# Rapid identification of literature relevant for setting sediment quality guidelines for direct toxicity of PFAS to benthic organisms

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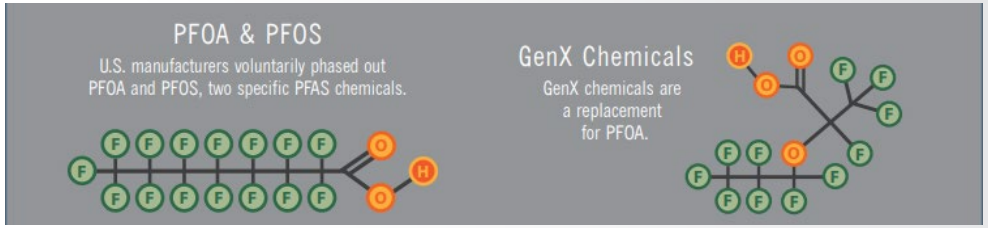
www.epa.gov/ecotox



The views expressed in this presentation are those of the authors and do not necessarily reflect the views or policies of the U.S. EPA.

# Per- and Polyfluoroalkyl Substances (PFAS)




- Persistence and wide distribution of some PFAS in the environment
  - Detection of PFAS across the world in water and other media
  - Detection in tissue samples of invertebrates, fish, amphibians, birds, marine mammals, terrestrial mammals
- Potential to bioaccumulate
- Effects on ecological species

- Evaluation of toxicity and development of benchmarks & criteria underway by federal and state agencies

# ECOTOX PFAS Literature Searches

- ECOTOX Knowledgebase, www.epa.gov/ecotox
  - Conducting large PFAS Literature searches 2018-2022 (chemical-based searches)
  - Reviewing literature for ECOTOX applicability
  - Extracting data on toxicity and study details, updated on public website

| # of Citations | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|
| Downloaded | 29,775 | 98,789 | 487,497 | 693,215 |
| Reviewed | 8,181 | 7,158 | 140,966 | 47,816 |
| Added to ECOTOX | 111 | 186 | 344 | 368 |

- Providing PFAS data to researchers, EPA Ecological Risk Assessment Forum (ERA), DoD Tri-Services ERA Work Group, EPA Program Offices, and others

# ECOTOX PFAS Literature Searches

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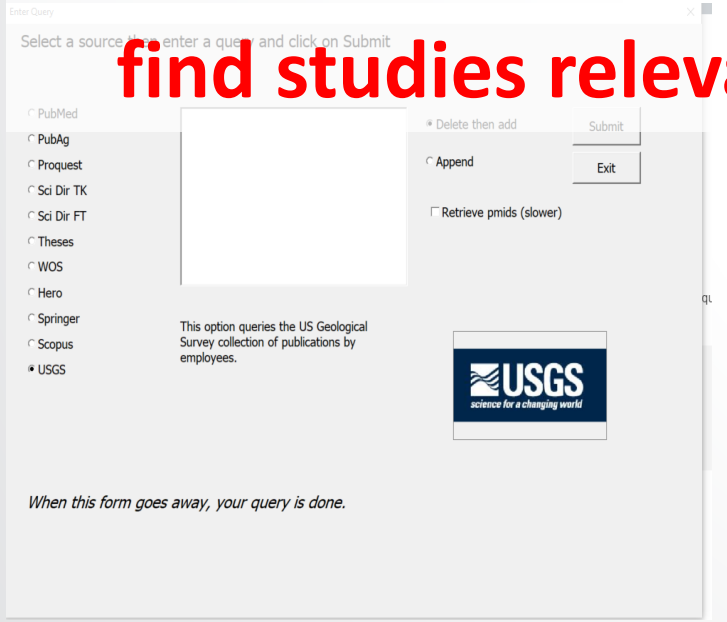
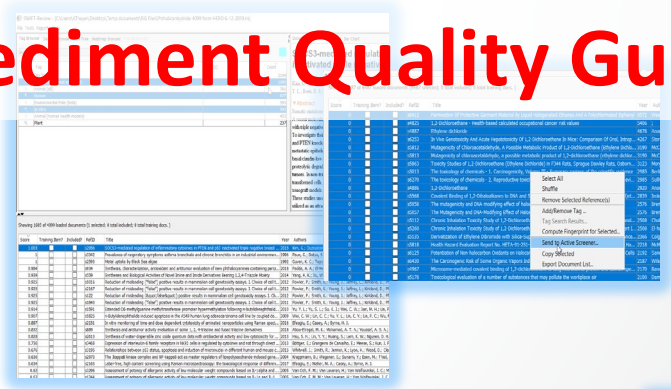
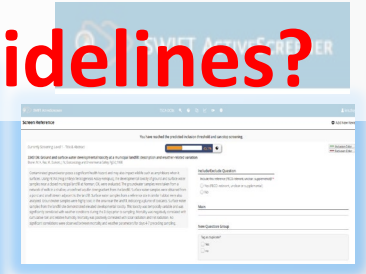
FY20 and FY21:
Implemented use of automated and semi-automated data analytic tools to significantly increase curation efficiencies

**Can we use these literature searches and data analytic tools to find studies relevant to setting Sediment Quality Guidelines?**

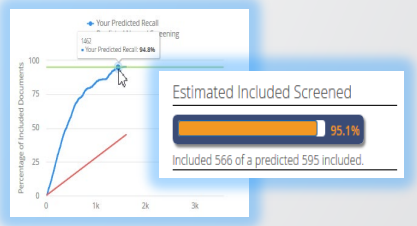



Abstract screening for API automated searches of abstract services databases





Machine learning AI tools for rapid Title/Abstract Screening



# Guidance Documents

- Sediment Quality Guidelines developed for the National Status and Trends Program. 1999.
- Donald D. MacDonald, Christopher G. Ingersoll. A Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater Ecosystems. Volume III - Interpretation of the Results of Sediment Quality Investigations. United States Environmental Protection Agency. Great Lakes National Program Office. EPA-905-B02-001-C. December 2002. 232 pages. - Appendix 3. Approaches to the Development of Numerical Sediment Quality Guidelines.
- Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates. ASTM International. Designation: E1706 – 20.
- Methods for Measuring the Toxicity and Bioaccumulation of Sediment -associated Contaminants with Freshwater Invertebrates. Second Edition. March 2000. Office of Research and Development Mid-Continent Ecology Division. U.S. Environmental Protection Agency. Duluth, Minnesota 55804. Office of Science and Technology. Office of Water. U.S. Environmental Protection Agency. Washington, D.C. 20460
- Sediment Quality Criteria for the Protection of benthic Organisms: Acenaphthene. September 1993. United States Environmental Protection Agency. Office of Water and Office of Research and Development. Office of Science and Technology

