Research Panel:

Key Findings & Data Gaps from a Decade of Pesticide Research

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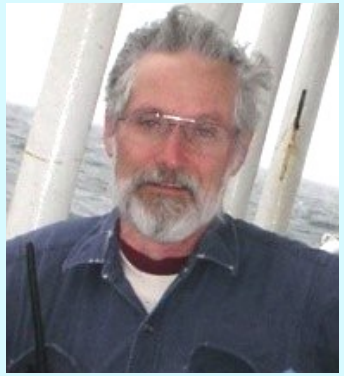

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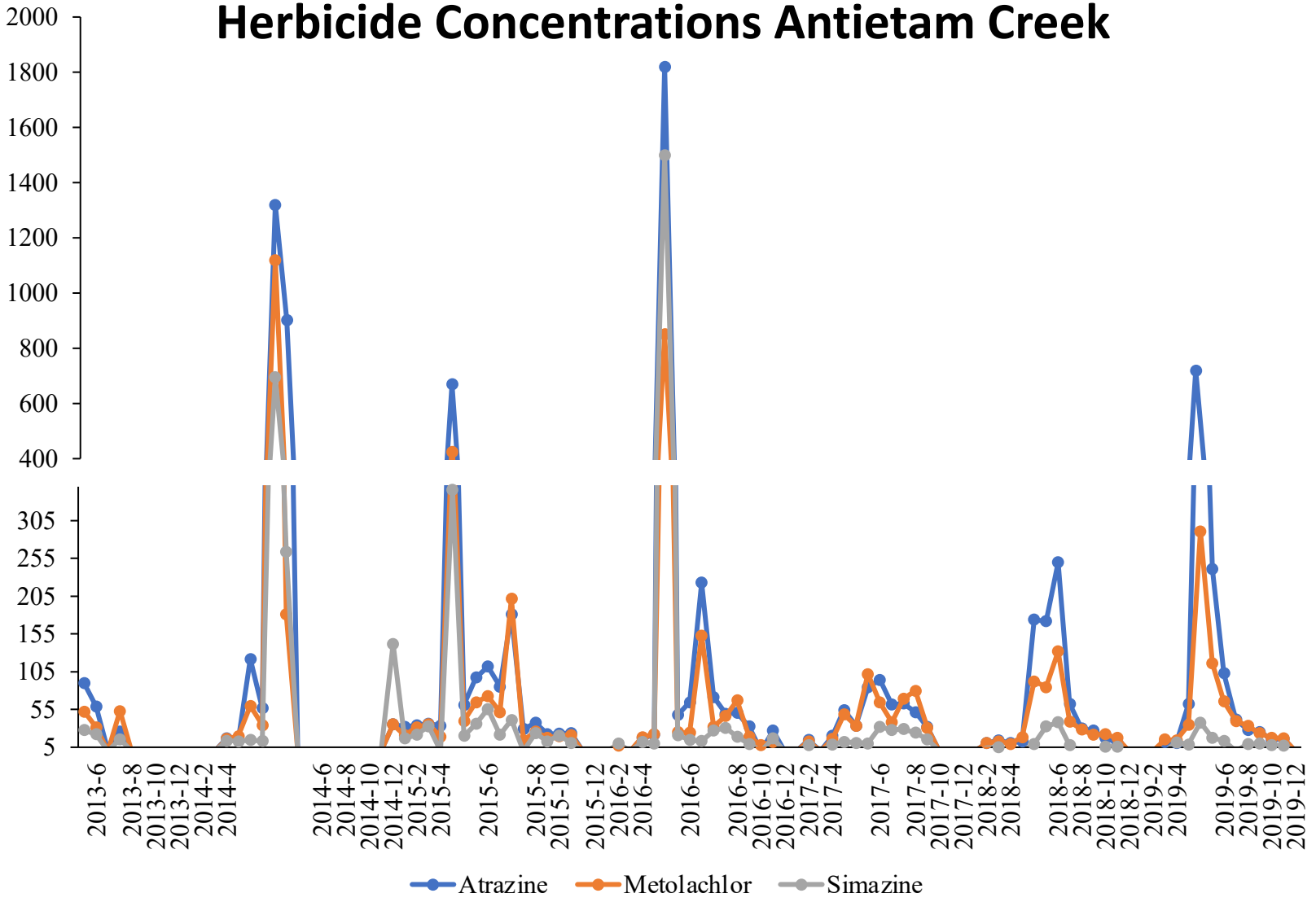
Ecotoxicologist,
National Oceanic & Atmospheric Administration (NOAA - retired)

Key Findings

1) **Pesticide use in recent years has decreased in mass (pounds used) but toxicity has increased**, particularly for insects and crustaceans, e.g. blue crabs.
2) **Pesticides are always found in mixtures in the environment**



Key Findings

3) Multiple studies point to the **importance of mixtures and ecosystem impacts**.

