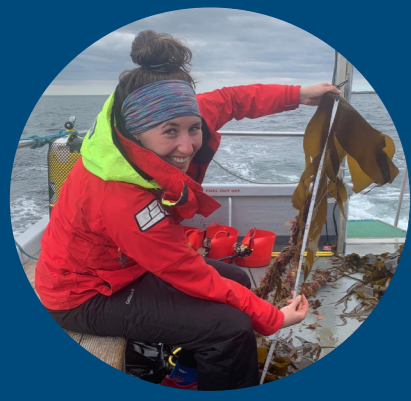
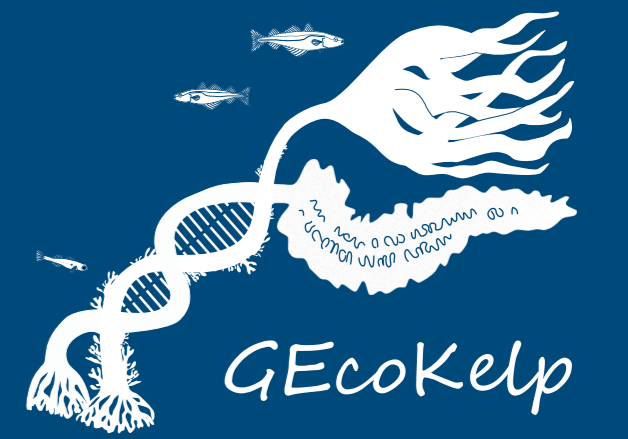


The GEcoKelp Project: Unravelling the impacts of climate change and anthropogenic activities on Norwegian kelp forests