# Overview

**Goal**

*Identification of references relevant to setting Sediment Quality Guidelines for direct toxicity of PFAS to benthic organisms*

**Approach**

*Utilize extensive ECOTOX PFAS literature search results conducted 2018 – 2021.*

*Develop criteria for inclusion and sediment toxicity-specific terms*

*Test approach and criteria with test set of "Positive Control" sediment toxicity studies*

*Screen references using data analytic software for efficient review*

**Result**

*List of 24 potentially relevant studies to aid in setting sediment quality guidelines*

# ECOTOX PFAS Literature Searches

| Search | Chemicals Included in Search | # Citations |
|---|---|---|
| **2018 – April (initial full list)** | 200 PFAS (internal list, Draft Cross-Agency List) | 8,181 |
| 2018 – November (extension) | 50 PFAS (ToxCast Set 1) | 7,887 |
| 2019 – April (refresh on extension) | 50 PFAS (ToxCast Set 1) | 1,602 |
| **2019 – July (updated full list)** | 322 PFAS (Added EPA Research List, ToxCast Set 2) | 6,435 |
| 2019 – October | 23 PFAS (ToxCast replacement chemicals) | 137 |
| 2020 – January | 24 Priority PFAS | 14,689 |
| 2020 – April | 24 Priority PFAS | 17,871 |
| **2020 – July (updated full list)** | 412 PFAS + expanded generic terms (total of ~880 terms) | 455,000 |
| 2020 – October | 24 Priority PFAS | 8,180 |
| 2021 – January | 24 Priority PFAS | 7,681 |
| 2021 - April | 24 Priority PFAS | 9,262 |
| **2021 – July (updated full list)** | 432 PFAS + synonyms + generic terms (total of ~950 terms) | 238,134 |
| | **TOTAL:** | **775,059** |

# Criteria for Inclusion - Species

- Creation of 2 filters: Species and General Sediment
- Testing of filters with test set of “Positive Control” citations

**Species**:

Sediment-related species common names, scientific names, general species terms

- Based on 11 assessment documents
- Expanded and refined based on Species module in ECOTOX back-end Unify database
  - For example: If an assessment document included “polychaete” as a test organism, “polychaete” as a common name was searched in Unify and all scientific names of the results were added to the species filter list.
  - Species associated with “terrestrial” habitat reviewed and removed from the list.

# Assessment Documents

- Ecological Risk Assessment Guidance Document. Guidance for Conducting Ecological Risk Assessments. Ohio Environmental Protection Agency. Division of Environmental Response and Revitalization Assessment, Remediation and Corrective Action Section. July 2018. 129 pages.
- Judy L. Crane and Steve Hennes. February 2007. GUIDANCE FOR THE USE AND APPLICATION OF SEDIMENT QUALITY TARGETS FOR THE PROTECTION OF SEDIMENT-DWELLING ORGANISMS IN MINNESOTA. Minnesota Pollution Control Agency. MPCA Document Number: tdr-gl-04. Environmental Analysis and Outcomes Division. 64 pages.
- Guidance on Evaluating Sediment Contaminant Results. January 2010. Division of Surface Water. Standards and Technical Support Section. Ohio Environmental Protection Agency. 30 pages.
- Christopher G Ingersoll, Donald D MacDonald,Ning Wang, Judy L Crane, L Jay Field, Pam S Haverland, Nile E Kemble, Rebekka A Lindskoog, Corinne Severn, and Dawn E Smorong. Prediction of sediment toxicity using consensus-based freshwater sediment quality guidelines United States Geological Survey (USGS) final report for the U.S. Environmental Protection Agency (USEPA) Great Lakes National Program Office (GLNPO). EPA 905/R-00/007 June 2000. 33 pages.
- Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites. Marianne Lamont Horinko. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY WASHINGTON, D.C. 20460 FEB 12 2002. OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE OSWER Directive 9285.6-08. 11 pages.
- Screening and Assessment of Contaminated Sediment New York State Department of Environmental Conservation Division of Fish, Wildlife and Marine Resources Bureau of Habitat June 24, 2014. 99 pages.
- Sediment Management Standards. Chapter 173-204 WAC. Department of Ecology, State of Washington. Revised February 2013, Effective September 2013. Publication no. 13-09-055. 151 pages.
- Sediment Quality Guidelines developed for the National Status and Trends Program. 1999. 12 pages.
- Donald D. MacDonald, Christopher G. Ingersoll. A Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater Ecosystems. Volume III - Interpretation of the Results of Sediment Quality Investigations. United States Environmental Protection Agency. Great Lakes National Program Office. EPA-905-B02-001-C. December 2002. 232 pages.
- D.D. MacDonald, C.G. Ingersoll, D.E. Smorong, R.A. Lindskoog, G. Sloane and T. Biernacki. January 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Technical Report. Florida Department of Environmental Protection. 150 pages.
- D.D. MacDonald, B.L. Charlish, M.L. Haines, and K. Brydges. January 1994. Development and Evaluation of an Approach to the Assessment of Sediment Quality in Florida Coastal Waters. Volume 3 - Supporting Documentation: Biological Effects Database for Sediment. 288 pages.

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- Guidance on Evaluating Sediment Contaminant Results. January 2010. Division of Surface Water. Standards and Technical Support Section. Ohio Environmental Protection Agency. 10 pages.
- Christopher G Ingersoll, Donald D MacDonald,Ning Wang, Judy L Crane, L Jay Field, Pam S Haverland, Nile E Kemble, Rebekka A Lindskoog, Corinne Severn, and Dawn E Smorong. Prediction of sediment toxicity using consensus-based freshwater sediment quality guidelines United States Geological Survey (USGS) final report for the U.S. Environmental Protection Agency (USEPA) Great Lakes National Program Office (GLNPO). EPA 905/R-00/007 June 2000. 33 pages.
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- Screening and Assessment of Contaminated Sediment New York State Department of Environmental Conservation Division of Fish, Wildlife and Marine Resources Bureau of Habitat June 24, 2014. 55 pages.
- [illegible] Publication no. 13-09-055. 151 pages.
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- Donald D. MacDonald, Christopher G. Ingersoll. A Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater Ecosystems. Volume III - Interpretation of the Results of Sediment Quality Investigations. United States Environmental Protection Agency. Great Lakes National Program Office. EPA-905-B02-001-C. December 2002. 232 pages.
- D.D. MacDonald, C.G. Ingersoll, D.E. Smorong, R.A. Lindskoog, G. Sloane and T. Biernacki. January 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Technical Report. Florida Department of Environmental Protection. 150 pages.
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# Species Filter

