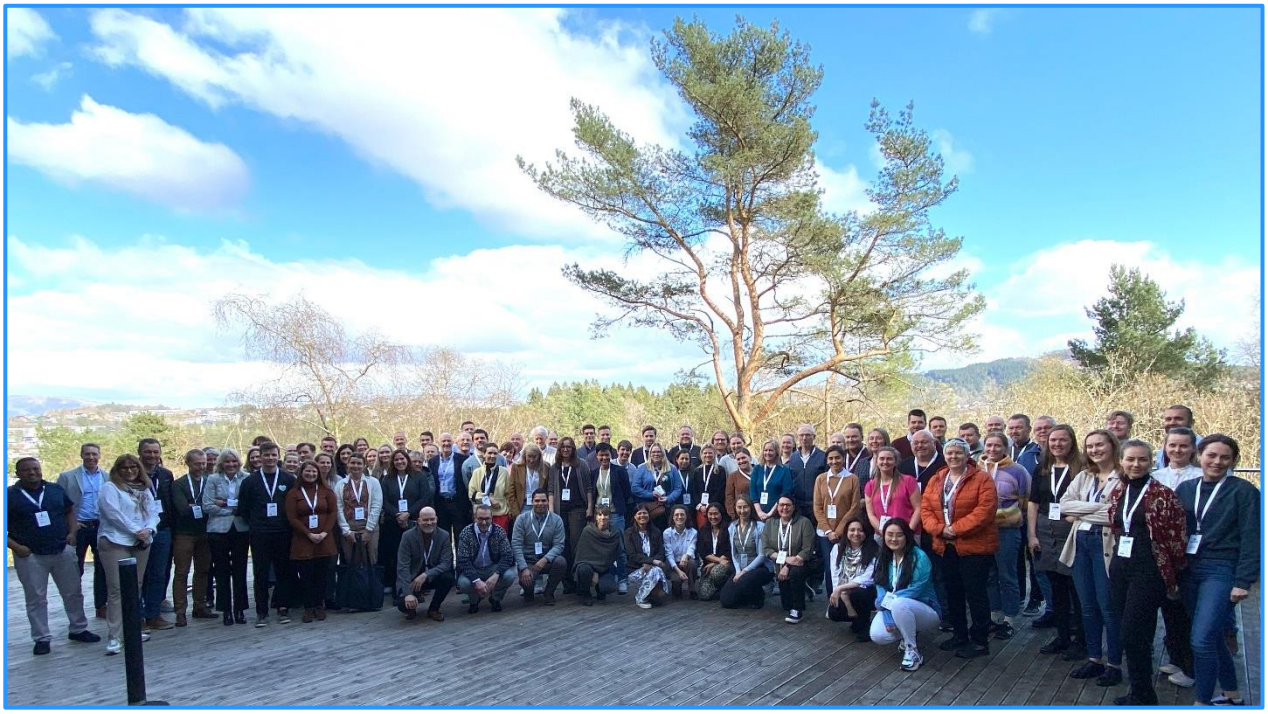
Sluttrapport 2024

Sekretariat for TriNation (2021-2024)



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Veterinærinstituttet
Norwegian Veterinary Institute

FHF 901715

TriNation initiative

Innhold

Sammendrag

TriNation secretariat er finansiert av FHF, for perioden juni 2021 – juni 2024 gjennom prosjekt FHF901715. Sekretariat sammen med komiteen har I prosjektperioden organisert to TriNation møter, ett I Edinburgh i November 2022, og det andre I Bergen I april 2024. To populærvitenskapelige artikler fra 2022 møte var publisert, og I løpet av høst 2024 blir sammendrag fra 2024 møte publisert.

På møtet i Edinburgh 2022 deltok totalt 135 deltakere fra Skottland, Irland, Norge, Færøyene, Danmark, Storbritannia, Spania, Sveits, Canada, USA og Chile. Det var 23 muntlige presentasjoner i tillegg til en diskusjonssesjon med temaet "Biosikkerhet og sykdomshåndtering". I 2024 møtet i Bergen, deltok 119 deltakere fra Skottland, Irland, Norge, Færøyene, Danmark, Frankrike, Storbritannia, Island, Canada og Chile på møtet. Det var 23 muntlige presentasjoner, og det ble arranger en diskusjonssesjon om tema: Biosikkerhetstiltak.

