

# Camilo Escobar-Sierra, PhD

Postdoctoral Researcher & Lecturer

Institute for Environmental Research (IfER) · RWTH Aachen University · Germany

Website · ORCID · GitHub · Google Scholar · LinkedIn · RWTH profile

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## Research profile

I study how environmental stress reorganises biological systems across molecular, organismal and ecological scales, and when adaptive responses give way to resilience loss. My research combines field-realistic environmental gradients with molecular ecology, integrative eco-omics and computational approaches to connect biological mechanisms with organismal performance and ecological consequences. I work primarily with aquatic organisms, communities and holobionts while developing reproducible approaches for complex and non-model biological systems.

**Research fields:** Molecular ecology · Environmental stress biology · Systems ecology · Integrative eco-omics

**Methods and observational tools:** Field ecology · Transcriptomics · Physiology · Microbiomes ·

Metagenomics · Genomics · Proteomics · Environmental bioinformatics · Network analysis · Reproducible computation

## Emerging independent research programme

**Biological organisation and resilience under environmental stress**

My emerging independent programme investigates how environmental stress alters biological coordination across molecular, physiological, microbial and ecological layers, and where compensatory responses transition into resilience loss. Current work combines real-world environmental gradients, non-model eco-omics, multi-omics integration and reproducible environmental bioinformatics.

**Current conceptual development:** Hierarchical Stress Gradient Hypothesis (Hi-SGH), an emerging framework for testing how cross-layer biological coordination changes along environmental stress gradients.

**Current direction:** consolidating this programme through competitive funding, independent project development, collaborative research, teaching and supervision, with the long-term aim of establishing and funding an interdisciplinary research group.

## Current position

**2025–present · Postdoctoral Researcher & Lecturer**

Institute for Environmental Research (IfER), RWTH Aachen University, Germany

- Research in ecotoxicogenomics and integrative eco-omics across aquatic systems.
- Development of reproducible approaches for transcriptomics and complex molecular datasets.
- Work with non-model transcriptomic resources, microbiomes, bacterial and viral metagenomics, genome annotation and multi-omics integration.
- Teaching and mentoring of BSc, MSc and PhD researchers.

## Education

**2024 · PhD in Biological Sciences, magna cum laude**

University of Cologne, Germany

Thesis: *Physiological responses of freshwater fish to multiple stressors in urban rivers: a transcriptomic approach.*  
Research integrated field ecology, fish stress physiology, transcriptomics, bioinformatics and molecular validation.

**2018 · Erasmus Mundus Joint Master's Degree in Aquaculture, Environment and Society (ACES)**

University of the Highlands and Islands · University of Crete · Nantes Université

Full Erasmus Mundus scholarship. Training across aquaculture, environmental management, marine systems and fish welfare; early research combined ecological and omics approaches.

**2013 · BSc (Hons) Biology**

Universidad de Antioquia, Colombia

Foundation in aquatic ecology, ichthyology and field ecology in tropical aquatic systems.

## Previous research and professional experience

**2021–2024 · Doctoral Researcher**

University of Cologne, Germany

**2019–2020 · Aquaculture Consultant**

B-Blue, Belize

**2019–2020 · Aquatic Ecology Consultant**

Hidrobiológica S.A.S., Colombia

**2017 · Aquaculture industry placement**

Andromeda S.A., Greece

**2015–2016 · Biological Collections Manager**

Natural History Museum, Universidad de Antioquia, Colombia

**2014–2015 · Aquaculture Consultant**

Ecotec Investments S.A.S., Colombia

**2014–2015 · Aquatic Ecology Consultant**

Fundación Omacha, Colombia

**2013 · Lecturer in River Ecology**

Universidad de Antioquia, Colombia

Earlier applied, field and collections work established the ecological foundation for subsequent molecular and computational research.

## Projects and research development

**Lead and emerging independent development**

**TROPECO-OMICS · 2026 · DFG–Universidad de Antioquia bilateral proposal**

**Status:** Under evaluation.

**Role:** German-side applicant and conceptual lead.

Developed the project and emerging Hi-SGH framework, integrating transcriptomics, proteomics, microbiome analysis and physiology to examine transitions from adaptive compensation toward resilience loss across real-world chemical-stress gradients.

**Funded research participation**

**MixTOX · Swedish Research Council FORMAS · 2025–present**

Researcher.

