When antidepressants reach the sea: the impact of fluoxetine on symbiotic algae

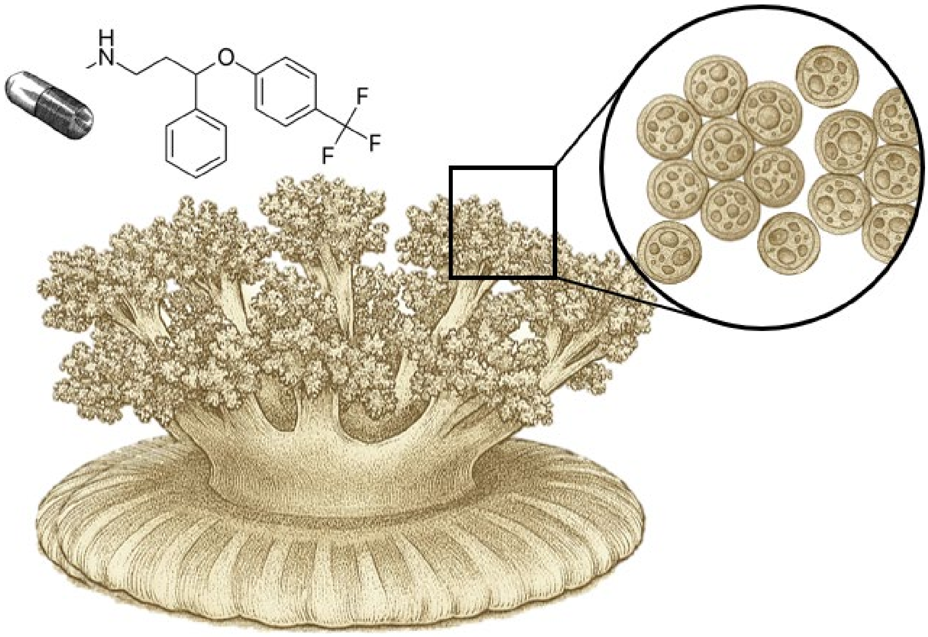
Pharmaceutical pollution is an emerging threat to marine ecosystems. Among these compounds, fluoxetine—a widely used antidepressant—is increasingly detected in coastal waters. While its effects on marine animals are still being uncovered, its impact on symbiotic algae remains largely unknown.

This project will focus on *Symbiodinium microadriaticum*, a dinoflagellate alga living in symbiosis with the upside-down jellyfish (*Cassiopea xamachana*). This model, widely used for its ease of culture, offers valuable insights transferable to coral reef health, since stress in these algae is linked to coral bleaching.

You will investigate how fluoxetine affects algal physiology and photosynthesis, both alone and in combination with other environmental stressors such as pulses of rainwater (mimicking runoff events) and plastic microfibers (acting as pollutant carriers). Using tools from cellular ecophysiology, flow cytometry, and photosynthetic performance analyses, you will explore how pollutants alter algal function. By joining this project, you will gain hands-on skills in marine ecophysiology while contributing to a better understanding of how pharmaceuticals interact with coral reef symbioses. The project runs in parallel with the “microfiber exposure” project, offering opportunities for collaboration and cross-comparison.

Skills you’ll gain:

- culturing marine symbiotic algae
- flow cytometry and photosynthetic efficiency analyses
- experimental design in ecotoxicology



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When fishing nets unravel: microfiber impact on marine symbiotic algae

Microplastics are infamous pollutants of the oceans, but microfibers from fishing gear are often overlooked despite being the most abundant form of plastic debris. Fishing nets release large amounts of nylon microfibers, which may significantly affect marine organisms. Recently, “biodegradable” nets have been developed as alternatives, yet their biological impacts remain poorly understood.

