Results of monitoring for gasoline & gasoline-derived compounds in Lake Tahoe, 2009

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Part of Shorezone Water-Quality Monitoring & Blue Boat Program

Cooperative Study:

- **U.S. GEOLOGICAL SURVEY**
- **TAHOE REGIONAL PLANNING AGENCY**

TRPA In-Kind Contribution:

Boat Crew & staff

40 YEARS OF PROGRESS
TAHOE REGIONAL PLANNING AGENCY

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Outline:

- Background
- Project Objectives
- Compounds of Interest
- Historic Organics Sampling & significant Findings
- 2009 Sampling & Sites
- VOC Sampling Methods
- VOC Results
- PAH Sampling Methods
- PAH Results
- Plans for 2010

Background:

- Truckee River - 116 miles from Head water to terminal Pyramid Lake
- LT Basin – 509 sq mi – 2/3 Calif, 1/3 Nevada
- Lake size – 192 sq mi
- Watershed – 317 sq mi
- Elevation range 6,220–10,881
- Lake volume – 122 Million Acre-Feet
- Residence Time – 700 years

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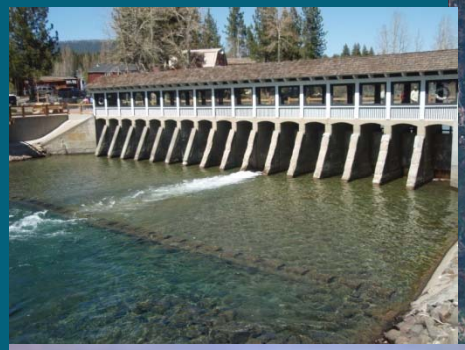
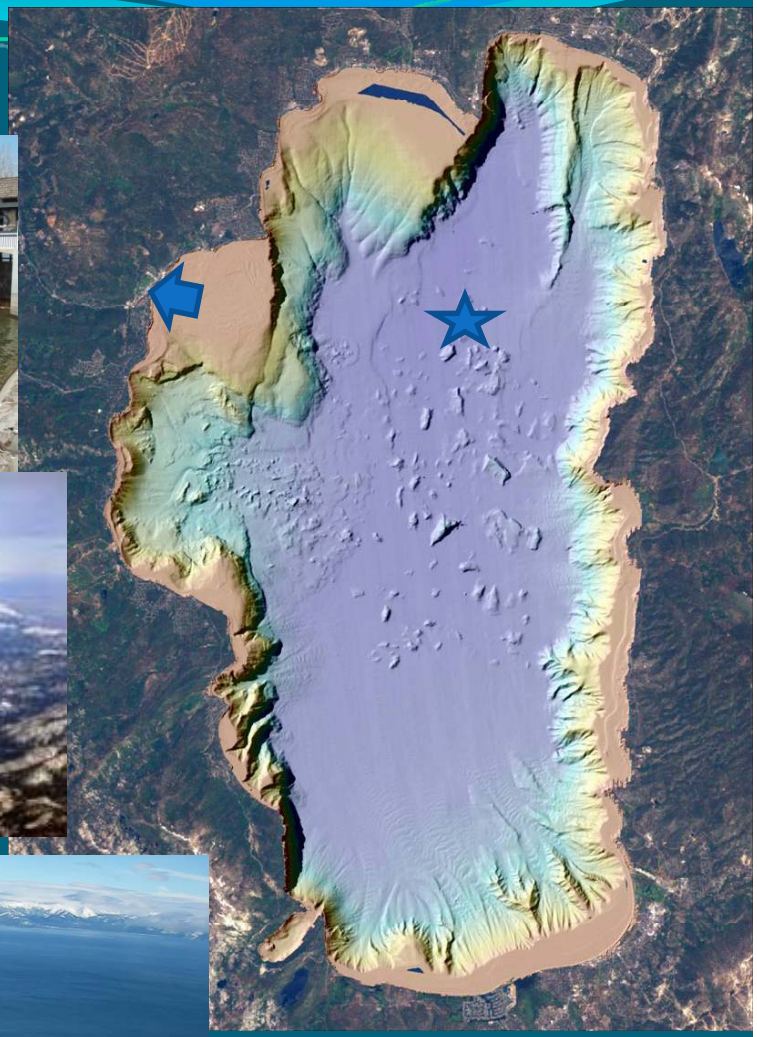
Background (cont)

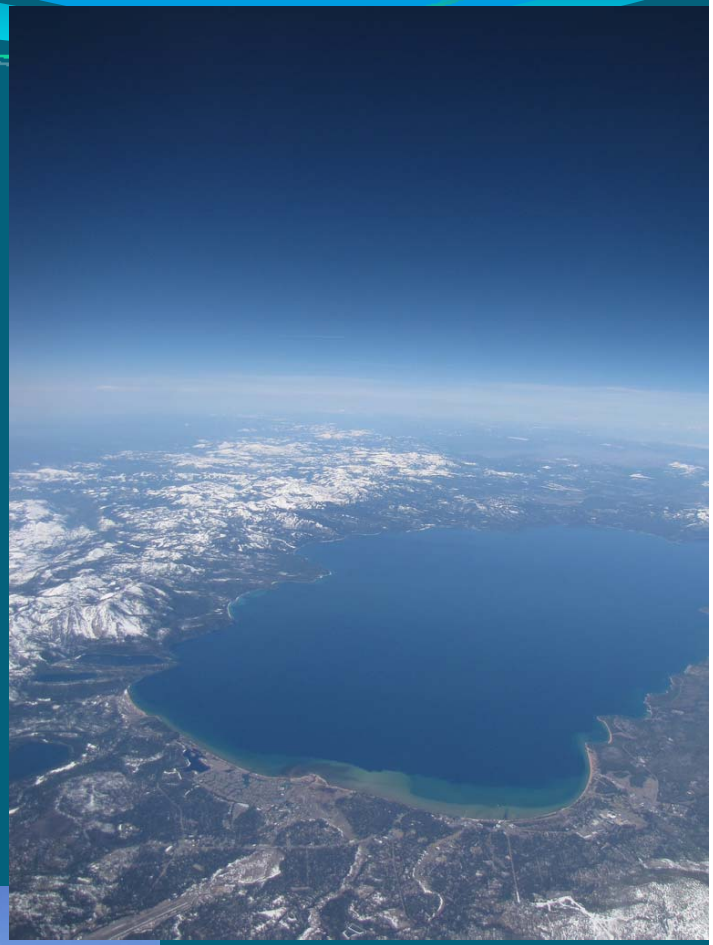
- Up 6 feet controlled by dam, 745,000 acre feet useable
- Max Depth 1,645 ft, ave depth 1,000 ft
- Most of the precipitation comes as snow Dec-March

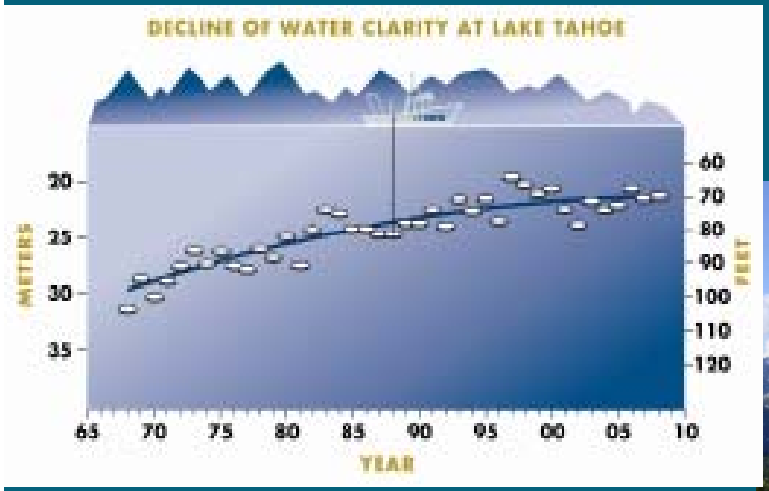


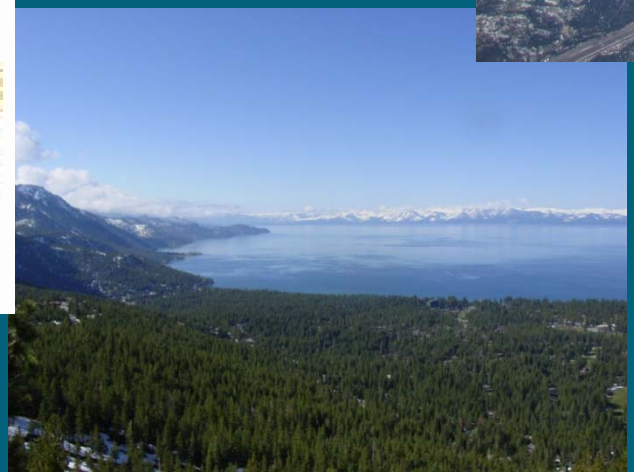


Why?

