Deliverable 18.1
Analysis of access provided by SINTEF Ocean Aquaculture facilities: types and users

Version 1.1

WP 18
Deliverable 18.1
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Executive Summary

Objectives
The objective of SINTEF to join the TNA programme was to strengthen collaboration with European institutions and companies. This applies to both installations, ACE and NSTC.
The main aim for providing access is the associated option for networking with potential collaboration partners and future customers.

Main Results:
Completed access: 3 (2x ACE, 1x NSTC)
Number of ongoing accesses: 3
Number of persons trained until now: 4
Reward for users: first and foremost, experience and data collection at a full-scale, industrially operated salmon and seaweed farm sites, as access for research at such sites is usually difficult to obtain.
Use for the installation: the opportunity to test out equipment with the support of the producer has led to the continued use of the equipment in further projects. Collaboration with researchers from other institutions has led to the writing of joint research proposals.

Authors/Teams involved:

For SINTEF Ocean: Nina Bloecher, Silje Forbord, Finn Olav Bjørnson

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1. Overview of TNA users projects realized in TNA ACE and NSTC

1.1.1. Installations

SINTEF ACE is an industry scale infrastructure for scientific research as well as for testing and verification of operational solutions in sea-based aquaculture owned by SINTEF. SINTEF has research licenses for industry scale salmon production, and this allows the offering of a combination of industry scale facilities for salmon farming and flexible technology test sites at different exposure levels, while the primary focus is the on-growing stages of salmon in exposed sea sites. The infrastructure consists of salmon farming sites at four locations outside the coast of Mid-Norway, allowing for experiments at different degrees of exposure, and different production cycles (time of year for deployment of fish). SINTEF ACE is integrated into the SINTEF e-Infrastructure for secure and controlled access to laboratory facilities, allowing, e.g., on-line access to sensors and actuators, and remote configuration, monitoring and operation of equipment.

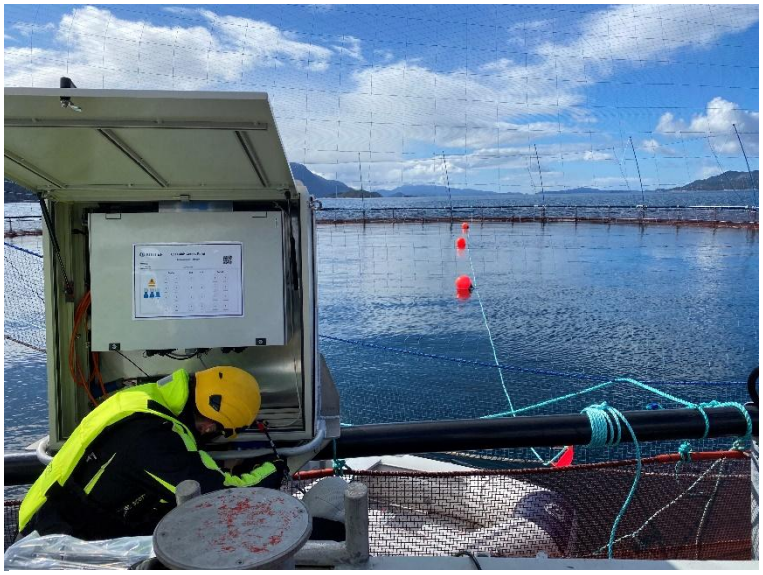

Figure 1: Installation at ACE Korsneset

SINTEF ACE bridges the gap from laboratory scale experiments to the application of new scientific knowledge in industrial production. ACE merges knowledge and technology from a wide range of disciplines into a single large-scale environment, adding the necessary operation, management and engineering aspects to put the results into a realistic context that is relevant for its application. Consequently, the current services meet the strong interest from education, research and industry in the field of sea-based salmon farming technology.

NSTC is a knowledge platform for technology development within industrial cultivation, harvesting, processing and application of seaweed in Norway. The center has a license for cultivating 7 macroalgae species: *Saccharina latissima, Alaria esculenta, Laminaria digitata, Palmaria palmata, Porphyra sp., Chondrus crispus* and *Ulva lactuca.* NSTC is composed of NSTC-Sealab and NSTC-Seafarm.