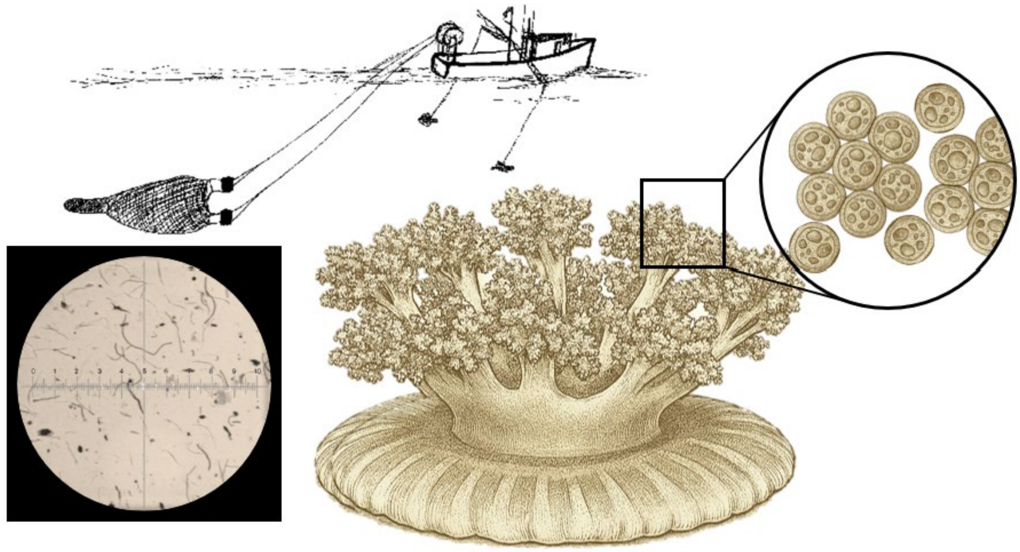
This project will examine the effects of nylon microfibers from conventional and biodegradable nets on *Symbiodinium microadriaticum*, a symbiotic dinoflagellate of the upside-down jellyfish *Cassiopea xamachana*. Because the health of these algae is tightly linked to coral resilience, this model system offers a powerful way to explore the ecological consequences of microfiber pollution.

You will test different fiber sizes and study their interactions with a common pharmaceutical pollutant. Using ecophysiology and photosynthetic assays, you will track short- and medium-term effects on algal performance.

Through this research, you will help clarify the risks posed by plastic fibers to marine symbioses, while acquiring a strong skillset in experimental marine biology. The project is closely connected to the “fluoxetine exposure” project, allowing shared expertise and potential collaborations.

Skills you’ll gain:

- Culturing marine symbiotic algae
- Ecophysiological assays and photosynthetic analyses
- Microplastic handling and exposure experiments



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Living under pressure: chronic exposure of fish to a cocktail of stress

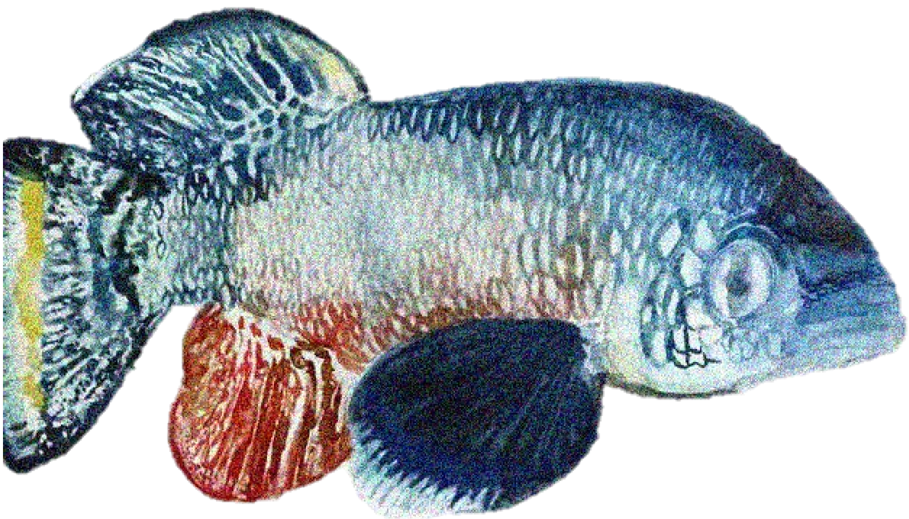
Aquatic ecosystems face a growing cocktail of human-induced stressors—chemical pollution, artificial light at night, and rising temperatures, to name just a few. Pharmaceuticals such as fluoxetine (Prozac) are of particular concern, as they interfere with serotonin signalling, a pathway conserved across animals. In fish, fluoxetine can alter behaviour and even disrupt circadian rhythms. Light pollution, another major stressor, is also known to change activity cycles. But what happens when fish are exposed to several of these stressors at once?

