EPA United States Environmental Protection Agency

Contaminated Sediments Virtual Workshop: Session 4: Long-term Monitoring

Role of Passive Sampling and Porewater Remedial Guidelines (PWRGs) in Long-term Monitoring (Part 1)

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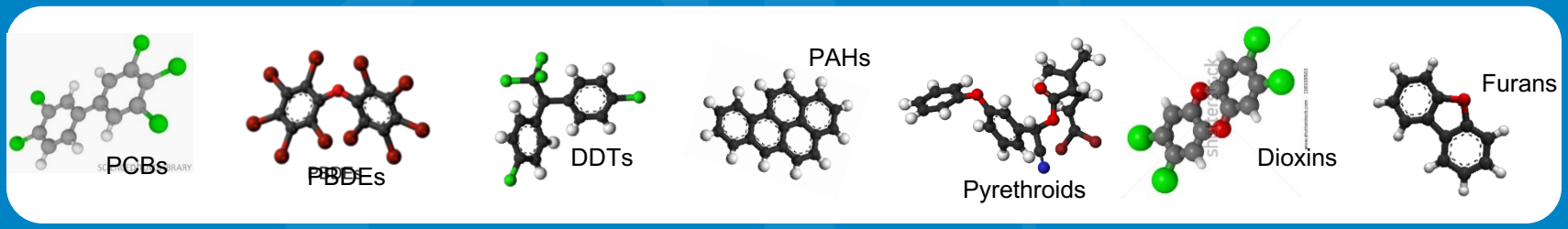
Outline

- What passive sampling tells us
- Why do we care about the freely dissolved concentration (C_{free})
- Preparing, deploying, recovering, and storing passive samplers
- Applications in long-term monitoring

  - *Focus on nonionic organic contaminants (no metals)*



What Passive Sampling Tells Us

- √ (1) Freely dissolved concentrations (C_{free}) of contaminants of concern (COC) in water around passive sampler
  - Surrogate for bioavailable concentrations of COC
    - Pore water (Interstitial Water)
    - Water column
  - Compare to Water Quality Criteria (WQC), other water quality standards, sediment guidelines or water-only toxicity data for exceedances

- √ (2) Concentration of COCs in passive sampler
  - Good correlation with bioaccumulation by aquatic organisms
  - Serve as surrogates for biomonitoring organisms
    - Benthic and water column organisms
    - Fish consumed by humans

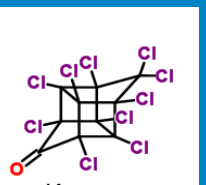
Why Do We Care about the Freely Dissolved Concentration (C_{free})?

- For benthic organisms: What media is an effective surrogate for exposure to bioavailable chemicals?
  - Sediment?
  - Food?
  - Pore Water = Freely dissolved concentration (C_{free})?

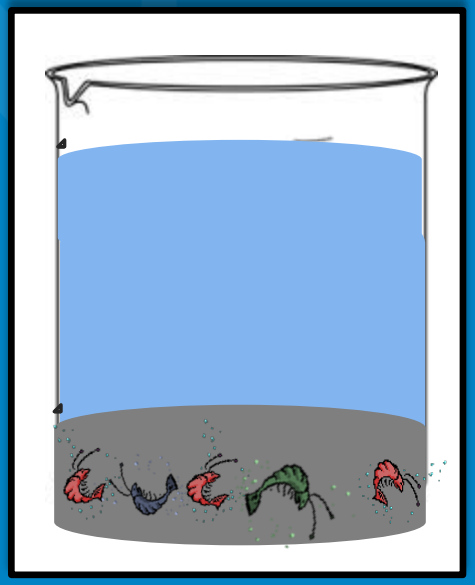
=

Chironomus tentans

- Adams et al. (1985) first addressed this question
  - Two Kepone-amended sediments (same levels)
    - 1.5% and 12.3% sediment organic carbon
  - Freshwater midge (*Chironomus tentans*)
  - Exposure-response relationships
    - Survival versus exposure



Kepone



Why Do We Care about the Freely Dissolved Concentration (C_{free})?

