

# Laura M. Langan

Assistant Professor

Department of Environmental Health Science, Arnold School of Public Health, University of South Carolina, Columbia, South Carolina, USA.

□ [langanl@mailbox.sc.edu](mailto:langanl@mailbox.sc.edu)

□ [www.researchgate.net/profile/Laura-Langan-2](http://www.researchgate.net/profile/Laura-Langan-2)

□ [@lauralangan4](https://twitter.com/lauralangan4)

## Research Interests

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Environmental toxicology, aquatic and eco toxicology, harmful algal blooms, Pharmaceuticals and personal care products (PPCPs), Early life exposure, Animal alternatives, Environmental Public health, One Health, Aquatic biology, wastewater-based surveillance/epidemiology, proteomics, transcriptomics, non-animal methods/New approach methodologies (NAMs), comparative physiology, extra hepatic metabolism, intestine, toxicological route of exposure

## Education

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### University of Plymouth, UK.

*Plymouth, England*

PHD ENVIRONMENTAL TOXICOLOGY

*Oct 2012 – June 2017*

- Advisor(s): Dr. Awadhesh Jha, Dr. Stewart F. Owen, Dr. Simon N. Jackson & Dr. Wendy M. Purcell
- Dissertation: “Fish intestine cultures for ecotoxicological studies: in vitro and primary culture models”

### Atlantic Technological University

*Galway, Ireland*

MSC FISHERIES BIOLOGY

*Jan 2009 - May 2012*

- Advisor: Dr. Pauline King
- Dissertation: “Ireland’s understudied flatfish: reproduction, age and growth of the dab *Limanda limanda* (L.) in Irish coastal waters”

### National University of Galway (NUIG)

*Galway, Ireland*

BSC (HONS) UNDERGRADUATE DEGREE

*Sept 2004 - May 2008*

## Professional Experience

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2023- **Assistant Professor**, Department of Environmental Health Sciences, Arnold School of Public Health, University of South Carolina, USA [ongoing]

2019-2023 **Research Scientist**, Department of Environmental Science, Baylor University, USA

- Leading project in SARS-CoV-2 (& others) wastewater surveillance at wastewater treatment plants and at-risk populations in Texas (~28 sites)
  - Linking epidemiological parameters with viral signal in wastewater via PCR and sequencing
  - Examining the emergence of cryptic lineages in two at risk populations (assisted living and correctional facilities)
- Leading projects on examining the use of early life stage zebrafish to understand biological and physiological changes following circadian rhythm perturbations and whether this can subsequently influence metabolic response to chemical stimulants/other pharmaceuticals
- Leading research investigating the influence of age of test organism (viz zebrafish) at time of exposure to perfluoroalkylated substances (PFASs) and a common toxicant through changes protein expression and behavioral responses

2019-2023 **Post-doctoral researcher** Department of Environmental Science, Baylor University, USA

- Develop methodology linking behavioral responses with proteomics and transcriptomics of harmful algal blooms (HABs) or cyanotoxins in two common fish models covering both biomedical and environmental impacts

2019-2019 **Consulting Research Scientist**, Skretting (Sweden) and School of Biological and Marine Sciences, University of Plymouth, UK

- Lead and test the feasibility of using the Transwell culture system with the RTgutGC cell line as a high through put method to evaluate fish feed without using animals (preliminary screening)
- Establish criteria comparable to what could be tested in vivo
- Test system with fish feed
- Perturb system with LPS/bacteria to see can system be used to evaluate treatment

2018-2019 **Post-doctoral research fellow [Trojan Horse Project]**, School of Biological and Marine Sciences, University of Plymouth, UK

- Develop and validate method for proteomic characterization of protein perturbations following exposure to nanomaterials and a common pollutant in non-model organism

2016-2018 **Post-doctoral research fellow [Virtual Fish Project]**, School of Biological and Marine Sciences, University of Plymouth, UK

- Lead and complete project incorporating the gill and liver 3D culture models into one
- Examine the influence of co-culture of models on uptake and metabolism of common toxicant pyrene viz gene expression protein expression (western blot), TEM/SEM etc.