This project will explore the long-term effects of chronic, combined exposure to pharmaceuticals and other stressors in fish. By focusing on behavioural endpoints—such as activity rhythms, feeding, or predator avoidance—you will investigate how different pollutants interact, and whether their effects are additive, synergistic, or antagonistic.

Your work will contribute to a deeper understanding of how multiple global change stressors affect aquatic wildlife, with implications for both ecosystem health and environmental management.

Skills you'll gain:

- Experimental fish husbandry and exposure design
- Behavioural tracking and analysis
- Ecotoxicological concepts of single *vs*. multiple stressors



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Fragile beginnings: acute stressor effects on fish early life stages

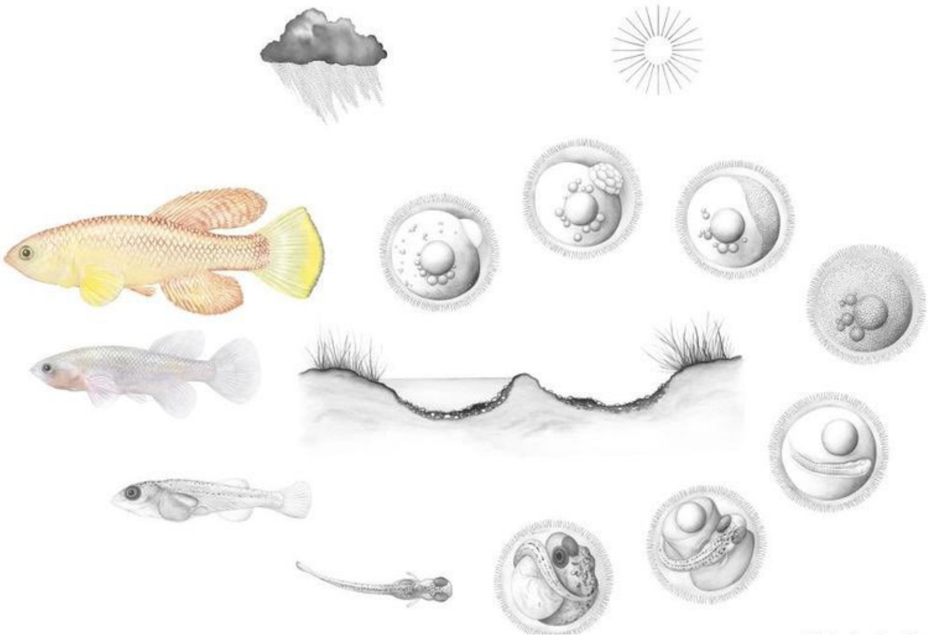
The earliest stages of life—eggs, larvae, juveniles—are often the most vulnerable to pollution. With their limited detoxification capacity and rapid growth, fish at these stages can experience lasting effects from even brief exposures to environmental stressors.

In this project, you will use the turquoise killifish (*Nothobranchius furzeri*), an emerging model species known for its short life cycle, to study the acute effects of multiple stressors such as fluoxetine, elevated temperature, and continuous light. By focusing on behavioural endpoints like activity and cognitive ability, you will also assess how short-term exposures during development can ripple into later life stages.

This work will shed light on how combinations of pollutants shape fish survival and performance, and on the outcome of additive, synergistic, or antagonistic interactions between stressors.

Skills you'll gain:

- Fish embryo and larval culture techniques
- Behavioural testing and developmental assays
- Experimental design for multiple-stressor studies



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Encaged Atlantic salmon as early indicators of stress in the Meuse River

European rivers are increasingly contaminated with a complex mix of emerging pollutants—pesticides, plasticizers, PFAS, hydrocarbons, and more. These compounds may threaten fish health and reproduction, but early-warning signals are often hard to detect.