- When the bottom layers of the food web are harmed, ecosystem impacts carry up the chain.
- Degradation and nutrient cycling mechanisms are disrupted.
- Immunomodulation and endocrine disruption are observed in animals exposed to pesticides.

Key Findings

4) **Pesticides may travel through an organism** and end up in products derived from their tissues, including food, medicines and serums.

5) **Some BMPs do work** for pesticides and estrogenic compounds.

Key Findings

6) **PFAS and related compounds** (thousands in industrial and other uses) are **ubiquitous and widespread**.

- Is PFAS used in pesticide formulations and as additives?
- Is PFAS leached from pesticide containers?
- Is PFAS used as surfactants in applications?

Perfluorooctanesulfonic acid

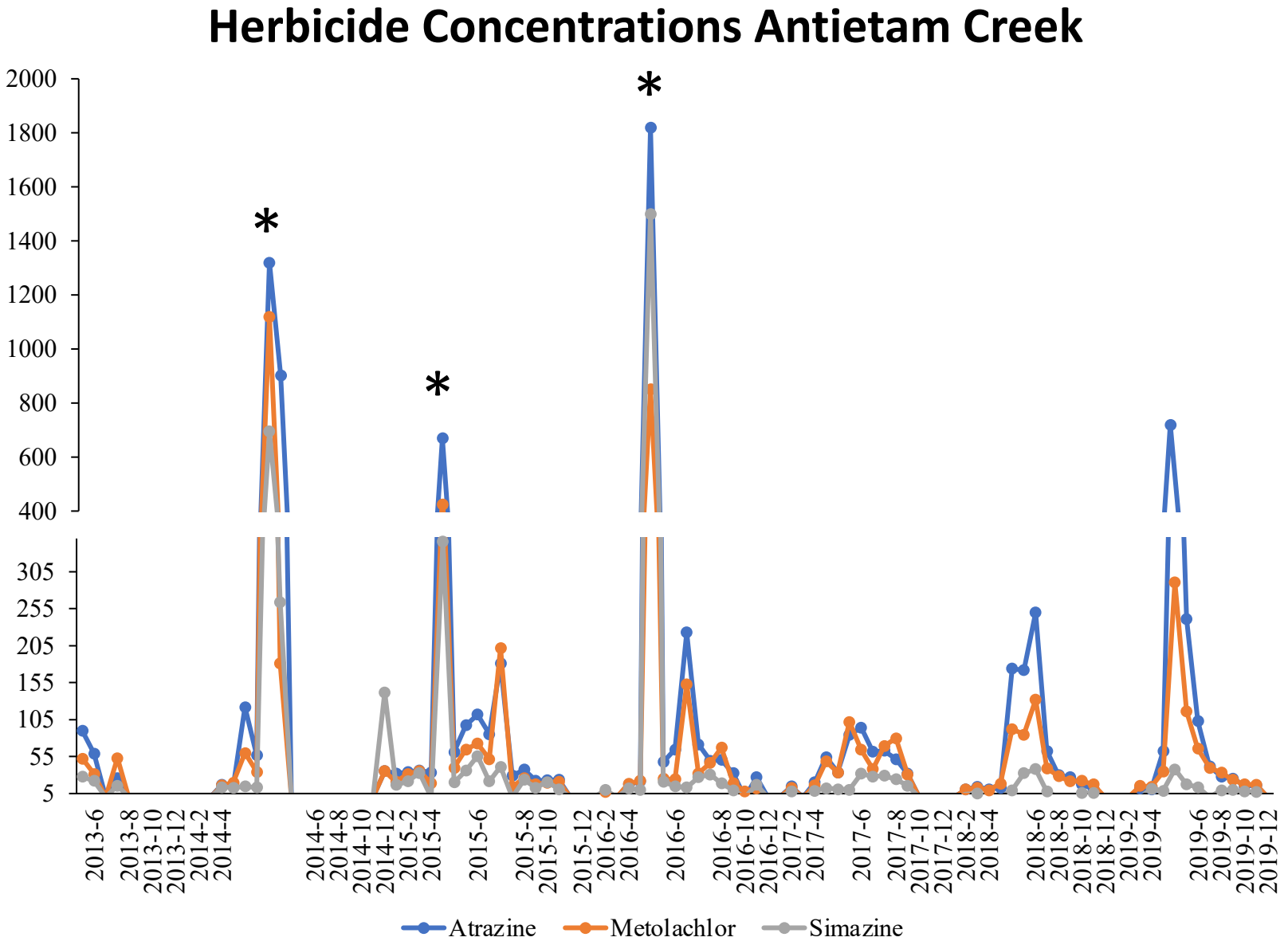
Perfluorooctanoic acid

Perfluorobutane sulfonate

Data Gaps

1) Better documentation of temporal changes in pesticide occurrence and exposure

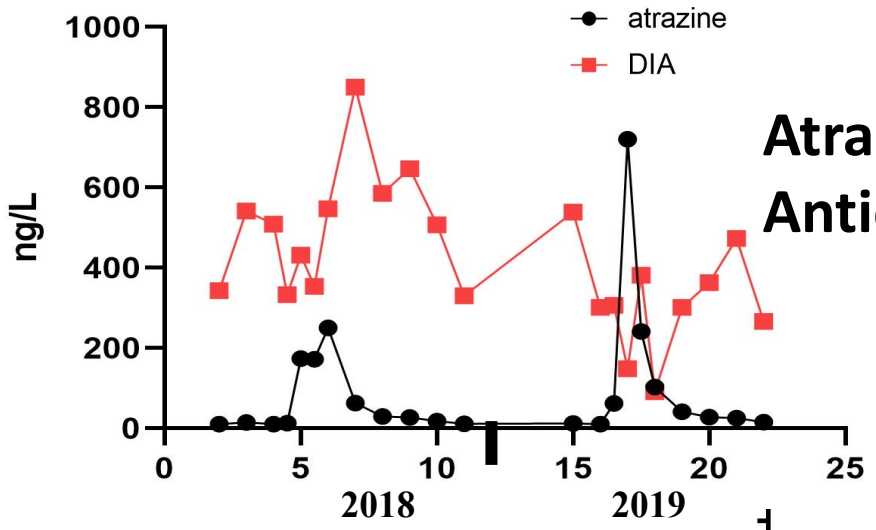
- Change in concentration seasonally and annually
- Influence of best management practices and land use practices
- Climatic factors regulating occurrence and exposure
- Exposures during key developmental and sensitive times



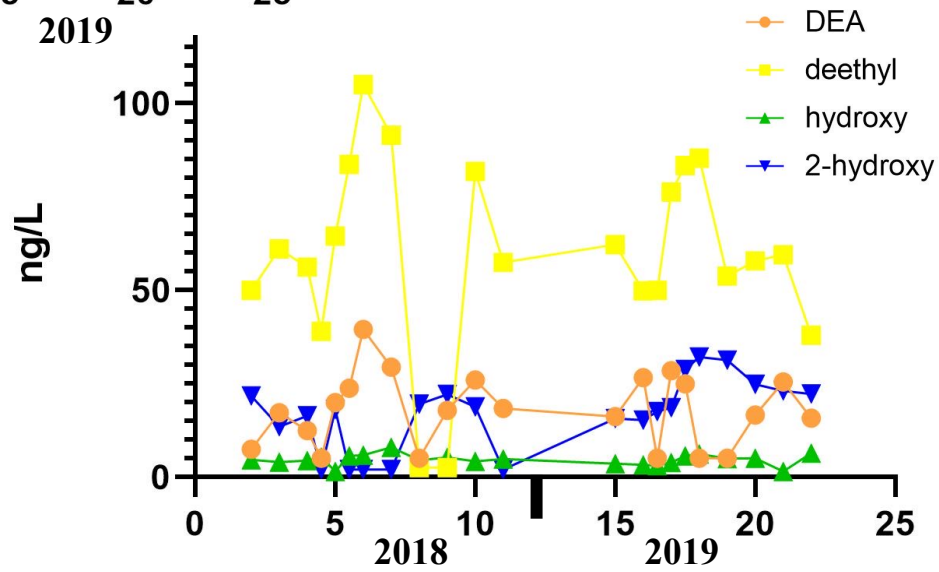
Data Gaps

2) Effects of exposure to complex mixtures

- Effects of pesticide mixtures
- Effects of pesticide degrades (metabolites)
- Interactions with other chemical contaminants
- Effects of ingredients other than parent chemicals in pesticide formulation – PFAS, other surfactants, inert additives
- Important to understand synergistic, antagonistic, additive effects



Atrazine and its metabolites
Antietam Creek 2018-2019



Data Gaps

3) Species sensitivity and ecosystem level effects

- Most laboratory exposures are conducted with model species which may or may not have similar sensitivities as economically important populations
- Better understanding of food web effects

Future Directions for the Research and Data Gaps Workgroup

1) **Stay current on methods developed to assess risk from multiple active ingredients and degradates**
   https://www.oecd.org/chemicalsafety/risk-assessment/considerations-for-assessing-the-risks-of-combined-exposure-to-multiple-chemicals.pdf

2) **Track the latest science on the quantity of PFAS associated with pesticide application**
   https://www.epa.gov/pesticides/pfas-packaging

3) **Mine the Jamboard input for important questions and perform literature reviews – Trends!**