# North Atlantic Chapter of SETAC

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Benefits include: networking, webinars, annual meeting, providing support for students in environmental fields.

## ANNUAL SPRING MEETING: April 5-7, 2021

****SUBMIT ABSTRACTS****

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****ATTEND!****

SHORT COURSE ON MICROPLASTICS, Monday, April 5, 9 a.m. to 12 PM
SESSIONS, Tuesday, April 6, 1 to 5 PM, ending with poster sessions and social, and Wednesday, April 7, 9 a.m. to 12 PM

# PFAS - Updates on Ecological Risk Assessment

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Disclaimer: Presentation represents the opinions of the author and are not official US Army Corps of Engineers policy.

# PFAS - Updates on Ecological Risk Assessment

- Governmental work groups
- Conferences and workshops
- Basic research – toxicity, bioaccumulation, background/reference
- Applied ecological risk assessment

How do we make sense of all that is going on?

Where will PFAS ecological risk assessment end up?

How do we plan site investigations and remedial actions in the ever-changing PFAS regulatory climate?

# Government Initiatives

- DoD PFAS Task Force established 2019:
  - To provide leadership and to ensure a coordinated approach on DoD wide efforts to proactively address PFAS.
- US Army Corps of Engineers Research Funding:
  - Focuses on treatment, sampling, analysis, and ecotoxicity.
  - For example, to address a critical data gap for higher level aquatic life funded research to provide PFAS toxicological data for commonly exposed wildlife.
- Tri-Services Ecological Risk Assessment Work Group (includes the EPA Ecological Risk Assessment Forum):
  - Major goal - to develop ecological risk assessment screening values for PFAS.
- EPA PFAS Action Plan:
  - Focuses on human health. Understanding of ecological risks of PFAS is a long-term goal (2022).

# Government Initiatives (continued)

- Many states have working groups, e.g.:
  - Maine
  - Connecticut
  - New York
  - Pennsylvania
  - Utah
  - Colorado
  - Michigan
- States' focus primarily on identifying sources, regulating drinking water and wastewater discharges, treatment technologies.
- Environmental Council of the States (ECOS):
  - Compiled information on state PFAS standards, advisories, and guidance values into a white paper; limited ecological levels.

# Conferences and Workshops

- 2019 SETAC Focused Topic Meeting and Workshop - Environmental Risk Assessment of PFAS - August 2019
- SETAC National Meeting November 2020
- SERDP-ESTCP virtual conference November 30, 2020 - December 4, 2020
- Postponed until 2022:  Northeast PFAS Science Conference: Public Health and the Environment, cosponsored by NEWMOA, NEIWPCC, NESCAUM, and NERC

# Basic Research - Toxicity

- From CRC 2018 document, studies exist for:
  - Reptiles and amphibians
  - Zooplankton
  - Freshwater algae
  - Marine diatoms
  - Terrestrial plants
- Review Articles/Presentations:
  - Arblaster et al. 2019 “Ecological Risks of Per and Polyfluoroalkyl Substances (PFAS)”: Mammalian data suggest the shortest PFCAs and PFSAs are generally less toxic than longer compounds for growth, reproduction and development endpoints. Some debate regarding potency of long- vs short-chain PFAS for some endpoints (e.g. immunosuppression). For non-mammalian receptors, lack of data beyond PFOA and PFOS.
  - Zodrow et al. 2020 “Development of Per and Polyfluoroalkyl Substances (PFAS) Ecological Risk Based Screening Levels (RBSLs).” Lists the number of studies identified with NOAELs and LOAELs for 9 PFOAs for mammals and 2 PFOAs for birds (shows wide range of effect levels for various PFAS compounds). Also summarizes effect levels for plants and soil invertebrates.
  - Ankley et al. 2020 “Assessing the Ecological Risks of Per- and Polyfluoroalkyl Substances: Current State-of-the Science and a Proposed Path Forward.” Aquatic invertebrates, fish, amphibians, reptiles, and mammals; acute and chronic exposure studies.

# Basic Research – Toxicity (continued)

- Toxicity study caveats:
  - Exposure Levels:  Are tests done at environmentally relevant concentrations? Toxicity may occur at higher concentrations than in the environment.
  - PFAS Species:  Unknown PFAS, their degradation products and precursors may be higher risk.
  - Sublethal Exposures and Risks:  Molecular markers of sublethal PFAS exposure are needed for risk assessment.

