PhD position in Marine Ecology (F/M/X)

Characterisation of biocolonisation on artificial structures in the context of offshore wind development: methodological approaches and ecological engineering

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France Energies Marines' Institute

France Energies Marines is an offshore wind energy research and innovation centre with a recognised industrial, economic and societal impact in France and internationally.

Its mission is to remove the obstacles facing the offshore wind energy sector. Backed by the French government and supported by a multidisciplinary team of more than 90 staff, a network of international experts and unique infrastructures, the Institute conducts multi-partner research projects guided by excellence.

The results are transferred to the industry through research and expert services, operating licenses, know-how transfer, as well as participation in expert committees and professional networks.

These activities are structured around four complementary departments: Wind and Ocean Dynamics, Systems and Performance, Wildlife and Interactions, and Ecosystems and Society. Cross-functional support services contribute to and support these activities.

Context

Offshore wind energy involves the introduction of new artificial structures into the marine environment, which create novel habitats that are rapidly colonised by a wide range of marine organisms, leading to local ecological changes. This biocolonisation and the associated habitat modifications have been identified as one of the main pressures linked to the development of offshore wind energy (France Energies Marines, 2023). In this context, bioufouling refers to: (i) the development of epibenthic communities—i.e. biofouling—directly on artificial substrates, but also (ii) the aggregation of various mobile fauna species, particularly teleost fish and decapod crustaceans (Taormina et al., 2022).

From an environmental perspective, the biocolonisation of offshore wind farm structures—also referred to as the "reef effect"—is often considered, from an anthropogenic standpoint, as an environmental benefit (Copping et al., 2016; Inger et al., 2009; Langhamer, 2012; Lemasson et al., 2024). This assumption partly originates from the increase in local biodiversity associated with the arrival of previously absent species, whose colonisation is facilitated by the enhanced structural complexity of habitats created during the installation of offshore wind farms on soft-bottom substrates (De Mesel et al., 2015).

However, these epibenthic communities generally exhibit a higher density of non-indigenous species compared to natural hard substrates (Airoldi et al., 2015; Mineur et al., 2012; Vivier et al., 2021; Taormina et al., 2024). Several French research projects have aimed to improve understanding of the reef effect associated with offshore wind farms (e.g. SPECIES 2016–2020, ABIOP+ 2019–2022, MARINEFF 2018–2023, VELELLA 2023–2027, FISHOWF 2022–2025, BIODHYL 2023–2026, and FISHOWF+ 2025–2028). At the European scale, research efforts have been underway for longer, such as in Belgium, where ecological succession on turbine foundations has been monitored over an 11-year period (Zupan et al., 2023).

However, significant knowledge gaps remain regarding the characterisation of biocolonisation in offshore wind farms, largely because existing studies have generally been conducted at limited spatial and temporal scales (Dannheim et al., 2025). This is notably due to the fact that most of these studies rely on the use of divers, a method that is constrained by high costs, limited underwater working time, restricted depth range, strong sensitivity to weather conditions, HSE risks, and heavy administrative procedures. Furthermore, as offshore wind farms expand further offshore and into deeper waters, the use of divers will become even more challenging to implement.

There is therefore a strong need to develop alternative monitoring methods—among which video-based approaches and environmental DNA (eDNA)—while clearly identifying their advantages and limitations compared to diver-based observations and sampling. Among these approaches, underwater imaging is increasingly used, particularly because data collection is rapid, non-invasive, and feasible at sites that are difficult to access (Taormina et al., 2020). In addition, imaging is widely used by offshore industries for maintenance and inspection purposes, which represents a valuable opportunity to exploit these largely underutilised datasets for scientific research (McLean et al., 2020).

Moreover, in order to enhance this reef effect, there is growing interest in ecological engineering methods that provide stakeholders with design options for marine structures that support biodiversity and/or limit their overall environmental impact while maintaining their primary function (O'Shaughnessy et al., 2020). These approaches are often referred to as "Nature-Inclusive Designs" (NIDs) (Hermans et al., 2020). Although increasingly implemented, the effectiveness of these ecological engineering measures remains insufficiently demonstrated, particularly over the long term (Taormina et al., 2022), even though some unintended negative effects have been reported (R. Gauff et al., 2023; R. P. M. Gauff et al., 2025).

