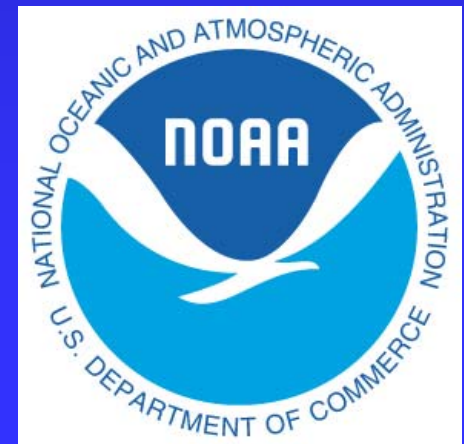
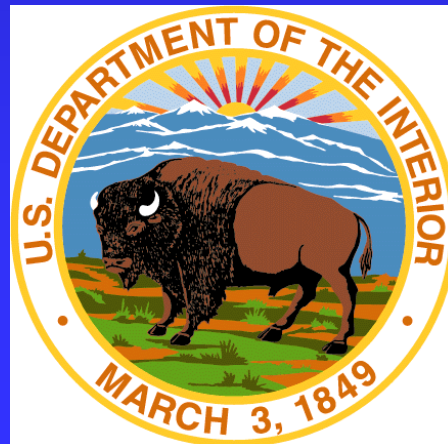


Hudson River Natural Resource Damages Assessment Summary 2006

New York State Department of Environmental Conservation

United States Department of the Interior

National Oceanic & Atmospheric Administration



Upper and Lower Hudson River



Terms and Concepts

Trustee Goals...

Quantify injuries

Restore to baseline

Compensate for losses

Terms and Concepts

CERCLA (Superfund)

Comprehensive Environmental Response,
Compensation and Liability Act

New York State common law

NRDA Process

- Preassessment
- Injury Assessment