| Common names |
|---|
| amphipod |
| amphipods |
| arthropod |
| arthropods |
| bivalve |
| bivalves |
| crustacean |
| crustaceans |
| echinoderm |
| echinoderms |
| mollusc |
| molluscs |
| mollusk |
| mollusks |
| nematode |
| nematodes |
| oyster |
| oysters |
| polychaete |
| polychaetes |
| shrimp |
| shrimps |

| |
|---|
| midge |
| midges |
| worm |
| worms |
| insect larva |
| insect larvae |
| benthic fish |
| benthic fishes |
| shellfish |
| shellfishes |
| Mayfly |
| Mayflies |
| Mayflys |
| Snail |
| snails |
| Clam |
| clams |
| Mussel |
| mussels |
| Oligochaete |
| Oligochaetes |

| General Species Terms |
|---|
| Benthic |
| epibenthic |
| infaunal |
| sediment-dwelling |
| sediment dwelling |

| Species Scientific Names |
|---|
| Genus |
| Genus species |
| ..... |
| 2,500 names |

| Subcategories within the Species filter | | |
|---|---|---|
| Common names | Species Scientific Names | General Species Terms |
| amphipod | Abarenicola | Benthic |
| amphipods | Abarenicola pacifica | epibenthic |
| arthropod | Ablabesmyia | infaunal |
| arthropods | Ablabesmyia monilis | sediment-dwelling |
| bivalve | Abra | sediment dwelling |
| bivalves | Abra alba | |
| crustacean | Abra nitida | |
| crustaceans | Acanthocephala | |
| echinoderm | Acantholyda | |
| echinoderms | Acetes | |
| mollusc | Achatina | |
| molluscs | Achatinidae | |
| mollusk | Achromadora | |
| mollusks | Achyra | |
| nematode | Aciculata | |
| nematodes | Acoela | |
| oyster | Acolpenteron | |
| oysters | Acolpenteron ureteroecetes | |
| polychaete | Acrobeles | |
| polychaetes | Acrobeloides | |
| shrimp | Acrobeloides buetschlii | |
| shrimps | Acrobeloides nanus | |
| midge | Acteocina | |
| midges | Actinonaias | |
| worm | Actinonaias pectorosa | |
| worms | Adenophlebia | |
| insect larva | Adenophlebia auriculata | |
| insect larvae | Aeolosoma | |
| benthic fish | Aeolosomatidae | |
| benthic fishes | Afghanurus | |
| shellfish | Afghanurus joernensis | |
| shellfishes | Afronurus | |
| Mayfly | Afronurus yoshidae | |
| Mayflies | Agamermis | |
| Mayflys | Agamermis unka | |
| Snail | Agathon | |
| snails | Alaimidae | |
| Clam | Alaimus | |
| clams | Alaimus primitivus | |
| Mussel | Alasmidonta | |
| mussels | Alasmidonta heterodon | |
| Oligochaete | Alectryonella | |
| Oligochaetes | Alectryonella plicatula | |

# Criteria for Inclusion - Methods

- Creation of 2 filters: Species and General Sediment
- Testing of filters with test set of “Positive Control” citations

**Sediment**:

Initially applied specific set of sediment methods terms

- Based on Guidance documents

- These were too specific to catch all Positive Control studies

Instead used general sediment terms:

"sediment" OR "sediments" OR
"-sediment" OR "-sediments" OR
"sediment-" OR "sediments-"

United States Environmental Protection Agency | Office of Research and Development Washington DC 20460 | Office of Water 4305 Washington DC 20460 | EPA/600/R-99/064 March 2000

EPA

**Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates**

Second Edition

ASTM INTERNATIONAL

**Designation: E1706 – 20**

**Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates[1]**

United States Environmental Protection Agency | Great Lakes National Program Office 77 West Jackson Boulevard Chicago, Illinois 60604 | EPA-905-B02-001-C December 2002

EPA

**A Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater Ecosystems**

*Volume III - Interpretation of the Results of Sediment Quality Investigations*

# Citation Test Set

- Creation of 2 filters: Species and General Sediment
- Testing of filters with test set of "Positive Control" citations

**Test Set of Positive Control Citations**:

- Positive Controls: manual screening to identify 20+ studies that should be included
  - PFAS and non-PFAS studies
  - Many are spiked sediment studies
  - Variety of species
- Combination of 2 filters identified all Positive Control citations

Arch. Environ. Contam. Toxicol. 35, 573–579 (1998)

## Sediment Tox
## with *Leptoch*

P. C. Fuchsman,[1] T.
[1] McLaren/Hart-ChemR
[2] McLaren/Hart-ChemR

Received: 23 February

**Abstract.** Hexachlor
chemical that has sl
concentrations up to
equilibrium partition
benchmarks, which
based on contamin
predicts that HCB v
invertebrates as a sed
for toxicity due to d
has not been thorou
survival and growth
*plumulosus*, the fresl
midge *Chironomus t*
sure to sediment spik
*azteca* was tested ur
salinity) conditions.
any test species at
normalized to 1% or
ences were less tha
endpoints. The obse
evidence indicating
ment toxicity to bent

Water Air Soil Pollut (2012) 223:5097–5104
DOI 10.1007/s11270-012-1261-y

## Assessing th
## Spiked in A

Leobardo Manuel
Nadia Neri-Cruz
Patricia Vieyra-Rey
Celene Razo-Estrad
Alba Yadira Corra

Received: 16 April 201
© Springer Science+Bu

**Abstract** Paracetar
widely used globally
water bodies and is
aquatic species; how
oxidative stress in s
The objective was to
uate the toxicity e
*Hyalella azteca* by p
ing oxidative stres
assays were determi
median lethal concer
ing oxidative stress
peroxidation (LPO),
in order to determine
activity of the an
dismutase (SOD),

Water Air Soil Pollut (2015) 226: 195
DOI 10.1007/s11270-015-2454-y

## Naproxen-En
## Stress and Ge

García-Medina Alba I
Gómez-Oliván Leobar

Received: 23 December 201
© Springer International Pu

**Abstract** The nonsteroi
sodium is among the mo
ticals in Mexico. Neve
regulation to control its
agent can enter water
attaining significant cor
ments since they are the
contaminants, and may
Naproxen sodium is wa
aquatic ecosystems, an
when oxidized. The ain
the oxidative stress and