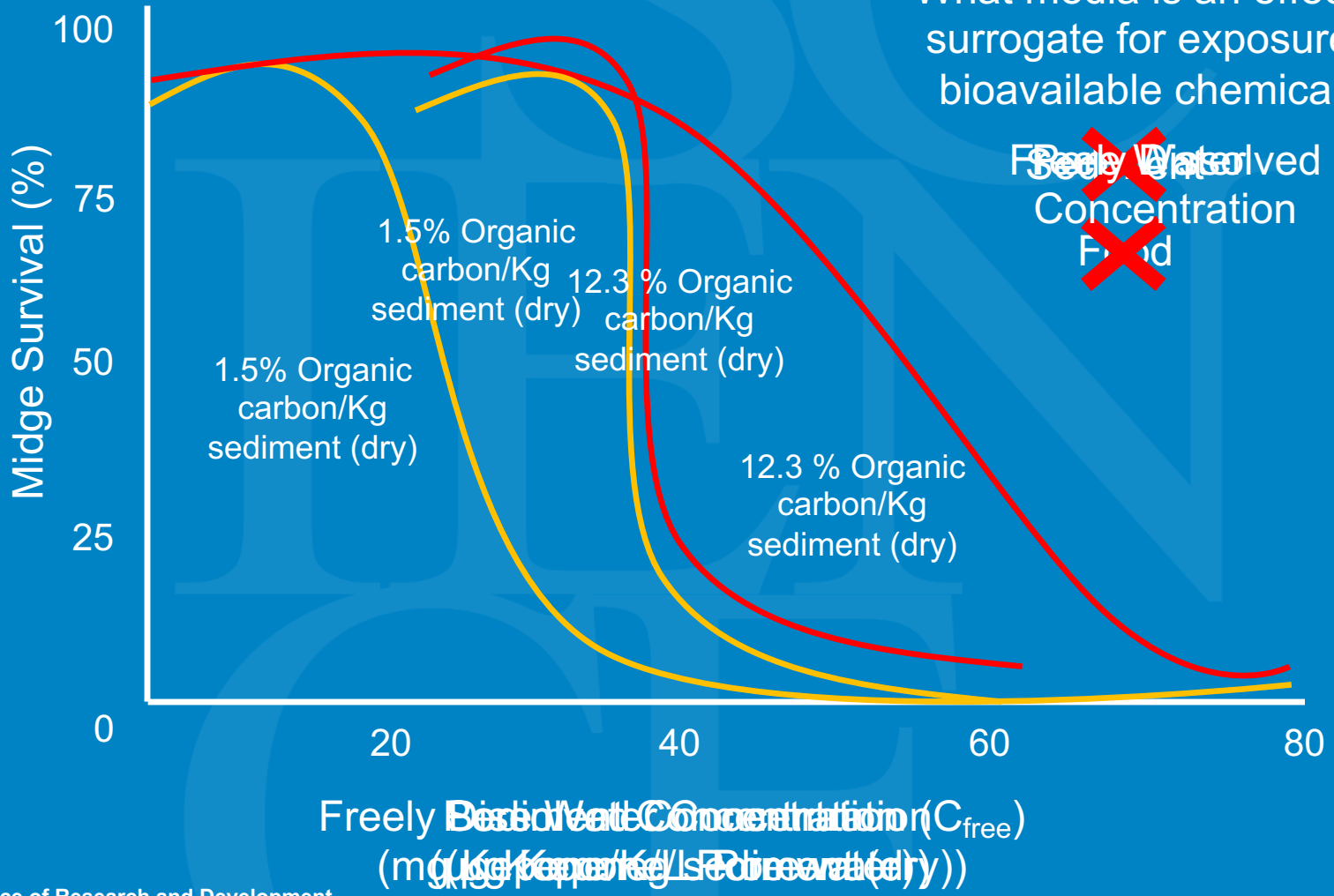
What media is an effective surrogate for exposure to bioavailable chemicals?

~~Bulk Sediment~~

~~Pore Water~~

Freely Dissolved Concentration

~~Food~~



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Preparing, Deploying, Recovering, and Storing Passive Samplers

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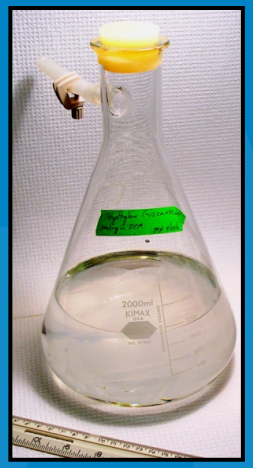
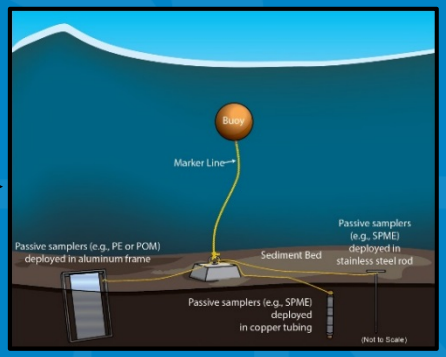
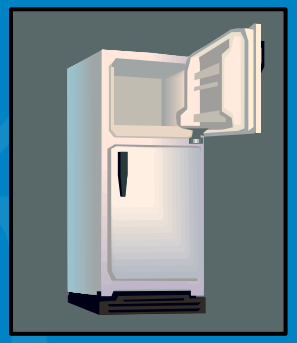
Passive Sampler (PE or POM)



