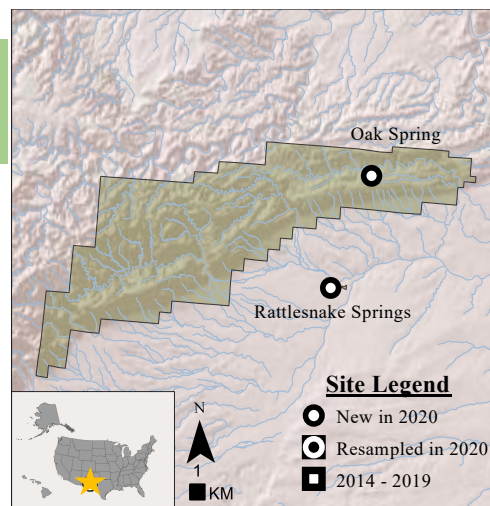




Carlsbad Caverns National Park (CAVE) 2020 Data Summary

The Dragonfly Mercury Project (DMP) is a national surveillance, monitoring, and research program that brings together citizen engagement and education with scientific efforts to understand mercury (Hg) risks to protected areas. 2020 was the first year that Carlsbad Caverns NP participated in the DMP!

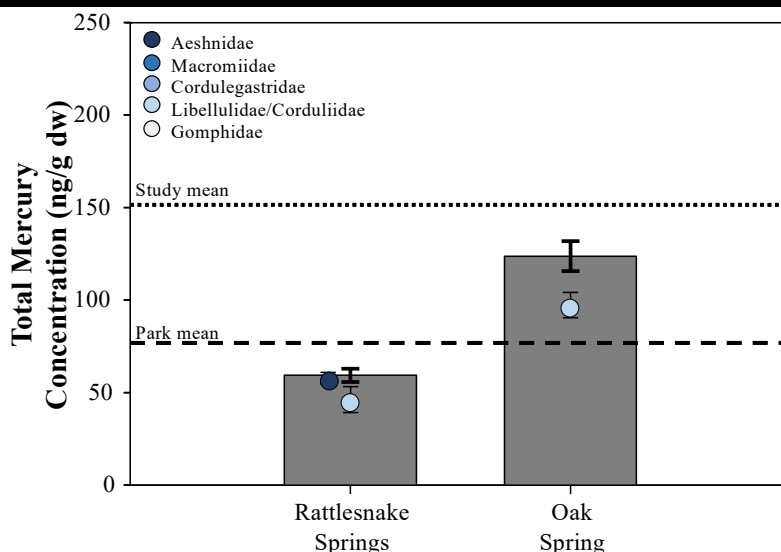


Summary

Unless noted, all Hg concentrations have been converted to their equivalent concentration in the family Aeshnidae (Eagles-Smith et al. 2020).

The park geometric mean ($\pm$ standard error) Hg concentration at CAVE in 2020 was 76.7 ± 7.1 ng/g dry weight (dw) compared to the study-wide (2014 – 2020) geometric mean Hg concentration of 151.3 ± 1.0 ng/g dw. Among the two sites sampled from CAVE in 2020, geometric mean dragonfly Hg concentrations were 59.3 and 123.7 ng/g dw.

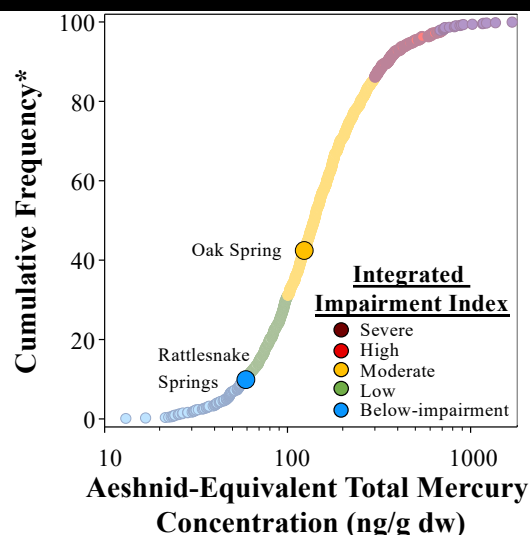
Eagles-Smith et al. 2020. A national-scale assessment of mercury bioaccumulation in United States national parks using dragonfly larvae as biosentinel through a citizen-science framework. *Environ Sci Technol* 54(14):8779–8790. DOI: [10.1021/acs.est.0c01255](https://doi.org/10.1021/acs.est.0c01255)



Site (bars), family (points), park (dashed line) and study (dotted line; 2014–2020) mean mercury concentrations in dragonfly larvae collected from CAVE in 2020. Park, site, and study mean mercury concentrations are Aeshnid-equivalents, family means are geometric means of raw mercury concentrations.

Integrated Impairment Index

- The Integrated Impairment Index classifies Aeshnid-equivalent dragonfly THg concentrations into five categories based on the number of taxa estimated to exceed increasingly severe impairment benchmarks for fish, wildlife, and human health risk. Because the Integrated Impairment Index looks at potential risks to a variety of taxa it provides a more complete estimate of potential health risks than would be seen examining any single benchmark. See Eagles-Smith et al. 2020 for additional details.
- In 2020, one CAVE site was classified as ‘below-impairment’ and the other site as ‘moderate risk’ of Hg impairment.
- Across all parks, 10% of sites sampled in 2020 were classified as ‘below-impairment’ and 51% as ‘moderate risk’.