- Outstanding Natural Resource Water
- Highest Alpine Lake of it size
- Deep blue waters
- Clarity issues







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Project Objectives:

1. Develop baseline conditions for gasoline-derived compounds, hydrocarbons (VOCs) and polycyclic aromatic hydrocarbons (PAHs)
2. Understand changes in water quality over time
3. Determine if mitigation measures are effective or need refinement.

Gasoline Compounds of Interest:

Hydrocarbons (VOCs):

- **Gasoline Components:**

  BTEX- Benzene, Toluene, Ethylbenzene, & Xylene

  Note Toluene – used as surrogate

- **Gasoline Oxygenates:**

  MTBE, ETBE, TAME, DIPE

Polycyclic Aromatic Hydrocarbons (PAH's):

- **Flouranthene**
- **Pyrene**
- **Naphthalene**
- **others**

Previous Sampling for Organics:

Lake Tahoe

- 1999-2003
- 2005-07

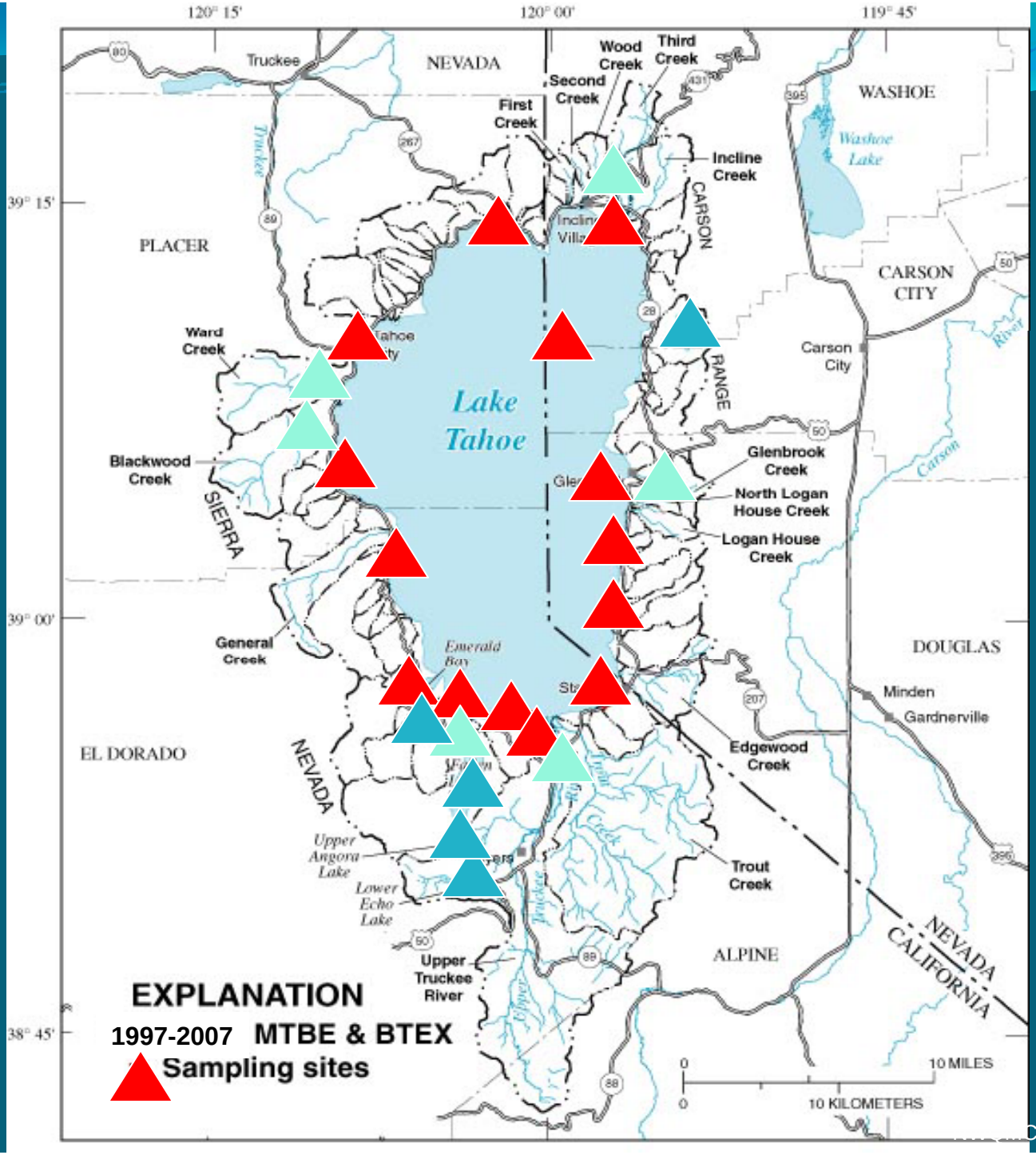
Streams:

- 1998
- 2002-03

Other Lakes:

