



Dragonfly Larvae as Bioindicators of Mercury Pollution

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INTRODUCTION

The Dragonfly Mercury Project (DMP) is a nation-wide study managed by the National Park Service (NPS), U.S. Geological Survey (USGS), and University of Maine that engages citizen scientists in the collection of dragonfly larvae in national parks for mercury analysis. The goals of the DMP are to (1) increase the understanding of mercury contamination across the United States, (2) engage and educate citizen scientists, and (3) inform resource management decisions. Since 2009, over 100 parks and 4,000 citizen scientists have contributed more than 10,000 hours of service to the DMP.

Mercury (Hg) is a global pollutant that enters the atmosphere by natural means (e.g. volcanoes) and human pollution (e.g. coal-burning power plants). Mercury can travel thousands of miles and be deposited in seemingly pristine places through atmospheric deposition. When methylated, mercury can biomagnify up the food chain and have toxic effects on wildlife and humans.

Dragonfly larvae are excellent bioindicators of mercury bioaccumulation due to their predatory role, wide distribution, and ease of collection. The analysis of the collected specimens informs potential risk and can be used to guide management actions and conservation efforts.



Figure 1. A) *Libellulidae* sp. dragonfly larva found in Glen Canyon National Recreation Area (GLCA). B) *Aeshnidae* sp. exuvia, or exoskeleton molt. Photos courtesy of GLCA.