Hovedfunn i 2022: Irland meldte om økning i PD-påvisninger, mens utviklingen i Norge og Skottland var mer positiv. Det var signifikant reduksjon av både SAV2- og SAV3-påvisninger i Norge. Hjerte- og skjelettmuskel betennelse (HSMB) var ikke en stor bekymring i noen av de tre landene, og det så ikke ut til at stress påvirker fiskens motstand mot HSMB i samme grad som for CMS. CMS ble trukket fram som det mest alvorlige problemet i alle tre landene. Hjertehelse, spesielt i settefiskfasen der livet til en oppdrettsfisk avviker mest fra villfiskens, ble stor fokus på. Det ble presentert studiet som viser at høyere intensitet, dvs økt temperatur og lysstyring, kan gi større endringer på hjertet enn om fisken holdes på lavere temperatur og naturlig lysregime. I tillegg, ble det uttrykt behov for utvikling og tilpasning i bruk av nye diagnostiske teknikker for å holde tritt med utvikling og endringer som skjer i produksjonsmetoder som eksempelvis RAS. Foredragene viste at mye innovasjon foregår på dette feltet.

Hovedfunn I 2024: PD ikke lenger er ansett som et stort problem, mens CMS fortsetter å gi økende utfordringer for næringen. Flere faktorer ser ut til å ha betydning, blant annet at CMS kan bli overført og introdusert til flere regioner ved at fisk transporteres. Det ble gjort et poeng av at med å ivareta god biosikkerhet for å redusere spredning av CMS til andre regioner, så vil dette gi en positiv tilleggseffekt også for reduksjon av andre sykdommer.
Mens antall påvisninger for HSMB har økt noe i Norge, var det nesten ingen påvisninger i Skottland og Irland. Det har bitt gjort vesentlig fremgang i tilbud på analyseverktøy og fokus nå er mer på helhetlig helseovervåking som kan støtte oppdretterne i å ivareta fiskens helse ved å ta valg og handle tidligst mulig.

Interessen I TriNation møte er stor, og antall deltakere I disse møter har økt, og mange flere land deltar i disse møter enn tidligere. Vi har mottat veldig god tilbakemelding fra bade akademisk miljø og industry om nytteverdien som et godt for a for utveksling av informasjon og diskusjon.

Summary

TriNation initiative with the coordination from TriNation secretariat funded by FHF 901715 har during the project period of June 2021 – June 2024 organised two meetings. The meeting in 2022 was held in Edinburgh, while in 2024 it was held in Bergen. The summary of 2022 was published in form of two popular science articles, and similarly the 2024 meeting will be summarised during Autumn 2024.

At Edinburgh 2022, a total of135 participants from Scotland, Ireland, Norway, Faroe islands, Denmark, Uk, Spain, Switzerland, Canada, USA and Chile attended the meeting. There were 23 oral presentations in addition to a discussion session on the theme “Biosecurity and disease management” was run on the second day.
In 2024 meeting in Bergen, 119 participants from Scotland, Ireland, Norway, Faroe islands, Denmark, France, UK, Iceland, Canada and Chile attended the meeting. There were 23 oral presentations in addition to a discussion session on Biosecurity measures.

Main findings in 2022: Ireland reported an increase in PD detections, while developments in Norway and Scotland were more positive. There was a significant reduction in both SAV2 and SAV3 detections in Norway. Heart and skeletal muscle inflammation (HSMI) was not a major concern in any of the three countries, and stress did not appear to affect the fish's resistance to HSMI to the same extent as for CMS. CMS was highlighted as the most serious problem in all three countries. Heart health, especially in the hatchery phase where the life of a farmed fish differs most from that of wild fish, was a major focus. The study was presented showing that higher intensity, i.e. increased temperature and light control, can cause greater changes in the heart than if the fish are kept at a lower temperature and natural light regime. In addition, discussion pointed towards the need for development and adaptation of new diagnostic techniques to keep pace with the developments and changes in production methods such as RAS. Presentations showed that there is already lot of ongoing innovation in this field.