NSTC-Sealab is a laboratory for macroalgae cultivation in Trondheim, comprising: 1) Climate room with light control for vegetative cultivation or sorus induction, 2) Climate room used for gametophyte cultivation, 3) Seedlings cultivation rigs in climate rooms with light control and equipment for seeding of substrates and mechanical transfer of seeded twine to carrier ropes. The laboratory is supplied with filtered, UV-treated nutrient rich 8-12°C seawater from a 70m depth intake in the Trondheimsfjorden.

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NSTC-Seafarm consists of two field sites at the coast, one of which is a site at the island Hitra characterised by being partly sheltered against waves but with strong currents. The other site cultivates macroalgae integrated with the two 5000t salmon farms at ACE locations at Frøya and is characterised by an exposed/semi-exposed location in open sea with strong water currents. This allows for cultivation of macroalgae close to the salmon farm to exploit the nutrient rich effluents from this (IMTA/integrated multitrophic aquaculture). The sites have mooring suitable for fastening of longlines and seeded cultivation substrates such as seeded droppers, continuous lines, nets or sheets. The water quality is good for cultivation of kelp and red algae regarding nutrients, light and temperature. The sites are accessible from Trondheim after 2 or 3 hours driving by car and 15 minutes by boat.

Figure 2: NSTC - Seaweed seafarm sites at Hitra and Frøya

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1.1.1. User projects

Min. quantity of access units to be provided according to the DoA: 14
Total number of access units (sum of access units in the table): 15

Installation number	Installation code	Project title	Project acronym	Description about the experiment	Coordinator	Already used installation (Yes/No)	Nature of the access unit*	Number of used access units during the project	(Potential) paper	How many people was trained by this procedure ?
1 + 2	SINTEF ACE/NSTC	Cross calibration and validation of echosounding ADCPs with application to fish farming and carbon sequestration	BEDLAM	Testing of new capabilities of Sonardyne Origin 600 Acoustic Doppler Current Profiler (ADCP) to enhance monitoring at aquaculture sites re. traditional post processing analyses and near real time monitoring; and enhancing the utility and value of post processing data analyses at a seaweed farm to drive efficiency improvements associated with Carbon sequestration	Thomas Culverhouse	Yes	Field site.week	2+2		2
1	SINTEF ACE	Using a dissolved oxygen forecast in a Norwegian salmon farm and analyzing how variations in oxygen affect feed intake and overall fish health.	DO4Fish	Improvement and training of an algorithm that can predict dissolved oxygen (DO) in water at aquaculture sites up to 48 hours in advance, based on environmental (e.g., weather) and production (e.g., fish size) data	Aurélien Gourdon	Yes	Field site.week	3		2
1	SINTEF ACE	Understanding the interactions between feeding slots and	DO4Fish 2	Further improvement and training of the DO prediction models, especially with data of fish feeding	Charlotte Dupont	Yes	Field site.week	3		2

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		dissolved oxygen variations in a Norwegian salmon farm, to optimize a dissolved oxygen (DO) forecasting tool.								
1	SINTEF ACE	Autonomous Underwater Robotic System for Aquaculture Applications	NetNavROV	Demonstration of autonomous net inspection and monitoring through innovative methods for ROV navigation	Waseem Akram	No	Field site.week	2		2
1	SINTEF ACE	Molecular and physiological stress response of Atlantic salmon to net cleaning operations	CleanStress	Investigation of effects of net cleaning operations on the gill health of farmed Atlantic salmon, utilizing advanced proteomics and lipidomics techniques to assess cellular stress responses	Mário Jorge Faria dos Santos Araújo	No	Field site.week	3		2

Project acronym	Coordinator	Institute/Company	Institute/Company Country	Users	Visit
BEDLAM	Thomas Culverhouse	Sonardyne International Limited	UK	Thomas Culverhouse Tom B. Bennets	29.5.2024 – 1.6.2024
DO4Fish	Aurélien Gourdon	BiOceanOr	France	Aurélien Gourdon Charlotte Dupont	17.-19.4.2024
				Aurélien Gourdon	11.-12.9.2024
DO4Fish 2	Charlotte Dupont	BiOceanOr	France	Charlotte Dupont Alexia Mouton	online
NetNavROV	Waseem Akram	Khalifa University	United Arab Emirates	Cancelled	
CleanStress	Mário Jorge Faria dos Santos Araújo	CIIMAR	Portugal	Mário Jorge Faria dos Santos Araújo Alexandre Campos	25.5.2025 – 31.5.2025

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2. TNA projects

2.1.1. TNA projects description

BEDLAM
Testing of new capabilities of Sonardyne Origin 600 Acoustic Doppler Current Profiler (ADCP) to enhance monitoring at aquaculture sites re. traditional post processing analyses and near real time monitoring without cable connection; and enhancing the utility and value of post processing data analyses at a seaweed farm to drive efficiency improvements associated with Carbon sequestration.