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Contents lists available at Scien

ELSEVIER

Aquatic Toxicol

journal homepage: www.elsevier.co

## Effects of sediment-spiked lufenuron on benthic in outdoor microcosms and single-species toxic

T.C.M. Brock[a,*], D.A. Bas[b], J.D.M. Belgers[a], L. Bibbe[b], M-C. Boe
N.J. Diepens[c], M.H.S. Kraak[b], J.A. Vonk[b], I. Roessink[a]

[a] Alterra, Wageningen University and Research Centre, P.O. Box 47, 6700 AA Wageningen, The Netherlands
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Sediment ecotoxicology
Benzoylurea insecticide
*Chironomus riparius*
*Hyalella azteca*
*Lumbriculus variegatus*
Semi-field experiment

ABSTRACT

Sediment ecotoxicity studies were condu
spiked mesocosm experiment with this l
value of laboratory single-species tests
macroinvertebrates, and (iii) to calibrate
For this purpose the concentration-resp
spiked microcosms and those of 28-d s
*riparius*, *Hyalella azteca* and *Lumbriculus*
of the microcosms. On average, 87.7% of t
sediment after 12 weeks. Overall, benth
and oligochaetes treatment-related incre
0.79 μg lufenuron/g organic carbon in dry
sp. Multivariate analysis of the response
NOEC of 0.79 μg a.s./g OC. The treatment-
with the results of the 28-d laboratory tox
crustacean *H. azteca* were approximately
*L. variegatus*. In our laboratory tests, usin
OC) was observed for *C. riparius* (endpoir
using artificial sediment, a NOEC of 2.35 μ
case, the sediment tier-1 effect assesme
NOEC (artificial sediment) of *C. riparius*
treatment-related responses observed in

Available online at www.sciencedirect.com
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Ecotoxicology and Environmental Safety 55 (2003) 204–212

Ecotoxicology and Environmental Safety

Arch. Environ. Contam. Toxicol. 42, 292–302 (2002)
DOI: 10.1007/s00244-001-0032-3

ARCHIVES OF Environmental Contamination and Toxicology
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## Biological Responses of *Lumbriculus variegatus* Exposed to Fluoranthene-Spiked Sediment

P. F. Landrum,[1] M. L. Gedeon,[2] G. A. Burton,[3] M. S. Greenberg,[3] C. D. Rowland[3]

[1] Great Lakes Environmental Research Laboratory, 2205 Commonwealth Blvd., Ann Arbor, Michigan 48105, USA
[2] Cooperative Institute for Limnology and Ecosystem Research, 2200 Bonisteel Ave., University of Michigan, Ann Arbor, Michigan 48109, USA
[3] Institute for Environmental Quality, 3640 Colonel Glenn Hwy., Wright State University, Dayton, Ohio 45435, USA

Received: 31 May 2001/Accepted: 9 November 2001

**Abstract.** *Lumbriculus variegatus* was used as a bioassay organism to examine the impact of the sediment-associated polycyclic aromatic hydrocarbon (PAH) fluoranthene on behavior, reproduction, and toxicokinetics. The number of worms increased between the beginning and end of the experiment at 59 μg $g^{-1}$ fluoranthene, but at the next higher treatment (108 μg $g^{-1}$) the number of worms found was lower and not different from the control. Worms exposed to 95 μg $g^{-1}$ also exhibited increased reproduction when fed a yeast-cerophyl-trout chow mixture. On a total biomass basis, only the 95 μg $g^{-1}$ exposure with food exhibited a statistically significant increase over the nonfed control. Evaluation of reproduction at the two highest treatments was compromised by a brief aeration failure 2 days before the end of the experiment. The behavioral responses were followed as changes in biological burial rate (sediment reworking rate) of a $^{137}$Cs-labeled marker layer. The biological burial rate increased toward a plateau as the concentration increased from the control (3.9 μg $g^{-1}$ dry weight total PAH) to 355 μg $g^{-1}$ dry weight fluoranthene in sediment. The aeration failure had minimal impact on the determination of reworking rate because all the data for the rate determination were collected prior to the aeration failure. Uptake and elimination rates declined with increasing treatment concentration across the range of fluoranthene concentrations, 59–355 μg $g^{-1}$ dry weight sediment. The disconnect between the increasing biological burial rates and the decreasing toxicokinetics rates with increasing exposure concentration demonstrates that the toxicokinetic processes are dominated by uptake and elimination to interstitial water. The bioaccumulation factor (concentration in the organisms on a wet weight basis divided by the concentration in sediment on a dry weight basis) ranged from 0.92 to 1.88 on day 10 and declined to a range of 0.52 to 0.99 on day 28 with the lowest value at the highest dose.

changes to mortality. Mortality was the dominant endpoint for many years during the development of sediment bioassays, but recent guidance calls for the addition of nonlethal endpoints, such as growth and reproduction (US EPA 2000; ASTM 2000).

Oligochaetes have an intimate contact with the sediment and have important roles in aquatic systems both as a prey item and for the bioturbation (mixing) of sediments by feeding at depth and depositing fecal materials at the surface (Fisher *et al.* 1980; Krezoski and Robbins 1985; Robbins 1986). Several species have been investigated for application in freshwater sediment bioassays (Bailey and Liu 1980; Keilty *et al.* 1988a, 1988b, 1988c; Reynoldson *et al.* 1991). Currently, the oligochaete *Lumbriculus variegatus* is the recommended organism for determining bioaccumulation of sediment-associated contaminants in fresh water (US EPA 2000; ASTM 2000) and has been used as a toxicity bioassay organism (Bailey and Liu 1980; Ankley *et al.* 1991; Kukkonen and Landrum 1994; Monson *et al.* 1995; Drews 1997).