Main findings in 2024: PD is not considered a major problem in any off the three countries anymore, while CMS continues to present increasing challenges for the industry. Several factors appear to be important, including the fact that PMCV can be transferred, and introduced to several and new regions through fish transport. Ensuring good biosecurity to reduce the spread of CMS to other regions is vital which will also have a positive additional effect on the reduction of other diseases. While the number of detections for HSMB has slightly increased in Norway, there were almost no detections in Scotland and Ireland. There has been significant progress in the development of analytical tools and the focus is now more on holistic health monitoring that can support farmers in taking decisions in the early phase of potential building up health issues and thus ensuring good fish health.

Interest in TriNation meetings is steadily growing, and number of participants has been continuously increasing, with participants from near and far countries. Feedback from academic environment and indestiral partners has been very uplifting as they consider this a great for discussions and sharing experiences and knowledge.

1 Introduction

The PD TriNation initiative was established in 2005 with the aim to integrate and focus the activities of academia and industry from Norway, Ireland, Scotland and more recently other salmon farming regions. Major contributions have been made to developing a fuller understanding of pancreas disease (PD) and related conditions such as heart and skeletal muscle inflammation (HSMI) and cardiomyopathy syndrome (CMS) by encouraging new and collaborative research, and sharing of results in a transparent manner. Greater knowledge of the risks associated with the development and spread of the diseases, as well as an understanding of the viral characteristics, has helped shape strategies for disease prevention and mitigation for the benefit of the salmon farming industry.
The increasing administrative load associated with the PD TriNation initiative resulted in a need for a more formal organization of the initiative to replace the previous, mainly voluntary-based coordination work. As a result, a formal secretariat was established as a project at the Norwegian Veterinary Institute, funded by the FHF.

Aims
The main aim of the PD TriNation secretariat was to ensure an efficient and continuous running of the PD TriNation initiative thereby facilitating and maintaining continuous international collaboration and dissipation of knowledge. More specifically, the role of the PD TriNation secretariat was to:

- Assist with the organization and running of the PD TriNation meetings
- Create and maintain a website for the PD TriNation initiative
- Create and maintain a contact list of individuals to whom information from the PD TriNation secretariat should be distributed

2 Organization of the PD TriNation secretariat

The TriNation secretariat has been based at the Norwegian Veterinary Institute, and since 2021 been run by Sonal Patel. The secretary has maintained regular contact with the President and the remaining members of the TriNation steering committee by emails, telephone and video conferences throughout the project period.

The TriNation steering committee has been revised during this period and now consists of:

Chairman: Tore Hovland, Akva Kompetanse, Norway

Secretary: Sonal Patel, *Norwegian Veterinary Institute, Norway*

Members:

Marit Stormoen, NMBU, Norway
Sven Martin Jørgensen, FHF, Norway
Kim Thompson, Moredun Scientific, Scotalnd
Kimberley McKinnell, Bakkafrost, Scotland
Susie Mitchell, Pharmaq Analytiq, Ireland
Samantha White, Marine Institute, Ireland

Reference group: The reference group is being revised and for the time being consists of following confirmed members:

1. Anne Berit Olsen (Norwegian Veterinary Institute), Norway
2. Chris Mitchell (WellTech), Scotland
3. Iain Berrill (Scottish Salmon), Scotland
4. Paul Savage (Agri-Food and Biosciences Institute), Ireland

Marian McLoughlin, Ireland – Happy to continue as Mentor

An announcement to invite 3 more members to Reference group was made at TriNation 2024, and the list will be finalized before the next TriNation meeting.

Steering committee prepared and approved statutes for the Steering committee and the reference group to ease future changes. The statutes are as follows, and will be updated on the website:
Guidelines/Statutes for the Steering Committee, TriNation:
The TriNation initiative aims to integrate and focus the activities of academia and industry from Norway, Ireland, and Scotland. The initiative should be governed by a committee comprising of two representatives for each of the three countries, with one committee member as a Secretary and local members supporting the organisation of meetings in their respective countries.
The members ideally should represent both academia and industry to enhance collaboration for the better of the aquaculture industry. The committee members are expected to play an active role in the organisation of the meetings.

Guidelines/Statutes for Reference group, TriNation:
The TriNation initiative aims to integrate and focus the activities of academia and industry from Norway, Ireland, and Scotland. The members of the reference group should be residing in one of the three countries and be committed to playing an active role in the Trination initiative. The members

ideally should represent both academia and industry to enhance collaboration for the better of the aquaculture industry.