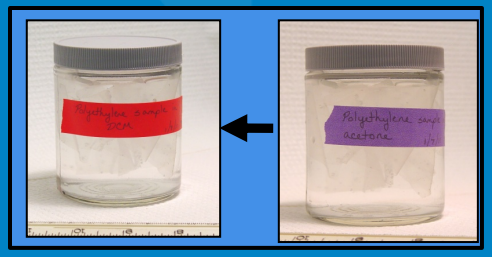
(1) Solvent Cleaning (~24 hours)



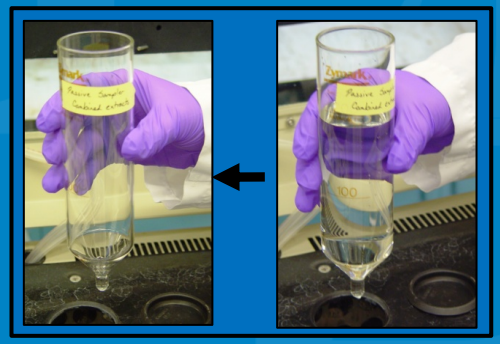
(2) Deployment and Recovery (~ 30 days)



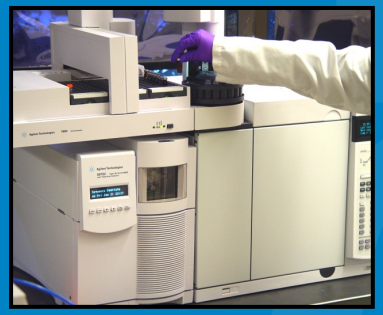
(3) Storage (-4 ˚C wrapped in foil)



(4) Solvent Extraction (48 hours)



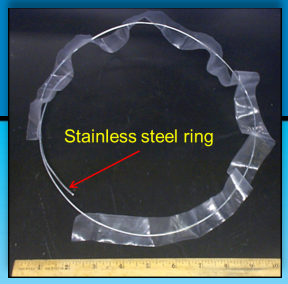
(5) Volume reduction (~ 1 hour)

