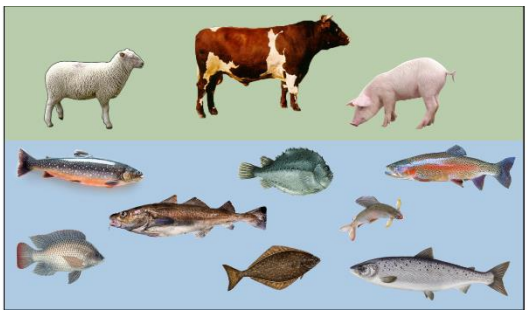
Master project descriptions:

Genome Biology – CIGENE

BIOVIT

Who are we?

We are a well established, motivated group of master- and PhD students, postdocs, researchers, technicians and professors, using cutting edge genome technologies to address basic and applied research questions.



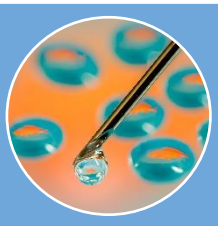
What do we study?

Our interests include genetics, evolutionary and comparative genomics, molecular biology and bioinformatics. We focus on aquatic species and domesticated animals.

What technologies do we have?

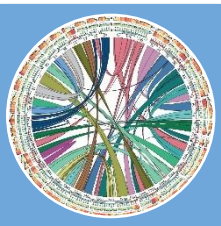
We use state-of-the-art technologies for short and long-read sequencing, genome annotation, and editing genomes *in vitro* and *in vivo*.

CRISPR-CAS9



Cell biology

Sequencing



Bio-informatics

-'omics'

We offer master projects from a variety of topics within genome biology

www.cigene.no
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Master project descriptions:

Genome Biology – CIGENE

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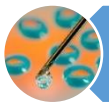
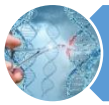
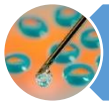
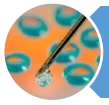
Master projects focused on Lab work

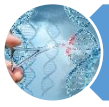

Pluripotent stem cell culture in Atlantic salmon


Development of CRISPR/Cas9 editing tools for whole genome screening in production animals

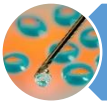

Discovering the genomic basis of fungal lipid production


The importance of gut microbiome for salmon metabolism and welfare


Genome editing of Atlantic salmon to study the effect of structural variants in evolution


Determine the role of important candidate genes and cell types in the reproductive function

Master projects focused on Lab & Bioinformatics


Responses to sea lice in salmon cells


Selection against Chronic Wasting Disease (CWD) based on PRNP-genotypes in reindeer - effects on genomic variation

Master projects focused on Bioinformatics / 'omics


Prediction of growth and welfare of Atlantic salmon in sea cages based on gill gene expression profiles


The role of transposable elements in evolution of liver enhancer landscape in Atlantic salmon


Explore how species adapted to various environments by using genomics

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Title: Pluripotent stem cell culture in Atlantic salmon

Key words: Induced pluripotent stem cells, cell line
Language: English
Credits: 60

Contact persons / supervisors

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Task description

Pluripotent stem cells (PSCs) are a unique subset of cells that can differentiate into virtually any other cell type. This remarkable ability of PSCs has been recently used to develop novel research approaches that have advanced regenerative medicine, cancer biology and aging. However, most of the research effort in PSCs has been focused on mammals. Even though Atlantic salmon plays a major role in sustenance and economy, there is still not much known about specifics of its stem cell biology. At CIGENE we have developed and started a series of projects that will address these shortcomings.

The Master student project will focus on testing the potential of using a set of genes that can de-program differentiated cell and turn them into induced Pluripotent Stem Cells (iPSC). The first step towards this goal is developing salmon skin fibroblast cell culture using protocols that have been used to culture rainbow trout cells. Following isolation of salmon fibroblasts we will test if iPSCs can be induced by a known mixture of 4 transcription factors (Yamanaka factors). If we are successful in inducing iPSCs, we will ultimately test the extent of their pluripotency by determining which differentiated cell types our novel cell lines can produce.

The master project will be performed in collaboration with AquaGen.

Master project descriptions:

Genome Biology – CIGENE

BIOVIT

Title: Development of CRISPR/Cas9 editing tools for whole genome screening in production animals

Key words: Cas9, Gene-editing, cell lines, genome-wide screening
Language: English
Credits: 60

Contact persons / supervisors

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Task description

Novel CRISPR based genome editing technology enables us to develop new approaches to selecting disease resistance traits in mammalian production species. However, tools to modify bovine and porcine genomes are not as well developed as those in model species. Specifically, there are still no assays suitable for whole genome screening for phenotypes that model host pathogen interactions in either of the production species. GENEInnovate project at CIGENE aims to close this gap by developing new libraries and working out methodology to test resistance to viral and bacterial pathogens ex vivo.

