Title of the thesis	Assessing the toxicity of plastic fragments on zooplankton ecology via video tracking and behavioral analysis
Acronym	TOPAZ
Reference number	004

Hosting institution	**Employer**
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Thesis information

Keywords	Zooplankton - Behavior - Pollution - (Bio)plastic - Video tracking
Abstract	Calanoid copepods are small crustaceans that play pivotal roles in aquatic ecosystems. Located at the base of the food web, they channel nutrients and energy from the primary producers to higher trophic levels, support the development of larger organisms including commercially important fishes, and contribute to the biological carbon pump. While their importance is global in scale, much of their ecology unfolds at small scales. That is because many ecological processes in copepods depend on interactions between organisms and between them and their environment. Indeed, copepods have limited swimming capabilities but are not necessarily at the mercy of the flow. They swim vigorously with respect to their small size, which allows them to engage in behavioral processes that are important for their survival and development. Attempts to understand and predict the dynamics of copepod populations therefore require a better mechanistic understanding of their behavioral ecology. A key issue in this context is to assess the effects of environmental forcing on copepod behavior, and to identify the mechanisms through which changes in behavior can influence fitness. This project focuses on the effects of anthropic pollution, a particularly important forcing because it causes marked changes in the kinematics and geometrical properties of copepod motion, even at very low concentrations and short exposure duration. These alterations may potentially affect many ecological processes, from biotic interactions to displacements in the water column, with direct effects on individual and population fitness. The objective is to quantify the behavioral alterations caused by nanoplastics and the smallest size fractions of microplastics (below 10 μm). This project builds on the current research of the *Laboratory of Oceanology and Geosciences* (LOG) in plankton ecotoxicology

	and behavioral analysis and on the expertise of the *Laboratory of Catalysis and Solid-State Chemistry* (UCCS) in the synthesis of polymers. The candidate will test copepods exposed to plastics derived from petroleum products and bio-sourced polymers over several generations, using multiple developmental stages from nauplii to adults. Trajectories will be reconstructed by means of three-dimensional particle tracking velocimetry, an advanced stereoscopic video tracking technique from the field of experimental fluid mechanics. The candidate will contribute to the development of computer programs to process data from video tracking and to quantify the behavioral fingerprints of plastic toxicity. This project will support the development of accurate descriptors of behavioral impairments that will complement the set of available toxicological endpoints, with the aim to better understand and predict the integrative effects of plastic pollution on copepod ecology. This research fits in well with the determined effort invested worldwide to assess the potential impacts of plastic fragments on the aquatic biota, but is novel in that it focuses on the nature and ecological consequences of their behavioral toxicity, for which virtually nothing is known, and on very small fragments, which are much less studied than larger particles. Results will be central to the development of new polymer microstructures that show more efficient hydrolytic degradation under standard marine conditions and that minimize toxicity to the biota.
Expected profile of the candidate	We are looking for an excellent candidate interested in improving our understanding of the toxicity of plastic fragments on the marine biota. The successful candidate should hold a MS degree in oceanography, marine biology, environmental science, or a related discipline. Candidates having multidisciplinary background and coming from other fields such as chemistry or biotechnology may also be accepted. Strong interest in experimental work, prior knowledge of MATLAB, and very good communication skills in English, orally and written, are required. This project builds on a collaboration between the LOG and UCCS at Lille University. It offers a multidisciplinary training that blends aquatic ecology, computer vision, ecotoxicology, and polymer chemistry. Behavioral tests will be conducted at LOG and the candidate will contribute to polymer synthesis at UCCS. The project also involves an active collaboration with the *Laboratory of Polymeric and Composite Materials* at the University of Mons (Belgium), where the candidate will spend a few months. There, the candidate will be actively involved in the identification, characterization, and fragmentation of the major commercial bio(micro)plastic sources including polymers and additives.
Application procedure & Eligibility criteria	The application procedure and eligibility criteria are detailed on the European doctoral programme PEARL website www.pearl-phd-lille.eu. The funding is managed by the I-SITE ULNE foundation which is a partnership foundation between the University of Lille, Engineering schools, research organisms, the Institut Pasteur de Lille and the University hospital. The application file will have to be submitted before March 31, 2021 (10:00 AM - Paris Time) and emailed to the following address : international@isite-ulne.fr.
Net salary and Lump Sum	A net salary of about €1,600 + €530 per month to cover mobility, travel and family costs.