- Damages Determination
- Restoration Planning
- Restoration

Injuries

- Water, sediment and soils
- Air
- Biological
- Recreation (lost use)
- Navigation (lost use)
- Cultural

Injuries

Exposure v. Injury

Interim v. Residual

Injuries

- *Per se* injury - exceeds government standards or criteria
- **Original science** - causes measurable harm

Injuries

for example:

NYSDOH Health Advisories
are a *per se* injury.

Injuries to Abiotic Resources ?

- Surface Water
- Groundwater
- Riverbottom sediments
- Floodplain soils

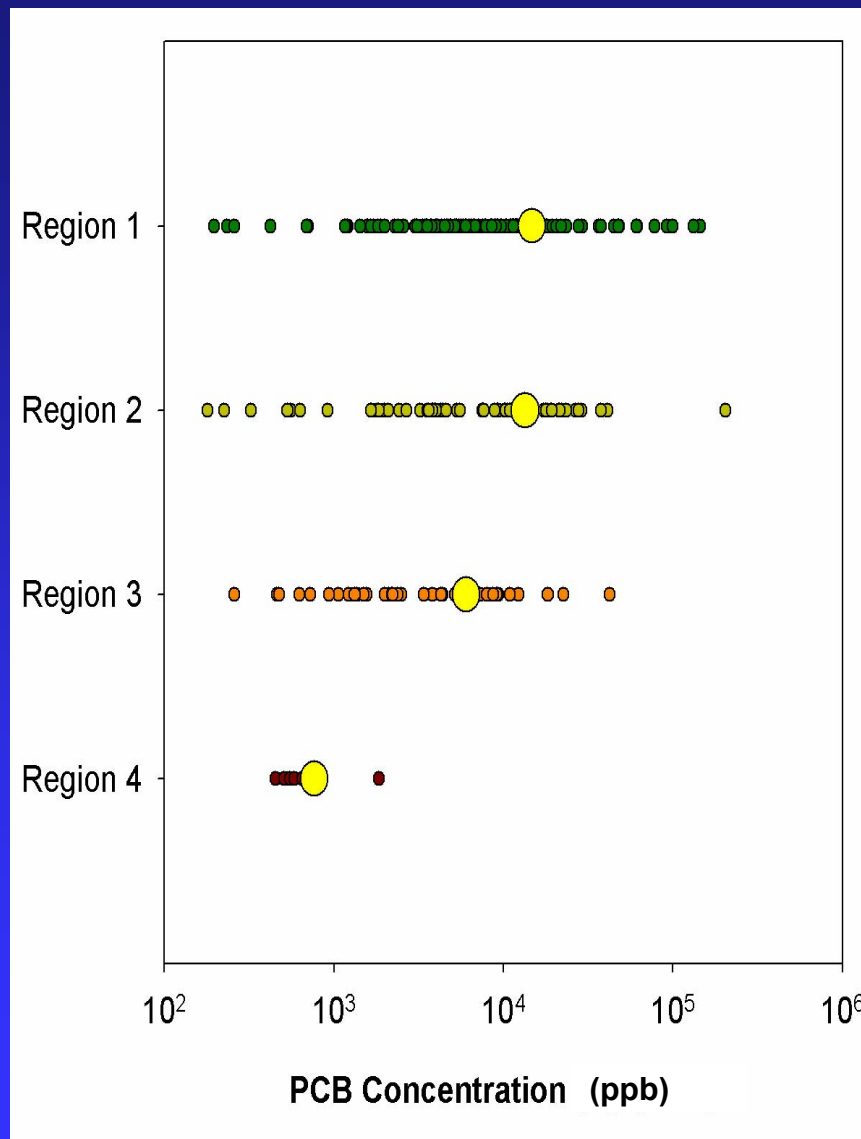
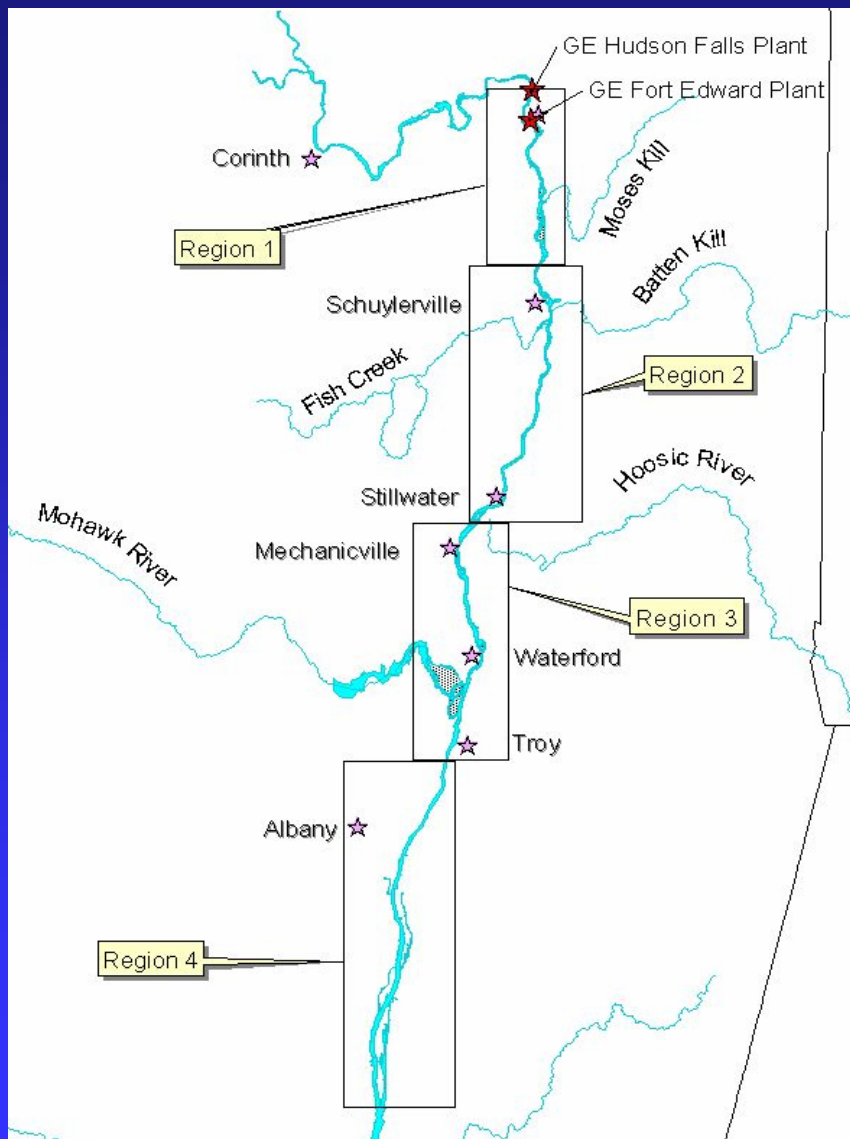
Water Quality