The project will focus on identification of optimal levels of Cas9 nuclease expression in porcine intestinal epithelial cells. To achieve this clonal populations of cells transduced with Cas9 will be grouped according to the levels of the nuclease produced in these cells. Efficiency of genome modifications will be determined by examining the frequency of mutations in a set of genes known to participate in host pathogen interactions. Upon completion of this analysis we expect to identify a specific cell line that will be most suitable for genome wide screening.

The master project will be part of the GeneInnovate project.

Master project descriptions:

Genome Biology – CIGENE

BIOVIT

Title: Discovering the genomic basis of fungal lipid production

Key words: Genome sequencing, gene expression, fungi
Language: English
Credits: 60

Contact persons / supervisors

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Volha Shapaval,
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Task description

Main aim: Understand the genomic basis of biotechnology traits (e.g. lipid profunction) of fungi

The project will a mix of lab- and data analyses.

- You will extract DNA/RNA from fungal species/lines used for production of lipids
- Produce genome assemblies from long-read technology (e.g. oxford nanopore)
- Use comparative genomics approaches to understand the differences in the repertoire of lipid producing genes across different fungal species/strains
- The student must be comfortable with at least one programming language (R, python etc)

The master project will be part of the Earth BioGenome Project Norway

Title: The importance of gut microbiome for salmon metabolism and welfare

Key words: aquaculture, gut microbial communities, metabolism, short chain fatty acids
Language: English
Credits: 60

Contact persons / supervisors

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Sabina Leanti La Rosa,
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Task description

Main aim: To evaluate the role of microbial gut communities for salmon welfare and lipid metabolism.

The student will work in the lab to isolate microbial cells from different salmon gut sections. We will then characterize the types of microbes that occupy the different gut sections using Oxford Nanopore long-read technology to sequence their genomes and finally use meta-transcriptomics to infer the potentially 'beneficial' metabolic functions microbes carry in the salmon gut.

The master project will be part of the ImprovAFish project

Master project descriptions:

Genome Biology – CIGENE

BIOVIT

Title: Genome editing of Atlantic salmon to study the effect of structural variants in evolution

Key words: Structural variants, evolution, developmental biology, molecular biology, in vivo
Language: English
Credits: 60

Contact persons / supervisors

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Marie Saitou,
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Task description

Main aim: Edit the genome of Atlantic salmon to study the physiological effect of different structural variants

This is a lab-based Master thesis, associated with a project studying the effect structural variants (deletions, duplications, insertions, inversions etc) have had in the evolution of Atlantic salmon. The student will edit or insert different variants in Atlantic salmon embryo in cooperation with a postdoc, using CRISPR or new transgenesis techniques, such as Tol2. The effect of the different structural variants will be studied during development using immunohistochemistry or *in situ* hybridization with fluorescent microscopy.

The master project will be part of SalmoSV (funded by RCN).

Please visit our website before contacting us:
https://sites.google.com/view/saitou-lab/home

Title: Determine the role of important candidate genes and cell types in the reproductive function

Key words: model fish, crispr/cas9, molecular biology, physiology
Language: English
Credits: 60

Contact persons / supervisors

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Romain Fontaine,
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Task description

Main aim:

The objective is to establish new transgenic line to investigate the role of specific receptors and the role of specific cell types in the proliferation of gonadotrope cells

The student will use the CRISPR/CAS9 technique to knockout the expression of specific receptors and use the Nitroreductase/Metronidazol technique to ablate specific cell types, hypothtized to play a major role in the control of thre reproductive function (light integration, hormonal regulation of gonadal development,…). The student will inject medaka eggs with the construct, let them grow and screen for the positive animals. qPCR, *in situ* hybridiation and immunofluorescence combined with advanced fluorescent imaging technique will be then used to analyze the effects.