- 1997-98

Sites: 1997-2007



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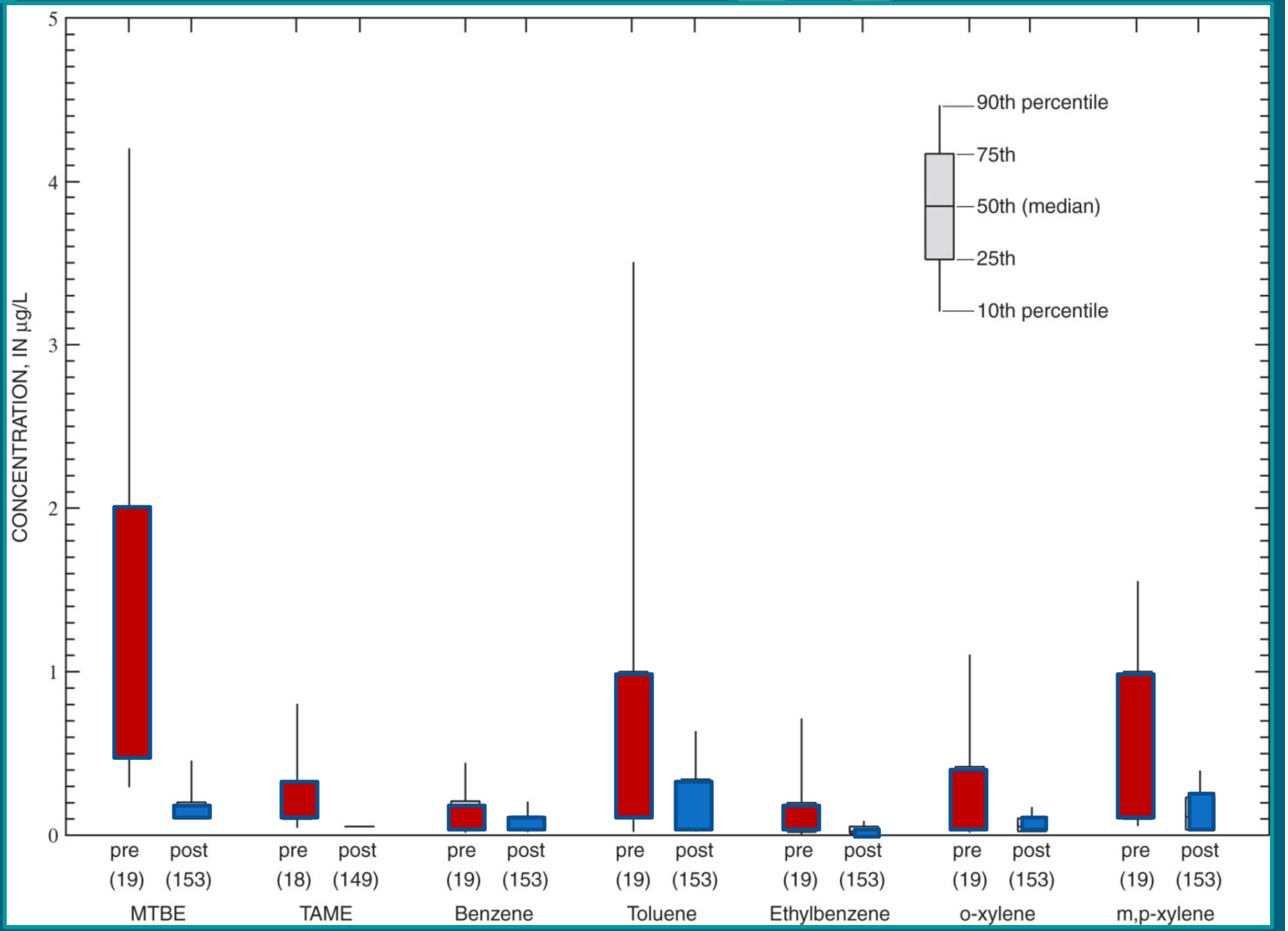
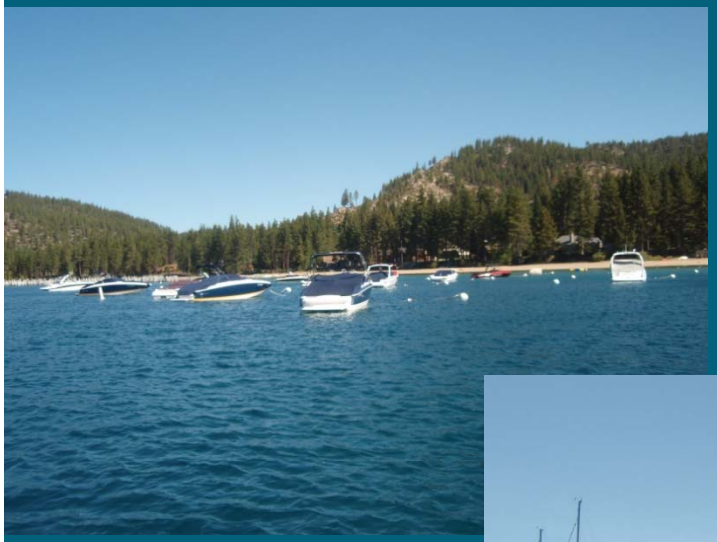
Previous Significant Findings:

The 1999 ban on carbureted 2-Stroke Engines has greatly decreased gasoline compounds in Lake Tahoe

Pre/Post 2-Stroke Ban:



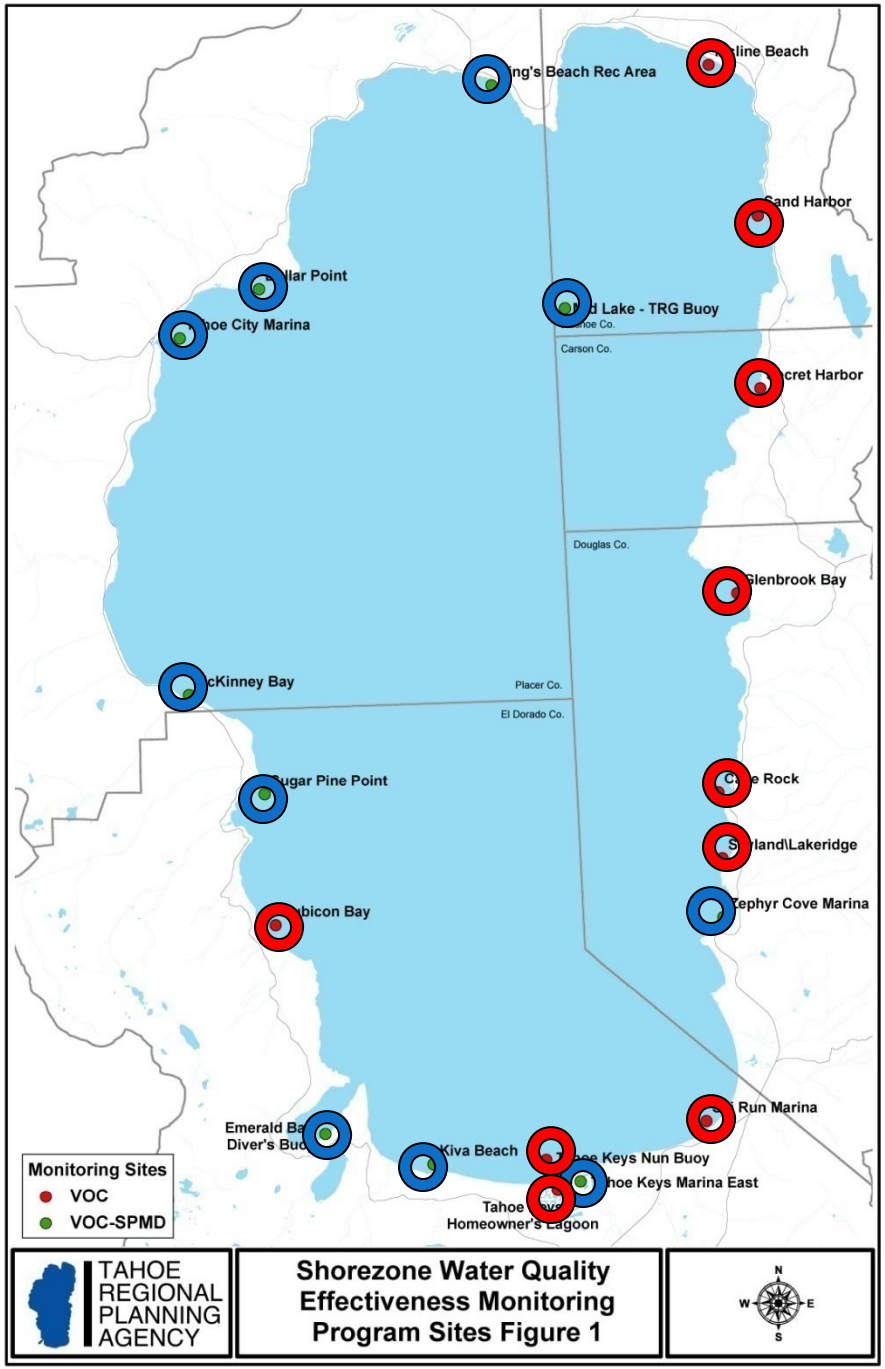
New Sites:



Added more sites in 2009 in areas of potential new buoys & piers

Sites: 2009

- -VOC
- -SPMD & VOC



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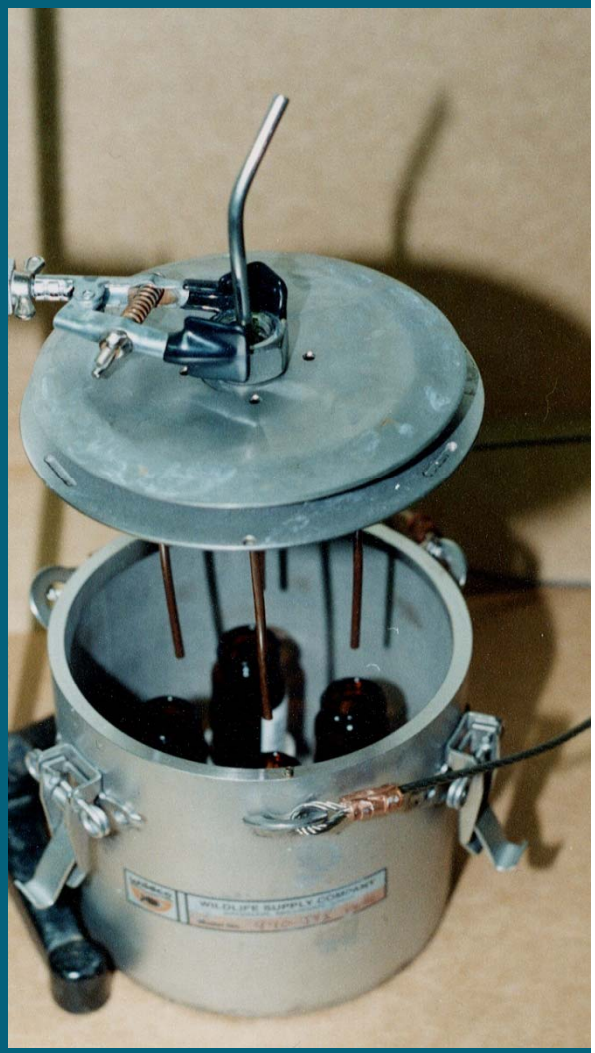
Lake Tahoe 2009 Sample periods

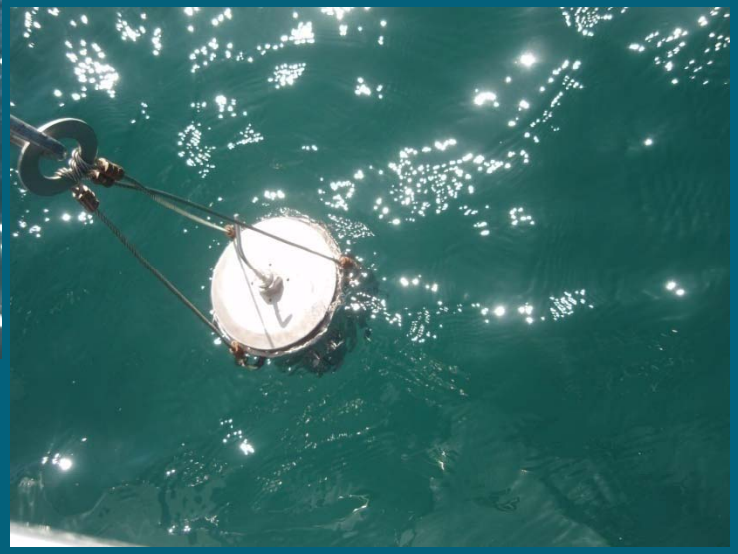
No. Time period - Boat Usage - Sample Type

1. Memorial Day - Light –VOC
2. Pre 4th of July - Medium – SPMDs In & VOC
3. Post 4th of July - Heavy – VOC
4. Early August - Heavy – SPMD Out & VOC
5. Mid August - Heavy – VOC
6. Labor Day - Heavy - VOC
7. Early Fall – Light - VOC

Clean VOC Sampler Load with 4 vials:



VOC Sampler lowered in Lake to 3m, until full

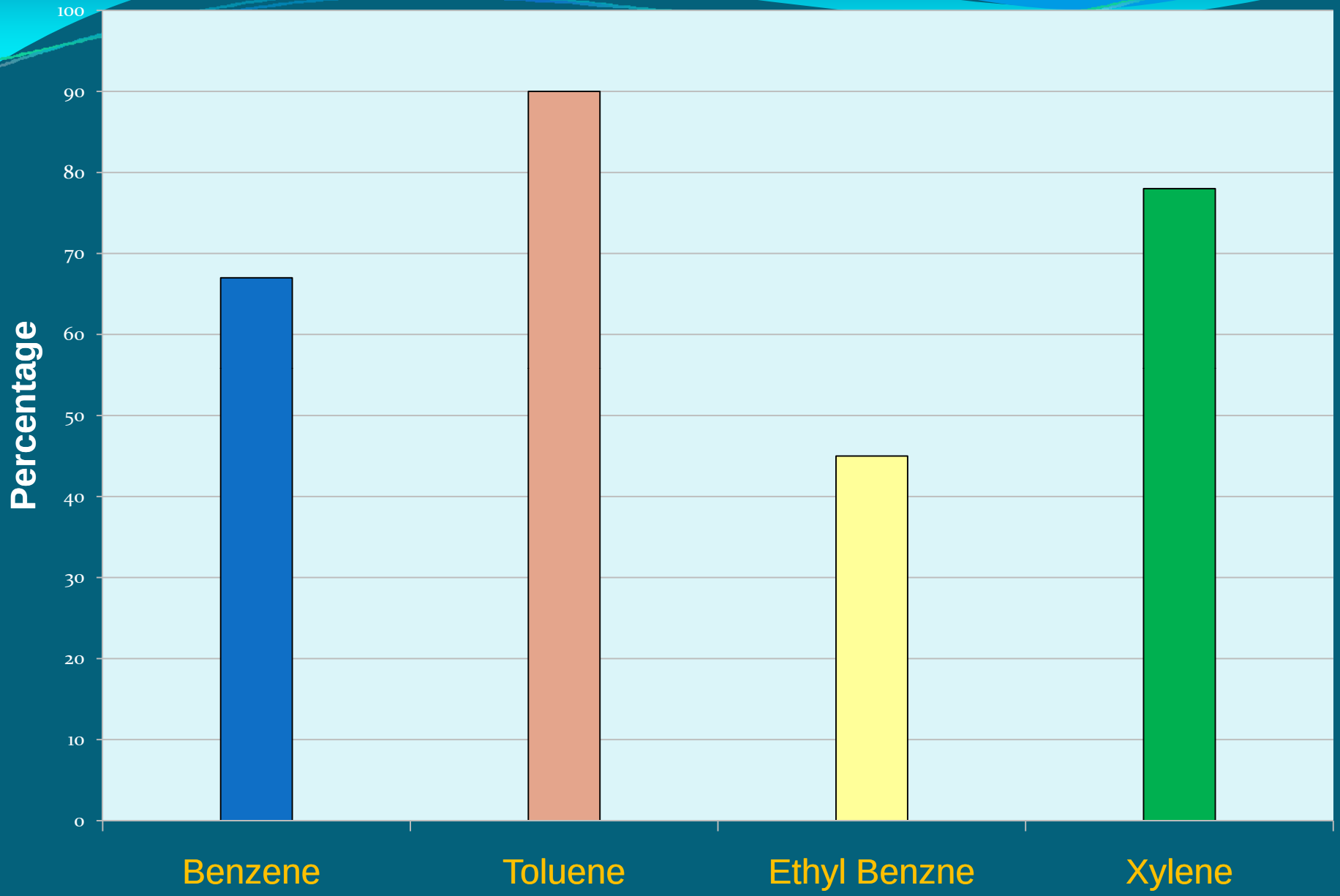


VOC Samples removed, acidified & sent to USGS NWQL

2009 Results:

- **Detections were low** for the most part.
- **VOC constituents detected**: BTEX, MTBE, & acetone. BTEX were detected at all 20 sites, except ethyl- benzene at Mid-Lake
- **Toluene detected in 90%** of the samples & ranged from <0.01 to 0.30 ug/L.
- **MTBE was detected** in only 2 samples and ranged from 0.03 to 0.15 ug/L.