Water Quality Injuries ?

82.5 percent of 7,000 water samples collected by federal and NYS agencies and GE since 1970s detected PCBs

exceeded NYS and federal water quality criteria from Hudson Falls to the Battery

PCBs in Hudson River Sediment



Sediment PCB concentrations represent surficial (0-25 cm) sediment data from various studies compiled on NOAA's Query Manager (<http://response.restoration.noaa.gov>)



Sediment Feeders



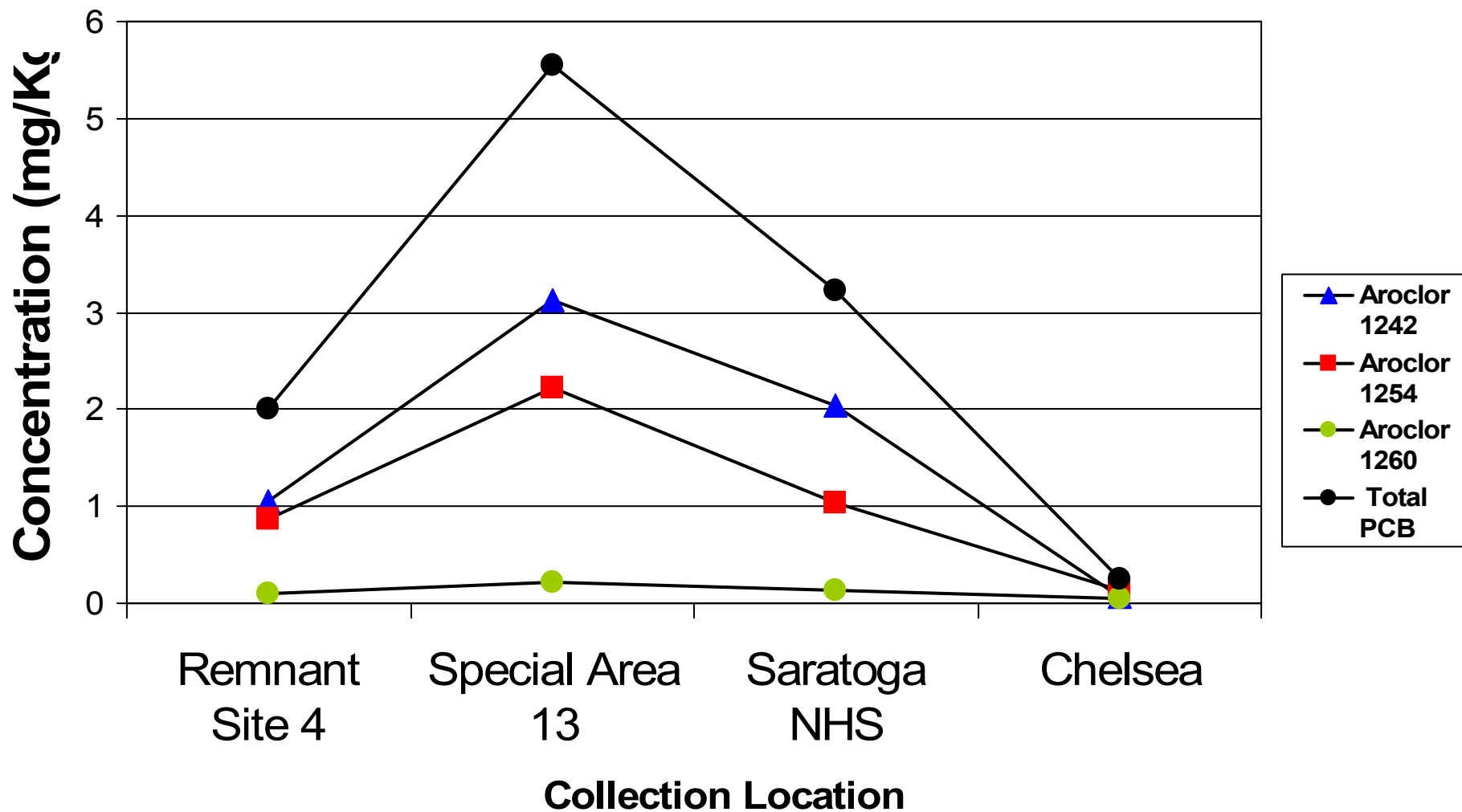
Sediment Dwellers

Aquatic Insects



PCB Aroclor Concentrations in Adult Aquatic Insects

Collected from the Hudson River



Injuries to Sediment Biota?

- Exposure in post-emergent aquatic insects ranged to 5.5 ppm
- Pathway to biota in floodplain and beyond
- Limited waterfowl samples