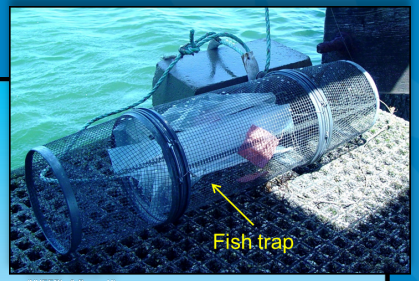


(6) GC/MS Quantification and Data Analysis/Interpretation

Preparing, Deploying, Recovering, and Storing Passive Samplers

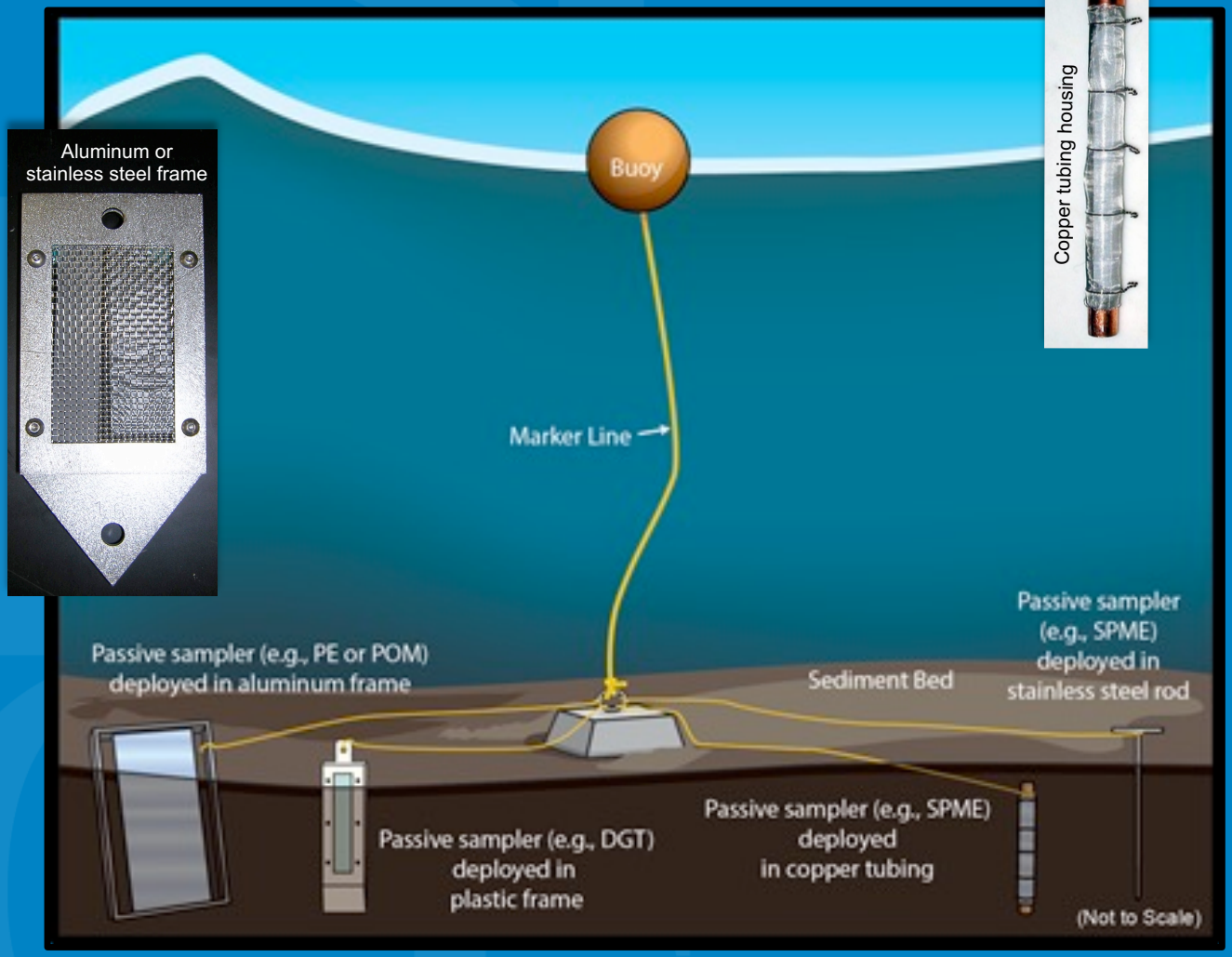
Water Column Deployment





Preparing, Deploying, Recovering, and Storing Passive Samplers

Pore Water Deployment



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Superfund Sites where Passive Sampling has been used (Updated October 2019) (Lambert et al. 2019):

Allegany Ballistics Laboratory (Region 3)
Aniston PCB (Region 4)
Berry's Creek (Region 2)
Brodhead Creek (Region 3)
Columbia Slough (Region 10)
Donna Reservoir (Region 6)
Dover Gas Light (Region 3)
Diamond Alkali (Region 2)
GLLA River Basin AOC (Region 5)
Grand Calumet (GLNPO-Region 5)
Grasse River (Region 2)
Kerr-McGee/Tronox (Region 4)
Lake Hartwell (Region 4)
Lower Duwamish Waterway (Region 10)
Manistique River (Region 5)
McCormick and Baxter (Region 10)
Metal Bank (Region 3)
MW Manufacturing (Region 3)
Naval Station Newport (Region 1)
New Bedford Harbor (Region 1)
Ordot Landfill (Region 9)
Pacific Sound Resources (Region 10)
Palos Verdes Shelf (Region 9)
Portland Harbor (Region 10)
San Jacinto Waste Pits (Region 6)
Tennessee Products (Region 4)
United Heckathorn (Region 9)
Whitmoyer Laboratories (Region 3)
Wyckoff (Region 10)

