

# Mercury in Fish from 21 National Parks in the Western U.S. and Alaska

*Inter- and Intra-park variation*

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Prepared in cooperation with the National Park Service, Air Resources Division

## Mercury in Fishes from 21 National Parks in the Western United States—Inter- and Intra-Park Variation in Concentrations and Ecological Risk



Eagles-Smith, C.A., Willacker, J.J., and Flanagan Pritz, C.M., 2014, Mercury in fishes from 21 national parks in the Western United States—Inter and intra-park variation in concentrations and ecological risk: U.S. Geological Survey Open-File Report 2014-1051, 54 p.

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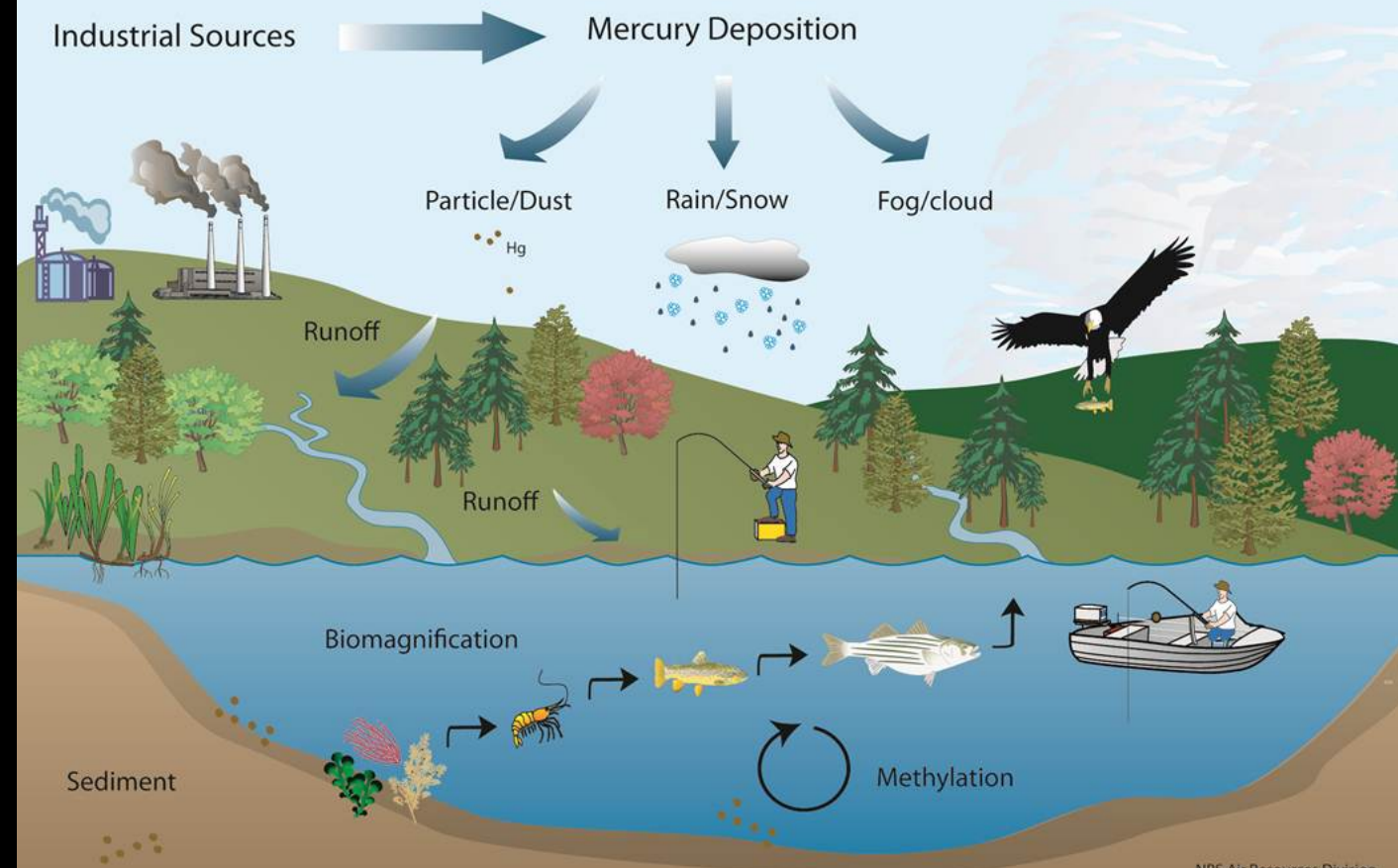
#### Elevated Levels of Mercury Found in Fish in Western U.S. National Parks

*Concentrations safe for human consumption in 96 percent of sport fish sampled*

WASHINGTON. — Mercury has been discovered in fish in some of the most remote national park lakes and streams in the western United States and Alaska. Mercury levels in some fish exceeded U.S. Environmental Protection Agency health thresholds for potential impacts to fish, birds, and humans.