Floodplain Dwellers

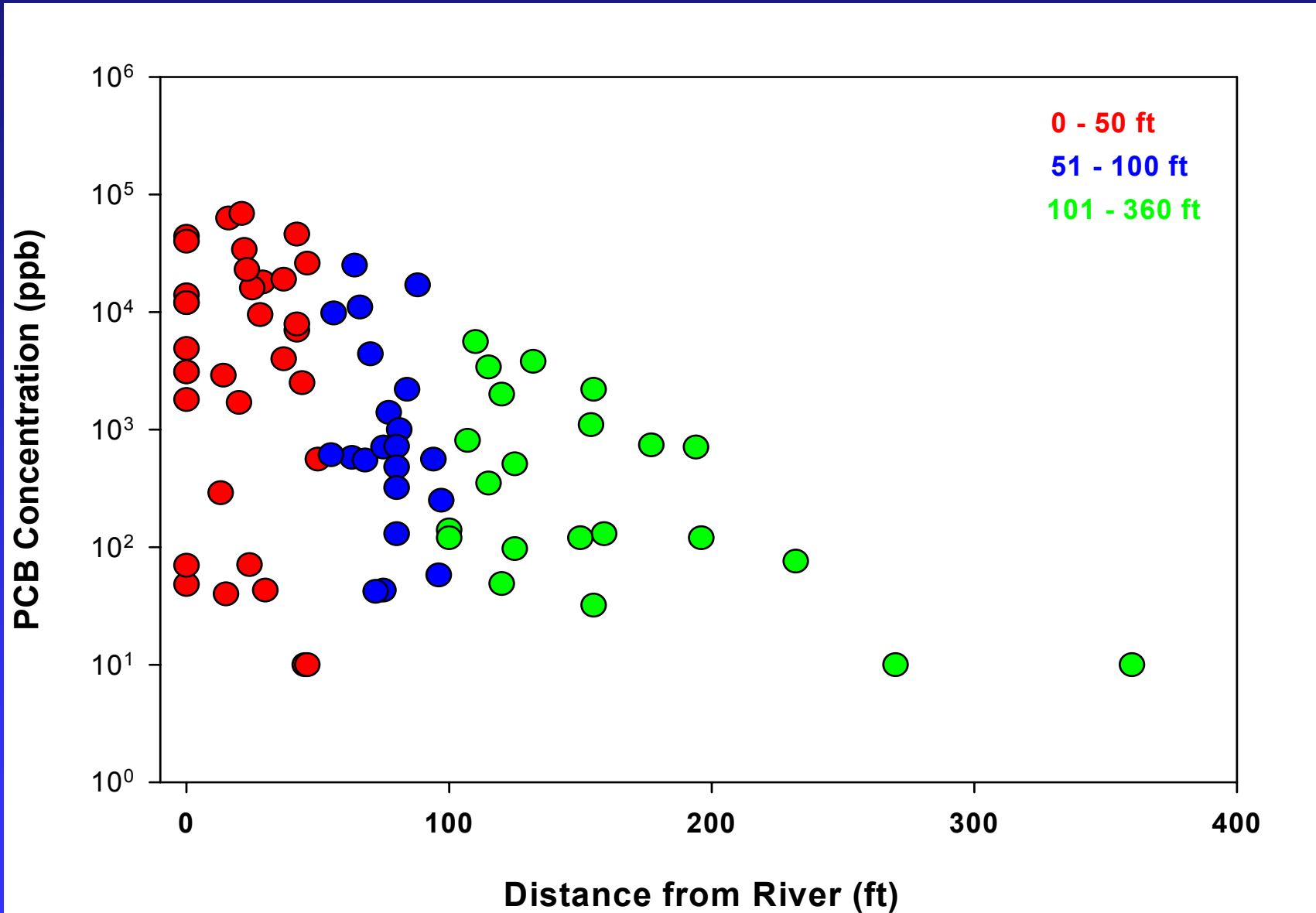


Floodplain & Related Studies

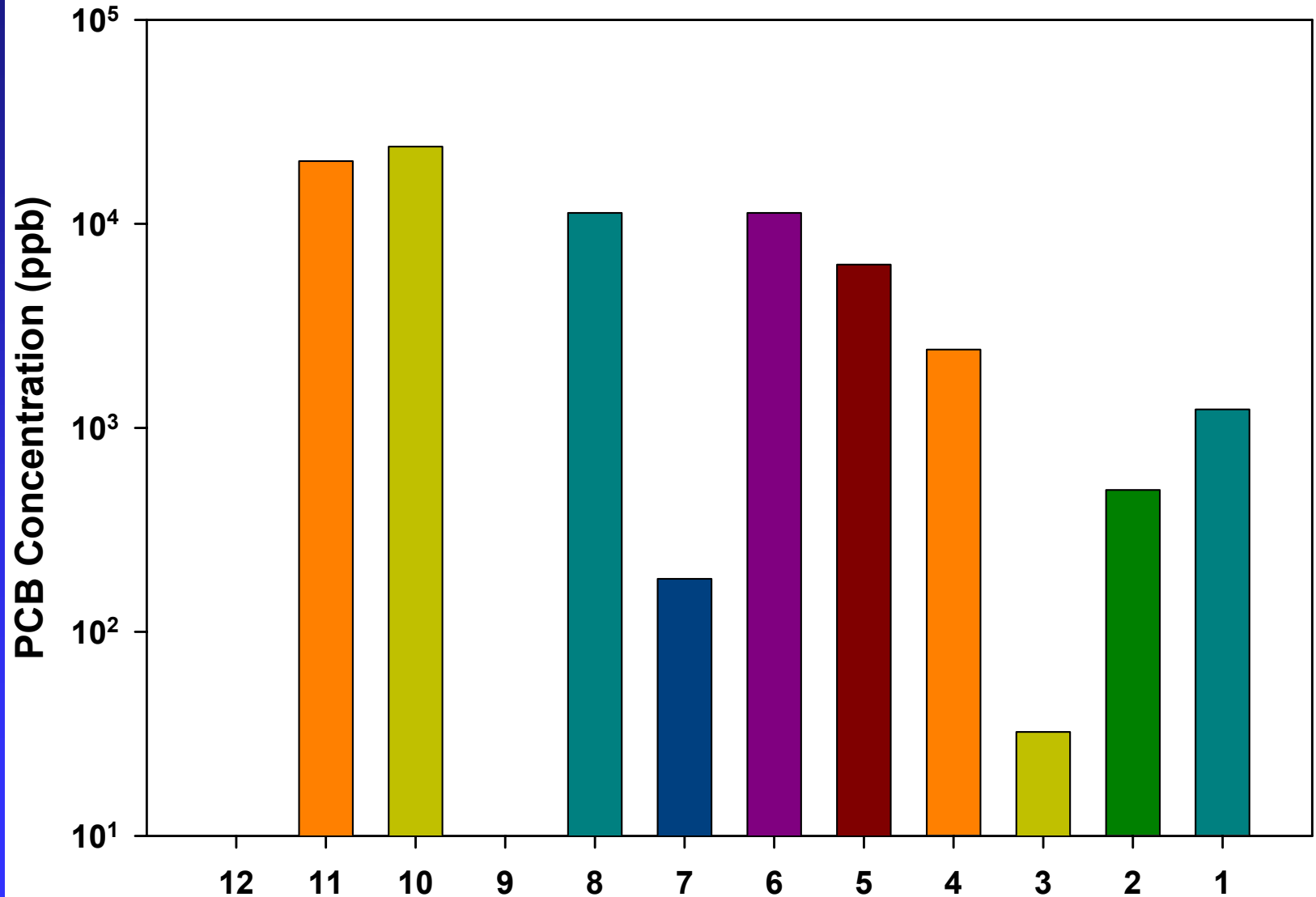
- 2000 Floodplain Soils, Shrews and Earthworms
- 2001 Small Mammals and Woodcock
- 2001 Little Brown Bats
- 2002 Peregrine Falcon Eggs
- 2002 Snapping Turtle Eggs
- 2002 Avian Eggs
- 2003 Screech Owl Eggs
- 2003 Bullfrog Tadpoles and Sediments
- 2004 Wood and Leopard Frog Breeding Habitat Survey (awaiting results)