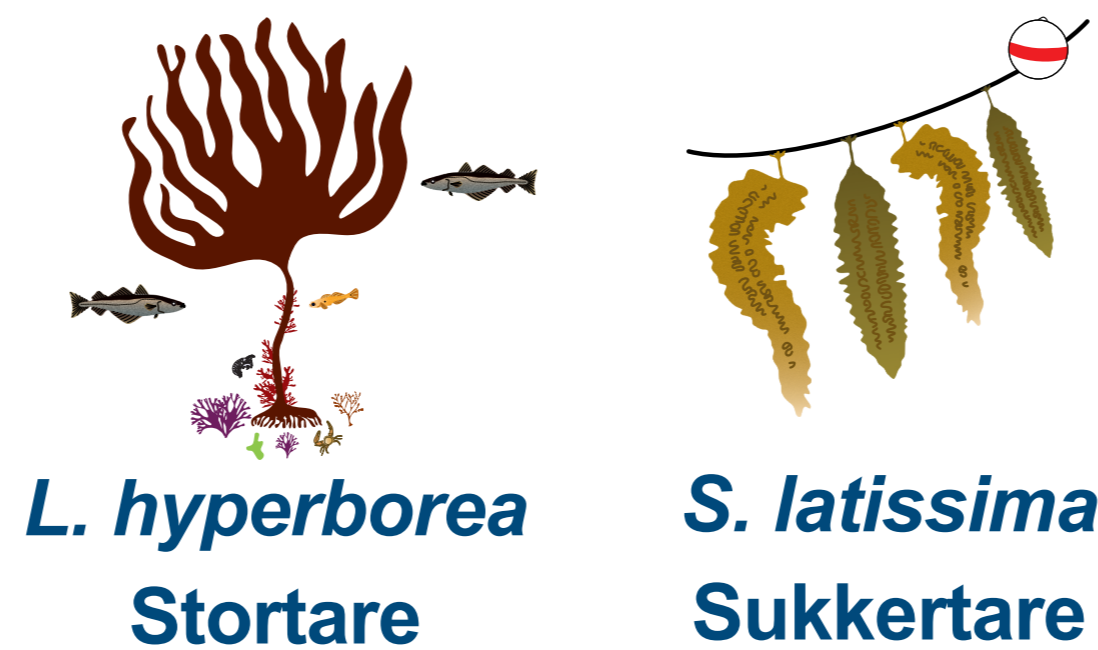
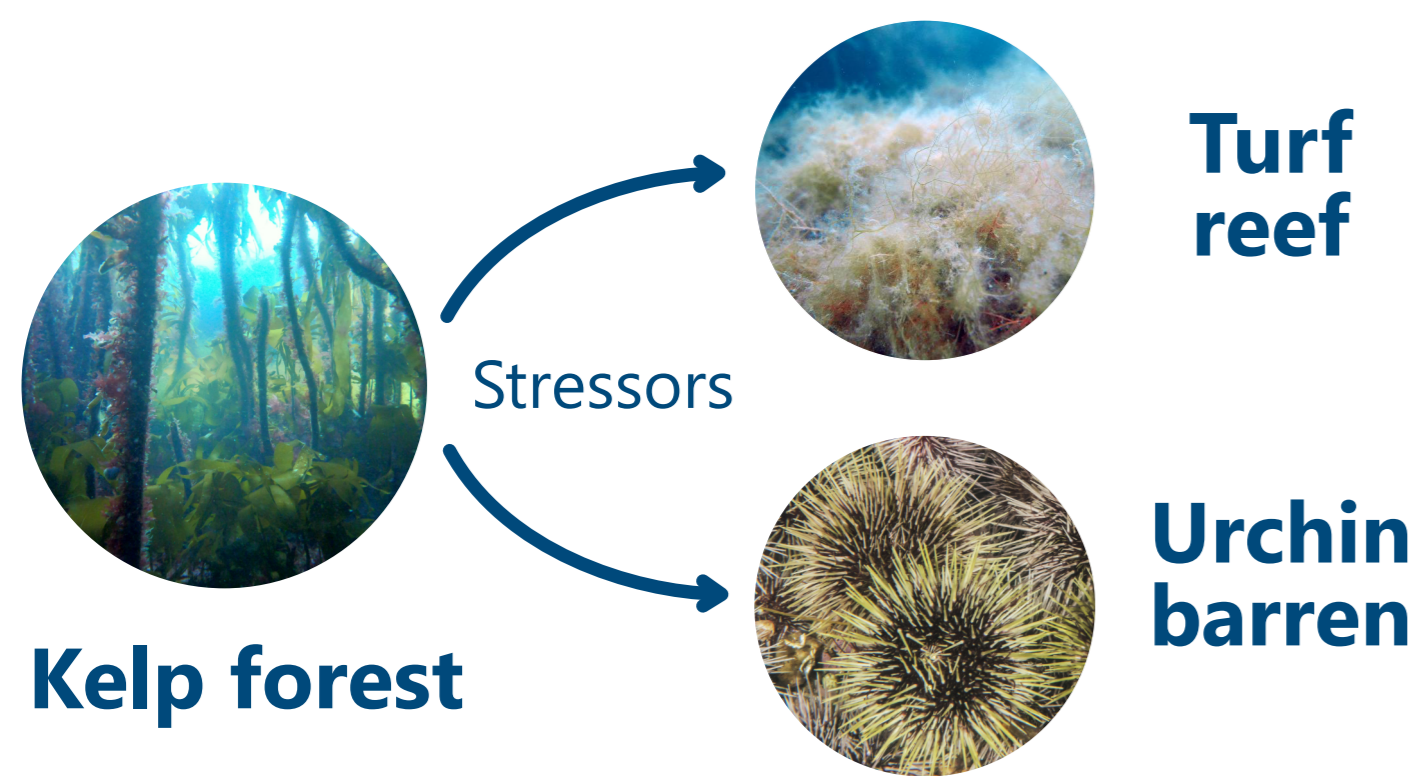


Hannah Earp¹, Rowen Monks², Grace Edwards³, Antoine Minne^{1,3}, Karen Filbee-Dexter^{1,3}, Georgina V. Wood^{3,4}, Thomas Wernberg^{1,2}

Underwater forests

Kelp forests are **dominant** marine ecosystems in **Norway** and along up to **one-third** of the **world's coastline**¹.