Lake Tahoe Percent BTEX Detections, 2009



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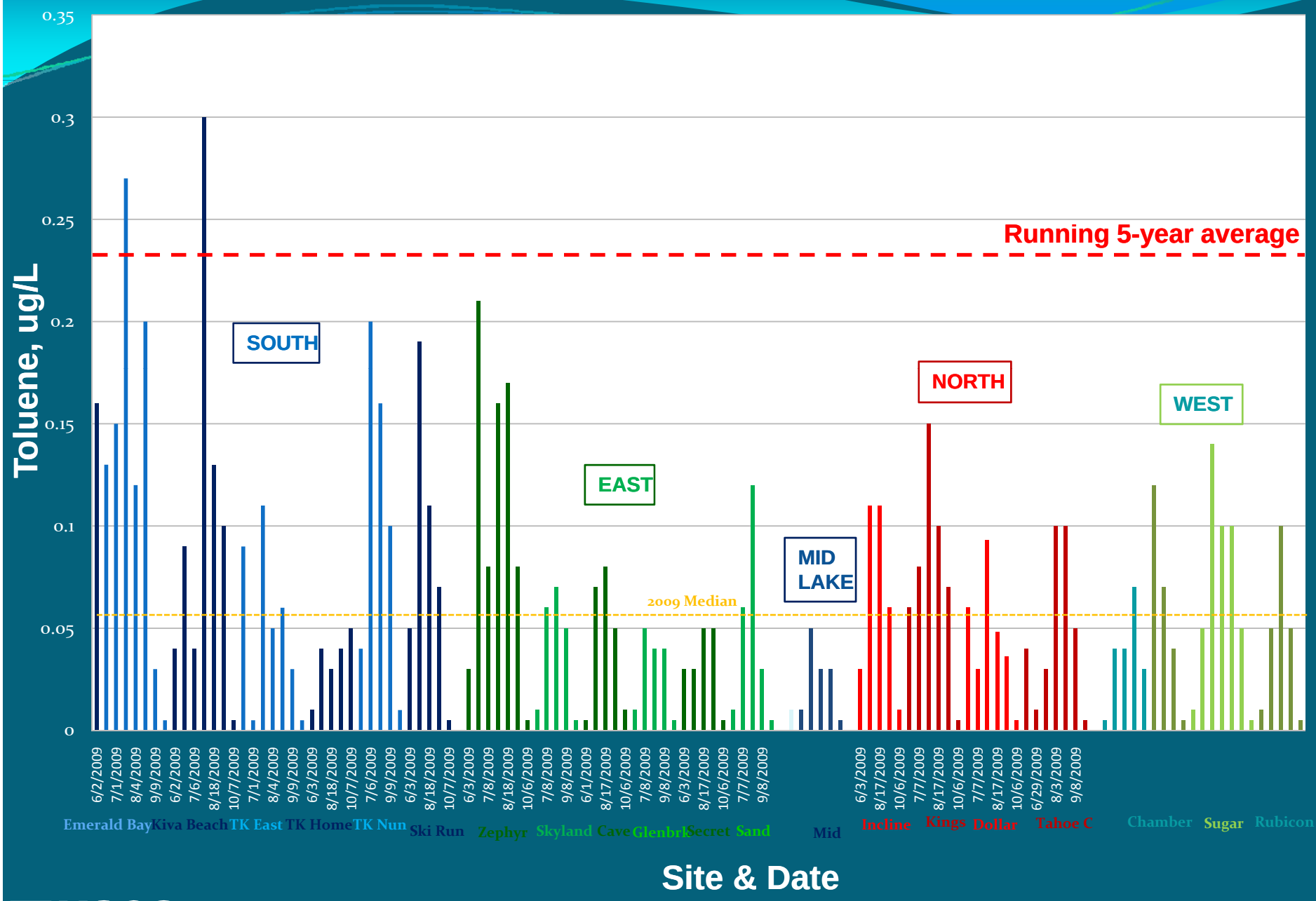
Lake Tahoe Toluene Concentrations, 2009



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2009 Results (cont):

- South Sites had highest percentage (78%) of detections, maximum level of detections and highest medians.
- Reference site; Mid-Lake; low
- Higher detections in Early-August & mid-August sample periods
- Lower detections in May & October sample periods
- Trends continue downward since 1999

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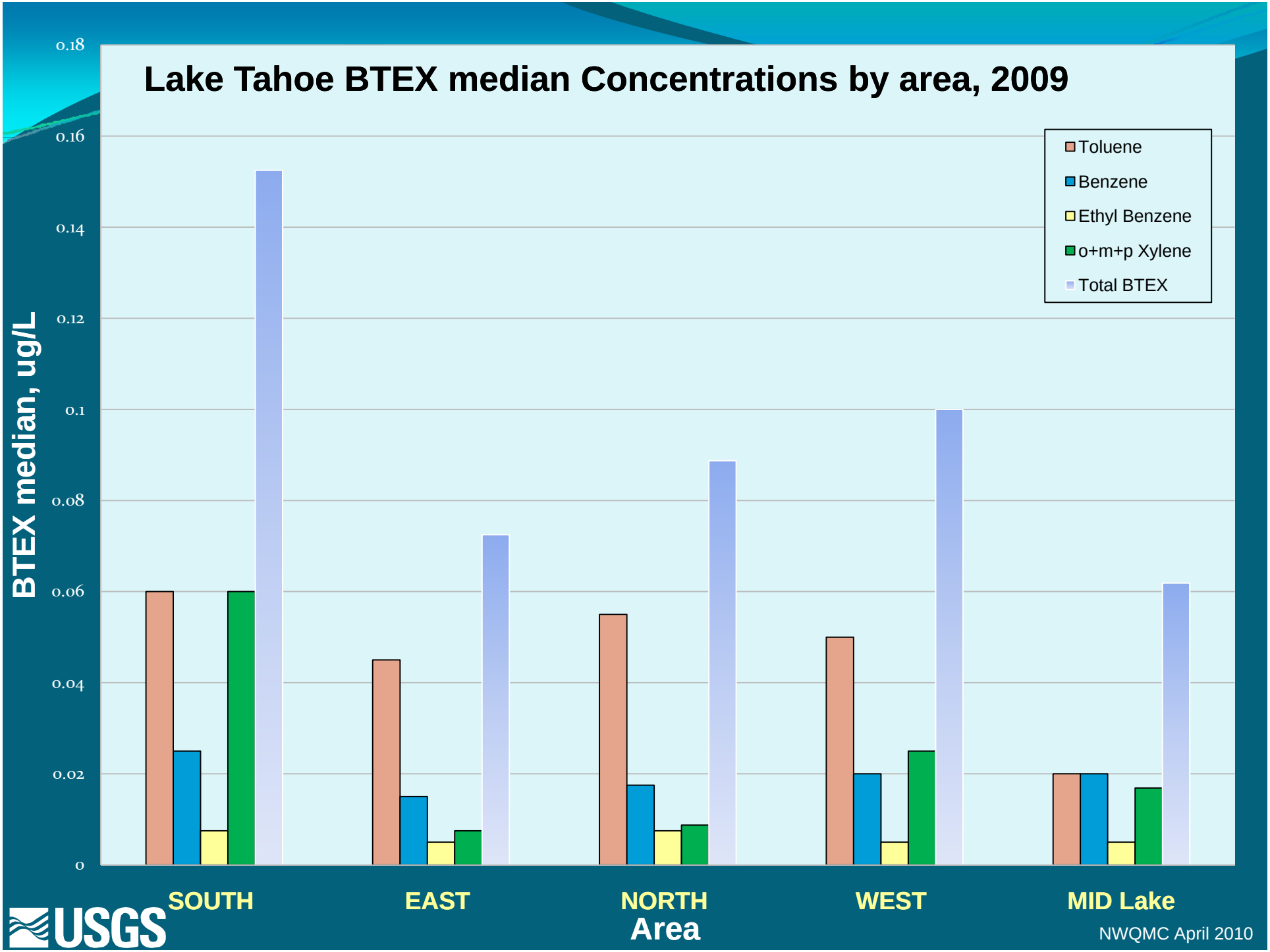
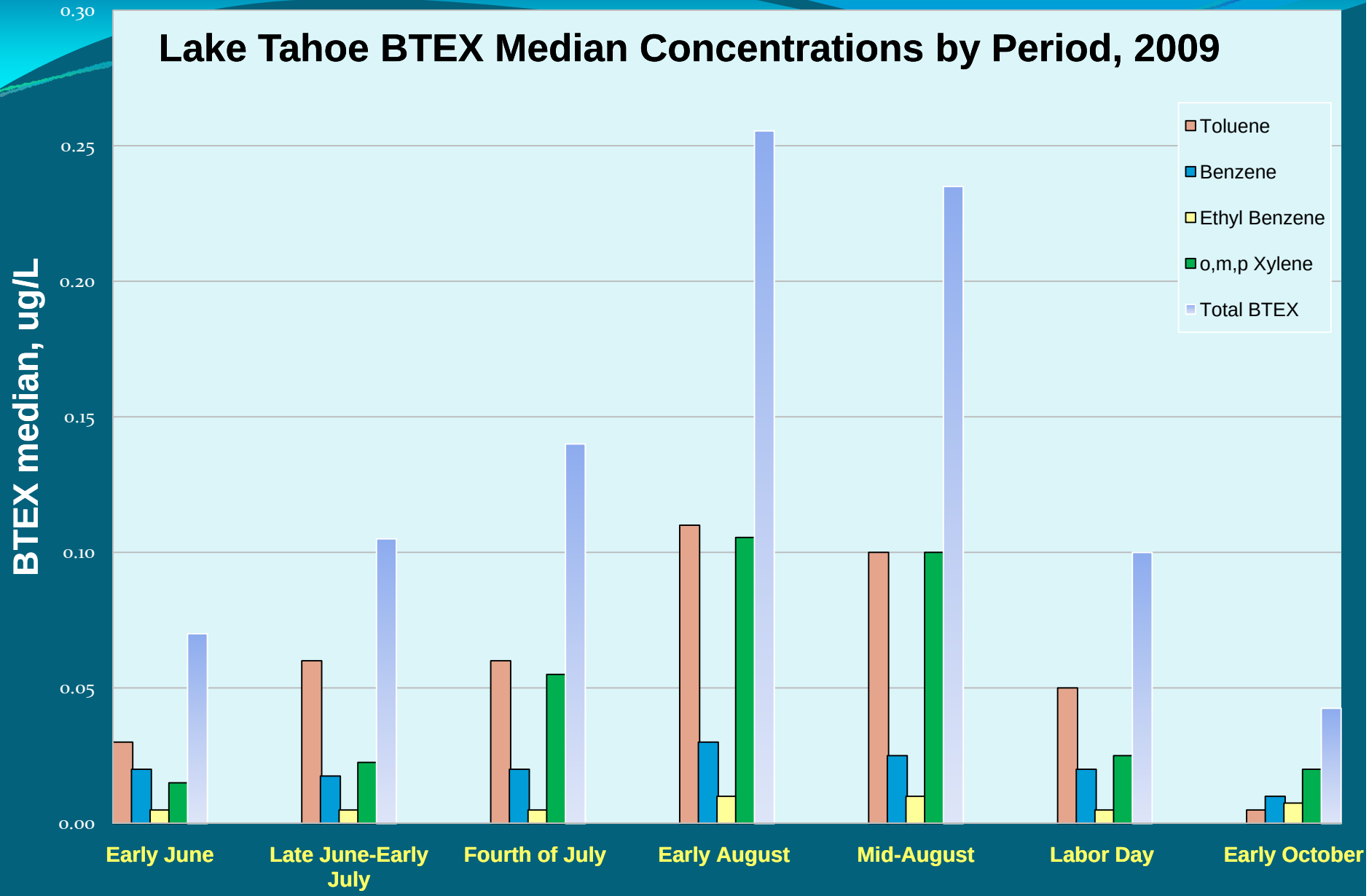

