**PhD subject :** Past and future spatio-temporal dynamics of functional diversity facing climate change: The case of the Celtic Sea

**Context and Objectives:**

The ocean provides many types of ecosystems services. Among the provisioning services, fish consumption currently contributes to 20% of the animal protein and supplies more than 3.3 billion people [1]. Climate change impact on biodiversity is recognized worldwide at multiple biological and ecological levels that scale up to ecosystems [2]. Indeed, the decrease of marine primary production expected in some ecoregions could be amplified through the trophic pathways and reduce the biomass of high trophic levels [3]. This threat would weaken coastal marine ecosystems already largely impacted by historical fishing pressure and habitat degradation. Additionally, species communities respond to sea temperature warming, both in terms of productivity and distribution, leading to local prey-predator spatial mismatch [4], increasing species turnover, restructuration of marine communities and modification of food-web structure and stability [5].

Climate change and overexploitation cause changes in community structure and the distribution of biological traits, influencing ecological processes and services. Marine species shift their range edge under global warming at an average of 19km/year and 75% of marine range shifts occur in a poleward direction [6]. At the scale of the Celtic sea, south Lusitanian species should shift northward and compete with boreal species for niche. We propose to test this hypothesis on trophic niche using isotopic and stomach content data for 5 Lusitanian (hake, sole, megrim and two species of anglerfish) and 5 Boreal (whiting, cod, plaice, haddock and blue whiting) species. To preserve ecosystem services in a context of ongoing fishing pressure and increased impacts of climate change, it is essential to understand the dynamics of marine biodiversity and their influence on the structure and functioning of these ecosystems.

This PhD project aims at analysing the spatio-temporal trends of communities over the 1997-2020 period and predicting the future trend of functional diversity in the Celtic Sea. The originality of this PhD project lays in the use of functional traits and trophic niche to hindcast and forecast the functional diversity and community composition in the Celtic sea under two climate change scenarios (RCP 8.5 and RCP 4.5). The PhD student will first investigate temporal changes in regional (gamma) functional diversity and turnover (beta). The PhD student will identify species contributing the most to gamma; and beta diversities; and assess their vulnerability to climate change using traits. The isotopic niche will be described and the isotopic niche overlap between species will be investigated. The evolution of dietary niches will be investigated through time and space along a latitudinal gradient of 500km to competition. Finally, the PhD student will integrate these outcomes in the modelling of future changes in functional and trophic diversities under two climatic scenarios for which we already have predictions on the trophic web. The quality of the estimations will be reinforced by the potential use of Bayesian modelling to characterize the dynamics of diversity patterns based on the 20-year time series. From a more general point of view, this work will contribute to the current international scientific debates on integrated ecosystem management and the necessary trade-offs between different management objectives [7].

**Application:**

The candidate will be supervised by :

Maud Mouchet (UMR 7204 CESCO, MNHN, Paris) and

Marianne Robert and Dorothée Kopp (LTBH, IFREMER, Lorient).

The completion of this thesis is conditional upon the success of the candidate in the Doctoral School 227 - NATURAL AND HUMAN SCIENCES: EVOLUTION AND ECOLOGY.

You will find the detailed application procedure at: <http://formation.mnhn.fr/fr/enseignement-superieur/doctorat/concours-ed227>

<https://www.adum.fr/as/ed/voirproposition.pl?langue=&site=ed227&matricule_prop=33991>

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**References :**

1. doi.org/10.5194/bg-8-1213-2011
2. doi:10.3389/fmars.2016.00062
3. doi:10.1111/gcb.14468
4. doi:10.1371/journal.pone.0084526
5. doi:10.1038/s41558-019-0631-5
6. doi:10.1111/j.1466-8238.2009.00519.x
7. doi:10.1093/icesjms/fst161