2016-2016 **Technical and support assistance**, School of Biological and Marine Sciences, University of Plymouth, UK

2012-2016 **Undergraduate Research Assistant**, School of Biological and Marine Sciences, University of Plymouth, UK

2010-2012 **Consulting Research assistant**, Atlantic Technological University, Ireland.

## Publications

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**\*Baylor graduate student coauthor; \*\*undergraduate student coauthor**

### PUBLISHED

17. Thapar, I\*\*, **Langan, L.M.**, Davis, H., Norman, R.S., Bojes, H.K., Brooks, B.W., 2023. Influence of storage conditions and multiple freeze-thaw cycles on N1 SARS-CoV-2, PMMoV, and BCoV signal. *Science of The Total Environment* 896, 165098. <https://doi.org/10.1016/j.scitotenv.2023.165098>
16. **Langan LM**, Paparella M, Burden N, Constantine L, Margiotta-Casaluci L, Miller T, Moe JS, Owen SF, Schaffer A, Sikanen T. 2023 From Big Questions to Developing Solutions: A decade of progress in the Development of Aquatic New Approaches from 2012 to 2022. *Environmental Toxicology and Chemistry*. doi: [10.1002/etc.5578](https://doi.org/10.1002/etc.5578)
15. **Langan LM**, O'Brien M\*, Rundell ZC\*, Back JA, Ryan BJ, Chambliss CK, Norman RS, Brooks BW. 2022. Comparative Analysis of RNA-Extraction Approaches and Associated Influences on RT-qPCR of the SARS-CoV-2 RNA in a University Residence Hall and Quarantine Location. *ACS EST Water*. doi:10.1021/acsestwater.1c00476
14. **Langan LM**, O'Brien M\*, Lovin LM\*, Scarlett KR\*, Davis H\*, Henke AN\*, Seidel SE, Archer N, Lawrence E, Norman RS, et al., 2022. Quantitative Reverse Transcription PCR Surveillance of SARS-CoV-2 Variants of Concern in Wastewater of Two Counties in Texas, United States. *ACS EST Water*. doi:10.1021/acsestwater.2c00103. doi:10.1021/acsestwater.2c00103.
13. **Langan LM**, Brooks BW. (2022). Exploratory analysis of the application of animal reduction approaches in proteomics: How much is enough? *ALTEX - Alternatives to animal experimentation*. 39(2):258–270. doi:10.14573/altex.2107212.
12. Taylor RB\*, Hill BN, **Langan LM**, Chambliss CK, Brooks BW. 2021. Sunlight concurrently reduces *Prymnesium parvum* elicited acute toxicity to fish and prymnesins. *Chemosphere*. 263:127927. doi:10.1016/j.chemosphere.2020.127927.
11. O'Brien M\*, Rundell ZC\*, Nemeč MD, **Langan LM**, Back JA, Lugo JN. 2021. A comparison of four commercially available RNA extraction kits for wastewater surveillance of SARS-CoV-2 in a college population. *Science of The Total Environment*. 801:149595. doi:10.1016/j.scitotenv.2021.149595.
10. McClary-Gutierrez JS, Aanderud ZT, Al-faliti M, Duvallet C, Gonzalez R, Guzman J, Holm RH, Jahne MA, Kantor RS, Katsivelis P, Kuhn, KG, **Langan, L** et al., 2021. Standardizing data reporting in the research community to

enhance the utility of open data for SARS-CoV-2 wastewater surveillance. *Environ Sci: Water Res Technol*. doi:10.1039/D1EW00235J.