Lake Tahoe BTEX median Concentrations by area, 2009
BTEX median, ug/L
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Toluene
Benzene
Ethyl Benzene
o+m+p Xylene
Total BTEX
SOUTH
EAST
NORTH
WEST
MID Lake
Area
USGS
NWQMC April 2010

Lake Tahoe BTEX Median Concentrations by Period, 2009



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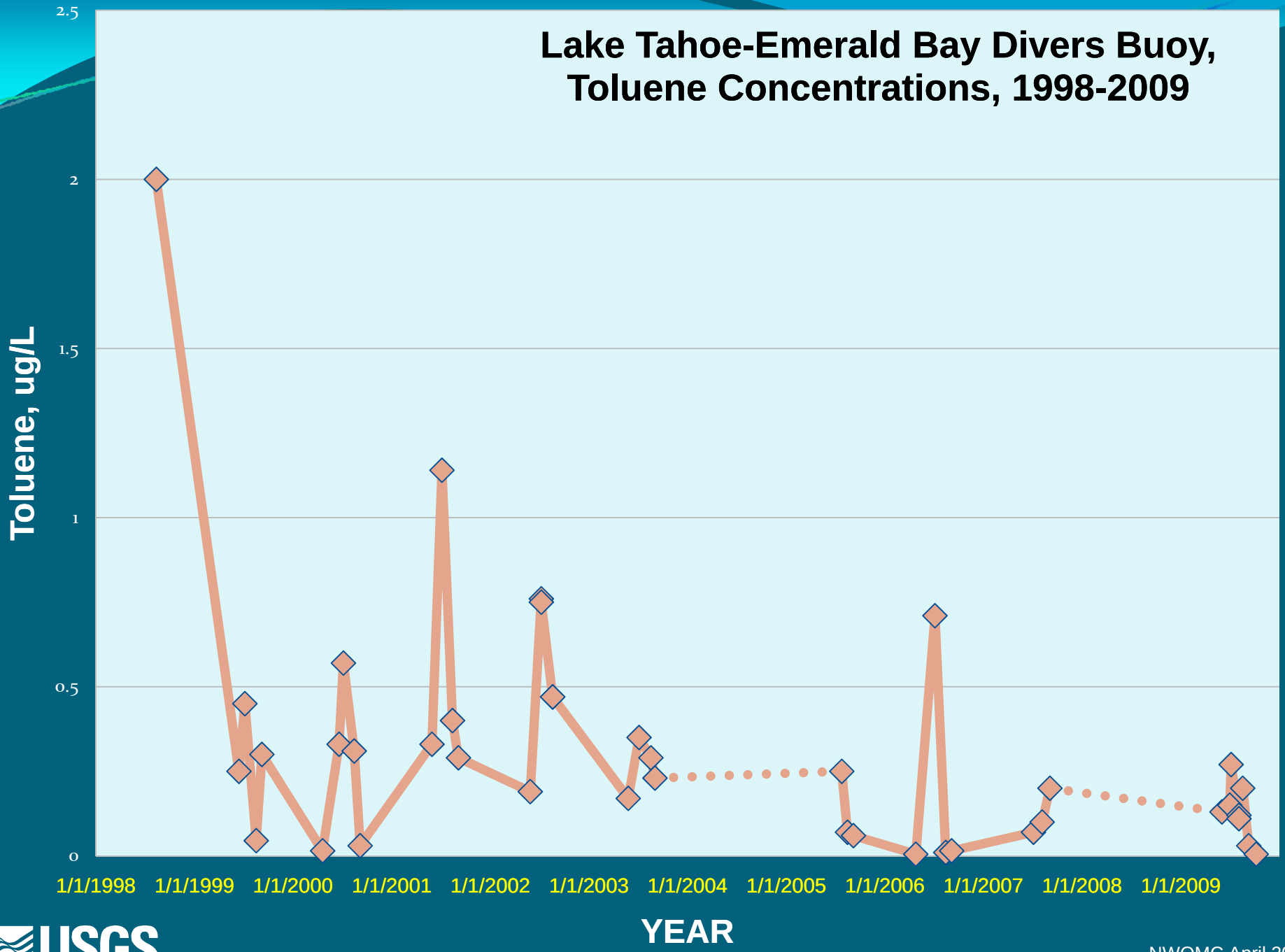
NWQMC April 2010