Main results from the experiment indicate that the wireless data transfer from the instrument to the surface worked as desired, and that data are compatible to traditional sonar data, offering novel application opportunities based on the remote operation and onboard processing.
Results have been communicated in form of a video and are disseminated directly to customers.

Two people were trained, a researcher and a technician.

Do4Fish
Improvement and training of an algorithm that can predict dissolved oxygen (DO) in water at aquaculture sites up to 48 hours in advance, based on environmental (e.g., weather) and production (e.g., fish size) data.

The main results indicate that the project has been able to validate and refine the oxygen forecasting models. By integrating environmental data points, it was possible to increase the precision of the forecasts and make them more relevant to the unique conditions at the facility.

Two people were trained, a researcher and a project manager.

DO4Fish 2
Continuation of DO4Fish, aiming to further improve and train the DO prediction models, especially with data of fish feeding, an activity that is expected to have relevant impact on dissolved oxygen in the net pens.

The project is ongoing and will train two researchers.

NetNavROV
Demonstration of autonomous net inspection and monitoring through innovative methods for ROV navigation.

The project is ongoing and will train two researchers.

CleanStress
Investigation of effects of net cleaning operations on the gill health of farmed Atlantic salmon, utilizing advanced proteomics and lipidomics techniques to assess cellular stress responses

The project is ongoing and will train two researchers.

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2.1.2. Selection of One exemplary project

BEDLAM

The project acquired continuous month-long set of measurements of ADCP data from a deployment near an operational fish pen. The measurements included both currents and echosounding data from the ADCP, and data from a traditional reference Echosounder. The ADCP data has allowed the development of fish tracking and growth metrics that can be deployed on the ADCP itself, meaning that the ADCP is performing useful processing tasks on the data rather than just logging it for post-processing after the device is recovered. In addition, the Origin 600 ADCP used in the project has an inbuilt acoustic modem, allowing the processed data to be exported in near real-time to the surface and into a Cloud account. This means that the site operators were able to view the behaviour of the fish in near real-time from their desks, allowing informed decisions to be made as events are unfolding. Both the deployment of such processing algorithms and the export of the real-time data is novel and innovative for the industry.

Figure 3: Bedlam deployment, surface

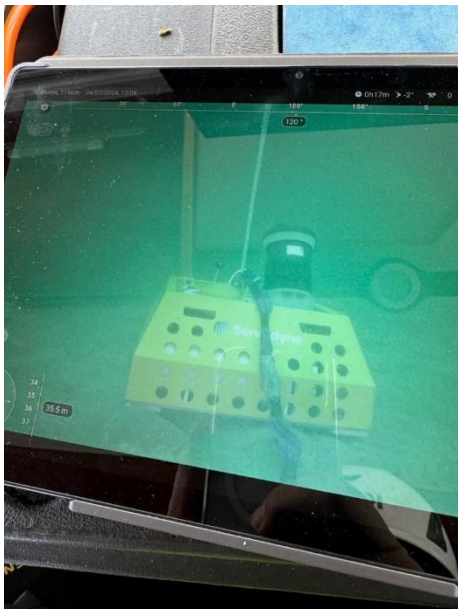

Figure 4: Bedlam deployment, submerged

3. Reflection on results of the TNA programme

For SINTEF the TNA programme has been useful as an opportunity to create first contact projects with potential customers and collaboration partners. This allowed us to establish cooperations within an already existing project instead of searching for possible funding opportunities for small initial projects.

The opportunity to test out equipment with the support of the producer has led to the continued use of the equipment in further projects. Collaboration with researchers from other institutions has led to the writing of joint research proposals.

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Work Participants	SINTEF			

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