Reference group members are expected to guide and support the committee members in the following:

1. Decisions on the program for meetings,
2. Feedback for improvement
3. Support local committee members in organisation of meetings in their respective countries
4. Engage and recruit speakers from academia and industry to cover relevant topics

Other PD TriNation secretariat activities

The TriNation secretariat has been responsible for the maintenance of trination.org website.

The TriNation secretariat updates the list of names and email addresses of individuals that have previously attended the PD TriNation meetings or have expressed an interest in these. The list has been continuously updated to ensure efficient dissipation of information from the TriNation secretariat to all interested parties.

All presentations from 2022 and 2024 meeting that were approved by the authors were uploaded on the TriNation website and all registered on the list for interest in TriNation initiative were notified about these through newsletter sent by mail.

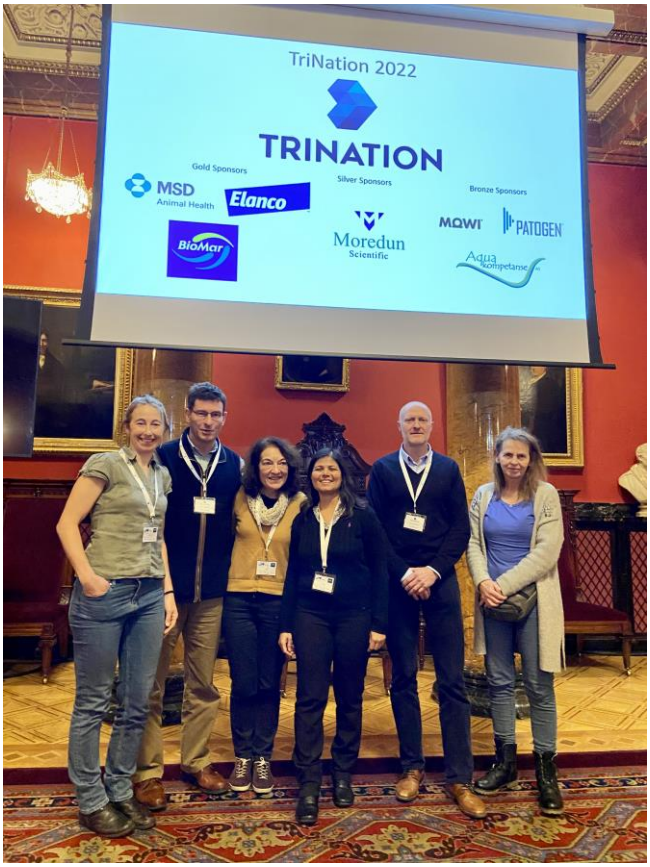
General note regarding financing the meetings: Attaining enough sponsorship for 2024 meeting was challenging, and we had to limit the number of particiapnts to maximum 120. In future, the steering committee will consider introducing a small token fee to cover partial costs.