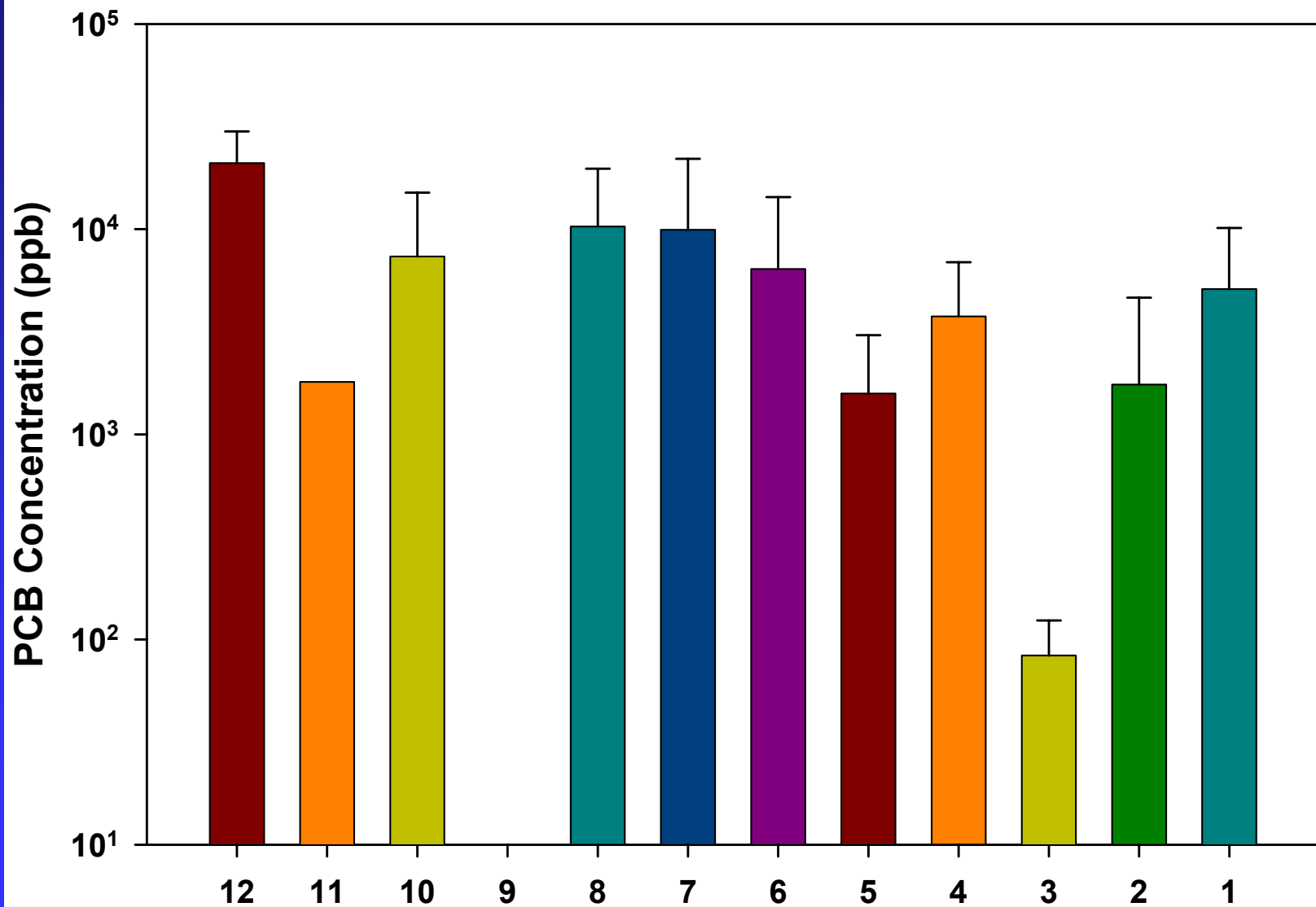
Soil PCBs v. distance from River



2000 Floodplain Earthworms



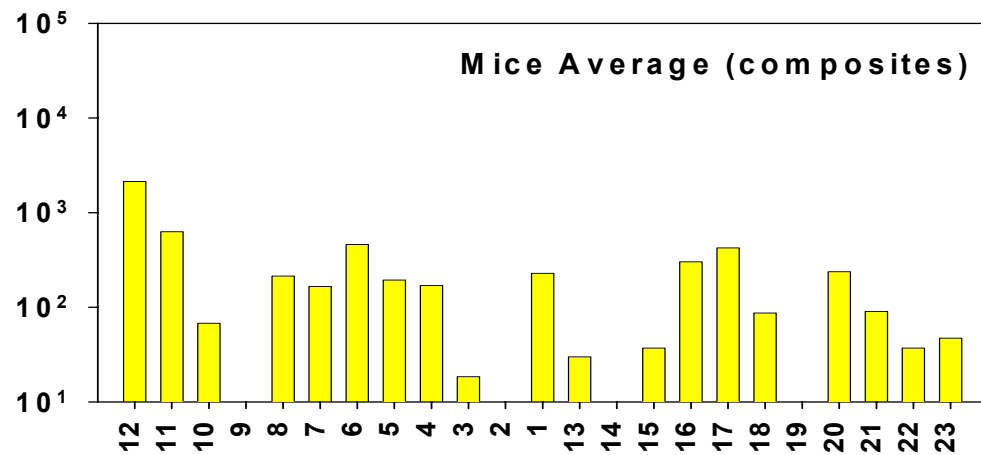
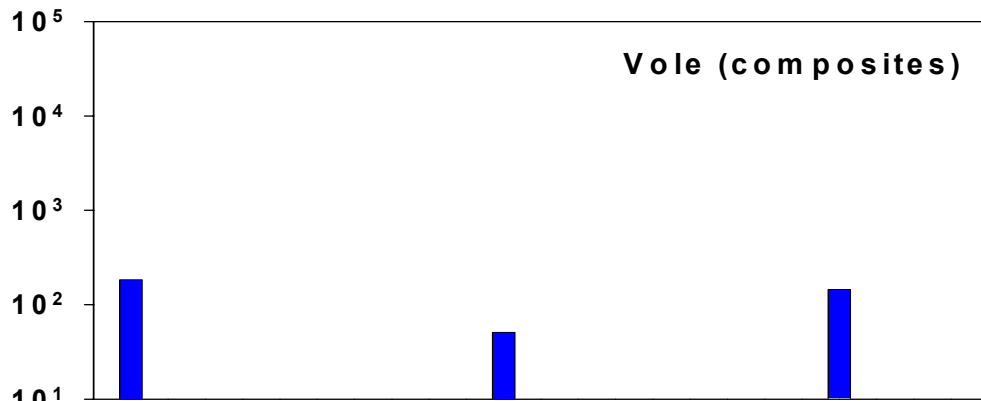
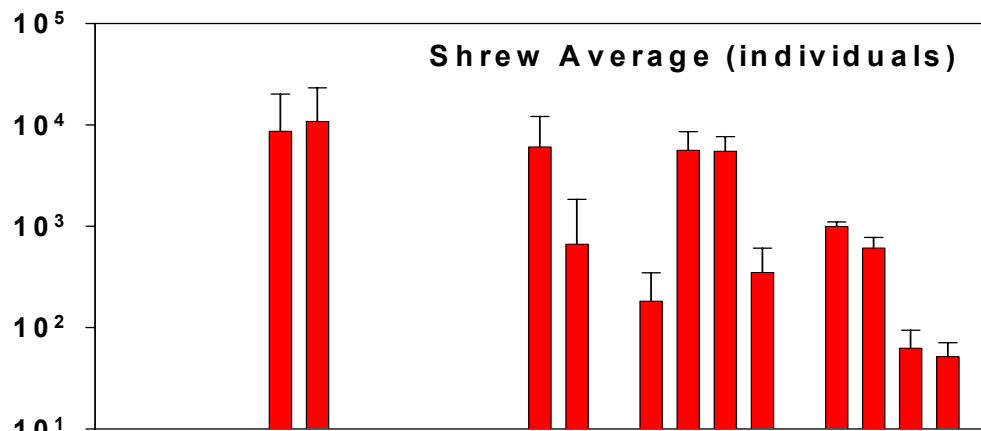
2000 Floodplain Shrews