**CRC 1439 RESIST · DFG · 2021–2024**

Doctoral researcher contributing research on freshwater fish responses to multiple stressors.

**TAPAS · EU Horizon 2020 · 2016–2018**

MSc researcher contributing to research on aquaculture impacts in marine systems.

**Research directions**

Research directions include biological resilience under environmental stress; fish ecophysiology and welfare; environmental molecular monitoring and field ecotoxicology; aquatic holobionts and microbiomes; non-model eco-omics; and reproducible environmental biology.

## Research resources

**Software and data**

**EchoGO · Open-source framework for annotation-context-aware functional interpretation in non-model ecotoxicogenomics.**

Role: lead conceptual development, workflow design and implementation.

[GitHub repository](#) · [Zenodo record](#)

**Gammarus pulex de novo transcriptomic resource · Peer-reviewed transcriptome assembly and annotation for ecotoxicogenomics.**

**Holtemme Gammarus ecotoxicogenomics reproducible research compendium · [Public GitHub repository](#)**

**Science communication**

Science communication for broad audiences, including an explainer article for *Frontiers for Young Minds*.

## Publications

- Bayat, H. S., He, F., Medina Madariaga, G., Escobar-Sierra, C., Prati, S., Peters, K., Jupke, J. F., et al. (2025). "Global thermal tolerance compilation for freshwater invertebrates and fish." *Scientific Data* 12, (1), 1488 doi:[10.1038/s41597-025-05832-w](https://doi.org/10.1038/s41597-025-05832-w).
- Escobar-Sierra, C., Hassan, S., Weichert, F. G., Aronsson, H., Lampert, K. P., Hollert, H., Backhaus, T., and Inostroza, P. A. (2025). "De novo transcriptome assembly and annotation of the common freshwater amphipod (*Gammarus pulex*): a valuable resource for ecotoxicogenomics." *Scientific Data* 12, (1), 1502 doi:[10.1038/s41597-025-05872-2](https://doi.org/10.1038/s41597-025-05872-2).
- Escobar-Sierra, C., Cañedo-Argüelles, M., Vinyoles, D., and Lampert, K. P. (2024). "Unraveling the molecular mechanisms of fish physiological response to freshwater salinization: A comparative multi-tissue transcriptomic study in a river polluted by potash mining." *Environmental Pollution* 357, 124400 doi:[10.1016/j.envpol.2024.124400](https://doi.org/10.1016/j.envpol.2024.124400).
- Escobar-Sierra, C., and Lampert, K. P. (2024). "Field application of de novo transcriptomic analysis to evaluate the effects of sublethal freshwater salinization on *Gasterosteus aculeatus* in urban streams." *PLOS ONE* 19, (3), e0298213 doi:[10.1371/journal.pone.0298213](https://doi.org/10.1371/journal.pone.0298213).
- Escobar-Sierra, C., Cock, W. de, Hasler-Sheetal, H., Holmer, M., Chatzigeorgiou, G., Tsapakis, M., and Apostolaki, E. T. (2023). "Metabolomics unravels grazing interactions under nutrient enrichment from aquaculture." *Diversity* 15, (1), 31 doi:[10.3390/d15010031](https://doi.org/10.3390/d15010031).
- Vos, M. et al. (2023). "The Asymmetric Response Concept explains ecological consequences of multiple stressor exposure and release." *Science of the Total Environment* 872, 162196 doi:[10.1016/j.scitotenv.2023.162196](https://doi.org/10.1016/j.scitotenv.2023.162196).
- Escobar-Sierra, C., Márquez Velázquez, V., Menezes, R., Souza Rosa, R., and Loaiza-Santana, A. (2021). "An updated reef fish checklist of the southernmost Caribbean reef system, with comments on the lionfish invasion." *Biota Colombiana* 22, (2), 70–87 doi:[10.21068/c2021.v22n02a04](https://doi.org/10.21068/c2021.v22n02a04).
- Blanco-Libreros, J. F., Carvajal, J. D., Escobar-Sierra, C., Jiménez, L. F., Lasso, C. A., and Sánchez-Duarte, P. (2015). "La diadromía como convergencia evolutiva en peces, crustáceos decápodos y gasterópodos en las cuencas pericontinentales de Colombia." *Cuencas pericontinentales de Colombia, Ecuador, Perú y Venezuela: Tipología, biodiversidad, servicios ecosistémicos y sostenibilidad de los ríos, quebradas y arroyos costeros* Instituto de Investigación de Recursos Biológicos Alexander von Humboldt.
- Blanco, J. F., Escobar-Sierra, C., and Carvajal-Quintero, J. D. (2014). "Gorgona, Baudó y Darién (Chocó Biogeográfico, Colombia): ecorregiones modelo para los estudios ecológicos de comunidades de quebradas costeras." *Revista de Biología Tropical* 62, (Suppl. 1), 43–64 doi:[10.15517/rbt.v62i0.15978](https://doi.org/10.15517/rbt.v62i0.15978).