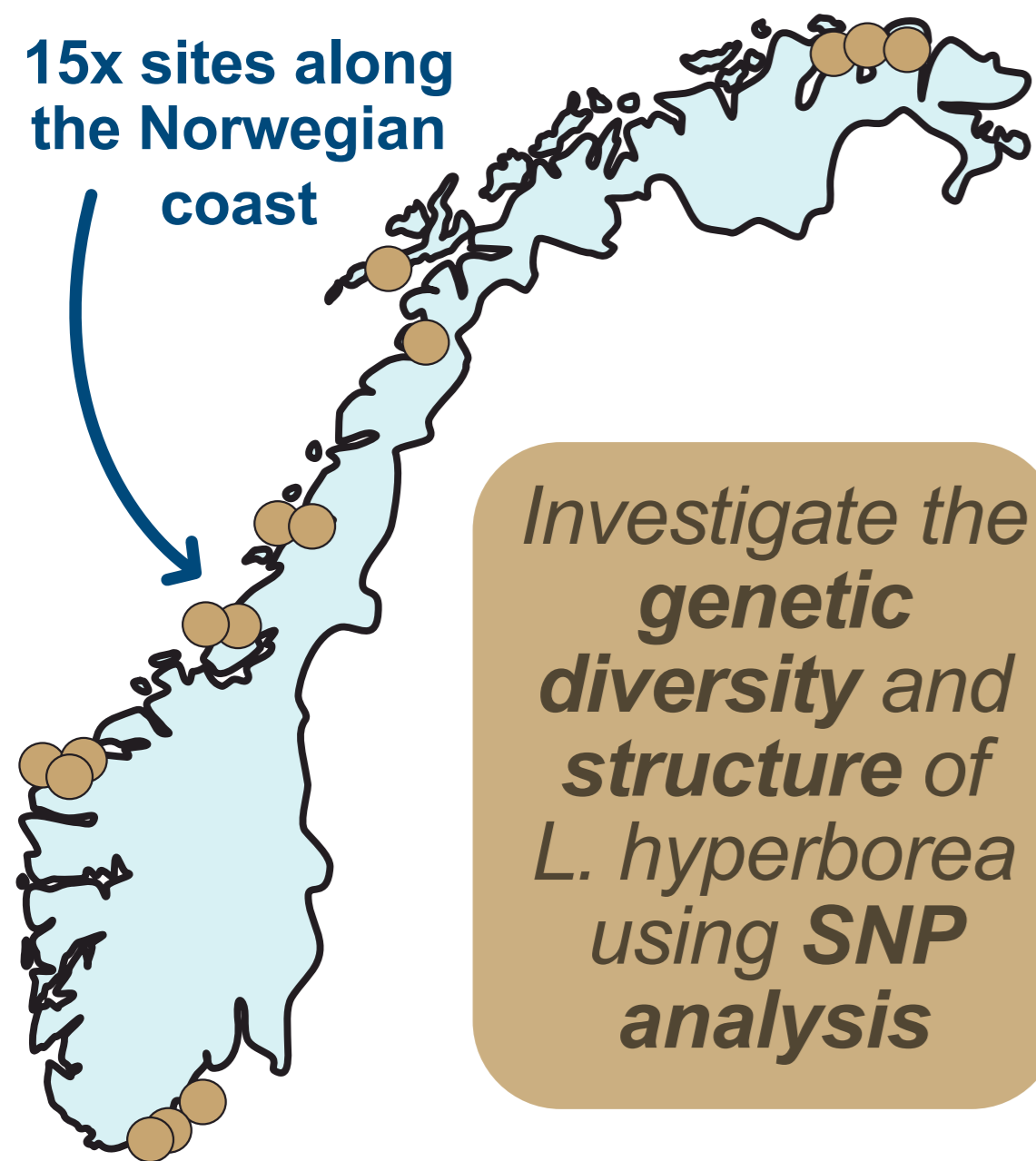
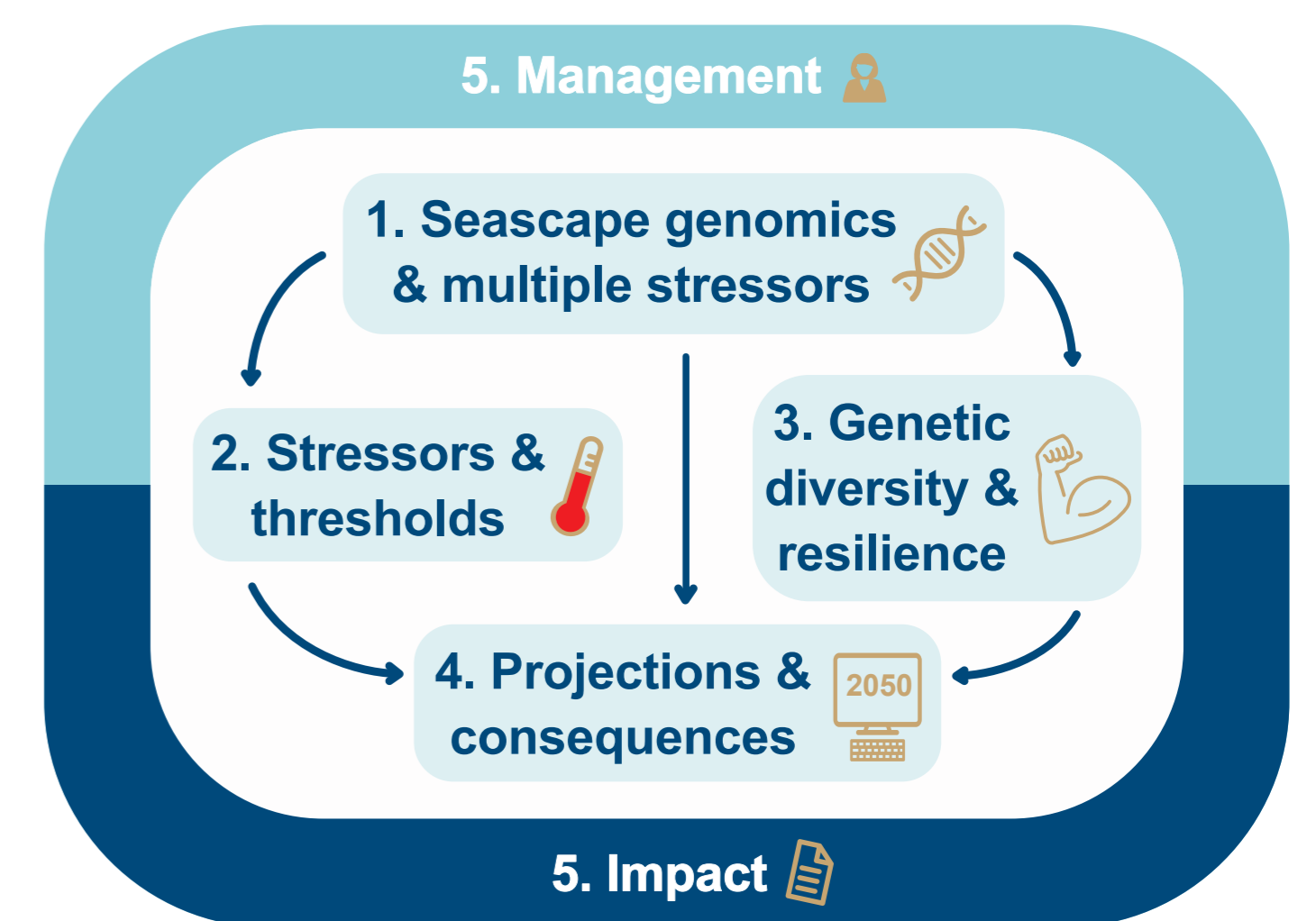
Despite their **ecological, social** and **economic value**, kelp forests are **threatened** by stressors including **climate change** (e.g. ocean warming, marine heatwaves) and **anthropogenic activities** (e.g. coastal darkening)².