Of the bioassays used for assessing effects on oligochaetes, sediment-reworking rates (determined as biological burial rates of a marker layer) have proven to be a sensitive indicator of oligochaete response to contaminant concentrations in sediments (Keilty *et al.* 1988b, 1988c; Keilty and Landrum 1990). The approach uses the conveyor-belt feeding activity of the oligochaete to bury a radiolabeled marker layer in sediment. For the control, changes in the burial rate are a function of feeding rate, the number and density of organisms, and the characteristics of the sediment. With exposure to contaminants, sediment reworking rate will also be affected by the impact of the contaminants on the worms. When sediment reworking rates were used for the assessment of endrin-contaminated sediment, a reduction of the biological burial rate of a marker layer was observed at endrin sediment concentrations approximately four to five orders of magnitude lower than those required to produce mortality at 96 h and about 10-fold lower

# Positive Control Citations

| | |
|---|---|
| 1 | Liu, Y.; Junaid, M.; Xu, P.; Zhong, W.; Pan, B.; Xu, N. 2020. Suspended Sediment Exacerbates Perfluorooctane Sulfonate Mediated Toxicity through Reactive Oxygen Species Generation in Freshwater Clam Corbicula fluminea. Environ. Pollut. |
| 2 | Brock, T. C. M.; Bas, D. A.; Belgers, J. D. M.; Bibbe, L.; Boerwinkel, M. C.; Crum, S. J. H.; Diepens, N. J.; Kraak, M. H. S.; Vonk, J. A.; Roessink, I. 2016. Effects of Sediment-Spiked Lufenuron on Benthic Macroinvertebrates in Outdoor Microcosms and Single-Species Toxicity Tests. Aquat. Toxicol. |
| 3 | Pasteris, A.; Vecchi, M.; Reynoldson, T. B.; Bonomi, G. 2003. Toxicity of Copper-Spiked Sediments to Tubifex tubifex (Oligochaeta, Tubificidae): A Comparison of the 28-Day Reproductive Bioassay with a 6-Month Cohort Experiment. Aquat. Toxicol. |
| 4 | Gomez-Olivan, L. M.; Neri-Cruz, N.; Galar-Martinez, M.; Vieyra-Reyes, P.; Garcia-Medina, S.; Razo-Estrada, C.; Dublan-Garcia, O.; Corral-Avitia, A. Y. 2012. Assessing the Oxidative Stress Induced by Paracetamol Spiked in Artificial Sediment on Hyalella azteca. Water Air Soil Pollut. |
| 5 | Fuchsman, P. C.; Barber, T. R.; Sheehan, P. J. 1998. Sediment Toxicity Evaluation for Hexachlorobenzene: Spiked Sediment Tests with Leptocheirus plumulosus, Hyalella azteca, and Chironomus tentans. Arch. Environ. Contam. Toxicol. |
| 6 | Martinez, E. A.; Moore, B. C.; Schaumloffel, J.; Dasgupta, N. 2003. Morphological Abnormalities in Chironomus tentans Exposed to Cadmium- and Copper-Spiked Sediments. Ecotoxicol. Environ. Saf. |
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| 12 | Taylor, A. M.; Maher, W. A. 2012. Exposure-Dose-Response of Anadara trapezia to Metal Contaminated Estuarine Sediments 3. Selenium Spiked Sediments. Aquat. Toxicol. |

# Positive Control Citations, cont.

| | |
|---|---|
| 12 | Taylor, A. M.; Maher, W. A. 2012. Exposure-Dose-Response of Anadara trapezia to Metal Contaminated Estuarine Sediments 3. Selenium Spiked Sediments. Aquat. Toxicol. |
| 13 | Beyrem, H.; Boufahja, F.; Hedfi, A.; Essid, N.; Aissa, P.; Mahmoudi, E. 2011. Laboratory Study on Individual and Combined Effects of Cobalt- and Zinc-Spiked Sediment on Meiobenthic Nematodes. Biol. Trace Elem. Res. |
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| 16 | Mendez, N.; Lacorte, S.; Barata, C. 2013. Effects of the Pharmaceutical Fluoxetine in Spiked-Sediments on Feeding Activity and Growth of the Polychaete Capitella teleta. Mar. Environ. Res. |
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| 22 | Bettinetti, R.; Cuccato, D.; Galassi, S.; Provini, A. 2002. Toxicity of 4-Nonylphenol in Spiked Sediment to Three Populations of Chironomus riparius. Chemosphere |

# Workflow for Screening Citations

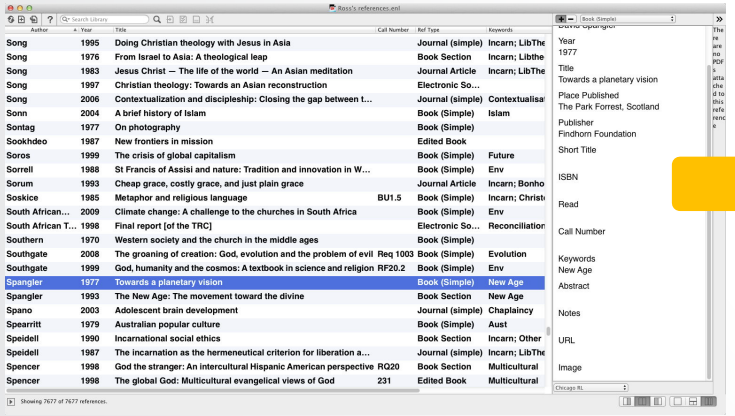
| Literature Search Results | | Apply Filters | | |
|---|---|---|---|---|
| Search | # Citations | Species Filter | Sediment Filter | Both Filters |
| 2018 – April | 8,181 | 320 | 302 | 49 |
| 2018 – November | 7,887 | 13 | 9 | 0 |
| 2019 – April | 1,602 | 4 | 2 | 0 |
| 2019 – July | 6,435 | 68 | 70 | 7 |
| 2019 – October | 137 | 1 | 0 | 0 |
| 2020 – January | 14,689 | 668 | 733 | 89 |
| 2020 – April | 17,871 | 782 | 970 | 107 |
| 2020 – July | 455,000 | 8,233 | 9068 | 1281 |
| 2020 – October | 8,180 | 134 | 263 | 18 |
| 2021 – January | 7,681 | 154 | 298 | 25 |
| 2021 - April | 9,262 | 279 | 295 | 41 |
| 2021 – July | 238,134 | 2186 | 1197 | 136 |
| **TOTAL:** | **775,059** | **12842** | **13207** | **1753** |