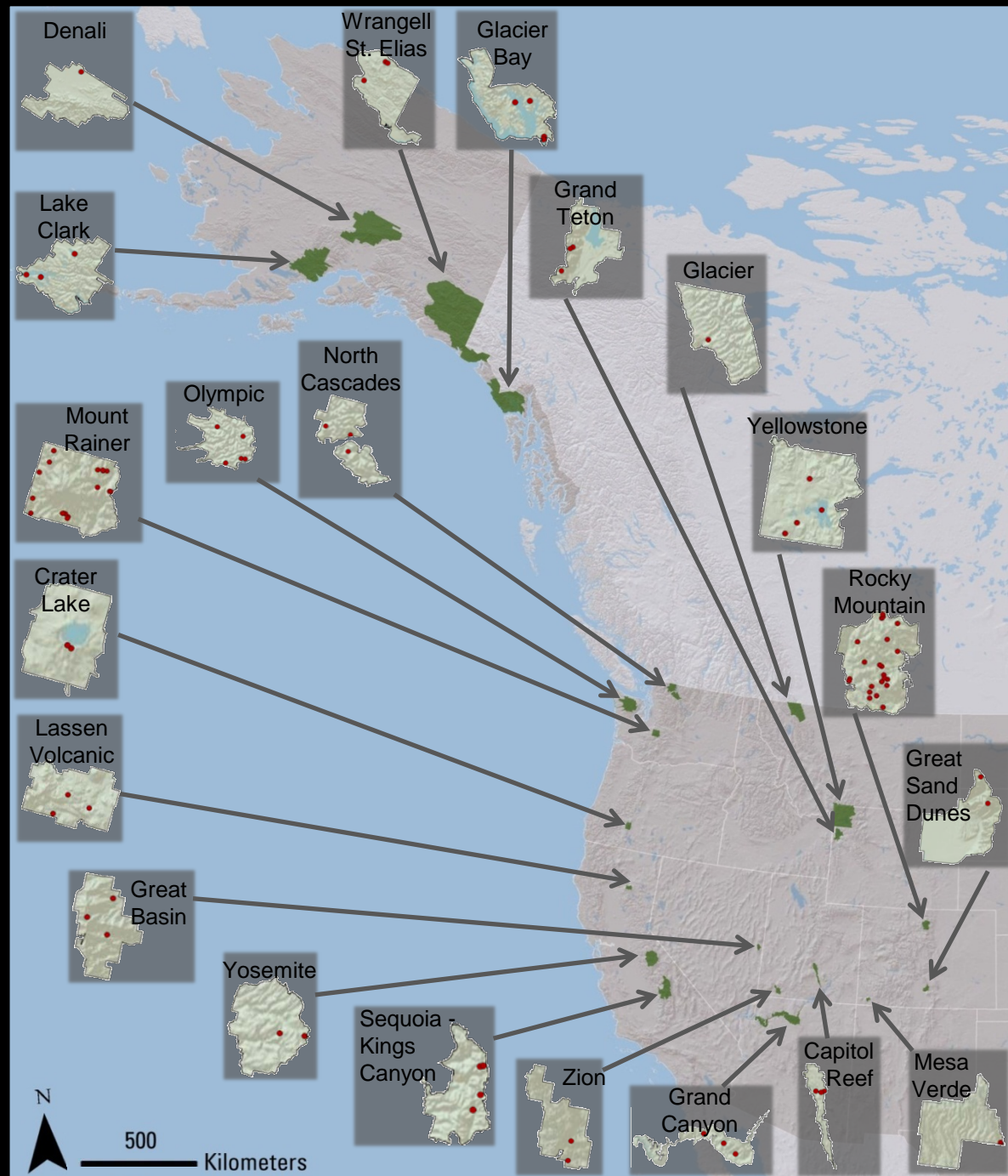
# Mercury (Hg)

## Sources and Paths of Mercury in the Environment



# Study Area

- 21 parks
- 86 sites
- 10 states
- 4,000 km
- 1,486 fish



# Site Selection

- Remote aquatic habitats
- High-elevation (where possible)
- Limited watershed inputs (where possible)
- Only non-migratory fishes