1. Map genetic structure of Norway's kelp forests.
2. Lab: determine how genetic diversity and adaptation influence responses to environmental stressors.
3. Field: assess the influence of genetic diversity and adaptation on resilience.
4. Predictive modelling of kelp forest responses to future climate change.
5. Co-ordination and communication of findings.

GEcoKelp scope

GEcoKelp aims to reveal the effects of **ocean warming** and **marine heatwaves** on **Norwegian kelp forests** in **multi-stressor seascapes**, at the **genomic, ecological** and **ecosystem levels**

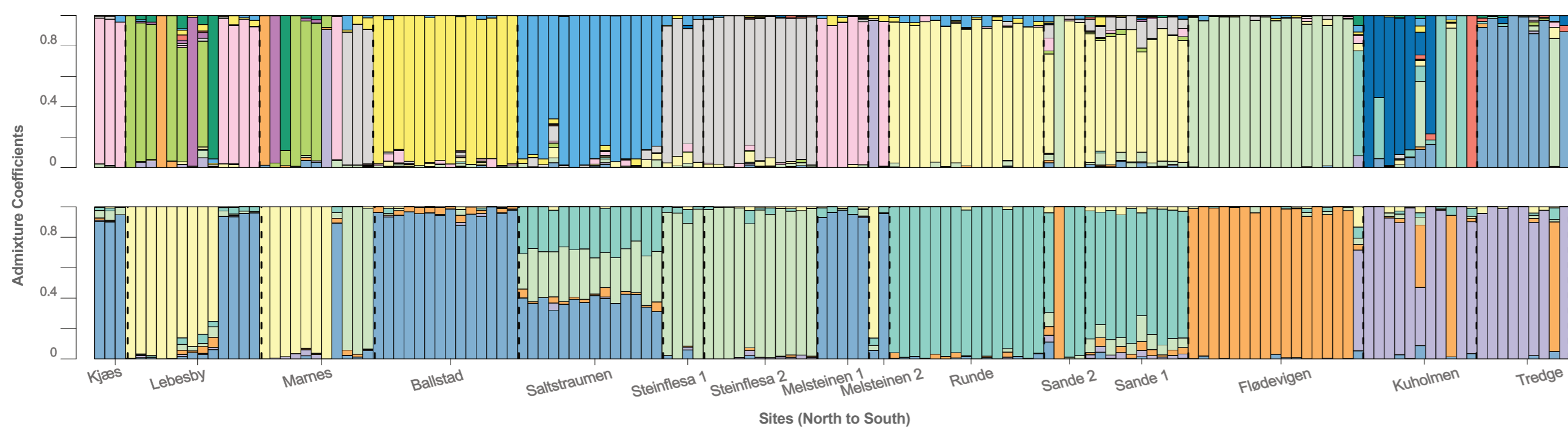


Genetic structure

High genetic diversity can allow species to **adapt** to future environmental change.

Genetic studies on *L. hyperborea* have used **microsatellites** but **single nucleotide polymorphisms (SNPs)** may be more accurate for determining genetic structure and within-population variation.

