

A new submarine observatory of the Sub-Antarctic coastal benthos facing climate change in Kerguelen Islands

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In the current context of climate change, variations in sea surface temperature, sea level change, and latitudinal shifts of currents and hydrological fronts are expected to affect marine biodiversity of the Sub-Antarctic Islands located near the Polar Front, such as the Kerguelen Islands, particularly in coastal waters. Characterizing the impact of these changes on sub-Antarctic biota and ecosystems requires recording environmental changes through the establishment of long-term *in situ* monitoring. The IPEV program PROTEKER aims at the establishment of such a submarine observatory consisting in multi-disciplinary research: oceanographic, benthic habitat mapping and inventories, genetic, eco-physiological, and trophic analyses. In addition, the program also aims at providing with scientific criteria the managers in charge of protection and conservation policies (TAF National Nature Reserve). Sampling sites of previous oceanographic programs focused on the Kerguelen Islands were revisited during summer campaigns. Among eighteen coastal sites explored through scuba diving, eight were selected for monitoring, as representative of the Kerguelen sub-Antarctic marine habitats, and were progressively equipped with sensors and settlement plots. ROV observations and beam trawling (50 and 100m) have also been conducted for contextualization. Eight sites in the Morbihan Bay [4], in the North [2] and in the South [2] of the Kerguelen Islands are monitored using photo and video surveys, temperature loggers installed at 5 and 15m depth, and settlement plots at about 10m depth. Temperature data have been recovered yearly since 2011 at some sites. Biodiversity found on settlement plots will be characterized yearly through morphology and DNA techniques. Phylogeographical studies of target taxa within molluscs, crustaceans, echinoderms, and fish are being conducted to improve our knowledge of endemism and connectivity levels among sub-Antarctic islands. In addition, our knowledge of sub-Antarctic life and of its potential resilience to environmental changes will be improved by trophic analyses and eco-physiological experiments performed *in situ*. The originality of the PROTEKER observatory consists of (1) the nature of the investigated region [Sub-Antarctic zone], (2) the large spatial scale of the observing system (8 permanent monitored sites with different environmental conditions of open sea, sheltered bays, and fjord), (3) the experiment duration [over 8 years], (4) the dynamic approach to characterize the colonization process, (5) the double approach including taxonomic and metagenomics analyses, (6) the fact that the monitored sites and data in open, interoperable and reusable formats will also be used for other scientific programs, hereby the submarine observatory truly making sense.

References

- Féral J.-P., Saucède T., Poulin E., Marschal C., Marty G., Roca J.-C., Motreuil S., Beurier J.-P. 2016. PROTEKER: implementation of a submarine observatory at the Kerguelen islands (Southern Ocean). *Underwater Technology* 34(1): 1-8, doi: 10.3723/ut.34.000
- González-Wevar C.A., Hüne M., Rosenfeld S., Saucède T., Féral J.-P., Poulin E. 2016 Patterns of genetic diversity and structure in Antarctic and Subantarctic *Nacella* (Patellogastropoda: Nacellidae) species. *Biodiversity* doi: 10.1080/14888386.2016.1181573