# Basic Research - Bioaccumulation

- Challenges:
  - Variable chemical properties – hard to predict partitioning between sediment and porewater or surface water.
  - Octanol water partitioning constant is not a good estimate for PFAS uptake.
- Uptake by biota depends on whether the PFAS is associated with sediment or dissolved in water.
- Some published studies available for benthic invertebrates.
- Biomagnification to higher level species depends on length of exposure and diet; limited fish and bird studies available.

# Basic Research – Background/Reference

- Lots of data from Great Lakes
  - Stahl, et al. (2014) measured PFAS concentrations in fish from U.S. urban rivers and the Great Lakes and found differences between them:
    - Urban Rivers: PFAS was detected in 80% of fish fillets in urban rivers; no detections for PFAS with seven or less carbon atoms including PFOA and PFBS.
    - Urban Rivers: PFOS was detected in 73% of the samples ranging from 0.0048 - 0.127 µg/kg fresh weight.
    - Great Lakes: PFAS with seven or less carbon atoms including PFOA were detected in all samples from the Great Lakes.
    - Great Lakes:  PFOS was detected in 100% of the samples and concentrations ranged from 0.0019 - 0.08 µg/kg fresh weight.
  - Other authors have been published; including Vedagiri, at al (2018), a summary of ambient levels of PFAS in various abiotic and biotic media.
- Important to check availability of background data at a regional level

Modified from: A Berndhardt poster SETAC Focused Topic Meeting 2019

# Applied Ecological Risk Assessment

1. **Planning**
   - How to plan site investigations to get usable data and to support decision-making?
   - Consider site-specific receptors and exposure pathways or pick representative receptors
   - Make sure the focus is on the end goals – will you be able to say:
     - Are there risks to ecological receptors?
     - Is this risk actionable?
2. **Selecting screening levels for environmental media and biological samples**
   - Compile publicly available screening levels
   - Or develop your own

# Applied Ecological Risk Assessment - Planning

- What are the target species?
- What biological tests are needed to support determination of risk?
  - Benthic toxicity testing
  - Fish tissue sampling
- What environmental samples should be taken?
  - Co-located surface water and sediment samples
  - Upstream and downstream
- How to select:
  - Site and background sampling locations
  - Number of samples
  - Analyte list and detection limits

# Applied Ecological Risk Assessment – Screening Levels – Public Sources

- Two SERDP Technical Reports
- CRC Contamination Assessment and Remediation of the Environment, Technical Report No. 43 PFAS Site Contamination (July 2018)
- ITRC tables: summary of available PFAS regulations as of March 2020: water table has about 75 lines, only about 20 are surface water or coastal water based; most are human health based, for drinking water or groundwater

# Applied Ecological Risk Assessment – Screening Levels – Public Sources (continued)

- **Guidance for Assessing the Ecological Risks of PFAS to Threatened and Endangered Species at Aqueous Film Forming Foam Impacted Sites, SERDP Project: ER18-1614, Revision 2, September 29, 2020**
  - Provides tables with recommended ecological toxicity and bioaccumulation values
  - Provides recommendations and suggestions for best practices based on the current state-of-the-science.
  - Based on a mid-2018 to early 2019 review of publicly available information.
  - "Approaches and recommendations in this guidance are subject to change based on new information, site-specific regulatory and scientific considerations, and common sense."

- **Second SERDP guidance document: Approach for Assessing PFAS Risk to Threatened and Endangered Species SERDP Project: ER18-1653, March 2020**
  - Develops SLs for aquatic life (aquatic plants, invertebrates, fish, and amphibians) terrestrial plants and soil invertebrates, and terrestrial and aquatic wildlife (birds and mammals)
  - Literature searches focused on primary studies published in 2017 or later.

