diazinon in the retail market.

METALS IN STREAM SEDIMENTS

CONCENTRATIONS OF SEVERAL METALS OCCASIONALLY REACHED LEVELS CONSIDERED HARMFUL TO BENTHIC ORGANISMS

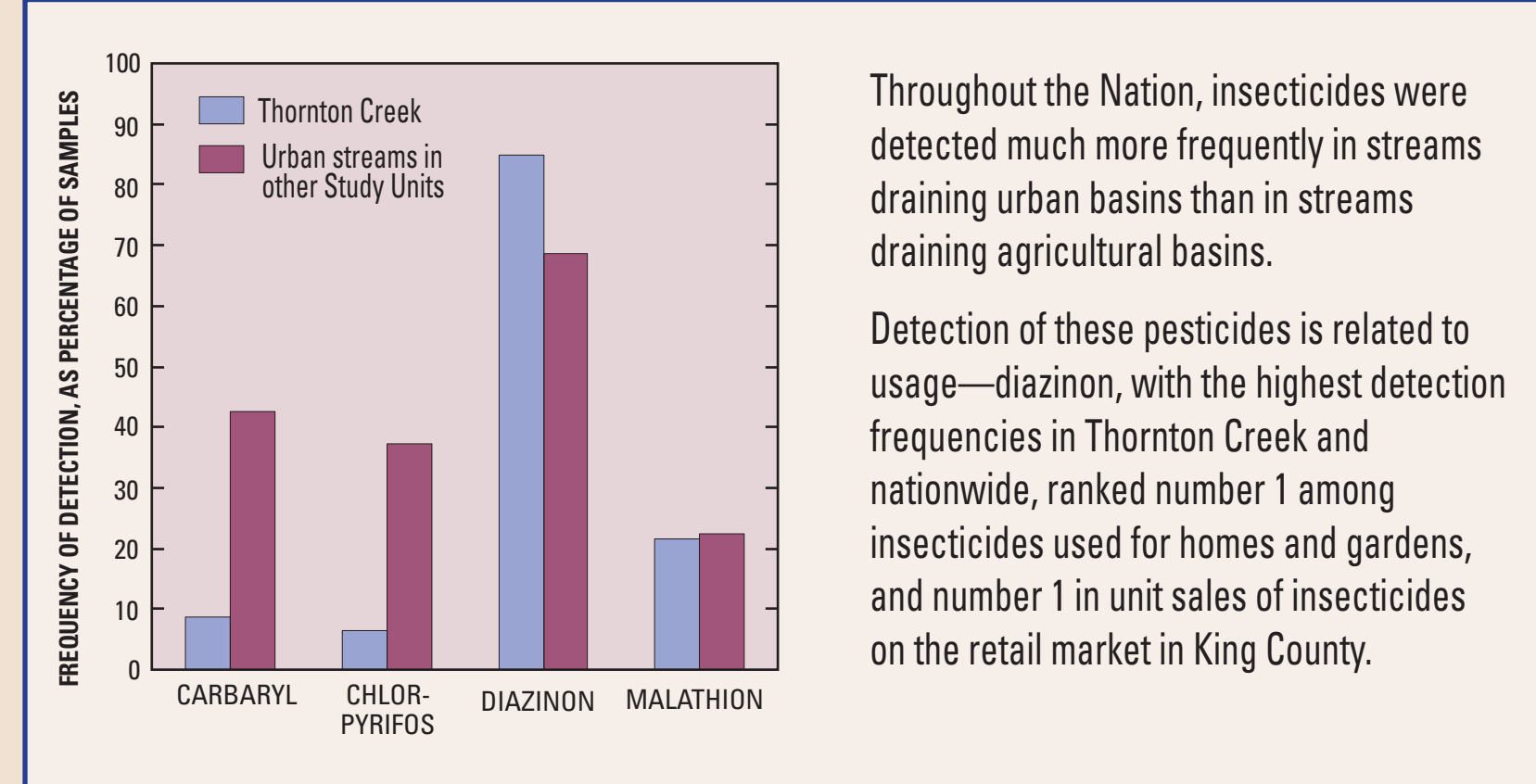


METHYL AND TOTAL MERCURY IN BOTTOM SEDIMENTS OF LOCAL PUGET SOUND STREAMS, 2004.



The percentage of total mercury detected as methyl mercury is small as compared to other locations across the country and suggests generally low rates of methylation in Puget Sound Basins.