9. Lovin LM\*, Kim S, Taylor RB\*, Scarlett KR\*, **Langan LM**, Chambliss CK, Chatterjee S, Scott JT, Brooks BW. 2021. Differential influences of (±) anatoxin-a on photolocomotor behavior and gene transcription in larval zebrafish and fathead minnows. *Environmental Sciences*, 33, doi:10.1186/s12302-021-00479-x.
8. Brooks BW, Sabo-Attwood T, Choi K, Kim S, Kostal J, LaLone CA, **Langan LM**, Margiotta-Casaluci L, You J, Zhang X. 2020. Toxicology Advances for 21st Century Chemical Pollution. *One Earth*. 2(4):312–316. doi:10.1016/j.oneear.2020.04.007.
7. **Langan LM**, Cheng Y, Hunka AD. 2019. Empirically supported out of the box strategies for science communication by environmental scientists. *Integrated Environmental Assessment and Management*. doi:10.1002/ieam.4145.
6. Barranger A, **Langan LM**, Sharma V, Rance GA, Aminot Y, Weston NJ, Akcha F, Moore MN, Arlt VM, Khlobystov AN, et al. 2019. Antagonistic Interactions between Benzo[a]pyrene and Fullerene (C60) in Toxicological Response of Marine Mussels. *Nanomaterials*. 9(7):987–987. doi:10.3390/nano9070987.
5. **Langan LM**, Owen SF, Trznadel M, Dodd NJF, Jackson SK, Purcell WM, Jha AN. 2018. Spheroid Size Does Not Impact Metabolism of the β-blocker Propranolol in 3D Intestinal Fish Model. *Frontiers in Pharmacology*. 9, doi:10.3389/fphar.2018.00947.
4. **Langan LM**, Owen SF, Jha AN. 2018. Establishment and long-term maintenance of primary intestinal epithelial cells cultured from the rainbow trout *Oncorhynchus mykiss*. *BIOLOPEN*. 7. doi:10.1242/bio.032870.
3. **Langan L**, Arossa S\*\*, Owen SF, Jha AN. 2017. Assessing the impact of benzo[a]pyrene with the in vitro fish gut model: An integrated approach for eco-genotoxicological studies. *Mutation Research - Genetic Toxicology and Environmental Mutagenesis*. 826, doi:10.1016/j.mrgentox.2017.12.009.
2. **Langan LM**, Harper GM, Owen SF, Purcell WM, Jackson SK, Jha AN. 2017. Application of the rainbow trout derived intestinal cell line (RTgutGC) for ecotoxicological studies: molecular and cellular responses following exposure to copper. *Ecotoxicology*. 26(8):1117–1133. doi:10.1007/s10646-017-1838-8.
1. **Langan LM**, Dodd NJF, Owen SF, Purcell WM, Jackson SK, Jha AN. 2016. Direct Measurements of Oxygen Gradients in Spheroid Culture System Using Electron Paramagnetic Resonance Oximetry.

## Awards, Fellowships, & Grants

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**Co-Principal investigator; Centers for disease Control and Prevention [2021-2023]**, Spatially Explicit COVID-19 Surveillance in “Sewersheds”- An Alternative Approach to Population Monitoring in Support of Decision Making. Award amount: \$1,657,130

**Co-Principal investigator; U.S. Food and Drug Administration [2021-2022]**, GenomeTrkr Networks: Wastewater surveillance for SARS-CoV-2 Variants. Award amount: \$ 67,855

**Research grant to support agriculture/aquaculture [2018-2021]**, Seale-Hayne Educational Trust (SHET) Plymouth University. Award amount: £15,000

**Travel award(s) [2013-2016]**, United Kingdom Environmental Mutagen Society (UKEMS). Award amount: £3,000

**Travel Award [2016]**, Laboratory Animal Science Association (LASA). Award amount: £1,000

## Presentations

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\* *presenting author*; + *mentored undergraduate or graduate student*

### INVITED TALKS

August 2022. The use of wastewater for COVID surveillance. California Environmental Health Association (CEHA) Annual Educational Symposium, California, USA.

Feb 2022. Using wastewater-based epidemiology (WBE) to track SARS-CoV-2 and its variants in Texas, USA. Environmental Health Science Seminar series, Baylor University, Waco, Texas.

Sept 2021. A guest lecturer. “*In-vitro bioaccumulation*”, Baylor University, Waco, Texas.

Feb 2020. A guest lecturer. “*Application of animal alternatives in environmental risk assessment: the development to of the virtual fish*”, Baylor University, Waco, Texas.

April 2020. A guest lecturer. “*Application of in vitro in risk assessment*”, Baylor University, Waco, Texas.