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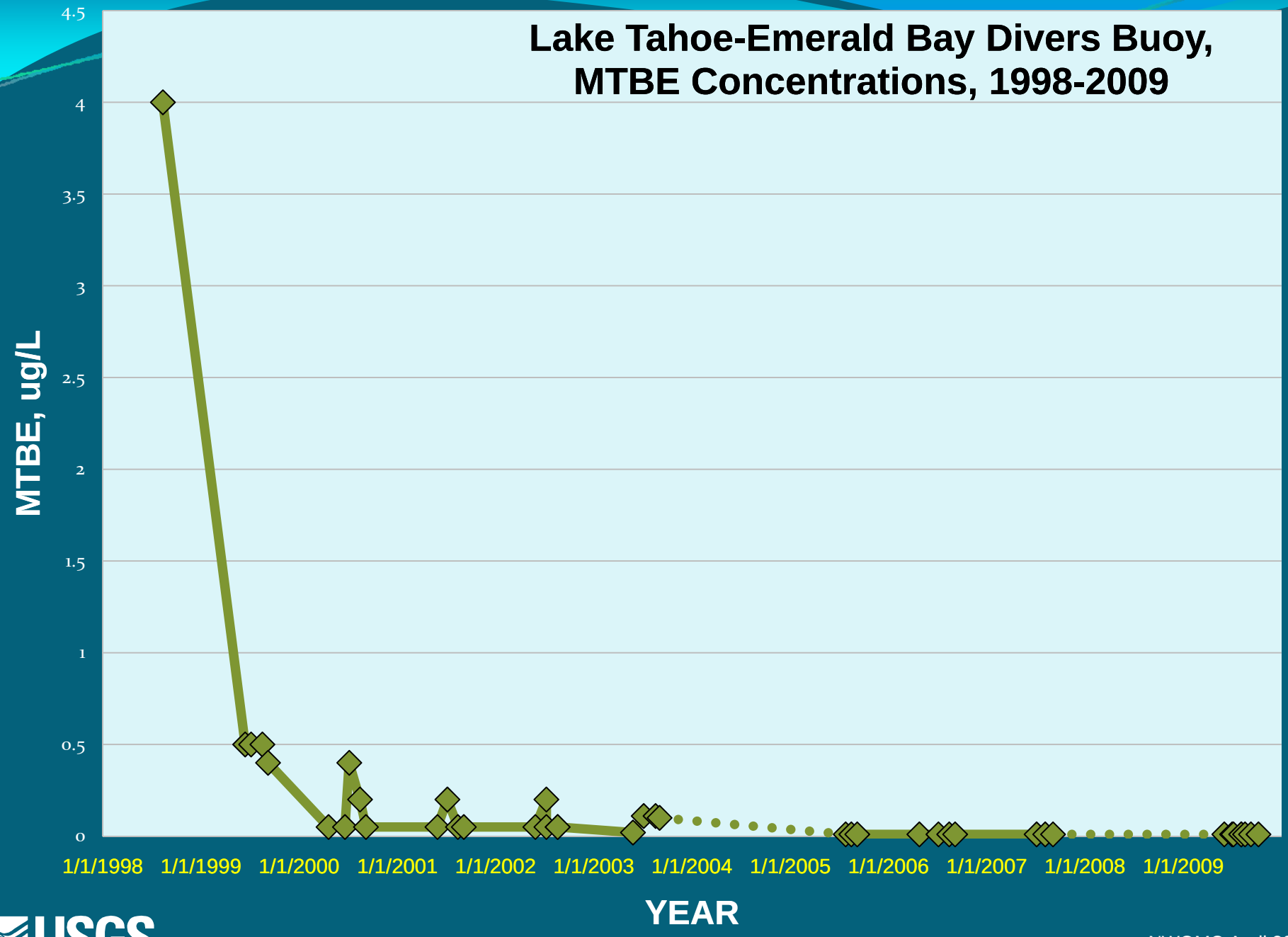
NWQMC April 2010


Lake Tahoe-Emerald Bay Divers Buoy, MTBE Concentrations, 1998-2009
MTBE, ug/L
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1/1/1998
1/1/1999
1/1/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
YEAR

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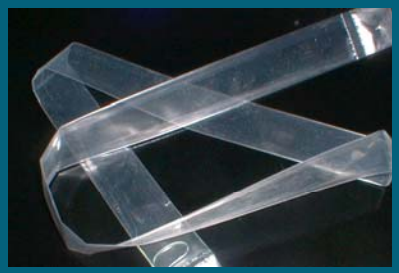
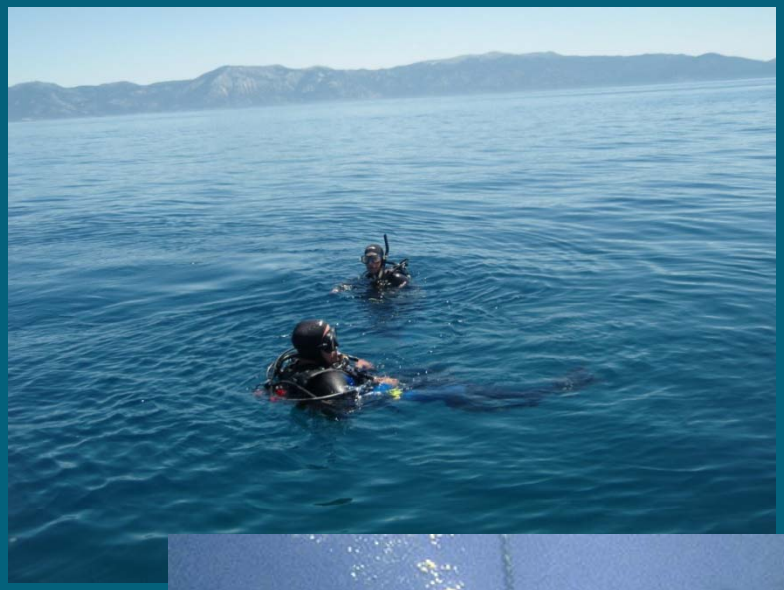
PAHs passively sampled using SPMDs - deployed & secured for ~30 days