Furthermore, the evaluation of NIDs still relies predominantly on structural indicators such as species richness, abundance, or biomass of colonising organisms (Taormina et al., 2022). However, structures with similar levels of biodiversity may support very different ecosystem functioning. It is therefore necessary to assess the functional consequences of the different ecological designs proposed. In particular, NIDs are likely to steer colonisation trajectories toward contrasting assemblages, dominated either by benthic primary producers or by consumer organisms such as suspension feeders and filter feeders (Vivier, 2022). These differences in community composition may profoundly influence overall community metabolism, carbon transfer pathways between biological compartments, as well as carbon retention or export capacities within coastal ecosystems.

A better understanding of these processes is now essential in order to assess the actual ecological benefits of NIDs and to develop design criteria that integrate not only biodiversity, but also the ecosystem functions associated with biogeochemical cycles.

Job Description

The PhD project is part of the QUANTUM project (2026–2029), which addresses key issues related to the biofouling of artificial structures from both engineering and environmental perspectives.

The PhD is structured around three main research themes:

- **Use of underwater imaging**: Develop and optimise image analysis methods for monitoring biocolonisation and apply them to existing datasets;
- **Monitoring methods**: Compare different biocolonisation monitoring protocols (e.g. diver-based sampling and imaging, ROV-based imaging and sampling, underwater imaging, environmental DNA) in order to identify their performance, limitations, and complementarity;
- **Ecological engineering**: Assess the ecological effectiveness of ecological engineering devices on biocolonisation.

The expected tasks include:

- Gaining a thorough understanding of the current literature in underwater image analysis and proposing and testing optimised annotation protocols based on an existing database of underwater images provided by project partners;
- Extracting biological data from these underwater image datasets to study and analyse biocolonisation patterns over large spatial and temporal scales (e.g. to identify specificities across different biogeographic provinces);
- Organising, preparing, and participating in offshore field campaigns to deploy various biocolonisation monitoring methods at two study sites: the export cable protection structure of an offshore wind farm in the Atlantic, and the met mast of the Fécamp offshore wind farm in Normandy;
- Processing samples collected during field campaigns (e.g. identification of benthic macrofauna, image analysis, preparation of samples for DNA sequencing);
- Statistically analysing and comparing biodiversity data obtained using different monitoring methods;
- Organising, preparing, and participating in biannual offshore field campaigns to study the biocolonisation of eco-engineered and non-eco- engineered artificial structures deployed in situ;
- Measuring oxygen and carbon fluxes (CO_2 and organic carbon) to characterise the metabolism of communities associated with eco- engineered artificial structures;
- Statistically analysing and interpreting ecological succession patterns of biocolonisation;
- Presenting results at international conferences and disseminating them through peer-reviewed scientific publications.

The PhD project will be carried out in collaboration between France Energies Marines, IFREMER, and the University of Caen.

Profile and skills

Initial training

Master's degree (MSc) in marine ecology/marine biology or equivalent engineering degree

Specific knowledge

- Knowledge of marine ecosystems, particularly benthic ecosystems,
- Skills in data processing and statistical analysing using R
- Experience in database management and handling
- Interest in environmental issues and marine renewable energy

Would be a +:

- Interest in image processing tools
- Ability to work at sea
- Interest in applied science

Work experience

- Previous experience in image analysis is desirable

Professional qualities

- Strong interest in fieldwork
- Initiative and proactivity
- Teamwork skills
- Scientific writing skills
- Proficiency in written and spoken English

Practical Information

Type of contract	Fixed-term contract – CIFRE PhD
Duration of the contract	36 months
Status	Executive
Workplace	France Energies Marines – 525 avenue Alexis de Rochon, 29280 Plouzané (part of the PhD may be carried out at the University of Caen – to be discussed with the selected candidate)
Starting date	15/11/2026 (flexible)
Deadline for application	10/08/2026
PhD supervision	**Pascal Claquin** : *PhD Director (Université de Caen ; laboratoire MERSEA)* - Pascal.Claquin@unicaen.fr **Antoine Carlier** : *PhD supervisor (IFREMER – Plouzané ; unité DYNECO)* - Antoine.Carlier@ifremer.fr **Bastien Taormina** : *PhD supervisor (France Energies Marines – Plouzané)* - Bastien.Taormina@france-energies-marines.org

In accordance with the regulations, priority will be given to people with disabilities who are equally qualified.

How to Apply

- Applications must consist of a **CV** and a **cover letter**.
- To apply, please go to the France Energies Marines **website** under the **Join Us** section.

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