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## From genes to ecosystems, adaptation of introduced salmonids to a changing sub-Antarctic environment.

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Polar regions undergo rapid changes to which both native and non-native species must adapt. Long term and well documented monitorings are paramount to understand the various processes and scales that participates to adaptation. The case of introduced salmonids to sub-Antarctic Kerguelen islands offers a rare opportunity to envision adaptation at these various scales. Our monitoring encompasses 8 introduced salmonid species over five decades and tenths of hydrosystems. Some of these species did not adapt, some managed to persist, and some thrived. We here give a report of these different outcomes in relationship with their introduction conditions (numbers, stages, origins, genetic diversity). We then browse a panel of recent or ongoing research, picturing how adaptation processes may be investigated through different scales, taking the brown trout as the model species. At the genes level, we seek footprints of selection on the colonization front by monitoring heterozygosity fitness relationships generation after generation, in populations where genetic variation is minimal. At the organism level, we show plastic behavioural adaptation in terms of feeding to these trophically limiting environments. At the population level, we investigate the temporal and spatial environmental aspects that trigger and facilitate colonization of virgin habitats throughout the archipelago. And at the ecosystem level, we investigate how fish may impact their new environment, and how in turn they may be used as markers of environmental change driven by other species, and how strong is this current change. We finish by underlining connexions between these processes and scales, their role in the dynamics of diversity, and by identifying the potential of our findings for other rapidly changing polar regions.