## CONTRIBUTED PRESENTATIONS [SUBSET]

- Langan LM**, Henke A, Ryon M\*, Bain F\*, Snow C\*, Miller A\*, Norman S, Brooks BW. 2023. Multi-purpose Use of Wastewater-based Epidemiology and Its Integration into Public Health. National Environmental Health Association (NEHA), New Orleans.
- Langan LM**, Henke A, Ryon M, Bain F, Miller A, Snow C, Norman S, Bojes H and Brooks BW. 2023 Variation in locational response to omicron, the emergence of cryptic lineages? Poster presented at Society for Experimental Toxicology and Chemistry, Dublin.
- Langan LM**, Henke A, Bain F, Miller A, Snow C, Norman S and Brooks BW. 2023 Wastewater based surveillance: more than a one trick pony. Poster presented at Society for Experimental Toxicology and Chemistry, Dublin.
- Langan LM**, Norman S, Bojes H and Brooks B. 2022 “Comparison of buffer concentration and direct capture method for purification of viral nucleic acid for epidemiological surveillance of SARS-CoV-2”. Platform presented at Society for Experimental Toxicology and Chemistry, Pittsburgh.
- Henke AN\*\*+, Stroski K\*, **Langan LM**, Brooks B. 2022 “Does Age Really Matter? Examining Age-Specific Proteomic and Behavioral Responses of Zebrafish (*Danio rerio*) to a Model Toxicant”. Platform presented at Society for Experimental Toxicology and Chemistry, Pittsburgh.
- Lovin L\*\*+, **Langan LM**, Kim S, Taylor RB\*, Scarlett K\*, Chambliss K, Chatterjee S, Scott JT and Brooks B. 2022 “Comparative Understanding of the Developmental Neurotoxic Effects of Chiral Cyanotoxin Anatoxin-a in Two Common Fish Models”. Platform presented at Society for Experimental Toxicology and Chemistry, Pittsburgh.
- Scarlett K\*\*+, Lovin L\*, **Langan LM**, Kim S, Stroski K\*, Chatterjee S, Scott JT and Brooks B. 2022 “Identifying Fish Photolocomotor behavioral response profiles and gene expression changes for the cyanobacterial toxin, Cylindrospermopsin”. Poster presented at Society for Experimental Toxicology and Chemistry, Pittsburgh.
- O’Brien M\*\*+, **Langan LM**, Lovin L\*, Scarlett K\*, Henke A\*, Davis H\*, Bain F\*, Snow C\*, Miller A\*, Norman S, Bojes H, Seidel S, Archer N, Lawrence E and Brooks B. 2022 “Long-term SARS-CoV-2 Wastewater Surveillance for Two Locations in Texas, USA Compared to COVID-19 Epidemiology Data”. Poster presented at Society for Experimental Toxicology and Chemistry, Pittsburgh.
- Ryon M\*\*+, **Langan LM**, Breenan C, Bain F\*, Miller A\*, Snow C\*, Norman S, Bojes H, and Brooks B. 2022 “Defining variability in formulas used to calculate gene copies in SARS-CoV-2 wastewater testing to aid comparability and increase reproducibility”. Poster presented at Society for Experimental Toxicology and Chemistry, Pittsburgh.
- Oh B, Bobier K, Pedrueza M, Jost M, **Langan LM**, Brooks B, Labonte J, Sun Y and Lee R. 2022” The Ebbs and Flows of Piloting SARS-CoV-2 Wastewater Sequencing in Texas”. Poster presented at Society for Experimental Toxicology and Chemistry, Pittsburgh.
- Langan LM**, Lovin L\*, Scarlett K\*, Taylor RB\*, Chambliss K, Chatterjee S, Scott JT, and Brooks B. 2022 “Changes in protein expression following anatoxin-a ( $\pm$ ) exposure in zebrafish (*Danio rerio*) and fathead minnows (*Pimephales promelas*)”. Platform presented at the 11<sup>th</sup> U.S. Symposium on Harmful Algae, Albany New York.
- Lovin L \*\*+, **Langan LM**, Kim S, Taylor RB\*, Scarlett K\*, Chambliss K, Chatterjee S, Scott JT and Brooks B. 2022 “Developing a comparative neurotoxicology understanding of the chiral cyanotoxin Anatoxin-A in two common fish models)”. Platform presented at the 11<sup>th</sup> U.S. Symposium on Harmful Algae, Albany New York.
- O’Brien M\*\*+, **Langan LM**, Brooks B. 2022 “RT-qPCR surveillance of SARS-CoV-2 variants of concern in wastewater of two counties, Texas, USA”. Poster presented at National Environmental Health Associations (NEHA), Spokane, Washington.
- Langan LM**, Lovin L\*, Scarlett K\*, Henke A\*, Davis H\*, Bain F\*, Snow C\*, Miller A\*, Norman S, Bojes H, Seidel S, Archer N, Lawrence E and Brooks B. 2022. “RT-qPCR surveillance of SARS-CoV-2 variants of concern in wastewater of two counties, Texas, USA. Poster presentation ”Gordon Research Conference: Microbiology of the Built Environment”, New Hampshire, USA.
- Lovin L\*\*+, **Langan LM**, Kim S, Taylor RB\*, Scarlett KR\*, Chambliss CK, Chatterjee S, Scott JT, Brooks B. 2022, “Developing a comparative neurotoxicology understanding of the chiral cyanotoxin anatoxin-a in two common fish models”. Platform presentation at the 21<sup>st</sup> International Symposium on Pollutant Responses in Marine Organisms (PRIMO)”, Gothenburg, Sweden.
- Langan LM**. 2022. “Using wastewater-based epidemiology (WBE) to track SARS-CoV-2 sublineage emergence in two cities in Texas. Oral presentation” Texas Water Conference”, San Antonio.