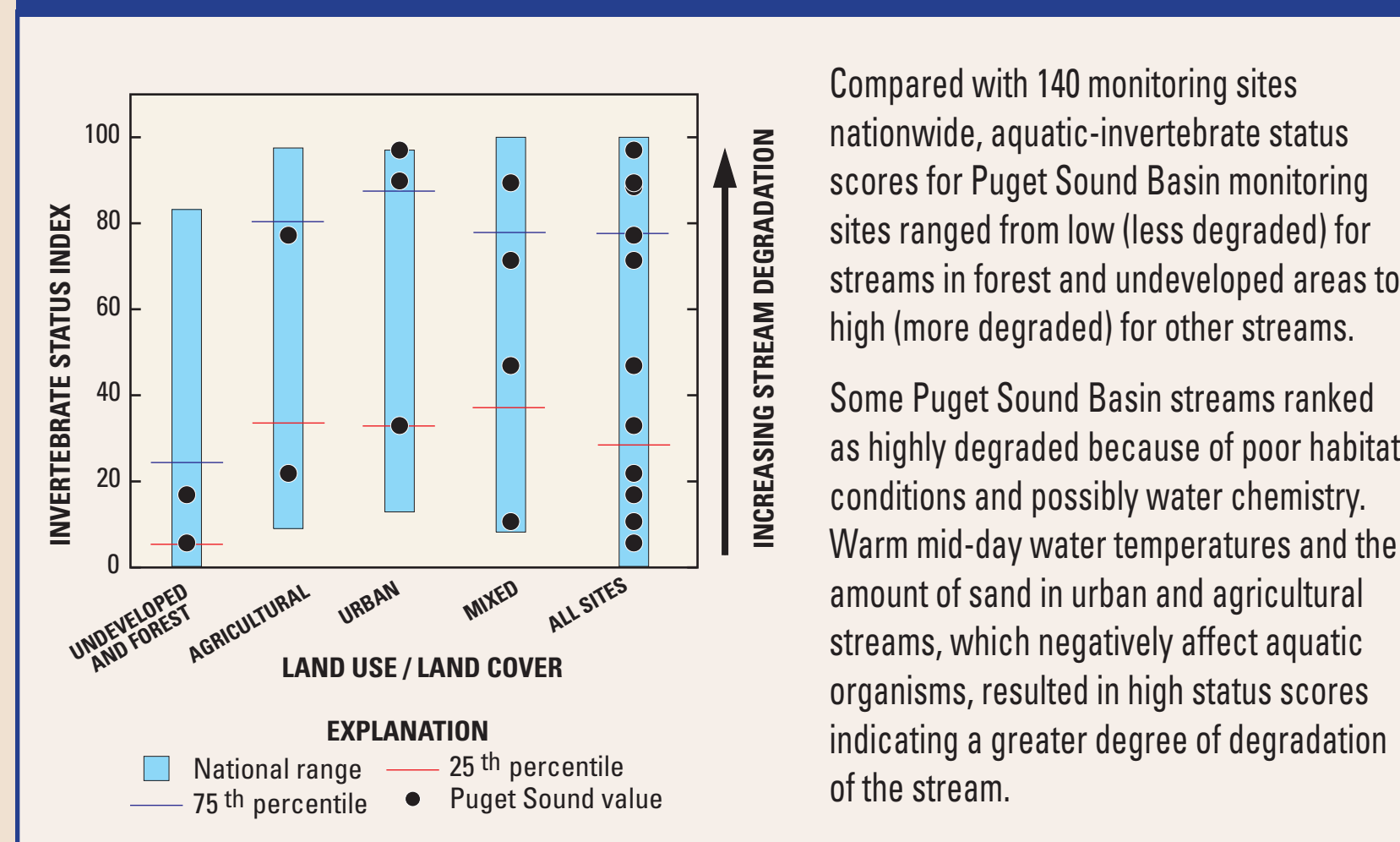
INSECTICIDES IN THORNTON CREEK AND URBAN STREAMS THROUGHOUT THE NATION



Throughout the Nation, insecticides were detected much more frequently in streams draining urban basins than in streams draining agricultural basins.

Detection of these pesticides is related to usage—diazinon, with the highest detection frequencies in Thornton Creek and nationwide, ranked number 1 among insecticides used for homes and gardens, and number 1 in unit sales of insecticides on the retail market in King County.

PUGET SOUND STREAM INVERTEBRATE STATUS AND NATIONAL LEVELS



Compared with 140 monitoring sites nationwide, aquatic-invertebrate status scores for Puget Sound Basin monitoring sites ranged from low (less degraded) for streams in forest and undeveloped areas to high (more degraded) for other streams.

Some Puget Sound Basin streams ranked as highly degraded because of poor habitat conditions and possibly water chemistry. Warm mid-day water temperatures and the amount of sand in urban and agricultural streams, which negatively affect aquatic organisms, resulted in high status scores indicating a greater degree of degradation of the stream.

THE FUTURE, 2006-2008 --EFFECTS OF URBANIZATION ON STREAM ECOSYSTEMS

During the next few years, the Puget Sound Basin study team will be engaged in a focused study to answer the question:

"How do characteristics of stream ecosystems respond to urban land-use changes and how do these responses vary across environmental settings?"

NATIONAL OBJECTIVES:

- Determine hydrologic, geomorphic, chemical, habitat, and biologic characteristics that respond to urban land-use changes.
- Determine key indicators of effects due to urbanization on ecology and biology.
- Determine how physical, chemical, and biological responses vary across environmental settings.
- Develop tools to relate responses to landscape conditions.

TIMELINES

- 2006 - Planning, site selection, gage installation
- 2006-08 - Streamflow, temperature continuous data collection
- 2007-08 - Biology, habitat, water, and sediment data collection
- 2009-11 - Data analyses and reports

LOCAL OBJECTIVES:

- The links between stream hydrology, chemical quality of streambed sediments, and the health and response of the biological community.
- Particular attention to salmonids and pollutants.

STUDY TEAM RESEARCH ELEMENTS

- Effects on stream biology (salmon, invertebrates, algae, and integrated biological processes), including:
 - An understanding of how streambed sediments that are affected by urbanization impact stream biology through changes in chemistry, thickness, hyporheic flow, and spatial distribution of different particle sizes
 - A more sophisticated, integrated measure (index) of urban development
 - A method for establishing response thresholds for the urbanization "factors."
- New technologies applied to ecological science:
 - Presence and concentrations of pyrethrin/pyrethroids in bottom sediment,
 - GIS analysis of urbanization proximity patterns in relation to streams and developing new metrics to describing these patterns, and
 - Identification of gene activation and protein/enzyme biomarkers through microarray analysis.

FOR ADDITIONAL INFORMATION:

Sandra Embrey - US Geological Survey
Patrick Moran - US Geological Survey

253 428 3600 <http://wa.water.usgs.gov/projects/pugt/>