3 TriNation meetings

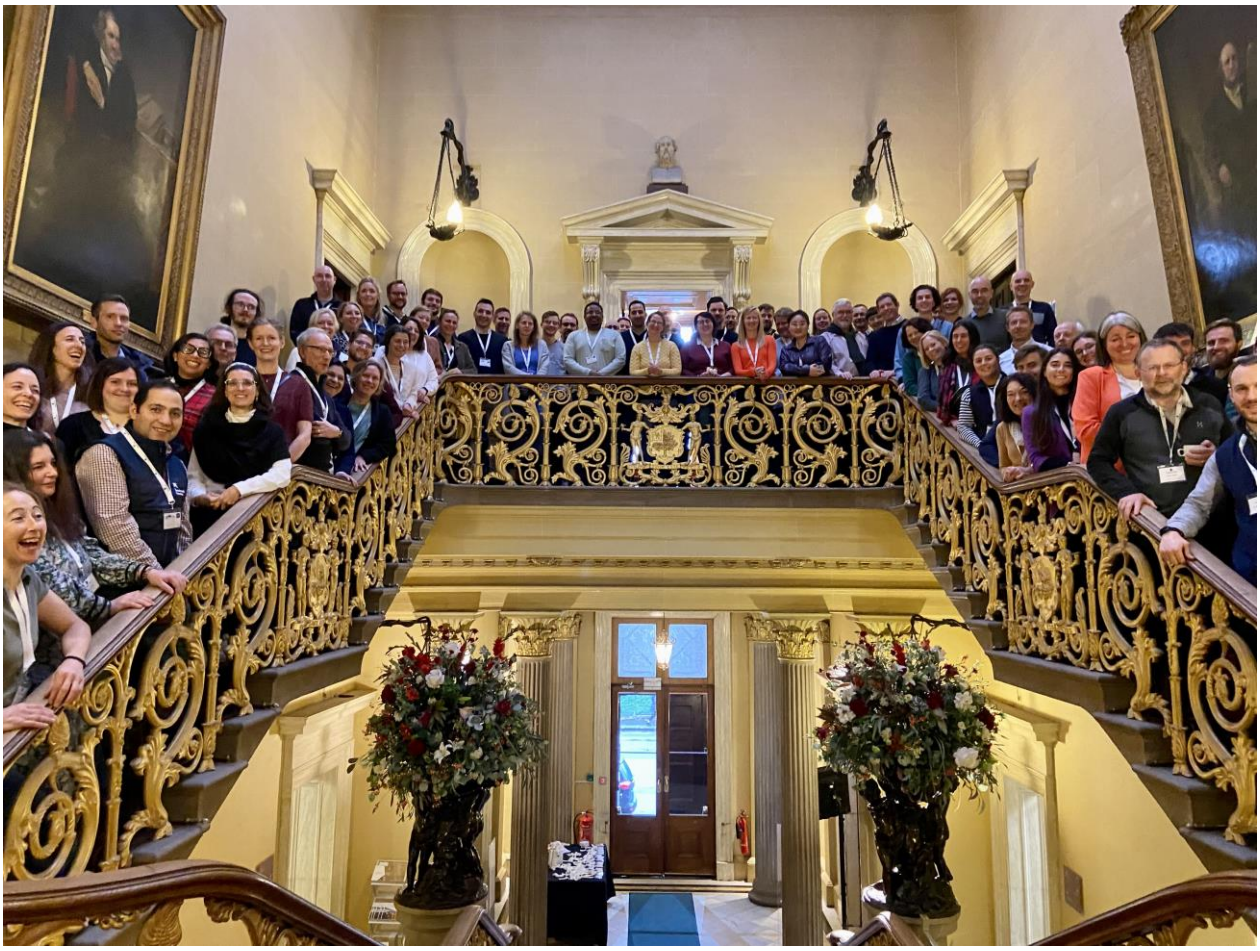
Two TriNation meetings have been arranged within the project period.
2022 PD TriNation meeting

2022 TriNation meeting, Edinburgh
The 2022 meeting was held at Great hall, Royal college of Physicians, Edinburgh on the 22th and 23th of November 2022.

A total of 135 participants from Scotland, Ireland, Norway, Faroe islands, Denmark, Uk, Spain, Switzerland, Canada, USA and Chile attended the meeting. There were 23 oral presentations in the following sessions: «Situation updates», «Production strategies on disease management», «Disease biomarkers and diagnostic tools «, «New research », and «Disease control strategies – including biosecurity and vaccination»,", In addition, a discussion session on the theme "Biosecurity and disease management" was run on the second day.



Representatives of Steering Committee and Reference group present at TriNation 2022 in Edinburgh