*Middle Blum Lake, NOCA*



*Crater Lake, CRLA*



*Lake Clark, LACL*



*Fremont River, CARE*

# Target Species

Brook trout



Rainbow trout



Cutthroat trout



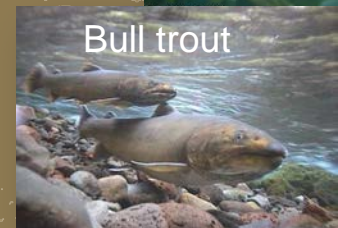
Lake trout



Northern pike



Bull trout



Arctic grayling



Golden trout

Brown trout



Kokanee



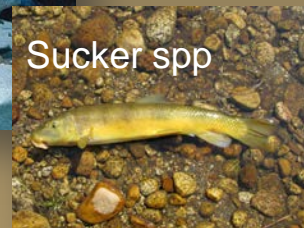
Dolly Varden



Lake whitefish



Sucker spp



Torrent sculpin

Threespine stickleback



Speckled dace



73%

# Hg Analysis

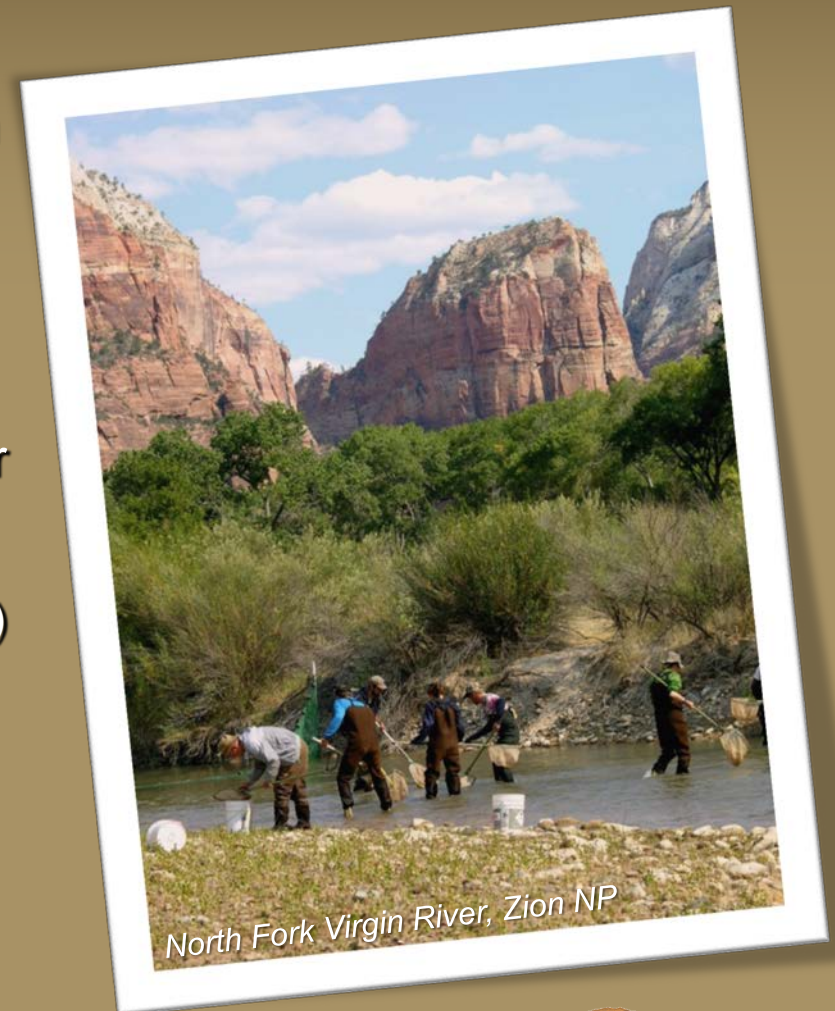


- Thermal decomposition
- Catalytic conversion
- Amalgamation
- Atomic absorption spectrometry
- EPA method 7473



# Statistical Analysis

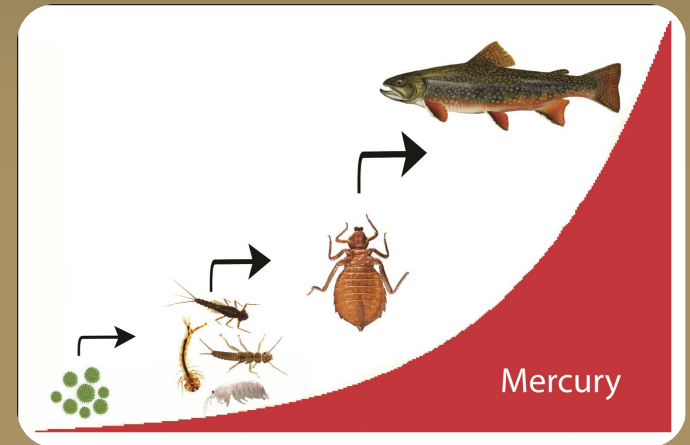
- Model selection to determine populations needing size correction
- Size-corrected Hg concentrations based upon species
  - “Large” fish – 400mm
  - “Medium” fish – 200mm
  - “Small” fish – 50mm
- Mixed-effects, nested general linear model ANOVA
  - Park (fixed effect)
  - Site nested within park (fixed effect)
  - Fish species (random effect)
- Independent models for each size classification
  - 400mm, 200mm, 50mm