2001 Small Mammals



PCB Concentration (ppb)



2001 Little Brown Bats

- Bats collected as part of NYSDEC study
- Saratoga National Park and two reference sites
- 31 bat brains (5 big brown, 26 little brown)
- Big brown: 32 – 640 ppb
- Little brown: 184 – 2400 ppb



2002 Avian Egg Exposure Study

- 11 species

- American Robin
- American Woodcock
- Belted Kingfisher
- Common Grackle
- Eastern Bluebird
- Eastern Phoebe
- Barn Swallow
- Red Winged Blackbird
- Spotted Sandpiper
- Eastern Screech Owl
- Northern Rough Winged Swallow



- 220 eggs collected; 168 samples analyzed

2002 Avian Eggs

<u>Species</u>	<u>n</u>	<u>Conc. Range (ppb)</u>	<u>Conc. Mean (+/- 1SD)</u>
American Robin	40	20 – 11200	1120 +/- 2170
American Woodcock	2	91 – 101	96 +/- 7
Belted Kingfisher	10	2030 – 42700	13900 +/- 12500
Common Grackle	10	702 – 16400	4360 +/- 4880
Eastern Bluebird	5	196 – 1140	520 +/- 385
Eastern Phoebe	27	144 – 17300	2040 – 3350
Barn Swallow	10	663 – 5140	2990 +/- 1730
Red Winged Blackbird	40	65 – 35000	3670 +/- 6870
N. Rough Winged Swallow	10	2140 – 13900	7240 +/- 4170
Screech Owl	1	8010	-
Spotted Sandpiper	13	488 – 56200	15200 +/- 17700
<u>Region</u>	<u>n</u>	<u>Conc. Range (ppb)</u>	<u>Conc. Mean (+/- 1SD)</u>
Region 1	51	65 – 56200	7620 +/- 11300
Region 2	48	44 – 15100	3320 +/- 3870
Region 3	39	20 – 42700	4450 +/- 8860
Region 4	30	36 – 2990	607 +/- 718

Tree Swallow





Spotted Sandpiper

Belted Kingfisher



2002 - 2003 Screech Owl Eggs



- 2002 – only 1 egg collected (Region 1)
- Additional sampling in 2003 yielded 10 eggs
- 2002 egg: 8,010 ppb
- 2003 eggs: 744 – 7,450 ppb



2002 Peregrine Falcon Eggs

- 5 eggs
- 2 Sites
 - Dunn Memorial Bridge (Albany)
 - Rip Van Winkle Bridge (Catskill)
- Analyses
 - Organochlorine pesticides
 - PCBs
 - % lipid
 - PBDEs
 - PCDD/Fs
 - Cadmium, lead and mercury



2002 Peregrine Falcon Eggs

<u>Site</u>	<u>Egg mass (g)</u>	<u>t-PCBs (ppb)*</u>
Dunn Memorial Bridge	32.55	5290
Dunn Memorial Bridge	30.24	6310
Dunn Memorial Bridge	31.98	6370
Rip Van Winkle Bridge	34.9	6690
Rip Van Winkle Bridge**	3.1	34200

*Wet weight basis, not corrected for moisture loss

** This egg was cracked and severely dessicated, with no observable embryo

Injuries to Birds?

- Eggs from 13 species exposed
- Developmental and reproductive injuries to Tree Swallows
- Injecting Tree Swallow, Kestrel and Chicken eggs with Hudson PCBs to study developmental effects

2003 Bullfrog Tadpole Study

<u>Site</u>	<u>n</u>	<u>Conc. Range (ppb)</u>	<u>Conc. Mean (+/- 1 SD)</u>	<u>Sediment</u>
7	4	2190 – 7680	3940 +/- 2540	57600
4	5	2500 – 9280	4810 +/- 2620	48900
3	4	501 – 4000	1710 +/- 1600	6880
6	6	723 – 1730	1020 +/- 404	2640
5	5	354 – 1070	607 +/- 289	5820
8	6	823 – 1570	1060 +/- 319	4550
1	6	48 – 108	82 +/- 24	834
9	5	15 – 97	40 +/- 33	508

Study sites are listed upstream (Site 7) to downstream (site 8); **Red font indicates reference sites**

2004 Wood and Leopard Frog Breeding Habitat Survey



Potential wood and
leopard frog
breeding habitats in the
Hudson River
floodplain were surveyed
in early spring 2004



Chorusing surveys
were used to determine
possible sampling sites

Researchers returned after several weeks, confirmed the presence of tadpoles and set up transects for the collection of soil samples



Injuries to Frogs?