# Workflow for Screening Citations

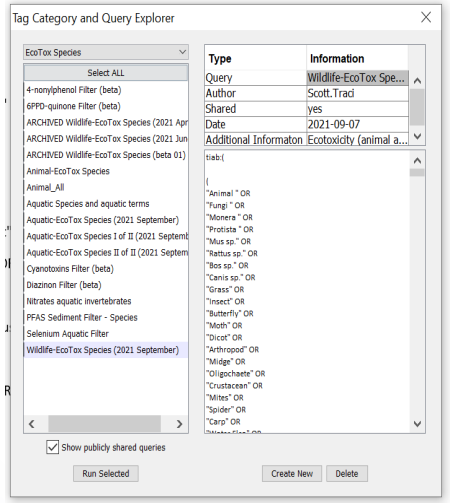
**PFAS 2018-2021**

**N = 775,059 refs** → **N = 1,753 refs** → **N = 330 refs**

## Literature Search Results




## Species and Sediment Filters

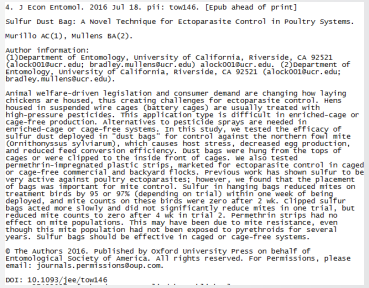



Swift Review

## DeDuplication

During import to SwiftActive Screener

## Title and Abstract Screening




SwiftActive Screener

# Citations by Search

| Search | # Citations | Species Filter | Sediment Filter | Both Filters | For Screening (after de-dup*) |
|---|---|---|---|---|---|
| 2018 – April | 8,181 | 320 | 302 | 49 | 24 |
| 2018 – November | 7,887 | 13 | 9 | 0 | 0 |
| 2019 – April | 1,602 | 4 | 2 | 0 | 0 |
| 2019 – July | 6,435 | 68 | 70 | 7 | 1 |
| 2019 – October | 137 | 1 | 0 | 0 | 0 |
| 2020 – January | 14,689 | 668 | 733 | 89 | 5 |
| 2020 – April | 17,871 | 782 | 970 | 107 | 2 |
| 2020 – July | 455,000 | 8,233 | 9068 | 1281 | 120 |
| 2020 – October | 8,180 | 134 | 263 | 18 | 0 |
| 2021 – January | 7,681 | 154 | 298 | 25 | 1 |
| 2021 - April | 9,262 | 279 | 295 | 41 | 41 |
| 2021 – July | 238,134 | 2186 | 1197 | 136 | 136 |
| **TOTAL:** | **775,059** | **12842** | **13207** | **1753** | **330** |

# Screening Inclusion Criteria

| | |
|---|---|
| P<br>(Population) | Animal: Aquatic benthic organisms (live, whole organism) of any lifestage, including crustaceans, molluscs, insects, worms, and other invertebrates.-Vertebrates include benthic fish. Bacteria and viruses are not included. |
| E<br>(Exposure) | Relevant forms:<br>All PFAS chemicals, based on inclusion in the CompTox Chemicals Dashboard PFAS Master List Version 2 (https://comptox.epa.gov/dashboard/chemical_lists/PFASMASTER, accessed June 10, 2021)<br>*Searches do not include all the PFAS on this list, but any PFAS in the paper would be considered relevant.<br>Animal: Any exposure to PFAS via sediment or artificial sediment/media.<br>*Exposures via overlying water, pore water, and interstitial water are of interest. Exposures with sediment present in the test system and have an effect are of interest.<br>*Studies with multiple PFAS toxicants mixed together are considered mixtures.<br>*Studies involving exposure to mixtures included only if exposure to a relevant form of chemical alone is included.<br>*Mixture-only studies are tagged as supplemental material and will be delivered as Excel files with exclusionary terms attached.<br>*Field-based survey studies are tagged as supplemental material and will be delivered as Excel files with exclusionary terms attached.<br>*Only sediment-related surveys were excluded as Survey at the TIAB stage. All other surveys were excluded as Aqueous/Terrestrial Exposure.<br>*Studies that include sediment collected from the field and tested in the laboratory were included at the TIAB stage, granted there was a concentration or effect reported. |
| C<br>(Comparison/ Control) | A concurrent control group exposed to vehicle-only treatment and/or untreated control (control could be a baseline measurement). |
| O<br>(Outcome) | All biological effects (including bioaccumulation from laboratory studies with concurrently measured media and tissue concentrations).<br>*Bioaccumulation is not ‘direct toxicity’. Bioaccumulation studies will be included at the TIAB stage. |

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# Screening Inclusion Criteria

| | |
|---|---|
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| | A concurrent control group exposed to vehicle-only treatment and/or untreated control (control could be a baseline measurement) |

# Screening Inclusion Criteria

| | |
|---|---|
| **P (Population)** | Animal: Aquatic benthic organisms (live, whole organism) of any lifestage, including crustaceans, molluscs, insects, worms, and other invertebrates. Vertebrates include benthic fish. Bacteria and viruses are not included. |
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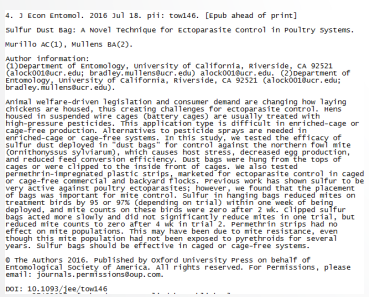
# Title and Abstract Screening

## PFAS 2018-2021

**N = 330 refs**

## Title and Abstract Screening



4. J Econ Entomol. 2016 Jul 18. pii: tow146. [Epub ahead of print]

Sulfur Dust Bag: A Novel Technique for Ectoparasite Control in Poultry Systems.

Murillo AC(1), Mullens BA(2).

Author information:
(1)Department of Entomology, University of California, Riverside, CA 92521 (alock0010@ucr.edu; bradley.mullens@ucr.edu) alock0010@ucr.edu. (2)Department of Entomology, University of California, Riverside, CA 92521 (alock0010@ucr.edu; bradley.mullens@ucr.edu).

Animal welfare-driven legislation and consumer demand are changing how laying chickens are housed, thus creating challenges for ectoparasite control. Hens housed in suspended wire cages (battery cages) are usually treated with high-pressure pesticides. This application type is difficult in enriched-cage or cage-free production. Alternatives to pesticide sprays are needed in enriched-cage or cage-free systems. In this study, we tested the efficacy of sulfur dust deployed in "dust bags" for control against the northern fowl mite (Ornithonyssus sylviarum), which causes host stress, decreased egg production, and reduced feed conversion efficiency. Dust bags were hung from the tops of cages or were clipped to the inside front of cages. We also tested permethrin-impregnated plastic strips, marketed for ectoparasite control in caged or cage-free commercial and backyard flocks. Previous work has shown sulfur to be very active against poultry ectoparasites; however, we found that the placement of bags was important for mite control. Sulfur in hanging bags reduced mites on treatment birds by 95 or 97% (depending on trial) within one week of being deployed, and mite counts on these birds were zero after 2 wk. Clipped sulfur bags acted more slowly and did not significantly reduce mites in one trial, but reduced mite counts to zero after 4 wk in trial 2. Permethrin strips had no effect on mite populations. This may have been due to mite resistance, even though this mite population had not been exposed to pyrethroids for several years. Sulfur bags should be effective in caged or cage-free systems.