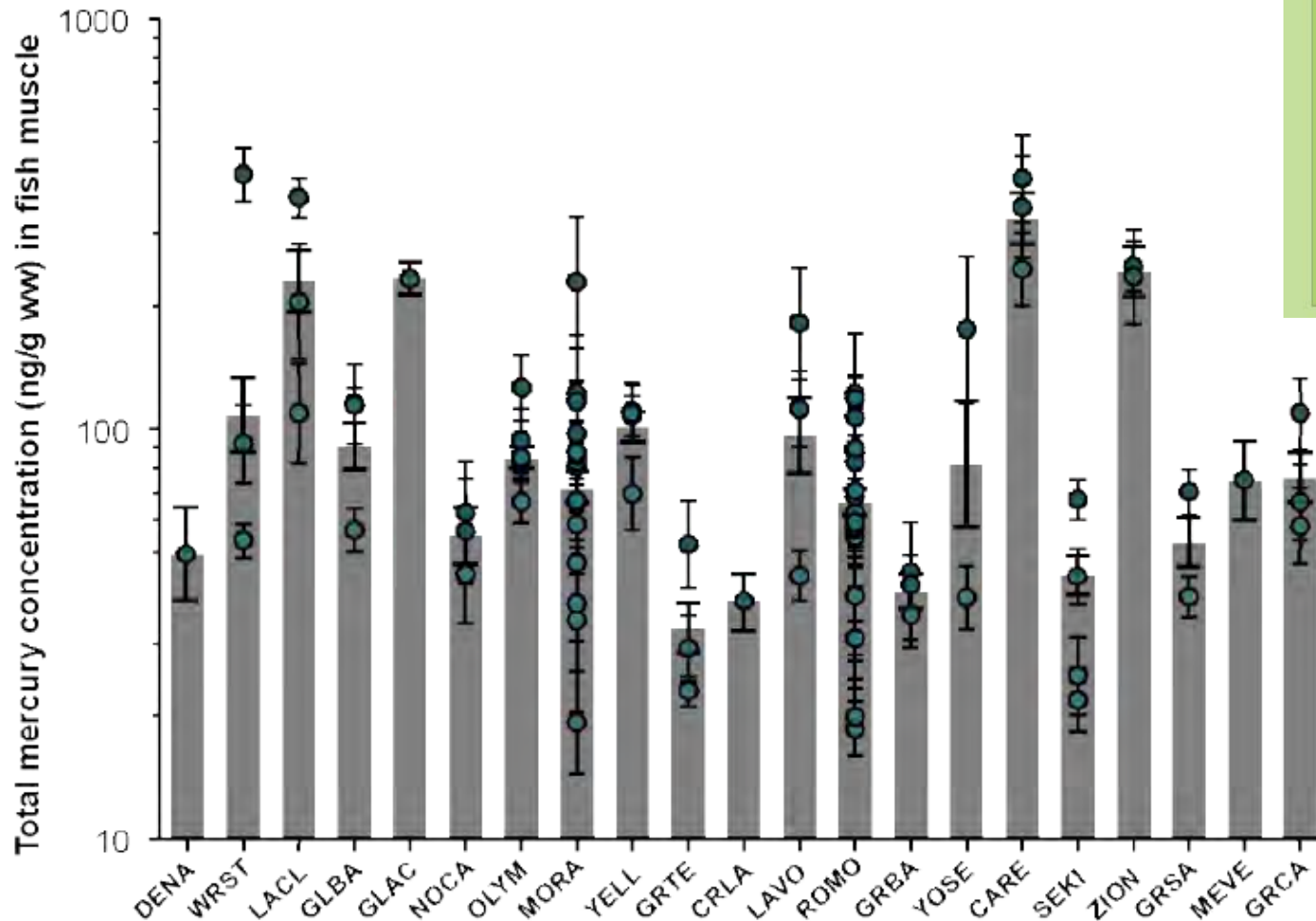


# Toxicological Benchmarks

- Fish Risk
  - NOER (0.2 ppm)
  - LOER (0.3 ppm)
- Wildlife Risk
  - High sensitivity (0.09 ppm)
  - Moderate sensitivity (0.18 ppm)
  - Low sensitivity (0.27 ppm)
- Human Risk
  - Unlimited consumption (0.05 ppm)
  - EPA criterion (0.3 ppm)
  - No consumption (0.95 ppm)