- Bojes H, **Langan LM** et al., 2022. “Wastewater Sampling for Tracking SARS-CoV-2 in Texas Correctional and Long-Term Care Facilities. Oral presentation” Texas Water Conference”, San Antonio
- Langan LM**, Lovin L\*, Taylor R\*, Chambliss K, Chaterjee S, Scott JT and Brooks B. 201. “Proteomic Analysis of anatoxin-a ( $\pm$ ) in zebrafish (*Danio rerio*)”. Poster presentation, Society of Experimental Toxicology (SOT), San Diego, California.
- Langan LM**, and Rodgers M. 2021. “Into the Abyss: Summarizing the past and identifying key future directions of the intestine in Aquatic toxicology”. Oral presentation: Society of Experimental Toxicology and Chemistry (SETAC), Portland, Oregon.
- Henke A\*\*\*, **Langan LM**, Chilukhuri C\*\*, Brooks B. 2021. “Recommendations for improving the reliability and reproducibility of ecotoxicoproteomics”. Oral presentation: Society of Experimental Toxicology and Chemistry (SETAC), Portland, Oregon.
- Langan LM**, Hutt L and Jha AN. 2020. “First generation annotation of the rainbow trout RTgutGC cell line transcriptome”, Platform presentation: Society of Experimental Toxicology and Chemistry (SETAC), Europe.
- Faßbender C, Paparella M, Belanger S, Bicherel P, Bopp S, Braunbeck T, Connors K, Halder M, Kienzler A, **Langan LM**, Laue H, Lillicrap A, Schirmer K, Scholz S, Walter-Rohde S, Stoddart G. 2019 “Developing an Integrated Approach to Testing and Assessment for Acute Fish Toxicity”. Poster presentation: Society of Experimental Toxicology and Chemistry (SETAC), Europe.
- Langan LM**, Maunder RJ, Owen SF and Jha AN. 2017. “Developing realistic fish in vitro models to assess impact of contaminants in the aquatic environment”. In Vitro Toxicology Society (IVTS), London, UK.
- Langan LM**, Owen SF, Jackson S, Purcell W and Jha AN.2016. “Morphological and metabolic characterization of the rainbow trout intestine grown *in vitro*: from the pyloric to posterior”. Platform presentation at the Improving experimental approaches in Animal Biology: Implementing the 3Rs at the Society of Experimental Biology (SEB), London

