

Masters 2 Internship : Project Proposal

Population genomics of Europe's largest temperate reef-builders

Species distributions have been profoundly affected by past climate change, and are expected to change considerably in response to future environmental change. Present-day stressors including human activity can also affect

population sizes and distributions, significantly

affecting where species thrive. To better apprehend how present-day activities and future climate change is likely to affect genetic diversity in marine populations, it is essential to evaluate the multiple processes that have shaped the current distribution of genetic diversity in the sea.

The honeycomb worm, *S. alveolata*, is a reef-building polychaete that hosts high biodiversity in the temperate reefs it constructs. Previous work based on mitochondrial DNA has shown that the species presents high genetic diversity in its northern and southern population range edges, with central populations in France having relatively lower genetic diversity (Nunes et al. 2021). This unexpected distribution of genetic diversity most likely resulted from population collapse due to glacial-interglacial cycles, which led to extirpation of *S. alveolata* from the Bay of Biscay (France), while populations north of the English Channel and in Northern Africa persisted.

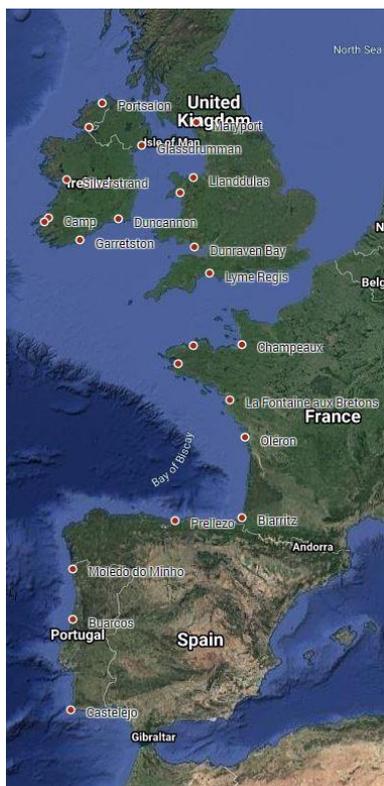


Fig. 1. The honeycomb worm *Sabellaria alveolata* builds the largest reefs in Europe

Mitochondrial DNA provides a partial, deep-time view of the processes that have shaped genetic diversity in this important reef-builder. However, recent or present day processes can also affect genetic diversity at local to regional scales. This is why examining the effects of selection or demography over the entire genome may provide a more complete view of the various processes controlling genetic diversity in a species. Local adaptation may provide an advantage to individuals living under a given set of environmental conditions, but as climate shifts, some populations may become mal-adapted to new conditions. Population bottlenecks or expansions can also

Fig. 2. Populations across the distributional range of *S. alveolata* will be screened for loci under selection, which will be correlated with environmental variables, reef state and hydrodynamic connectivity metrics.

affect genetic diversity and a population's ability to adapt to future change.

Many resources are now available to explore the population genomics of this important temperate reef builder:

- SNP profiling of 24 populations in Europe and North Africa (unpublished data)
- A genome sequenced with Pacbio long-read technology (Robert 2020), which will be used to map SNPs onto.
- Habitat suitability modeling parameterized for the species, under present-day and climate change scenarios (Curd 2020)
- Hydrodynamic connectivity models (David et al. 2022)
- Reef state metrics for dozens of sites in Europe (Boye et al, in prep.)

This Masters 2 project will examine the population genomics of Europe's largest reef builder, *Sabellaria alveolata*. We will use a population genomics approach based on 2bRAD genotyping on 24 populations, to characterize genetic diversity across the species range, from Ireland to Morocco. Genes under selection will be identified by outlier SNP analysis and will be correlated with various environmental parameters, reef-state indicators and connectivity metrics to better understand which processes have shaped genetic diversity across different parts of the distribution.

The internship will be based at Ifremer's Center in Brittany, and a stipend of 650 euros per month will be provided over the course of 6 months. International students are eligible for a supplementary travel grant from ISBlue (<https://www.isblue.fr/tous-les-appels/mobilite-internationale-entrante-etudiants-niveau-master/>)

Bioinformatic and statistical analyses will be conducted on Ifremer's computing cluster, DATARMOR. Basic experience with Unix command line and programming in R are desired.

Please contact Flavia Nunes for more information at flavia.nunes@ifremer.fr

Deadline for applications: Dec 2, 2022.

(please note that the deadline for an international travel grant is 25/11/2022.

International students should make contact as soon as possible).

Curd A (2020) On the macroecology and global distribution of the ecosystem engineer: *Sabellaria alveolata* in a changing world.

David CL, Marzloff MP, Knights AM, Cugier P, Nunes FLD, Cordier C, Firth LB, Dubois SF (2022) Connectivity modelling informs metapopulation structure and conservation priorities for a reef-building species. *Divers Distrib* 1–15. doi: 10.1111/ddi.13596

Nunes FLD, Rigal F, Dubois SF, Viard F (2021) Looking for diversity in all the right places? Genetic diversity is highest in peripheral populations of the reef-building polychaete *Sabellaria alveolata*. *Mar Biol* 168:63. doi: 10.1007/s00227-021-03861-8

Robert J (2020) Assemblage du génome de l'annélide polychète *Sabellaria alveolata*. Masters 2 thesis.