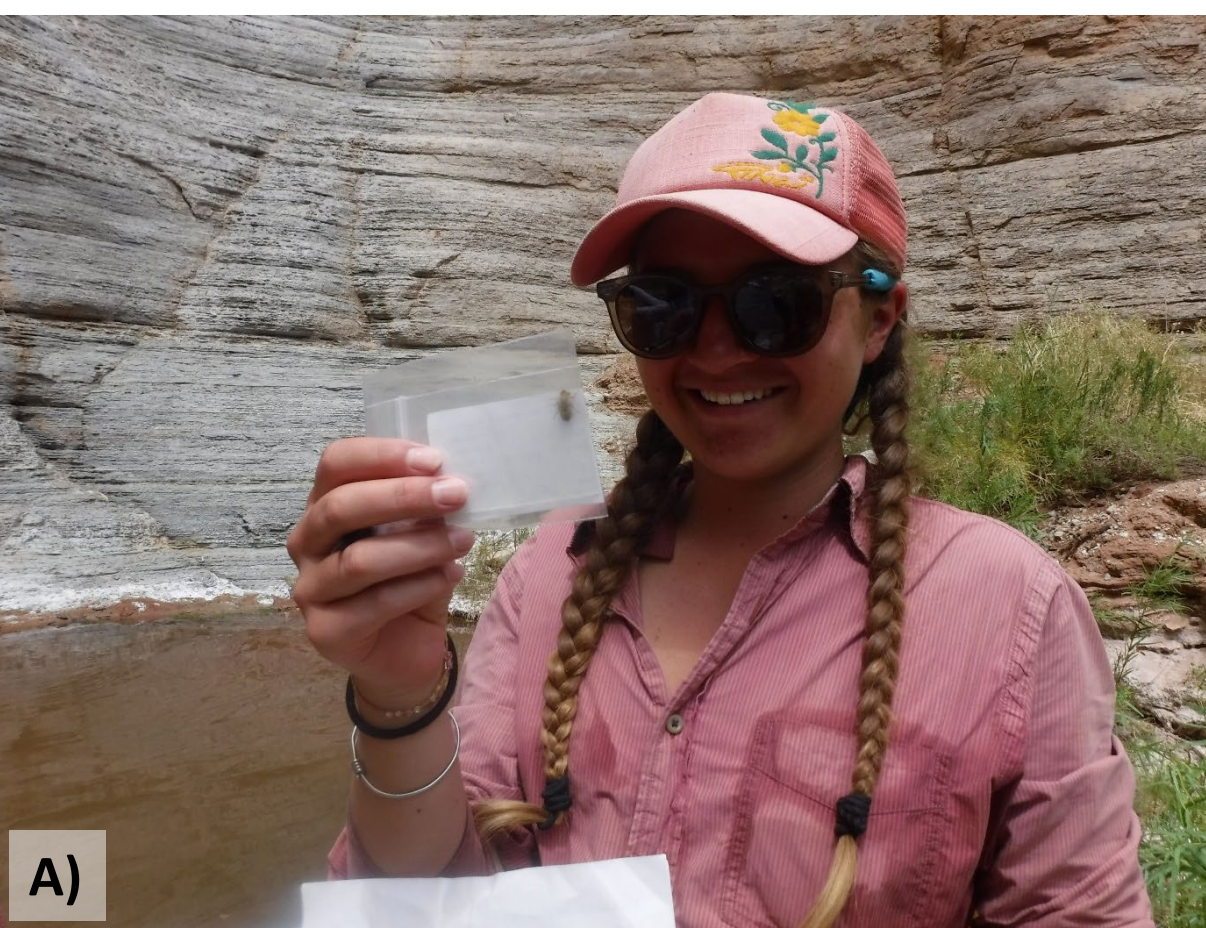


Figure 2. A) A citizen scientist bags and tags samples. B) Participants on a Grand Canyon Youth river trip measure and identify larvae. C) Geoscientists-in-the-Parks intern Katherine Ko leads a sampling effort with local girl scouts at GLCA. Photos courtesy of GLCA.

METHODS

Dragonfly larvae were sampled in accordance with the nation-wide DMP protocol. Every year, various park units and citizen science groups participate. Parks sample a number of sites and collect 10-15 dragonfly larvae per site. Dip nets are used to sample larvae in aquatic ecosystems. Site description and characteristics are recorded for each site.

Each individual is placed into a small zipper-seal bag, measured for length, and identified to family. The samples are then analyzed for total mercury concentrations at the USGS Contaminant Ecology Research Lab in Corvallis, OR. In the lab, the specimens are weighed, and identification is verified by trained scientists.