## Teaching Experience

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- 2019-2022 **Beyond Benign**, Curriculum development: Toxicology for chemists  
 Spring 2016 **Environmental Science**, Teaching Assistant  
 Winter 2015 **Environmental Science**, Teaching Assistant

## Mentoring

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- 2021-2023 **Mia Ryon**, Masters researcher, Baylor University  
 2020-2024 **Abigail Henke**, Graduate researcher, Baylor University  
 2019-2023 **Megan O'Brien**, Masters researcher, Baylor University  
 2021-2023 **Isha Thapar**, Undergraduate researcher, Baylor University  
 2019-2021 **Jazz Conway**, Research assistant, University of Plymouth  
 2017-2018 **Valeria Maselli**, Research training programme; University of Naples (Italy)  
 2014-2016 **Silvia Arossa**, Research training programme, University of Ancona (Italy)

## Outreach & Professional Development

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### PROFESSIONAL SOCIETY SERVICE

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|------|---|----------|
| 2020 | <b>Aquatic Toxicology - things Down the Drain</b> , Co-organizer [NEPRIS]                     | USA      |
| 2014 | <b>Society for Experimental Toxicology and Chemistry</b> , Committee, volunteering & training | UK & USA |
| 2014 | <b>Nobel Journal Club</b> , Co-organizer [University of Plymouth, UK]                         | UK       |
| 2014 | <b>Science in the News Explained</b> , Co-organizer   | UK       |

### DEVELOPMENT

**Special issue Frontiers in Toxicology “Women in Environmental Toxicology 2023” [2023]**, a special issue I am co-leading with European collaborators highlighting the diversity of women lead science in the field of environmental toxicology on a global level.

**Special issue Environmental Chemistry “At the interface: NAMs in Environmental Chemistry and Toxicology” [2023]**, a special issue I am co-leading on new approach methodologies (NAMs) in environmental chemistry and toxicology, aimed at advancing our understanding of linkages between chemistry and biological processes.

**Curriculum development: Toxicology for chemists [2021]**, a collaboration with the charity Beyond Benign which I participated in which helped expand my understanding of science cannot exist in a vacuum and working from a similar understanding of concepts in a project can greatly benefit science.

**Fish Biotransformation in Bioaccumulation Technical Workshop [2019]**, Invitation by Health and Environmental Sciences Institute (HESI) Bioaccumulation Technical Committee to identify short-, medium- and long-term needs related to the use and application of fish in vitro biotransformation methods for bioaccumulation assessment with specific focus on the hepatic and extra hepatic via the intestine routes.

**Science and risk communication for non-experts workshop [2018]**, a workshop I co-organized on how we can communicate our science to a very disparate audience. Critically important in the re-establishment of trust in scientists which has been subtly eroded over the past few years.

**Prioritization and Intelligent Testing of Pharmaceuticals in the Environment (II) [2016]**, a workshop on how we move forward with non-animal methods for chemical testing incorporating the needs of business, academia, and regulatory requirements.

**International Council for the Exploration of the Sea (ICES) Workshop on Age Reading of Dab (WKARDAB) [2010]**, a workshop on exchange and ageing workshop to evaluate and improve the age interpretation based on whole otoliths of dab via refinement of the interpretation of the growth pattern and for identifying gaps and opportunities concerning the current knowledge of the age estimation of this species.

#### PEER REVIEW [REVIEWER OF ARTICLES/REPORTS]

*Science of the Total Environment (STOTEN), Environmental Science & Technology Letters, Environmental Toxicology and Chemistry, Frontiers in Physiology, Frontiers in Toxicology, In vitro Cellular & Developmental Biology - Animal, Neurotoxicology, Ecotoxicology, Aquatic Toxicology, Chemosphere.*

#### PROFESSIONAL MEMBERSHIPS

Society of Experimental Toxicology and Chemistry (SETAC)

Society of Toxicology (SOT)

European Society of Toxicology In Vitro (ESTIV)

National Environmental Health Association (NEHA)