## Teaching, supervision and mentoring

### University teaching

**RWTH Aachen University:** teaching contributions in Limnology, Data Science, Molecular Ecotoxicology, Introduction to Environmental Sciences, and interdisciplinary scientific-skills activities.

**Universidad de Antioquia:** Lecturer in River Ecology.

### Supervision and mentoring

Previous MSc co-supervision and ongoing mentoring and support for BSc, MSc and PhD researchers.

Training and guidance includes experimental design, transcriptomics, ecotoxicogenomics, microbiome and metagenomics, environmental bioinformatics, reproducible workflows and ecological interpretation.

My teaching and mentoring emphasise scientific independence, reproducible analysis and the integration of field, experimental and computational approaches.

## Invited talks and selected conference contributions

### Invited talks

#### 2026 · Pontificia Universidad Javeriana

Invited seminar: “Omics approaches in ecology and ecotoxicology: integrating molecular responses to environmental stress in aquatic organisms.”

#### 2026 · University of Aveiro / EPIBOOST

Invited talk: “From Transcriptomic Patterns to Multi-Omic Mechanisms: Wild Exposure to Micropollutants in Freshwater Macroinvertebrates.”

### Selected conference contributions

#### 2026 · SETAC Europe, Maastricht

Oral contribution on RNA-seq in the Eurasian eagle-owl.

#### 2026 · SETAC GLB/GDCh Umwelt meeting

Oral contribution on EchoGO.

#### 2025 · SETAC Europe, Vienna

Contribution on the *Gammarus pulex* transcriptome.

#### 2025 · DGL, Frankfurt

Contribution on *Cottus* transcriptomics and multiple stressors.

#### 2023 · Symposium for European Freshwater Sciences (SEFS), Newcastle

Contribution on comparative fish transcriptomics.

#### 2022 · YOUMARES

Session chair and presenter on omics applications in aquatic science.

## International mobility and collaboration

2025 · EPIBOOST Chromatin Explorer Summer School, IDAEA-CSIC

Training in environmental epigenetics and chromatin biology.

2024 · Research stay, IDAEA-CSIC, Barcelona

Ecotoxicogenomics, including transcriptomic and epigenetic responses to multiple stressors.

2016–2018 · ACES international mobility

Study and research across the United Kingdom, Greece and France.

## Academic service

### Peer review

Nature Communications · Ecotoxicology · Symbiosis · Journal of Fish Biology · Journal of Thermal Biology ·

Aquaculture Reports · Aquaculture Research

### Scientific service

Session chair at YOUMARES (2022); additional service through peer review and collaborative research.

## Technical expertise

**Environmental omics:** RNA-seq; de novo and reference-guided transcriptomics; functional annotation; microbiomes; metabarcoding; bacterial and viral metagenomics; genome annotation; multi-omics integration.

**Computational biology:** R; Python; Unix/bash; Snakemake; high-performance computing; reproducible workflows; Quarto/R Markdown; data visualisation.

**Molecular laboratory:** DNA/RNA extraction; PCR/qPCR; molecular quality control; sample preparation through sequencing workflows.

**Field and organismal biology:** Freshwater and marine ecology; fish and invertebrate sampling; environmental assessment; ecotoxicology; aquaculture; environmentally realistic study design.

## Distinctions

- Full Erasmus Mundus+ Scholarship, ACES (2016–2018).
- DFG-funded doctoral position, CRC 1439 RESIST (2021–2024).
- DAAD conference travel grant, SETAC Europe (2025).
- Idea Wild equipment and supplies grant (2012).

## Languages

**Spanish:** Native

**English:** Professional / advanced working proficiency (C2 listening, reading and writing; C1 spoken production and interaction).

**German:** Intermediate / receptive working proficiency (B2 listening; B1 reading; A2 spoken production, interaction and writing).