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Harnessing novel non-invasive biomarkers for biosensor-based health monitoring in aquaculture: the IGNITION project

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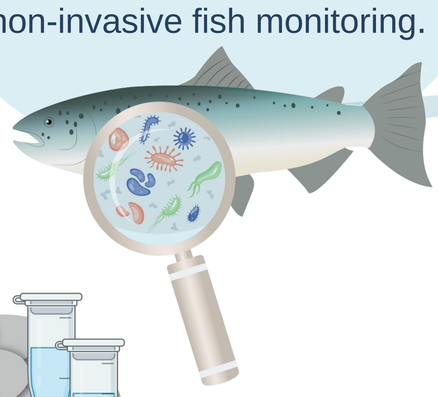
IGNITION

The project explores innovative approaches to enhance animal welfare and disease resistance through the identification of a **biomarker signature** and their incorporation into cutting-edge **biosensors** for continuous, non-invasive fish monitoring.

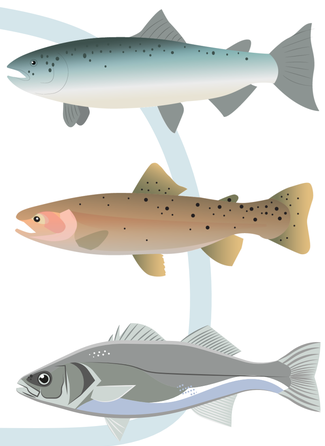
BACKGROUND

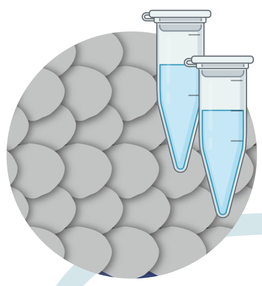
The rising global demand for high-quality animal protein has intensified pressure on aquaculture, highlighting the need for **advanced and sustainable farming solutions** that prioritize both productivity and animal welfare. Climate change further exacerbates challenges, subjecting aquatic species to stressors such as fluctuating temperatures, altered salinity levels, diseases and consequently more handling procedures.

METHODOLOGY



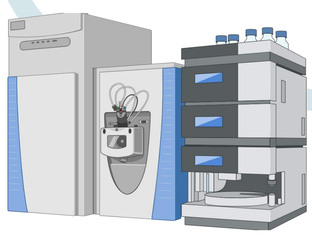
FISH TRIALS
Trials were conducted with key aquaculture species: **European seabass** (*Dicentrarchus labrax*), **Atlantic salmon** (*Salmo salar*), and **rainbow trout** (*Oncorhynchus mykiss).*





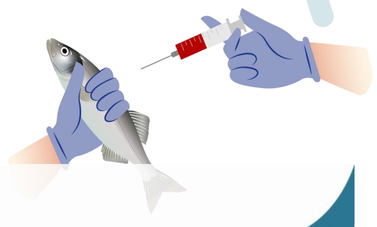
SAMPLING
Skin, skin mucus and water samples were collected in all trials, as these are promising **minimally and non-invasive biological matrices** for welfare and health surveillance.

EXPERIMENTAL CONDITIONS
At this point, two different stressors were tested: **transport (acute)** and **high temperature (chronic)** challenges. Transported fish were submitted to different challenging times (2/4/6h) and allowed to recover for 24h afterwards. High-temperature fish were exposed to 23h and 27h for a month.

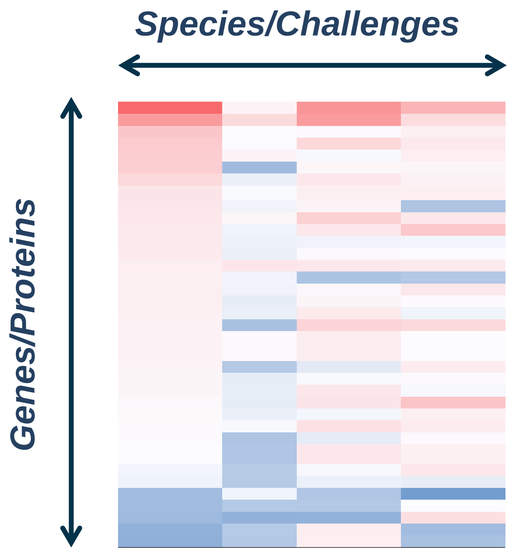


OMICS
Untargeted **transcriptomics** (skin) and **proteomics** (mucus) analyses have been conducted on these samples. Analyses of miRNAs of the mucus and water are underway.

OTHER INDICATORS
Molecular markers will be integrated with other physiological and behavioral indicators as surrogate endpoints.



RESULTS

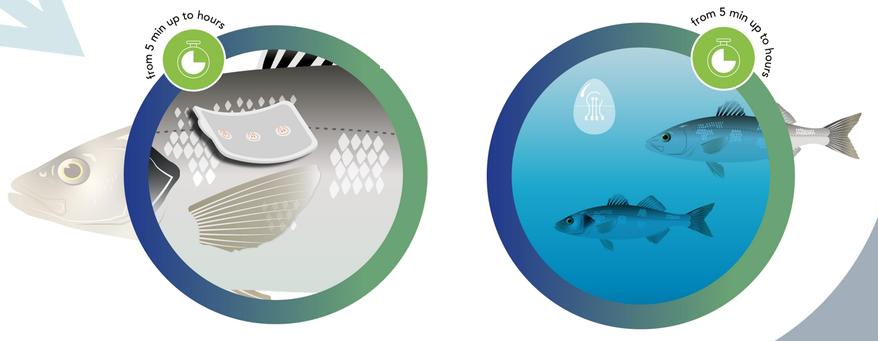


Machine learning

After multiomics integration, a **panel of 35 molecular features** responding to the different challenges, across the different species, was identified. These were involved in relevant biological pathways such as response to stress, MAPK and FoxO signaling and wound healing. ML is being applied to assess their discriminatory and predictive power.
New trials and omics layers are underway to integrate with these data, along with validation trials.

FUTURE WORK

To transition from research to practical applications, IGNITION is developing cutting-edge **biosensors for continuous, non-invasive monitoring**. These electrochemical sensors, designed as **skin patches or floating devices**, are being tested to detect these validated biomarkers in water and skin mucus samples, allowing real-time health surveillance and facilitating early interventions.



IGNITION

Scan for a video of this work

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