As part of the ORION Interreg VI project, this thesis will use Atlantic salmon (*Salmo salar*) as bioindicators of river pollution. In spring 2026, juvenile salmon will be caged for 21 days at several sites along the Meuse River. After exposure, the fish will be collected and analysed in the laboratory. A suite of early biomarkers will be assessed, including gonad histology, oxidative stress, immune responses, and endocrine markers. These analyses will reveal how pollution can compromise reproduction long before visible effects—such as reduced sperm quality—appear.

The project combines fieldwork (hands-on experience during the April caging campaign with project partners) and laboratory analyses, offering an integrative ecotoxicology approach. Importantly, the results will contribute to ongoing conservation and management efforts for large European rivers.

Skills you'll gain:

- Field sampling and fish handling during caging experiments
- Laboratory techniques in histology, biochemistry, and molecular biology
- Biomarker analysis linking pollution to fish health
- Experience working in an international, applied ecotoxicology project

Important: The thesis runs from March – December 2026, with mandatory fieldwork in April


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Shedding light on stress: how multiple pollutants shape zooplankton rhythms

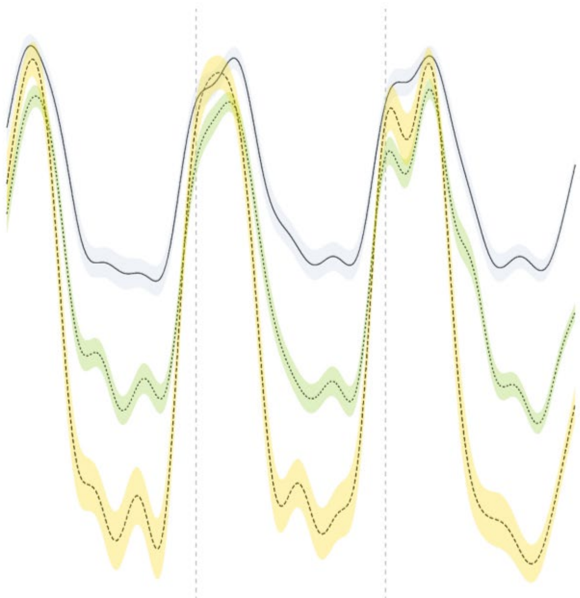
Every night, trillions of tiny zooplankton migrate upwards in the water column to feed and sink back down during the day to hide from predators. This "daily vertical migration" is the largest animal movement on Earth, and it is crucial for food webs and global carbon cycles. But in human-altered waters, this rhythm faces new challenges. Artificial light at night (ALAN) disrupts natural light–dark cycles, pharmaceuticals such as fluoxetine interfere with neurochemical pathways, and predators add further pressure. How do these stressors, alone and together, affect zooplankton behaviour and population dynamics?

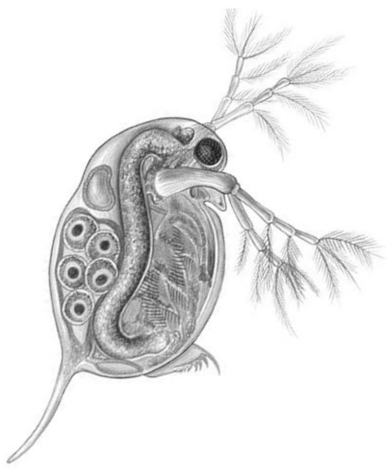
In this project, you will work with *Daphnia*, a classic freshwater model organism, to experimentally test how light pollution, predation cues, and pharmaceutical contaminants interact. Using infrared-sensitive imaging, you will track daily migration patterns and link them to changes in population growth and biomass. The project is flexible: depending on your interests, you may focus more on light × predation, light × pharmaceuticals, or all three stressors combined.

Your research will contribute to a better understanding of how multiple environmental stressors jointly alter aquatic ecosystems. By bridging chronobiology, ecotoxicology, and behavioural ecology, you will help reveal the hidden vulnerabilities of one of the planet's most important animal groups.

Skills you'll gain:

- Culturing and experimenting with zooplankton
- Behavioural tracking with infrared time-lapse imaging
- Ecotoxicological concepts of single *vs*. multiple stressors
- Data analysis of biological rhythms and population dynamics





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