# Applied Ecological Risk Assessment – Screening Levels – Public Sources (continued)

- SERDP ER 18-1614 has recommended:
  - Wildlife (mammalian) effects values for 11 individual PFAS compounds, each based on a single study lab animal study
  - When no available data, document suggests using the TRV for PFOS (the lowest, most conservative TRV identified), or TRVs with similar perfluorocarbon chain lengths, as surrogate TRVs.
  - Avian toxicity literature much more limited – 3 reported effect values are based on single wild bird species studies.
- SERDP ER18-1653 has recommended:
  - Aquatic life screening levels for 23 individual PFAS
  - Aquatic and terrestrial screening levels for mammals and birds
  - Soil screening levels for terrestrial plants for 6 individual PFAS
  - Soil SLs for soil invertebrates for 6 individual PFAS
- CRC, 2018 - develops and presents screening levels for freshwater and marine ecosystems

# Applied Ecological Risk Assessment – Screening Levels – Public Sources
(continued)

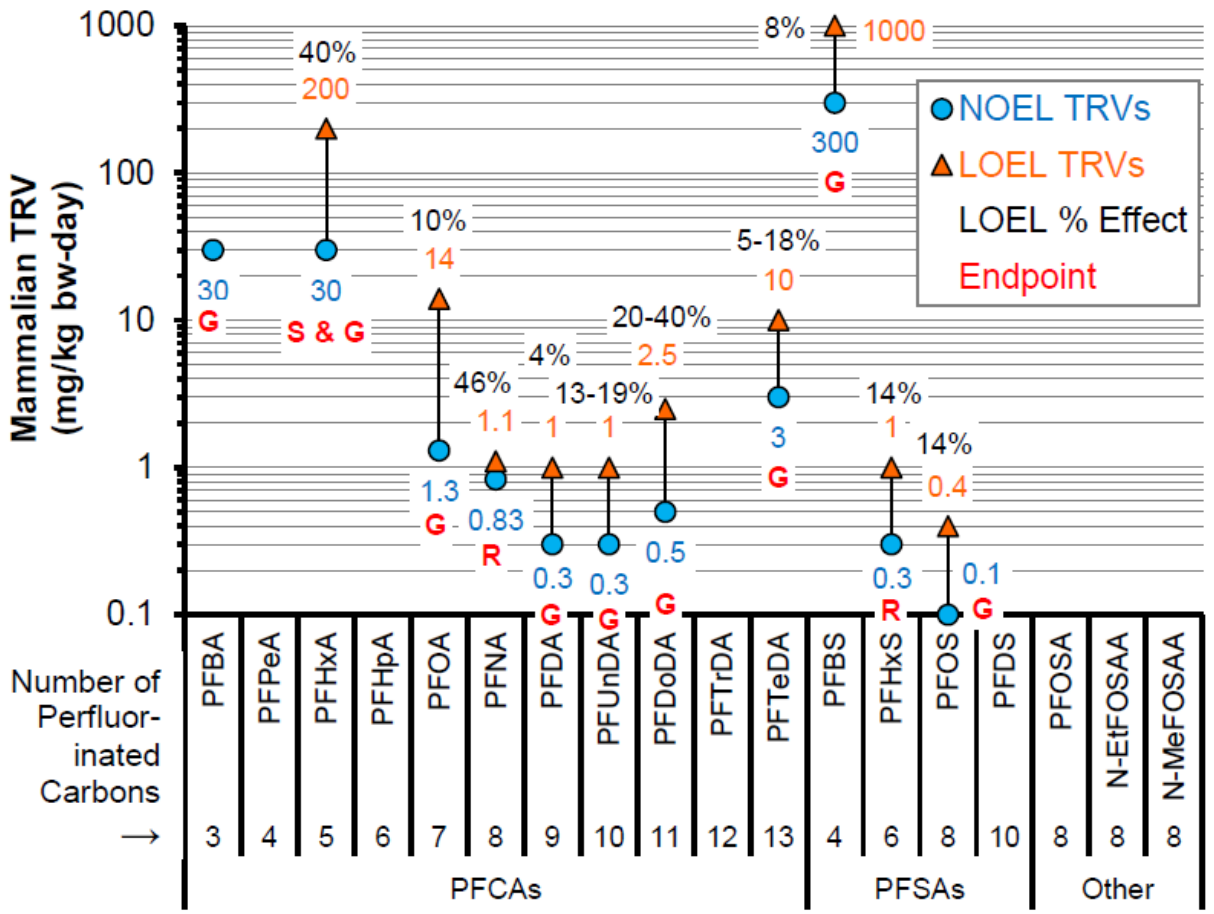



*Figure 11: Recommended NOEL and LOEL Values for Mammals for various PFAS. Endpoints are based on growth (G), survival (S) or reproduction (R).*