# Total Hg (THg) in fish, by park



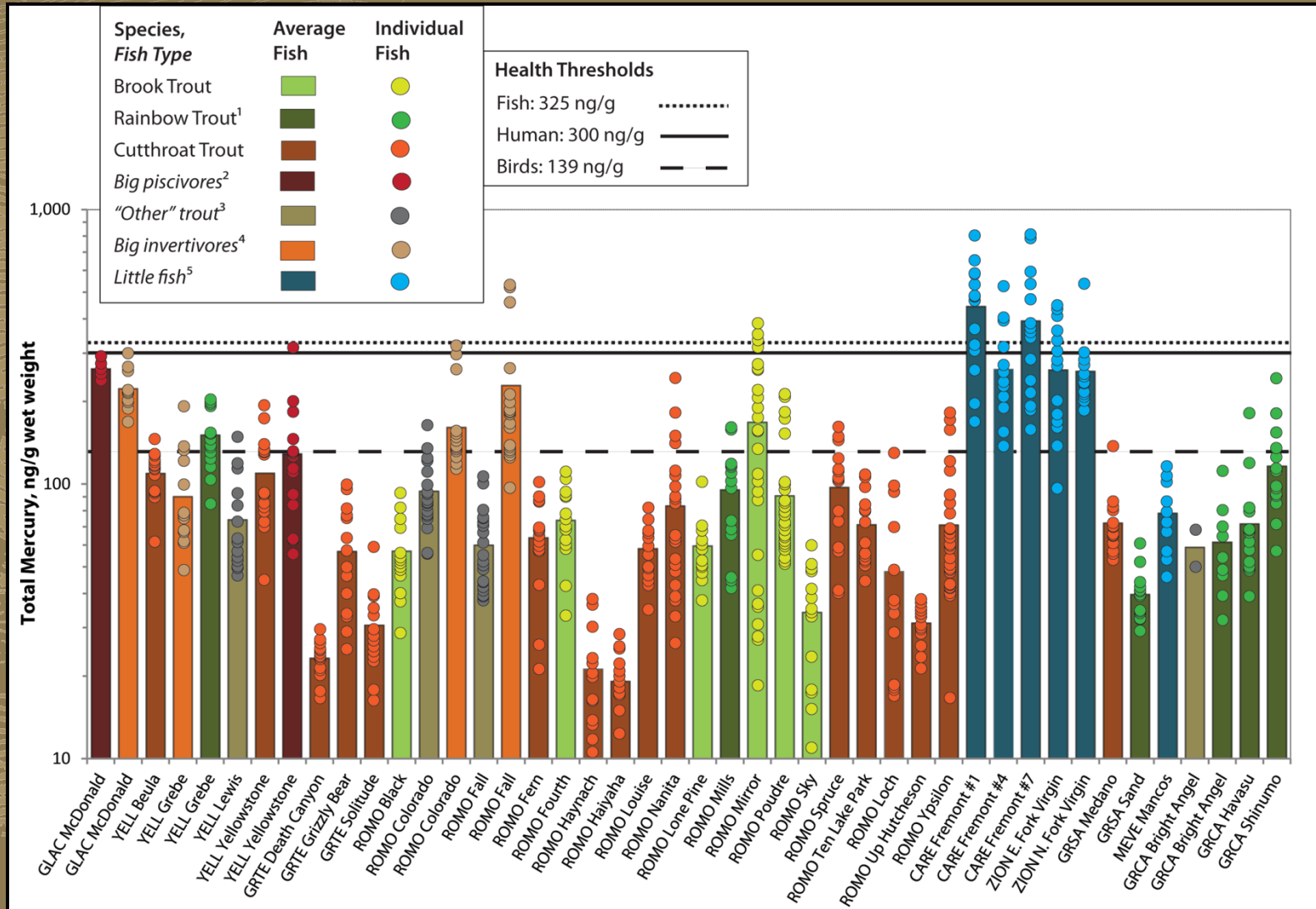
## PARK CODE

- CARE Capitol Reef
- CRLA Crater Lake
- DENA Denali
- GLAC Glacier
- GLBA Glacier Bay
- GRBA Great Basin
- GRCA Grand Canyon
- GRSA Great Sand Dunes
- GRTE Grand Teton
- LACL Lake Clark
- LAVO Lassen Volcanic
- MEVE Mesa Verde
- MORA Mount Rainier
- ROMO Rocky Mountain
- NOCA North Cascades
- OLYM Olympic
- SEKI Sequoia-Kings Canyon
- WRST Wrangell-St. Elias
- YELL Yellowstone
- YOSE Yosemite
- ZION Zion