- Exposure in 3 species
- Muscle tissue in bullfrogs low viz. human health
- Bullfrog tadpoles as pathways to other biota



Mink

Injuries to Mink?

- Mink and otter associated with the Hudson River were more highly contaminated than animals in other areas
- Mink trapping results indicate lower mink activity near the Hudson River versus other areas
- Preliminary track plate survey results indicate lower mink activity near the Hudson River versus other areas

Injuries to Mink?

- Feeding Study 2006-2007 – captive mink will be fed a diet including Hudson River fish
- Measure reproduction and survival

Snapping Turtle



2002 Snapping Turtle Eggs

- Eggs from 42 nests or turtles were sampled within study site (Regions 1 – 4)
- Two reference sites (upstream and other) yielded 17 nests or turtles
- Each sample was a composite of 5 eggs (one sample consisted of 3 eggs)
- Study site t-PCBs: 70 – 31,800 ppb
- Reference site t-PCBs: 10 – 565 ppb

Injuries to Snapping Turtles?

- All exposed.
- Varies by tissue type. Highest in fat (up to 610 ppm)
- Eggs higher from Hudson River than from reference sites
- Developmental studies?

Brown Bullhead



Brown Bullhead - Thompson Island at Griffin Island (River Mile 189)

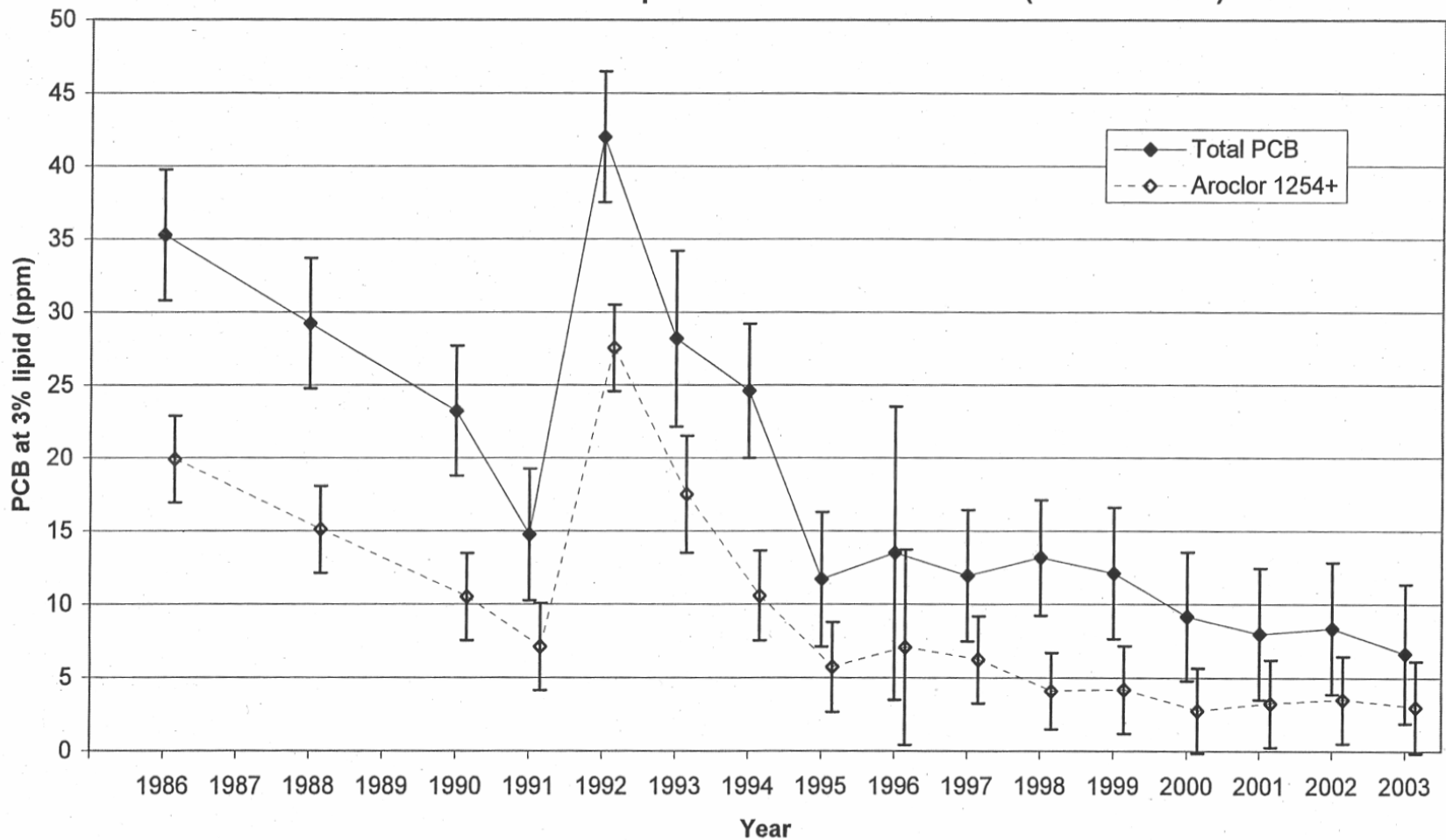


Figure 9. Trend in PCB concentrations at 3% lipid for brown bullhead collected at Griffin Island in the Thompson Island Pool (River mile 189). Results shown are Least Significant Difference mean comparisons (95% confidence intervals) for total PCB - solid lines, and higher chlorinated 'Aroclor 1254+' fraction - dashed lines.