Title: Responses to sea lice in salmon cells

Key words: Salmon, sea lice, cell culture, molecular biology, immunology
Language: English
Credits: 60

Contact persons / supervisors

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Mari Austad Brandt,
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Task description

Main aim: Study the effect of different components from sea lice on Atlantic salmon skin cell cultures

This is a lab-based Master project but might involve some analysis of RNAseq data depending on the interest of the student. The student will culture cells from the skin from Atlantic salmon, and then apply crushed sea lice, whole sea lice, or different components isolated. Changes in the transcriptome of the cells will be measured to find out which substance is giving the response. Techniques used will be advanced cell culturing, measurements of gene transcription (with RNAseq, quantitative PCR and/or specific reporter cell lines), and molecular biology techniques. Gene editing with CRISPR might be used to verify which pathways are involved in the response.

This project is associated with the NCR project LiceRESIST.

Title: Selection against Chronic Wasting Disease (CWD) based on PRNP-genotypes in reindeer - effects on genomic variation

Key words: domesticated reindeer, PRNP-genotyping, Illumina sequencing, relationship analysis
Language: English
Credits: 60

Contact persons / supervisors

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Dag Inge Våge,
Professor, Biovit
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Task description

Main aim: Different PRNP-genotypes in reindeer are known to cause different susceptibility to CWD. In this study we want to investigate how selection against Chronic Wasting Disease (CWD) based on PRNP-genotypes will affect genomic variation in commercial herds of reindeer.

The project will mainly include bioinformatic analyses and also some wet-lab:

Lab: DNA will be collected from bucks in 4 different commercial herds for PRNP-genotyping (the prion protein gene). A subsample of these animals will be genotyped by Illumina-sequencing (genome wide), to investigate the relationship between PRNP-genotypes and the genome wide genetic variation.

Bioinformatics: Analyse Illumina sequencing data to derive SNP-genotypes from these. Cluster animals based on PRNP-genotype and investigate how the clustering affect the genome wide genetic (SNP) variation

The master project will be part of RRF-project «*Tamreinlag samarbeider med forskere for å forebygge utbrudd av skrantesjuke*» , led by Tranulis.

Title: Prediction of growth and welfare of Atlantic salmon in sea cages based on gill gene expression profiles

Key words: Gene expression, smoltification, Atlantic salmon, welfare, growth, machine learning
Language: English
Credits: 60

Contact persons / supervisors

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Torgeir R. Hvidsten,
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Task description

Main aim: Investigate if gene expression in Atlantic salmon smolts can predict the growth and welfare after sea water transfer.

The project will be only data/bioinformatic analyses:

- Use machine learning on gene expression data from 3000 Atlantic salmon to identify gene expression patterns that predict high/low growth and good/bad welfare after 4 months of sea water transfer
- The student must be comfortable with at least one programming language (R, python etc)

The master project will be part of the project Syncrosmolt.

Master project descriptions:

Genome Biology – CIGENE

BIOVIT

Title: The role of transposable elements in evolution of liver enhancer landscape in Atlantic salmon

Key words: Genome evolution, cis-regulatory elements, enhancers, massive parallel reporter assays
Language: English
Credits: 60

Contact persons / supervisors

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Lars Grønvold
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Task description

Main aim: To test the importance of transposable elements in enhancer evolution in Atlantic salmon

- The student will analyse results from a massive parallel reporter assay experiment in Atlantic salmon hepatocyte cells. This data has already been generated by a former postdoc in the group (Alex) using the HiDRA protocol (link here).
- Analyses will use existing software (SHARP-RE) to identify cis-regulatory regions that either induce or repress gene transcription in liver.
- Next, the student will use information from annotations of transposable elements (TEs) in the Atlantic salmon genome to test the idea that TEs has been an important source for evolution of novel enhancer elements.
- The student must be comfortable with at least one programming language (R, python etc)

The master project will be part of the project Rewired.

Master project descriptions:

Genome Biology – CIGENE

BIOVIT

Title: Explore how species adapted to various environments by using genomics

Key words: evolutionary genomics, molecular evolution, population genomics, statistical genomics, bioinformatics, computer simulation

Language: English

Credits: 60

Contact persons / supervisors

Marie Saitou,

Tenure Track PostDoc, **Biovit**

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Task description

Recent advances in genomics have unveiled numerous varieties in genomes within and between species. In the projects below, we utilize genomics datasets and bioinformatics methods to understand evolution. For example:

1. Evolutionary genetics of freshwater/marine water adaptation across fish
2. Evolution of milk-related genes in mammals
3. Evolution of circadian rhythm genes among birds at high- and low- latitudinal area

You are welcome to bring your own idea about interesting species/phenomena.

- Slurm (alternatively Galaxy.no) and R/Python familiarity are preferred.
- You are likely to work with incoming Ph.D. students.

Please visit our website before contact Marie:
https://sites.google.com/view/saitou-lab/home