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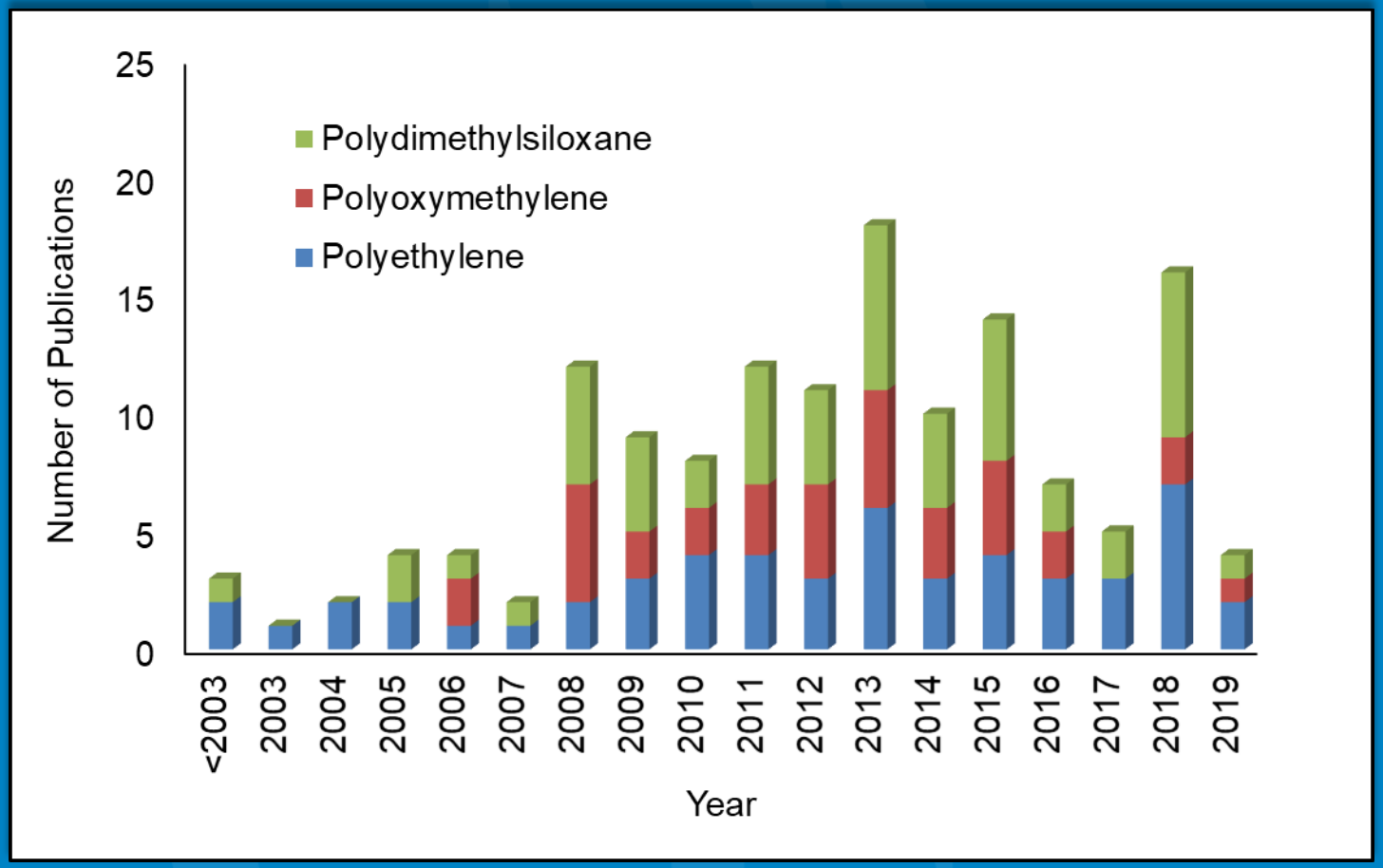
Most Commonly used Passive Samplers:



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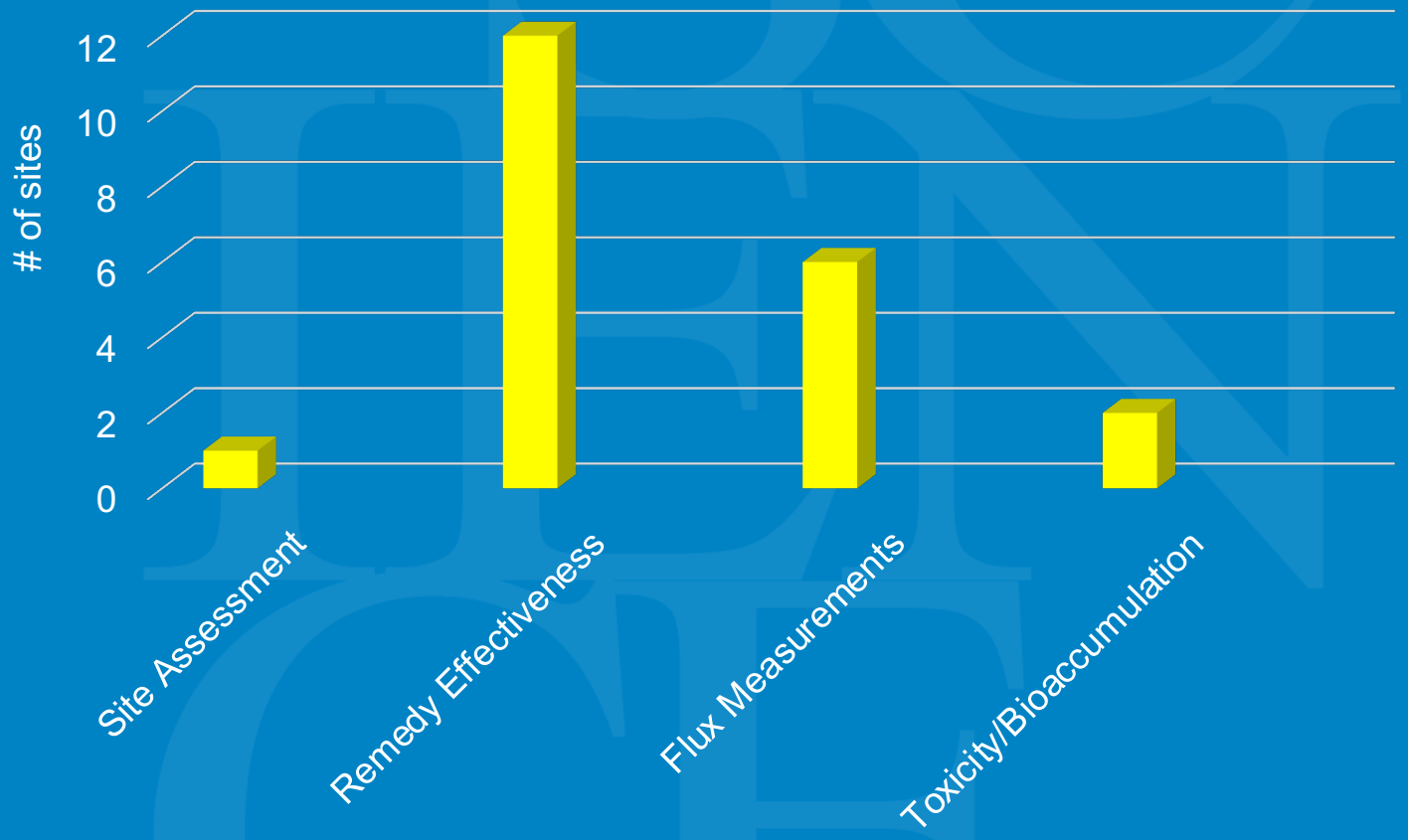
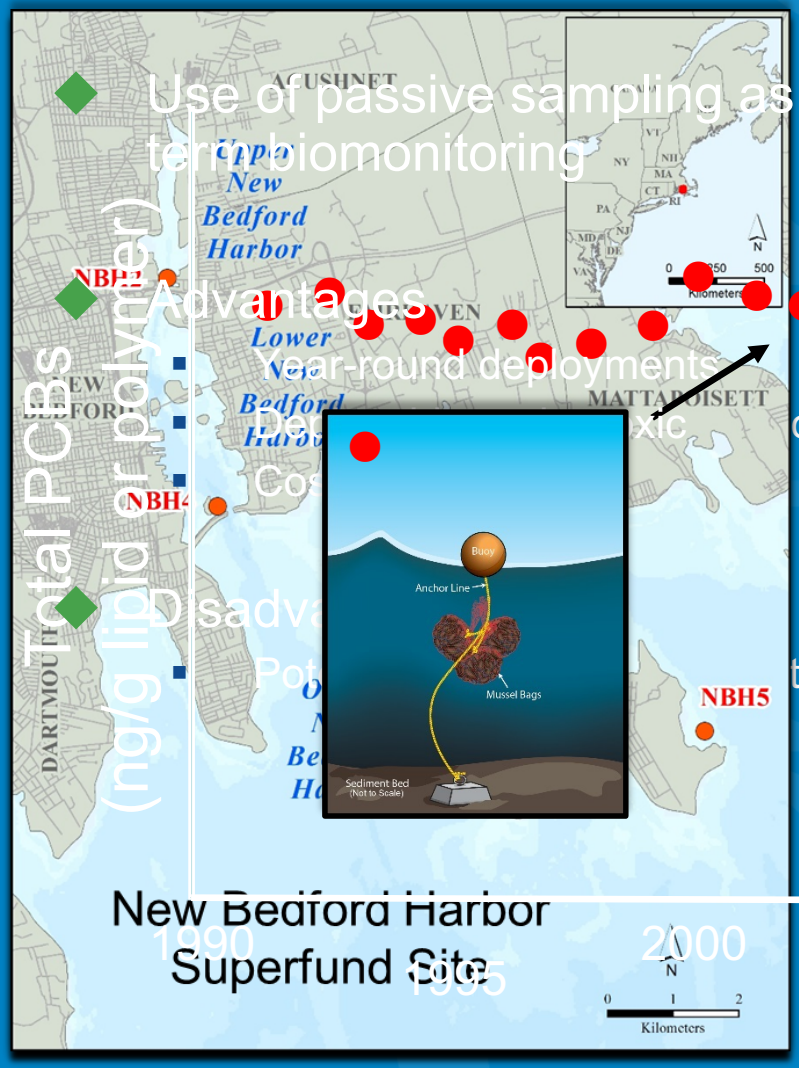
Use of Passive Sampling at Superfund Sites (n = 22)
(Lambert et al. 2019)