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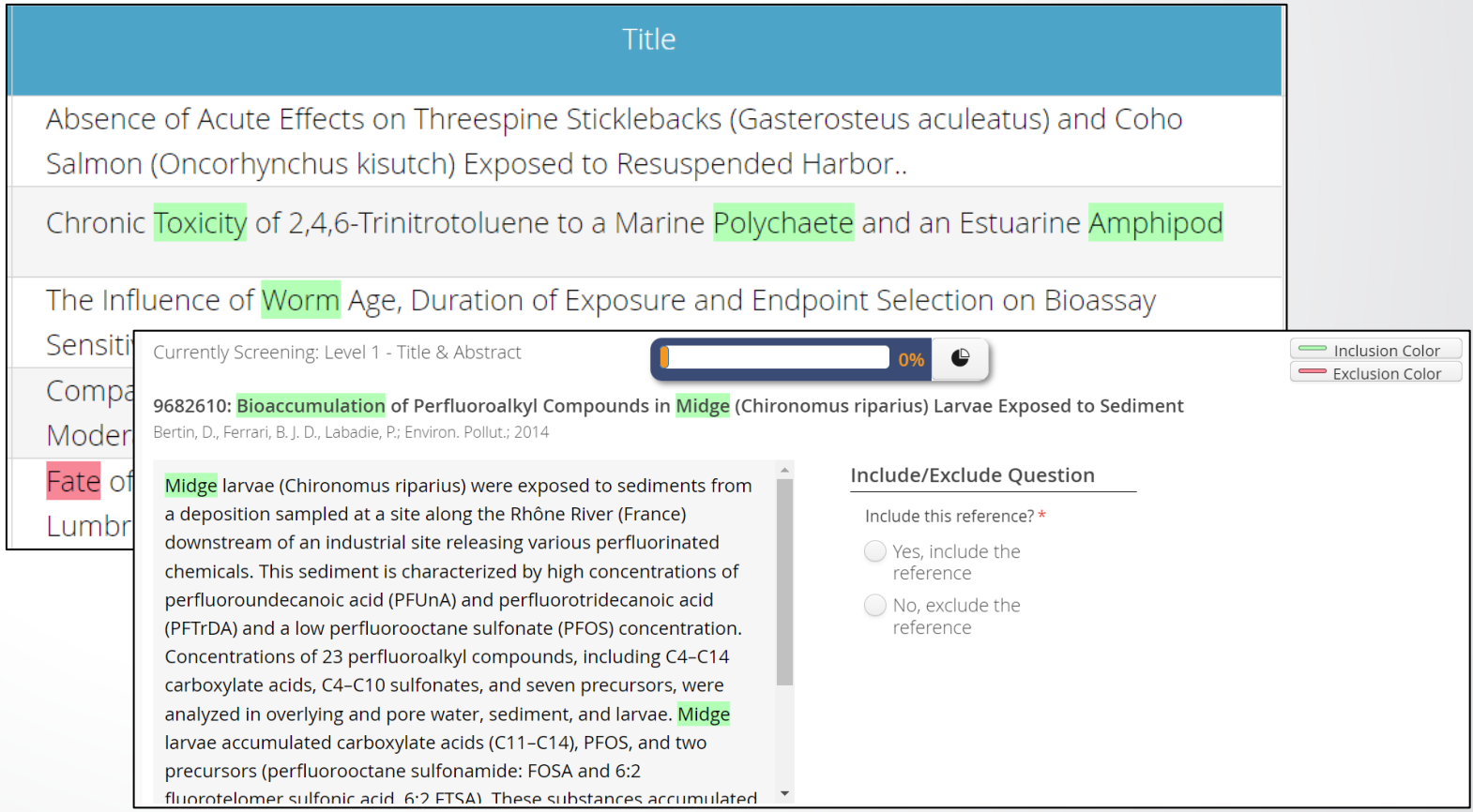
DOI: 10.1093/jee/tow146

SwiftActive Screener

*<u>Screener aids</u>:*

- *Highlighted Terms*
- *Positive seeds (Positive Control studies)*



Title

Absence of Acute Effects on Threespine Sticklebacks (Gasterosteus aculeatus) and Coho Salmon (Oncorhynchus kisutch) Exposed to Resuspended Harbor..

Chronic Toxicity of 2,4,6-Trinitrotoluene to a Marine Polychaete and an Estuarine Amphipod

The Influence of Worm Age, Duration of Exposure and Endpoint Selection on Bioassay

Currently Screening: Level 1 - Title & Abstract

0%

Inclusion Color

Exclusion Color

9682610: Bioaccumulation of Perfluoroalkyl Compounds in Midge (Chironomus riparius) Larvae Exposed to Sediment

Bertin, D., Ferrari, B. J. D., Labadie, P.; Environ. Pollut.; 2014

Midge larvae (Chironomus riparius) were exposed to sediments from a deposition sampled at a site along the Rhône River (France) downstream of an industrial site releasing various perfluorinated chemicals. This sediment is characterized by high concentrations of perfluoroundecanoic acid (PFUnA) and perfluorotridecanoic acid (PFTrDA) and a low perfluorooctane sulfonate (PFOS) concentration. Concentrations of 23 perfluoroalkyl compounds, including C4–C14 carboxylate acids, C4–C10 sulfonates, and seven precursors, were analyzed in overlying and pore water, sediment, and larvae. Midge larvae accumulated carboxylate acids (C11–C14), PFOS, and two precursors (perfluorooctane sulfonamide: FOSA and 6:2 fluorotelomer sulfonic acid, 6:2 FTSA). These substances accumulated