RESULTS

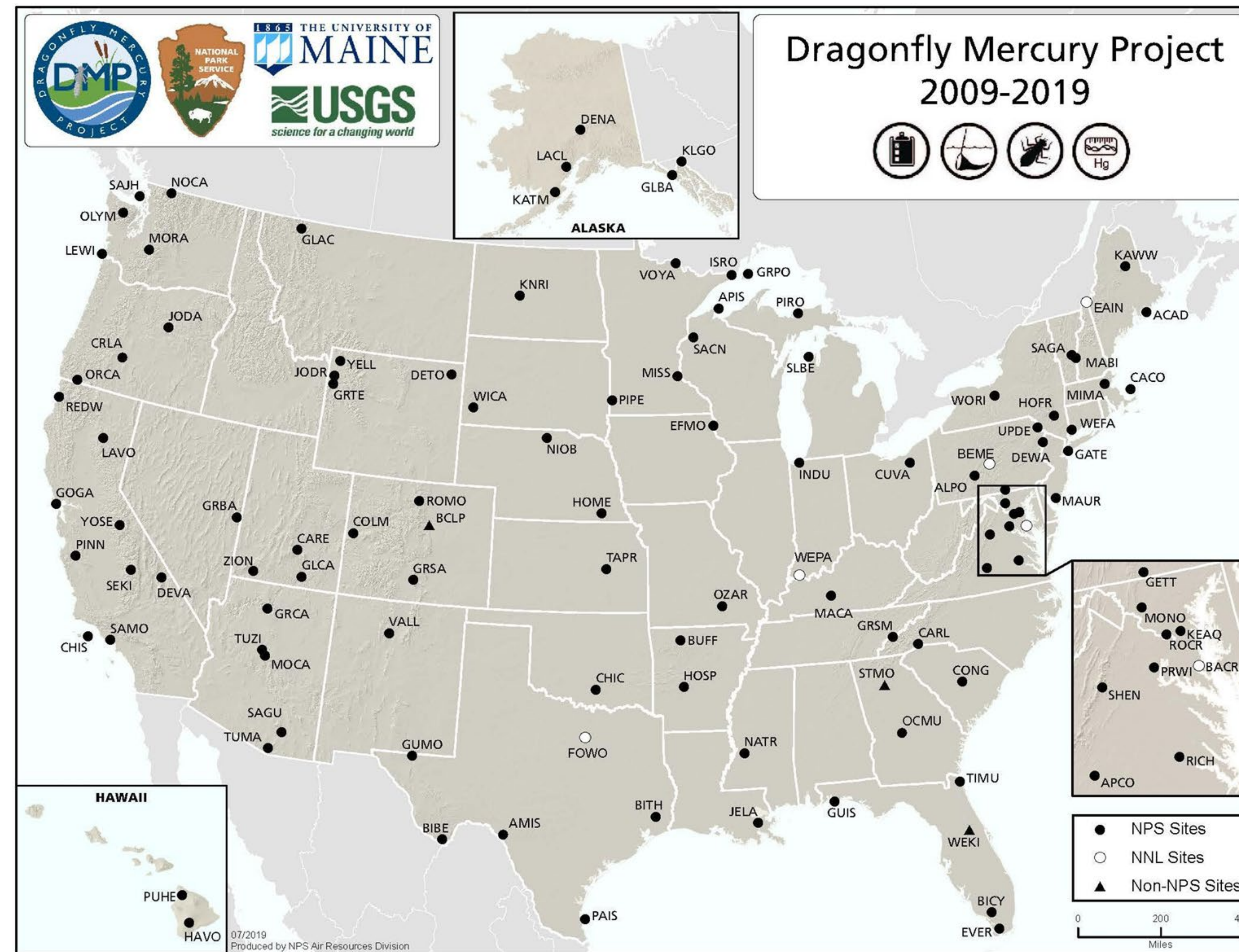


Figure 3. Map of sites that have participated in the DMP between 2009 and 2019. Provisional data provided by USGS.