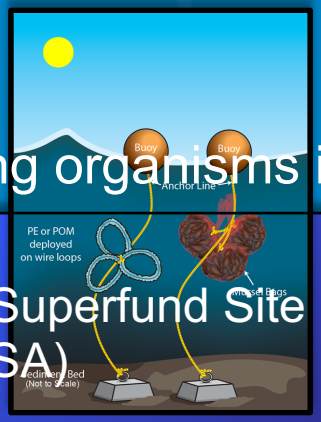
Applications in Long-term Monitoring

- Use of passive sampling as a surrogate for deploying organisms in long-term biomonitoring

- Advantages
  - Year-round deployments
- Disadvantages
  - Potential toxicity



Fall 2014

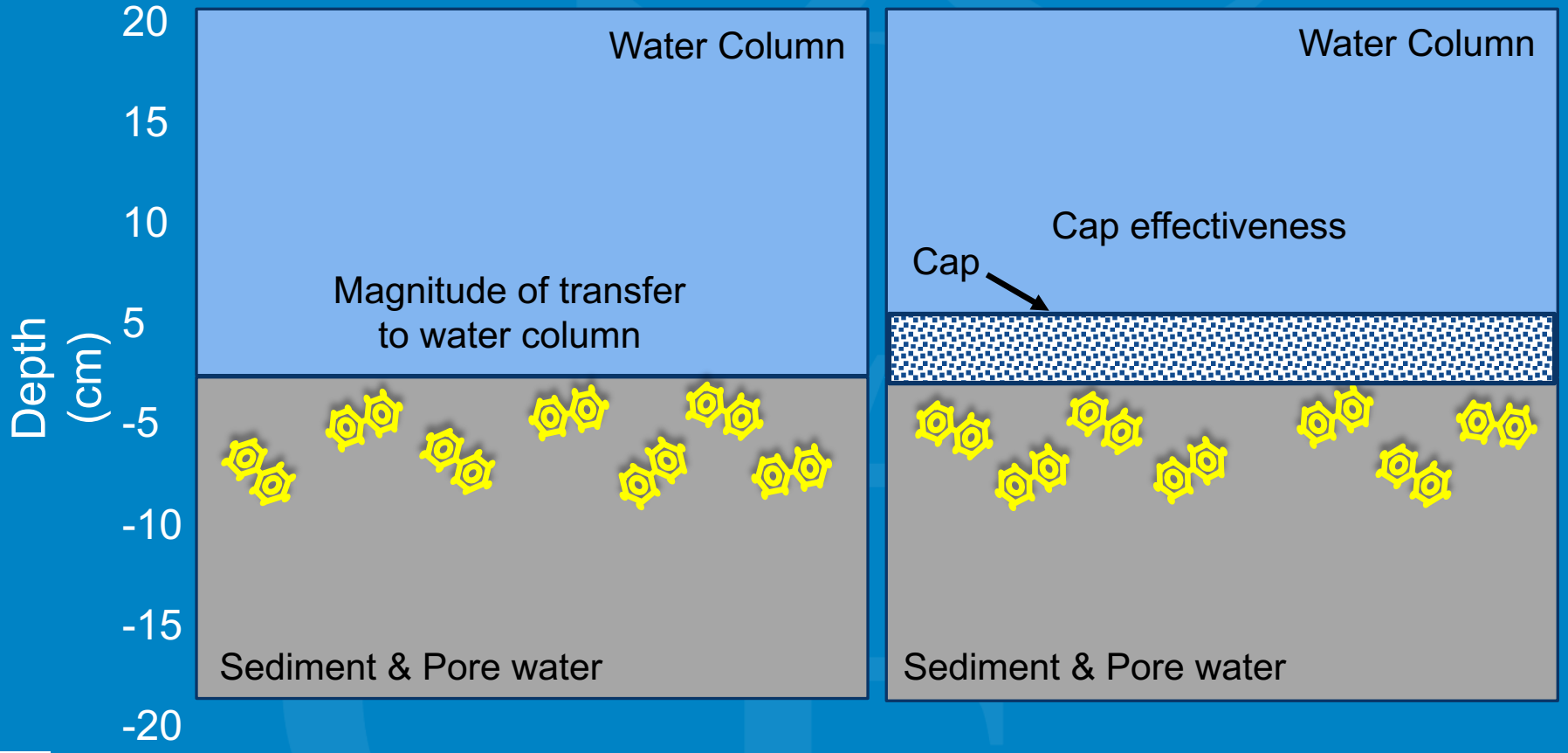


- New Bedford Harbor Superfund Site (New Bedford, MA, USA)
- Sediments contaminated with elevated concentrations of PCBs
- Water column biomonitoring with blue mussels since early 1990s at three stations
- In 2014, started assessing use of passive sampling
  - Parallel deployments for three years