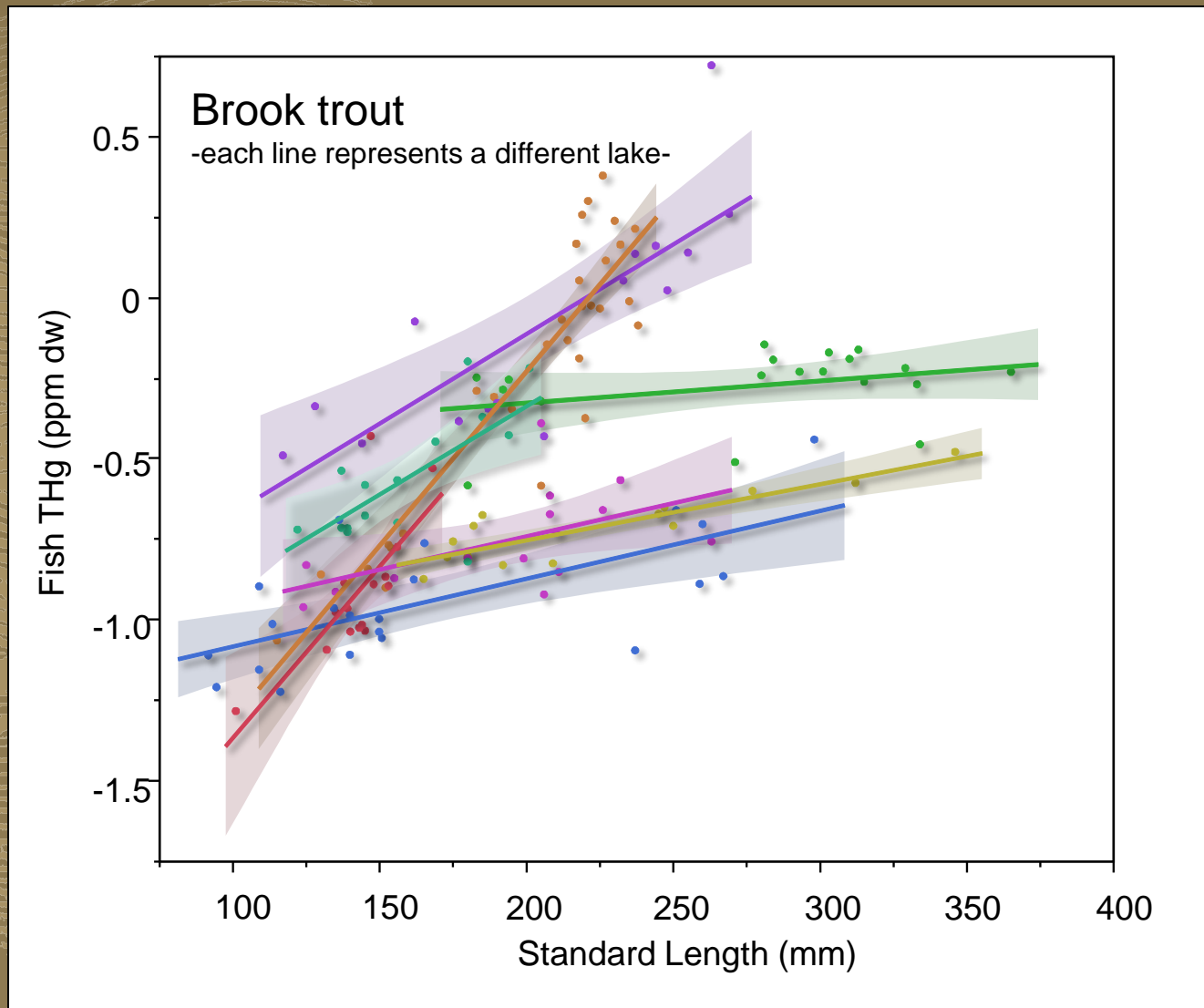




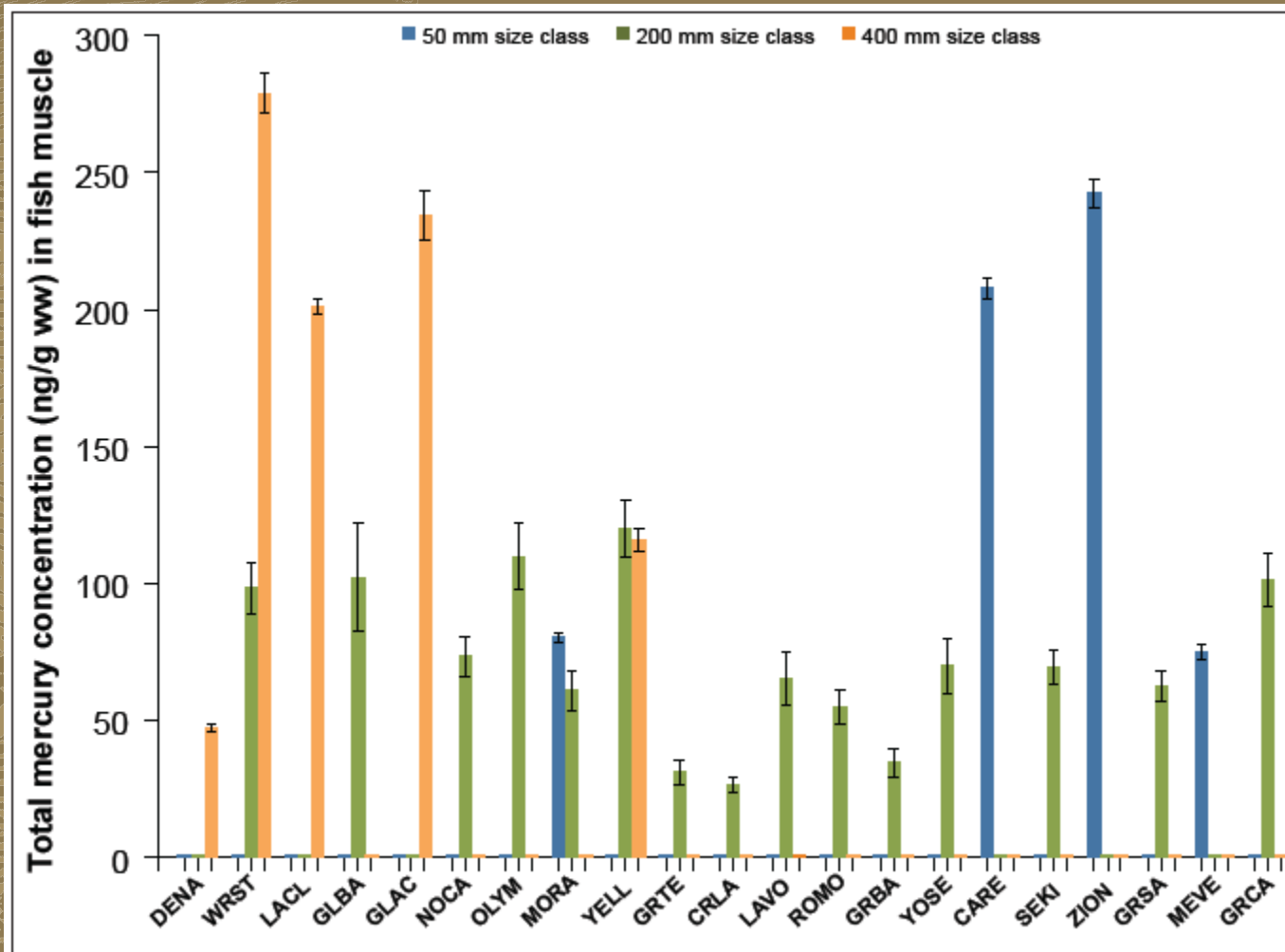
# THg in Intermountain West, by site



# Fish Size and Mercury



# Size-normalized THg in fish

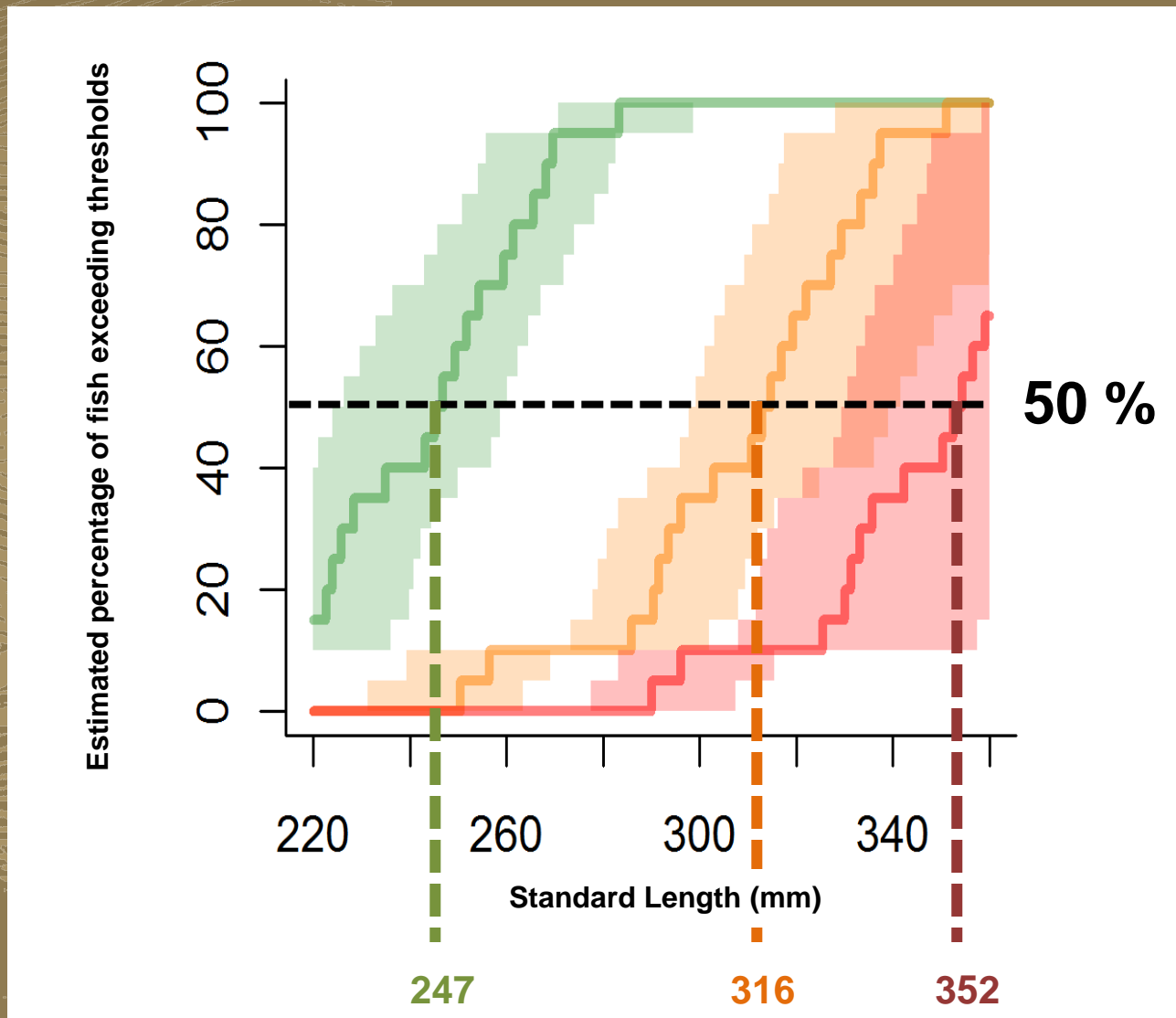


**PARK CODE**

CARE	Capitol Reef
CRLA	Crater Lake
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GLAC	Glacier
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GRTE	Grand Teton
LACL	Lake Clark
LAVO	Lassen Volcanic
MEVE	Mesa Verde
MORA	Mount Rainier
ROMO	Rocky Mountain
NOCA	North Cascades
OLYM	Olympic
SEKI	Sequoia-Kings Canyon
WRST	Wrangell-St. Elias
YELL	Yellowstone
YOSE	Yosemite
ZION	Zion

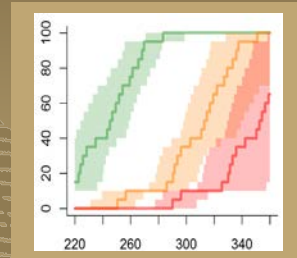
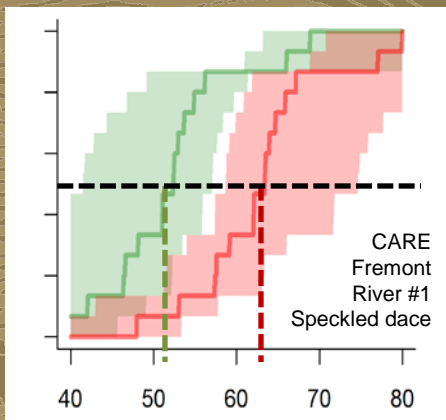