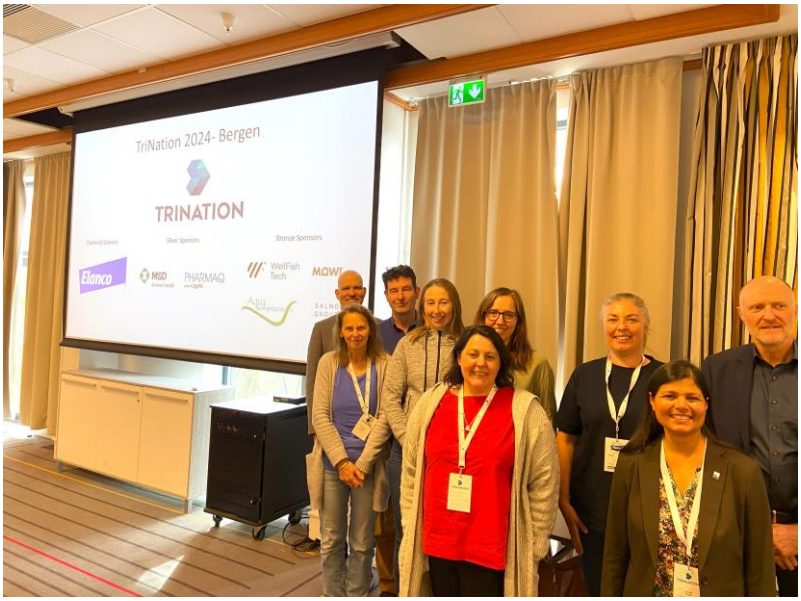


Attached is the program for the meeting in Appendix 1.

The cost for the meeting in 2022 were covered by our sponsors: MSD Animal Health, Elanco, Biomar, Moredun Scientific, Mowi, PatoGen AS and Aquakompetanse

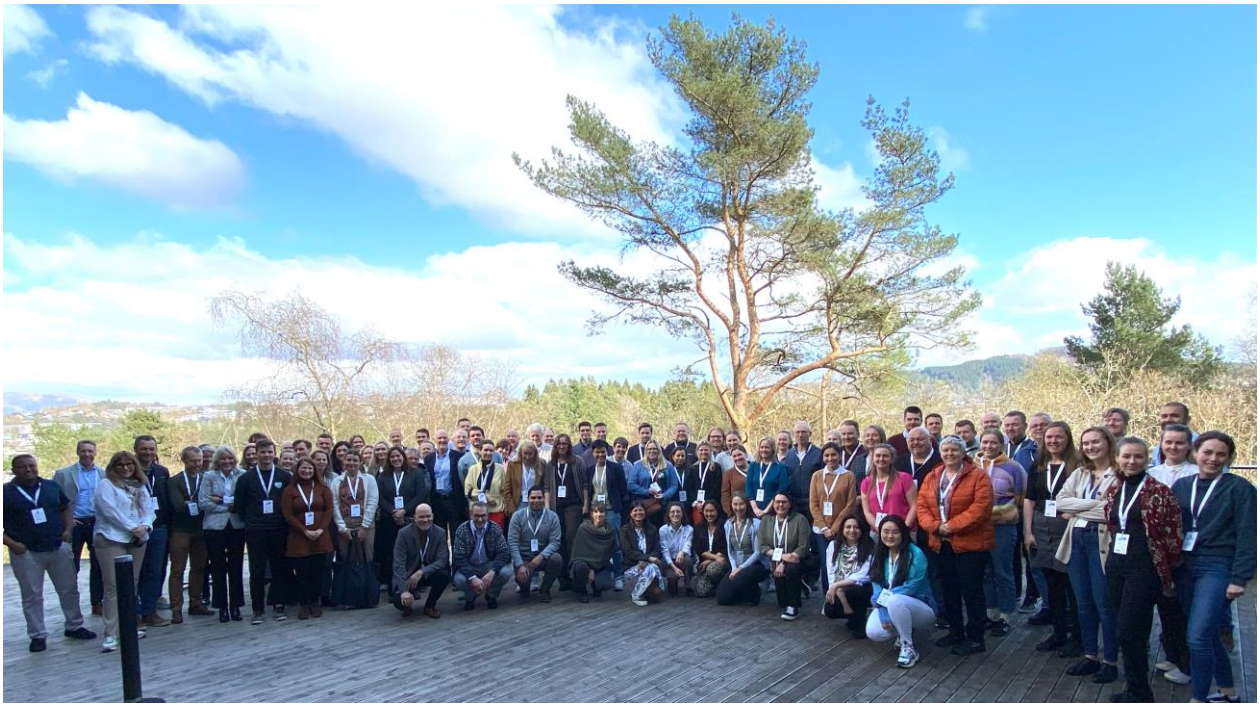
2024 TriNation meeting, Bergen:

The 2024 meeting was held at Quality Edvard Grieg Suitell hotel in Bergen, Norway on the 24th and 25th of April 2024.
119 participants were registered from Scotland, Ireland, Norway, Faroe islands, Denmark, France, UK, Iceland, Canada and Chile attended the meeting. There were 23 oral presentations within the following sessions: “Situation updates”, “Experiences from industry”, “Biosecurity and control strategies”, “Disease control strategies”, and “new research” In addition we had a discussion session on Biosecurity measures. The program for the meeting can be found in Appendix 2.