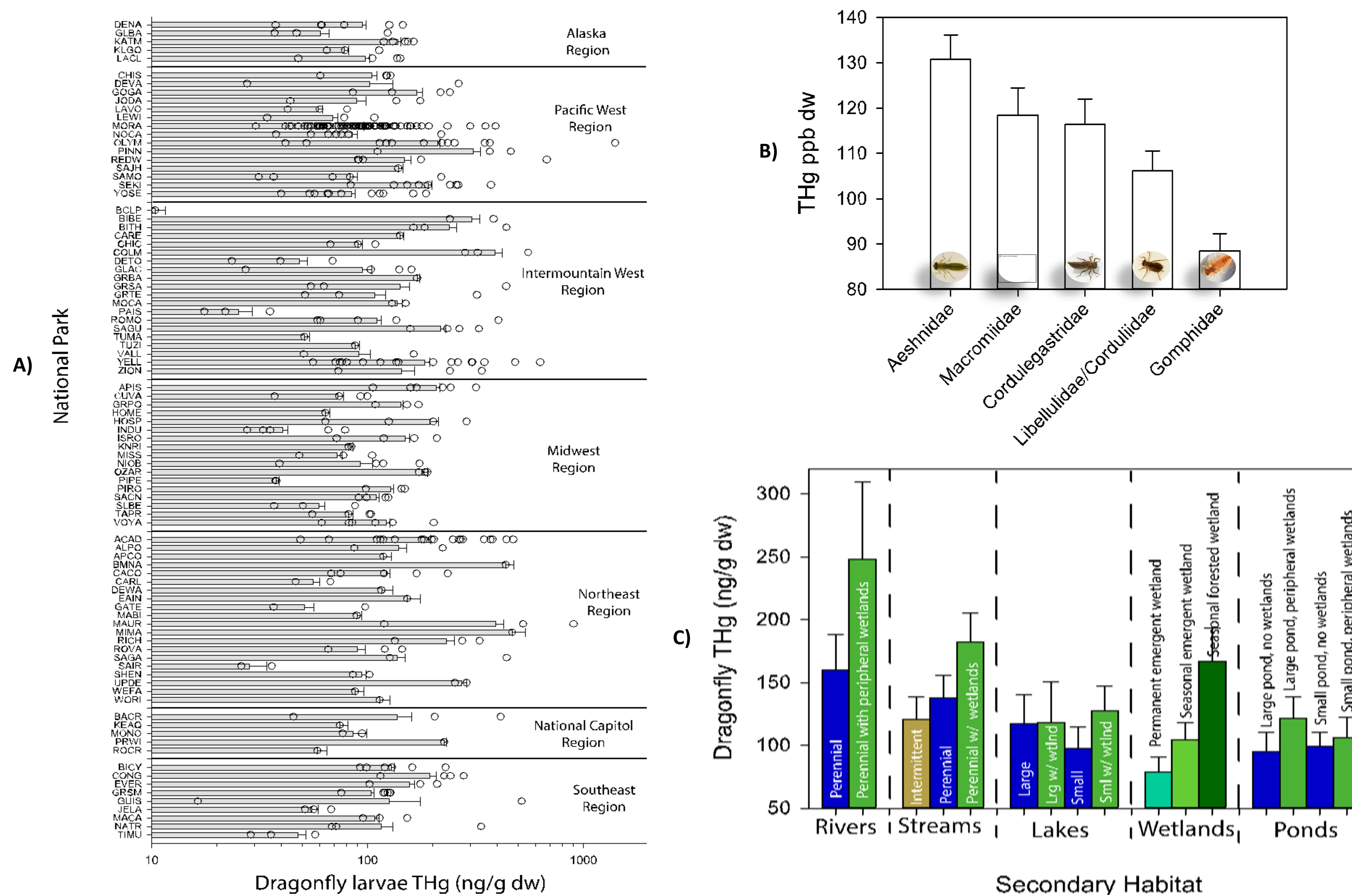


Figure 4. A) Total mercury (THg) concentrations in dragonfly larvae collected from National Park units. Bars represent park geometric means, and circles represent geometric means for individual sampling sites. B) THg concentrations in dragonfly larvae family as a factor of taxonomic family. C) Mean THg concentrations in dragonfly larvae as a factor of habitat type. Provisional data provided by USGS.

DISCUSSION

Results show that mercury (Hg) concentrations in dragonfly larvae are highly variable, both across and within National Parks (Fig. 4A). The risk from mercury varies widely across landscape and is influenced by both Hg emissions and deposition. Landscape processes control the entry of Hg into aquatic food webs.

Results highlight the influence of site-specific characteristics, including intrinsic (taxonomy and body size) (Fig. 4B) and extrinsic (habitat and ecoregion) factors (Fig. 4C), on mercury bioaccumulation.

The data produced by the DMP supports resource managers in sound decision-making regarding future research and safeguarding human and wildlife health. The DMP continues to grow and reach new regions of the United States, capturing a nation-wide image of mercury pollution. In the coming years, the project plans to continue expanding and reaching new parks, partners, and citizen scientists.