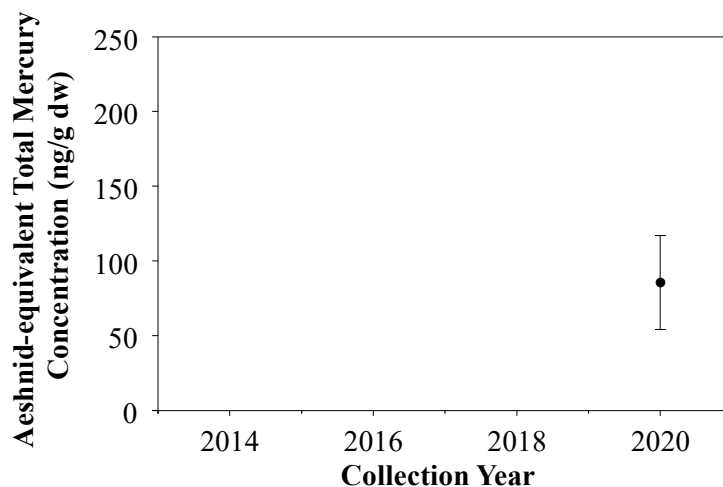
Distribution of site mean Aeshnid-equivalent total mercury concentrations among the five Integrated Impairment Index categories. Sites sampled from CAVE in 2020 are highlighted and labeled. *The percent of sites across all parks that have lower Hg concentrations than each of the highlighted sites.

Temporal Variation in Dragonfly Hg

2020 was the first year dragonfly Hg concentrations were measured at CAVE.

What are these data and what do they mean?

We estimated annual mean dragonfly Hg concentrations using a model that takes into account differences in the sites sampled each year of CAVE's participation in the DMP and used a Tukey HSD test to identify differences among annual means. This enables comparisons of Hg concentrations among years and provides insights into temporal variability, despite inconsistencies in which sites were sampled each year. However, any apparent trends in the data must be interpreted cautiously because individual site characteristics have an important influence on dragonfly Hg concentrations. Although these results account for variation due to sampling site, doing so increases the uncertainty in the estimates and thus our power to identify trends.

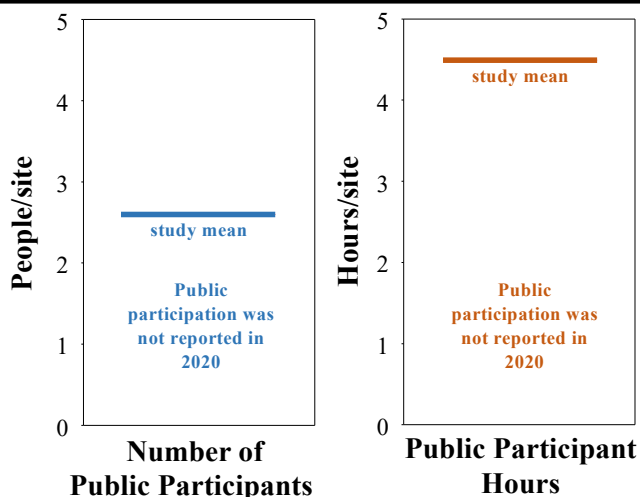


Annual mean total mercury concentrations (Aeshnid-equivalents; ng/g dw $\pm$ standard error) in dragonfly larvae collected from CAVE between 2014 and 2020. Means are least-squares means from a model that accounts for differences among the sites sampled each year.

Public Engagement

The DMP engages local communities and promotes scientific curiosity while harnessing the power of public science to study mercury pollution nationwide.

In 2020, no public participation was reported for the dragonfly collections at CAVE. Across all sites, 100% of the dragonfly larvae from CAVE with field identifications were correctly identified to family.



Average (bars) and total (numbers in bars) public participants (left) and public participant hours (right) contributing to dragonfly collection at CAVE in 2020. Bold lines indicate average values across all parks that participated in 2020.

Summary Table

Site	Site Code	Family	N	ID Accur.	Total Length (mm)		Total Mercury (ng/g dw) ^a	
					Mean	Range	Mean	Range
Oak Spring	CAVE-02	Corduliidae/Libellulidae	7	100%	10.8	7.5 - 17.7	97.3	75.7 - 128.8
Rattlesnake Springs	CAVE-01	Aeshnidae	8	100%	19.3	9.8 - 34.5	57.7	47.8 - 75.0
		Corduliidae/Libellulidae	5	100% ^b	12.5	10.0 - 18.6	46.2	29.1 - 65.7

^a raw Hg concentrations not converted to Aeshnid-equivalents; ^b samples without field identifications were excluded

For more information

Dragonfly Mercury Project Website: <https://go.nps.gov/dragonflymercury>

Dragonfly Mercury Project Email: dmp@nps.gov

Data source: <https://doi.org/10.5066/P9TK6NPT>