# ex) Size-Specific Risk Profiles



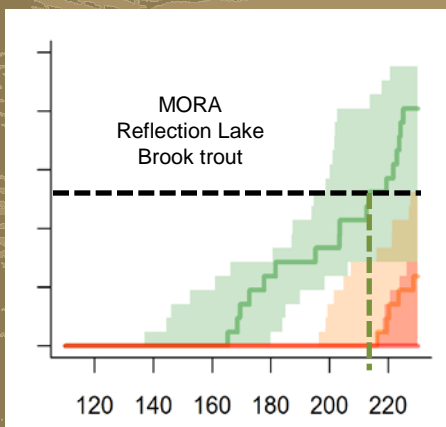
# Size-Specific Risk Profiles

## ■ Risk to fish

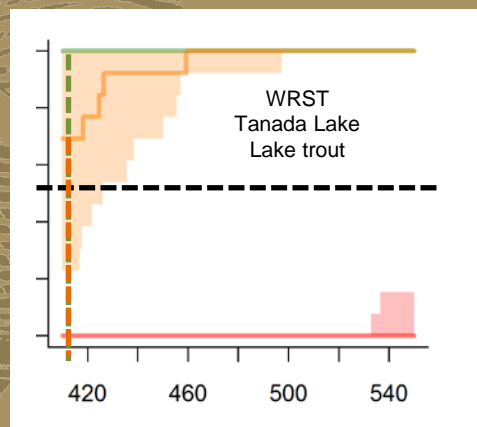


- Green- low
- Orange- moderate
- Red- high

## ■ Risk to birds



## ■ Risk to humans





# Findings

- Hg concentrations in fish sampled from these parks were generally low, but were elevated in some instances.
- The majority of fish across the West had concentrations that were below most wildlife and human health benchmarks.
- Hg concentrations were below EPA's fish tissue criterion for safe human consumption in 96% of the sport fish sampled.
- Hg levels varied greatly, from park to park and site to site.
- The data suggest further study of key ecological endpoints in CARE, GLAC, LACL, LAVO, WRST, YOSE, ZION due to high levels of mercury in fish from these areas.

# Implications



## NPS Organic Act, 1916

“...fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them **unimpaired** for the enjoyment of future generations.”

- Areas of further study
- Research toxicological response in parks and sites with elevated risk
- Identify source contribution: Hg isotopes
- Define “why”
  - Use landscape and deposition layers
- Assess spatial risk

- Dragonfly larvae
- Fish – Eastern U.S.
- Establish baseline: MATS
- Coordinate on fish consumption advice



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