Figure from SERDP 2020

# Applied Ecological Risk Assessment – Developing Screening Levels

- Select appropriate assessment endpoints:
  - Focus on evaluating key endpoints that relate to overall community function such as growth, survival, reproduction, and development
  - Other potentially adverse endpoints may need to be considered.
- Compile published toxicity data for selected endpoints and site-specific receptors
  - Understand the magnitude and proportion of an effect from a toxicity study
    - Use of NOAEL (conservative) or LOAEL
    - Benchmark-dose modeling
- Exposure assumptions are needed for each receptor including:
  - Bioaccumulation factors (BAFs) for dietary items
  - Ingestion rates (soil ingestion rate [SIR] and food ingestion rate [FIR])
  - Body weight (BW)
  - Site use factor (SUF)
- Consider balancing factors

# How do we plan site investigations and remedial actions in an ever-changing PFAS regulatory climate?

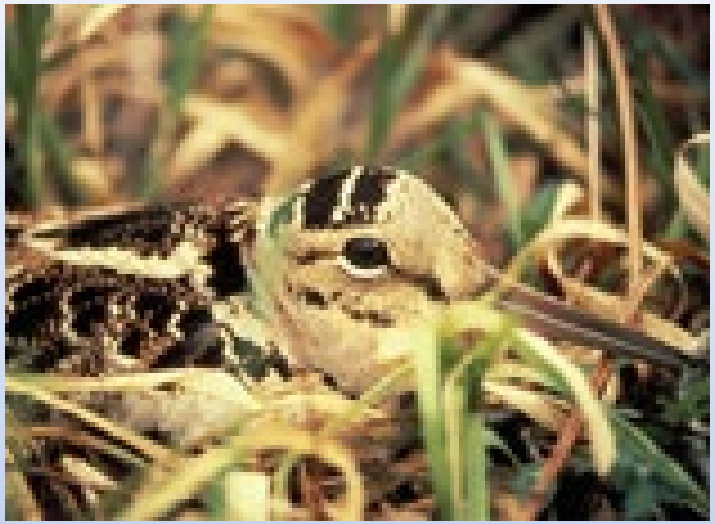
- Key is using scientifically defensible screening levels
- Don’t just take a published screening level at face value
- Select appropriate screening levels for the ecosystem and receptors under investigation
- Consider background levels in biota and environmental media

# Conclusions

- PFAS ecological regulations are evolving:
  - Expanding lists of regulated PFAS
  - Changing standards
- Growing toxicological dataset will inform new regulations

# Photos from Oxbow National Wildlife Refuge, formerly Fort Devens, Massachusetts

THANK YOU!



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- CRC Contamination Assessment and Remediation of the Environment, *Technical Report No. 43, PFAS Site Contamination* (July 2018)
- Environmental Council of States Summary of State PFAS regulations: https://www.ecos.org/pfas/
- EPA collaborating with states: https://www.epa.gov/newsreleases/icymi-epa-state-and-local-partners-team-address-pfas-across-country
- EPA PFAS Action Plan: https://www.epa.gov/sites/production/files/2020-01/documents/pfas_action_plan_feb2020.pdf
- Johnson et al., 2020. Estimating Environmental Hazard and Risks from Exposure to Per- and Polyfluoroalkyl Substances (PFASs): Outcome of a SETAC Focused Topic Meeting. *Environmental Toxicology and Chemistry*, 25 May 2020, https://setac.onlinelibrary.wiley.com/doi/full/10.1002/etc.4784
- Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP) - PFAS efforts: https://www.serdp-estcp.org/Featured-Initiatives/Per-and-Polyfluoroalkyl-Substances-PFASs
- SERDP Ecotoxicity Project Currently Funded: Advancing the Understanding of the Ecological Risk of Per- and Polyfluoroalkyl Substances, Dr. Christopher Salice, Towson University, ER-2627: https://www.serdp-estcp.org/Program-Areas/Environmental-Restoration/Risk-Assessment/ER-2627/ER-2627
- SERDP Guidance Document: *Guidance for Assessing the Ecological Risks of PFAS to Threatened and Endangered Species at Aqueous Film Forming Foam Impacted Sites*, SERDP Project: ER18-1614, Revision 2, September 29, 2020. (Note: J Arblaster presentation was a summary of this document.) https://www.serdp-estcp.org/content/download/49882/491435/file/ER18-1614%20Guidance%20Document.pdf
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