Include/Exclude Question

Include this reference? *

Yes, include the reference

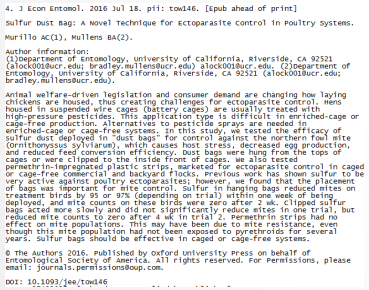
No, exclude the reference

# Title and Abstract Screening

## PFAS 2018-2021

**N = 330 refs**

**Title and Abstract Screening**



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DOI: 10.1093/jee/tow146

SwiftActive Screener

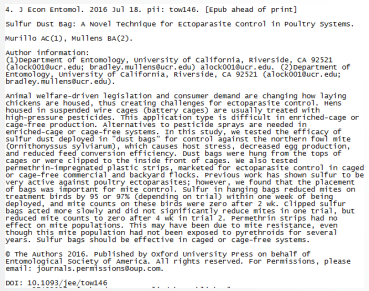
| | # of Citations |
|---|---|
| **Included** | 25 |
| **Excluded** | 305 |
| Survey | 41 |
| Mixture | 1 |
| Survey and Mixture | 13 |
| Fate, Bacteria, Chem Methods, Methods, Modeling, Review, Duplicate | 96 |
| Aqueous Exposure | 16 |
| NO COC | 77 |
| No Toxicant | 35 |
| Other - Abstract/Title Mismatch | 26 |
| **Total Citations** | **330** |

# Title and Abstract Screening

## PFAS 2018-2021

**N = 330 refs**

**Title and Abstract Screening**



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SwiftActive Screener

| | # of Citations |
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| **Included** | 25 |
| **Excluded** | 305 |
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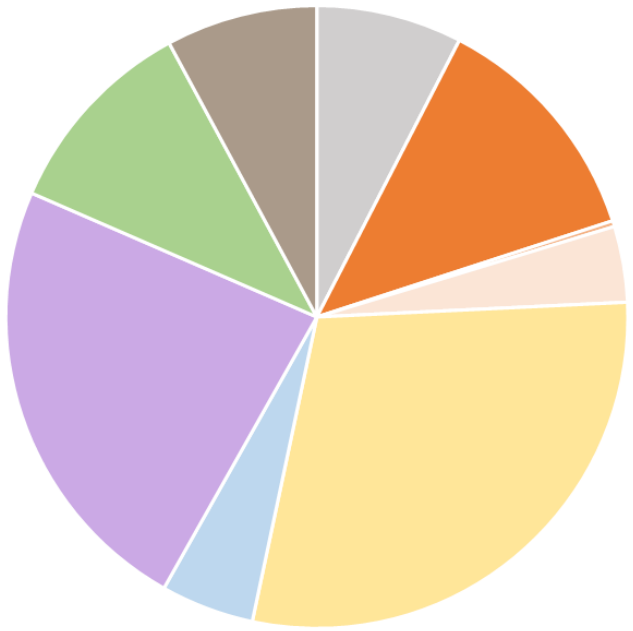

# Resulting 24 publications

| # | Citation |
|---|---|
| 1 | Prosser, R. S., Mahon, K., Sibley, P. K., et al. Bioaccumulation of Perfluorinated Carboxylates and Sulfonates and Polychlorinated Biphenyls in Laboratory-Cultured Hexagenia spp., Lumbriculus variegatus and Pimephales promelas from Field-Collected Sediments. Sci. Total Environ., 2016. |
| 2 | Bertin, D., Ferrari, B. J. D., Labadie, P., et al. Bioaccumulation of Perfluoroalkyl Compounds in Midge (Chironomus riparius) Larvae Exposed to Sediment. Environ. Pollut., 2014. |
| 3 | Martin, J., Hidalgo, F., Garcia-Corcoles, M. T., et al. Bioaccumulation of perfluoroalkyl substances in marine echinoderms: Results of laboratory-scale experiments with Holothuria tubulosa Gmelin, 1791. Chemosphere, 2019, PMID:30317097. |
| 4 | Higgins, C. P., McLeod, P. B., MacManus-Spencer, L. A., et al. Bioaccumulation of Perfluorochemicals in Sediments by the Aquatic Oligochaete Lumbriculus variegatus. Environ. Sci. Technol., 2007. |
| 5 | Stomperudhaugen, E. S., Overas, N. H. H., Langford, K., et al. Cellular Energy Allocation in Hediste diversicolor Exposed to Sediment Contaminants. Journal of Toxicology and Environmental Health, Part A: Current Issues, 2009. |
| 6 | Simpson, S. L., Liu, Y., Spadaro, D. A., et al. Chronic effects and thresholds for estuarine and marine benthic organism exposure to perfluorooctane sulfonic acid (PFOS)-contaminated sediments: Influence of organic carbon and exposure routes. SCI TOTAL ENVIRON, 2021. |
| 7 | Wen, W., Xia, X., Chen, X., et al. Co-effects of Carbonaceous Material and Dissolved Organic Matter on-Bioconcentration of Perfluoroalkyl Substances by Chironomus plumosus in Sediments. 2016. |
| 8 | Muir, D. C. G., Grift, N. P., Townsend, B. E., et al. Comparison of the uptake and bioconcentration of fluridone and terbutryn by rainbow trout and Chironomus tentans in sediment and water systems. Archives of Environmental Contamination and Toxicology, 1982, PMID:0. |
| 9 | Xia, X., Chen, X., Zhao, X., et al. Effects of Carbon Nanotubes, Chars, and Ash on Bioaccumulation of Perfluorochemicals by Chironomus plumosus Larvae in Sediment. Environmental Science & Technology, 2012, PMID:23121516. |
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**Cellular Energy Allocation in *Hediste diversicolor* Exposed to Sediment Contaminants**

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Suspended sediment exacerbates perfluorooctane sulfonate mediated toxicity through reactive oxygen species generation in freshwater clam *Corbicula fluminea*☆

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Effects of sediment-spiked lufenuron on benthic macroinvertebrates in outdoor microcosms and single-species toxicity tests

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JOINT EFFECTS OF DENSITY AND A GROWTH INHIBITOR ON THE LIFE HISTORY AND POPULATION GROWTH RATE OF THE MIDGE *CHIRONOMUS RIPARIUS*

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Toxicity of sediment-bound lufenuron to benthic arthropods in laboratory bioassays

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# Next Steps?

- Evaluate work-flow?
  - Other known set(s) of relevant publications
  - Forward searching on citations
- Apply to new PFAS literature search results?
  - 2022 search underway for 10,000+ PFAS compounds
- Apply this approach for other queries of PFAS citation files?

# Acknowledgements and Contact Info

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