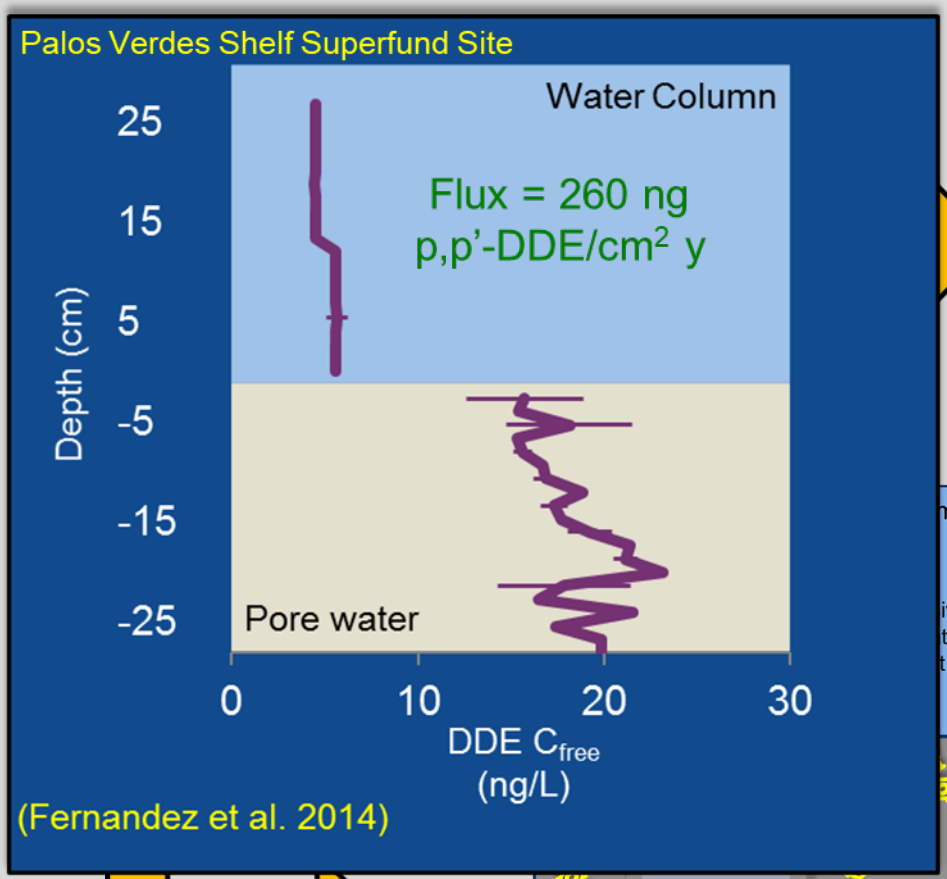
Evaluate Relationship & Provide Guidance to RPMs

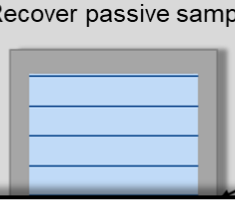
Applications in Long-term Monitoring

- Use of passive sampling to measure contaminant fluxes and capping-effectiveness in long-term monitoring



Applications in Long-term Monitoring





Superfund Sites:
Palos Verdes Shelf (Region 9)*
Lower Duwamish Waterway
(Region 10)
Grasse River (Region 2)
Dover Gas Light (Region 3)

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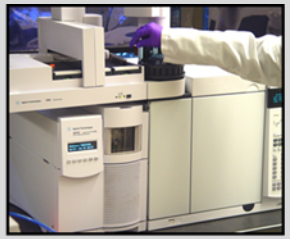

Extraction, GC/MS Analysis and
Data Interpretation