DNA from 143 kelp → ddRAD sequencing → Identified 12,345 SNPs

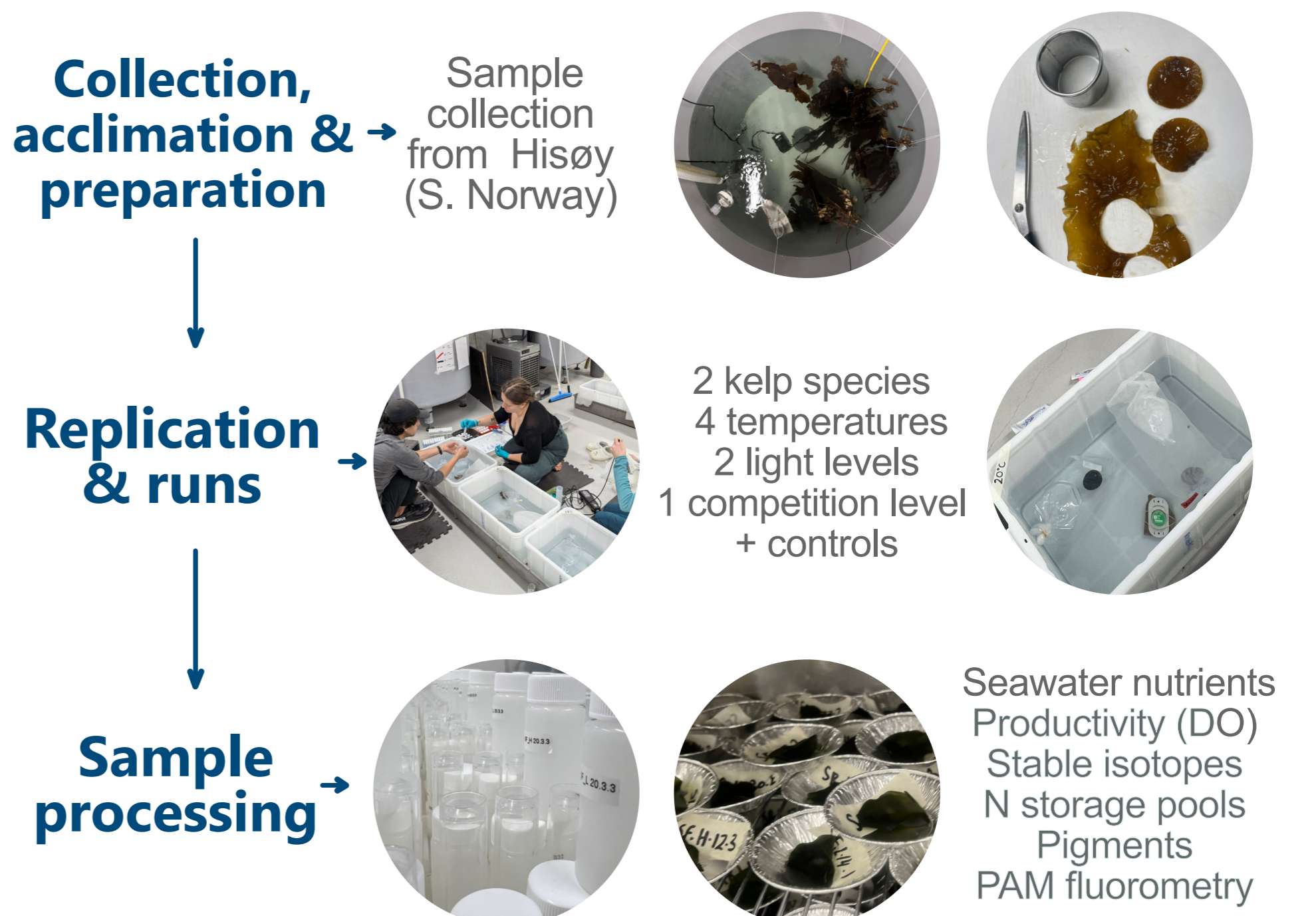


At most sites, *L. hyperborea* exhibited **low genetic diversity** and **high differentiation**. Cluster analysis identified **6 populations** across the 15 sites.

The results suggest that many of Norway's *L. hyperborea* populations may be **small** with a **low resilience** to climatic stress, meaning **management** and **conservation** is imperative. The analysis will be repeated with *S. latissima*.

Nutrient uptake dynamics

Assess the impact of **ocean warming** and **coastal darkening** on **nitrogenous nutrient uptake and cycling** by *L. hyperborea* and *S. latissima*



This experiment will be repeated to explore **spatio-temporal variation**. The findings will provide insights into **kelp functioning** and **nutrient competition** under varying environmental conditions, with implications for natural forests and kelp-farming operations.

Coming soon

Lab: Gametophyte culture experiments **Modelling:** Genomic vulnerability & future scenarios

Fieldwork: Runde, Posangerfjord & Svalbard 2025

Aquarium: Heatwave experiments with kelp sporophytes/gametophytes & associated species

Impact: Publications & conferences