Largemouth Bass



Largemouth Bass - Thompson Island Pool at Griffin Island (River Mile 189)

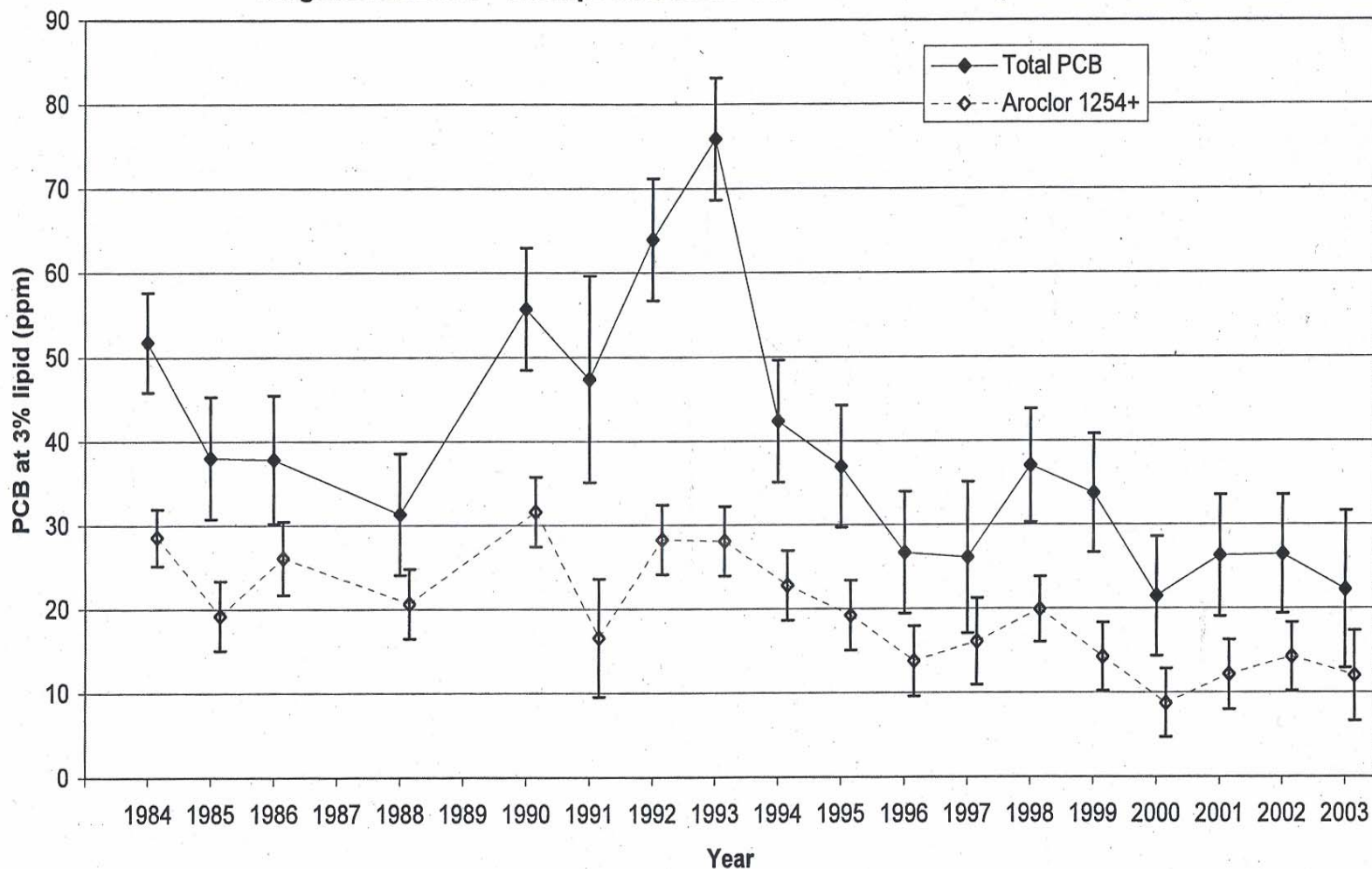


Figure 8. Trend in PCB concentrations at 3% lipid for largemouth bass collected at Griffin Island in the Thompson Island Pool (River mile 189). Results shown are Least Significant Difference mean comparisons (95% confidence intervals) for total PCB - solid lines, and higher chlorinated 'Aroclor 1254+' fraction - dashed lines.

Injuries to Fish?

- Body burdens declined over time
- Levels remain high viz. human health and for fish-eating biota
- Injury to fish themselves?



Saratoga National Historic Site

Injuries to Cultural Uses ?

- Historic artifacts
- National Park Service lands

Injuries to Human Uses ?

- Recreational uses
- Commercial uses

Recreational Fishing



Injuries to Recreational Fishing

In the Hudson River, **recreational fishing** was (is) injured because anglers' ability to safely consume fish was reduced by GE's release of PCBs.



Waterfowl Hunting

Injuries to Waterfowl Hunting ?

In the Hudson River, **waterfowl hunting** was (is) injured because hunters' ability to safely consume ducks was reduced by GE's release of PCBs.

Boating



Navigation



Injuries to Navigation

In the Hudson River, **navigation** was (is) injured because the cost of disposing of dredge spoils was (is) greatly increased by GE's release of PCBs.

Restoration Planning

"...restore,
rehabilitate,
replace, and/or
acquire the equivalent of
the injured natural resources..."

Restoration Planning

Which injured resources need to
be restored?

Restoration Planning

Primary
v.
Compensatory

Restoration Planning

- Connection to **injuries**
- **Public ideas**
- **Public support**

Websites

- www.dec.state.ny.us/website/dfwmr/habitat/nrd/index.htm
- contaminants.fws.gov/restorationplans/HudsonRiver.cfm
- www.darp.noaa.gov/neregion/ HUDSONR.htm
- www.epa.gov/r02earth/superfnd/ HUDSON/