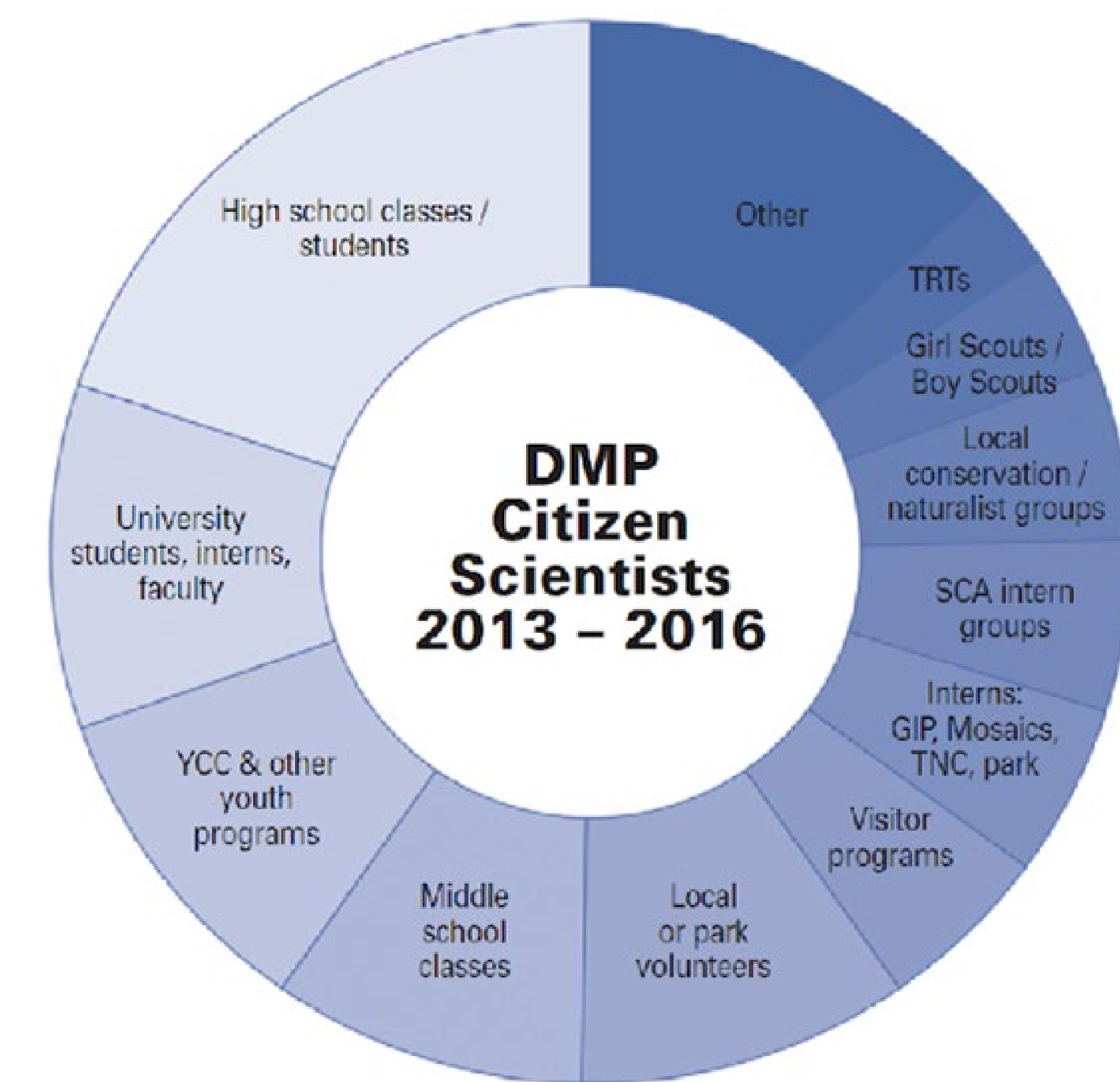


Figure 5. The DMP has engaged a variety of citizen scientists in an authentic outdoors experience. TRT = Teacher Ranger Teacher; SCA = Student Conservation Association; YCC = Youth Conservation Corps; GIP = Geoscientists in Parks; TNC = The Nature Conservancy. Courtesy of Maine Policy Review.

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For more information on the DMP, visit <https://www.nps.gov/articles/dragonfly-mercury-project.htm>.