The Challenge
Productive and sustainable UK aquaculture systems require a reliable supply of high quality stock. Well-managed programmes of domestication and selective breeding have huge potential for cumulative gains in production. However, the level of technology used for breeding and production is wide-ranging across aquatic species. Reliance on wild or near-wild stock creates vulnerability and limits profitability via impaired ability to improve stock performance and to combat emerging challenges. As such, a key research challenge for UK aquaculture is to enable selective breeding. Current barriers to this include knowledge gaps in the genetic basis of economically important traits, and a lack of molecular tools and quantitative genetics expertise.

Objectives
AquaLeap aims to improve genetics and breeding for four UK aquaculture sectors including a large, advanced industry (salmon), and smaller or emerging industries (lobster, flat oyster and lumpfish).

1. To develop and apply a range of novel genomic tools and resources to underpin domestication and genetic improvement for four species of commercial importance or potential in UK aquaculture.
2. To investigate the genetic and epigenetic basis of variation in key commercial production traits, with a focus on growth, robustness and disease resistance.
3. To improve gene editing techniques in aquaculture species, and use gene editing approaches to identify the causative factors underlying a major locus affecting disease resistance in salmon.
4. To address skill gaps in key areas defined by the ARCH-UK network, including quantitative genetics, bioinformatics and gene editing.
5. To engage societal stakeholders in aquaculture genetics, including future uses of advanced genetic technology.

Industry Relevant Outputs

- New genomic tools to assist selective breeding of several UK aquaculture species.
- Improved knowledge of the genetic and epigenetic basis of traits of importance to the aquaculture production industry.
- Improvements in gene editing which has future potential to tackle production barriers for the industry, including disease resistance.
- Addressing gaps in skills that are lacking, including quantitative genetics and bioinformatics.
- Improved engagement of the public and other stakeholders in the use of genetics technology in aquaculture.
BASIC METHODOLOGY AND WORK PACKAGES (WP)

WP1. Genomic tools underpinning aquaculture genetics
Task 1A: Generate high-quality genome sequences for European lobster, European flat oyster, and Lumpfish.
Task 1B: Design of low density SNP panels for future cost-effective genomic selection and parentage assignment for all species.
Task 1C: Develop a cost-effective assay to measure trait-relevant copy number variation in Atlantic salmon.
Task 1D: Testing and improving gene editing technology for aquaculture.

WP2. Domestication and genetic improvement of emerging species
Task 2A: Estimate genetic parameters for growth and disease traits in European lobster.
Task 2B: Investigate the relationship between epigenetic modifications and growth traits in European lobster.
Task 2C: Investigate genetic resistance to Bonamia in flat oyster.
Task 2D: Develop measurements of physiological resilience in flat oyster and its relationship to disease resistance.
Task 2E: Assess genetic diversity and estimate heritability of performance traits in lumpfish.

WP3. Advancing genomic selection for disease resistance
Task 3A: Genotype a large sample of pedigreed salmon for copy number variation polymorphisms.
Task 3B: Assess the contribution of copy number variation to heritability of gill disease resistance.
Task 3C: Develop cost-effective methods of genomic prediction of breeding values.

WP4. Gene editing for resistance to viral disease in salmon
Task 4A: Designing and testing guide RNA for targeting specific genomic variants.
Task 4B: Develop gene edited cell stable cell lines for IPNV resistance targets.
Task 4C: Test high-priority disease resistance variants for in vivo gene editing.

WP5. Training, Management and Public Engagement
Task 5A: Improve societal engagement on genetics technology in aquaculture.
Task 5B: Design and regularly update website, social media, and infographics.
Task 5C: Hold regular project management meetings.
Task 5D: Training exchanges between partners.
Task 5E: Develop and implement training workshops.

Project outline made in collaboration with ARCH-UK
More project outlines can be found at www.aquaculturehub-uk.com