SPMD: 3 Polyethylene Layflat Films

With Lipid

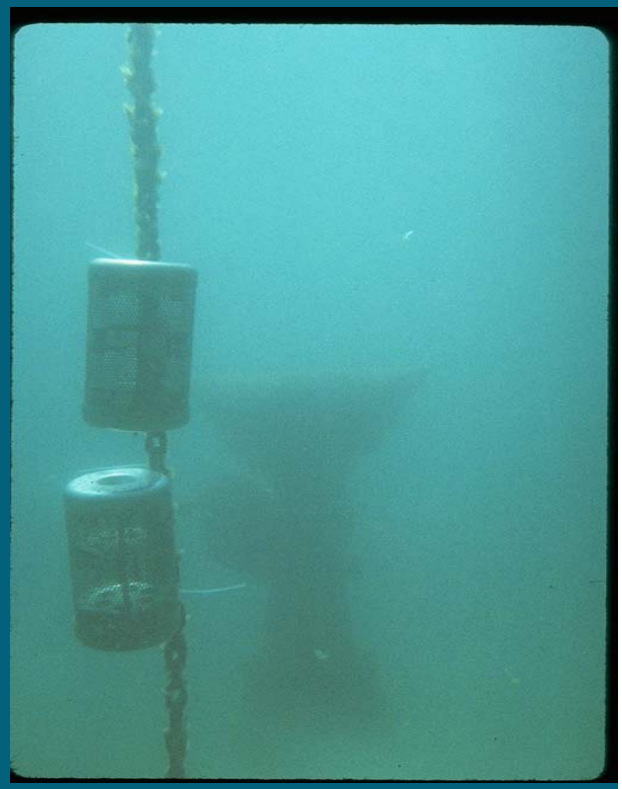
Triolein layer



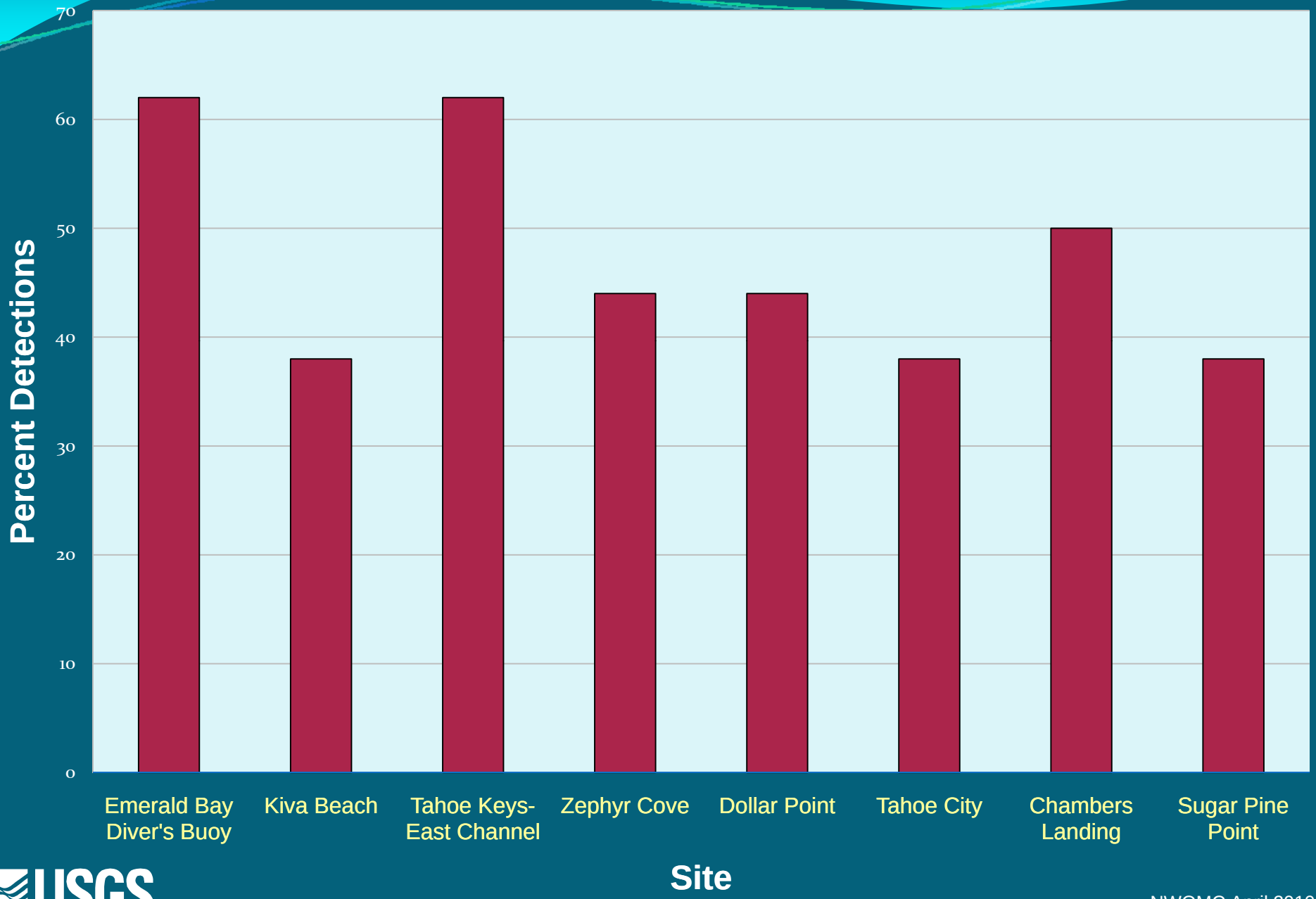


SPMD Deployment Problems

- due to unusually large waves on July 7
  - 3 - In stayed in place, OK
  - 5 – Broke & fell to bottom, OK
  - 1 – Broke & washed up on beach, not analyzed
  - 1 – Broke, fell & Lost



Lake Tahoe Percent PAH Detections by Sampling Site, 2009



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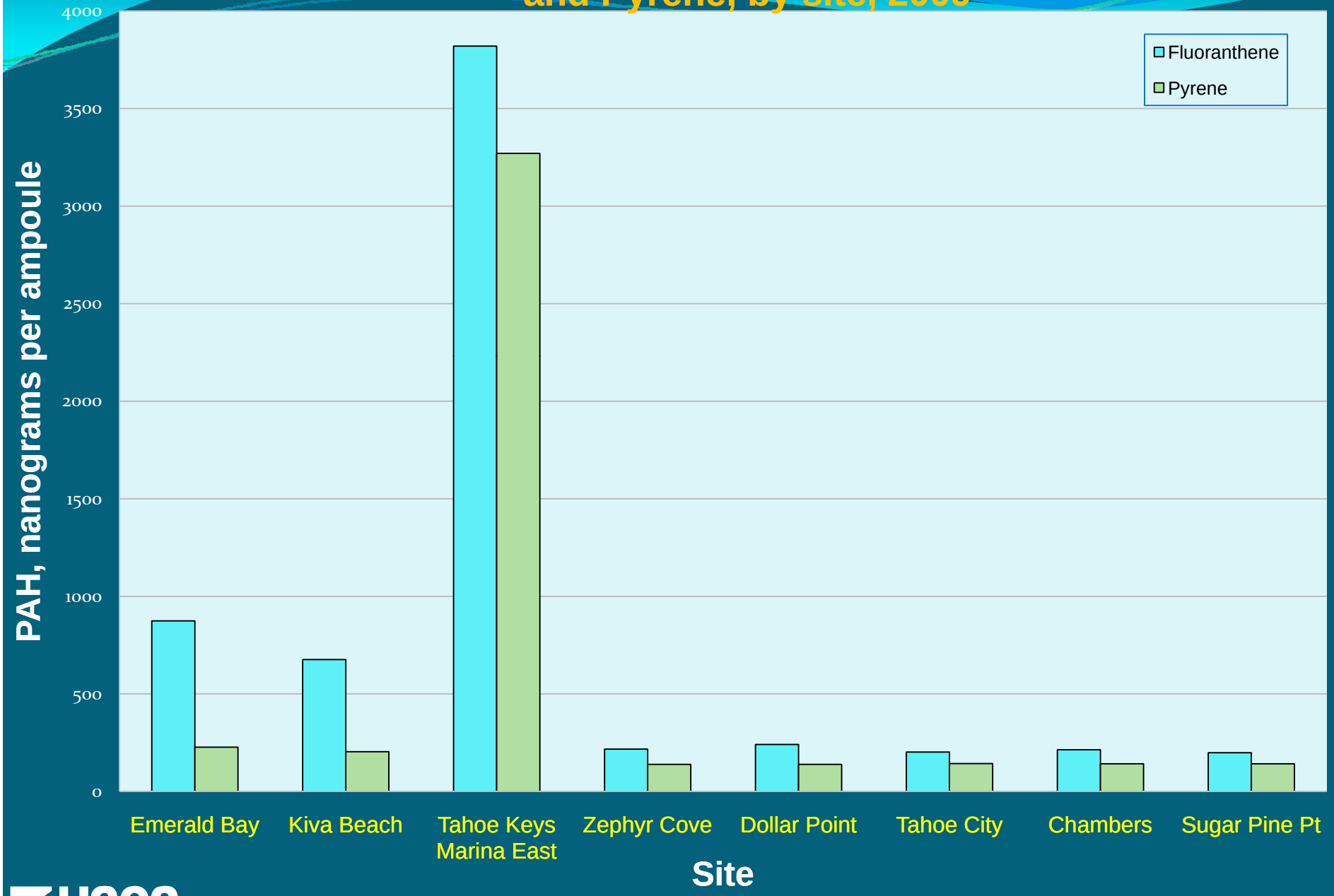
NWQMC April 2010

Lake Tahoe Results for Key PAH constituents, Fluoranthene and Pyrene, by site, 2009



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SPMD-PAH Results:

- Results possibly compromised because 6 broke loose and settled to bottom
- 13 PAH's detected – highest number of detections for, Acenaphthylene, Fluorene, Fluoranthene, Naphthalene, Phenanthrene & Pyrene
- Highest percent detections were at Tahoe Keys & Emerald Bay
- For Tahoe Keys; Fluoranthene & Pyrene were highest

Plans for 2010:

- **Begin VOC sampling in early May 2010 at same sampling design as 2009**
- **Expand SPMD deployments to 2 periods, 5 in Spring (before boating) and 10 again in mid-Summer (during heavy boating period) - both with more secure attachment.**

Any Questions?