Representatives of Steering Committee and Reference group present at TriNation 2024 in Bergen

The cost for the meeting in 2024 were covered by our sponsors: Elanco Animal health, MSD Animal Health, Pharmaq, WellFish Tech, Mowi, Salmon Group and Aquakompetanse.



Non-scientific publications by the PD TriNation steering committee
In order to disseminate information from the 2022 TriNation meeting to a wider audience, two articles were published:

1. In Norsk Fiskeoppdrett: nr NorskFiskeoppdrett - Nr04-2023, with title «Trination: Åpenhet og samarbeid gir resultater», authored by Tore Hovland, Chris Mitchell og Sonal Patel (submitted earlier)
2. In Fish Farmer magazine April 2023, with title «Heart of the matter», authored by Chris Mitchell (sent earlier).

There are plans for similar publications based on the 2024 TriNation meeting to be published during Autumn 2024.

Future plans within the TriNation initiative
The initial planning of the next TriNation meeting is underway. The meeting has been tentatively scheduled for April 2025 and Ireland has been approached and asked to act as host for the meeting with the TriNation secretariat as meeting coordinator. It is hoped that renewed funding for the TriNation secretariat for the next period of 2024 – 2026 is obtained in order to ensure an efficient continuation of the TriNation initiative.

4 Appendix 1 – Program TriNation 2022, Edinburgh

Tuesday November 22nd	**Program Day 1: 10.15 – 17.00**	
Registration and coffee	**09.30 – 10.15**	
10.15-12.20 Session I	***Welcome, situation updates and Production strategies on disease management***	**Chair: Susie Mitchell**
10.15	Welcome	Tore Hovland, president TriNation
10.25	Scotland	Silvia Soares, Marine Scotland
10.45	Norway	Hilde Sindre, Norwegian Veterinary Institute
11.05	Ireland	Susie Mitchell, Pharmaq Analytiq
11.25	Cardiomyopathy in Scotland – experience from industry	Iain Berill
11.40	Promoting cardiac robustness to withstand infections: Is it important?	Ida Beitnes
11.55	Maintaining clearance of PD caused by SAV2 in Mid-Norway	Aoife Maloney Westgård
12.05	Discussion	
12.20-13.30	Lunch break	
13.30-15.15 Session II	***Disease biomarkers and diagnostic tools***	Chair: Kim Thompson
13.30	Novel myocardial pathology in farmed salmonids in Norway	Helene Wisløff
13.45	Histopathologic cardiac scoring methods used in Cardiomyopathy syndrome (CMS), Pancreas disease (PD) and Heart and skeletal muscle inflammation (HSMI)	Marta Alarcón
14:00	Characterisation of early phases of cardiomyopathy syndrome (CMS) pathogenesis in Atlantic salmon through various diagnostic methods	Camilla Fritsvold
14.15	Serum Proteomics of CMS Field Outbreak Samples	Lewis Moore
14.15-14.45	Coffee break	
14.45	Clinical Blood Biochemistry as a Predictive Tool for Managing infection with SAV	Josip Barisic
15.00	Infection challenges for rainbow trout farmed in RAS – from a diagnostic challenge to an opportunity for innovative diagnostic approach	Niccolò Vendramin
15.15 – 16.15	**Discussion**	**Modulator: Chris Mitchell**
16.15	SC meeting	
17.00	End of Day 1	
19.00	Dinner at Ghillie Dhu	

Wednesday **November 23rd**	**Program Day 2: 09.15-13.30**	
Registration and coffee	**09.00 – 09.15**	
09.15-11.00 ***Session III***	***New Research***	Chair: Sonal Patel
09.15	Salmonid alphavirus accumulates deletion variants localized to specific regions of the viral genome	Turhan Markussen
09.30	Metabolomics in aquaculture: metabolic changes in response to Piscine orthoreovirus (PRV) infection of Atlantic salmon	Lada Ivanova
09.45	Dynamics of Piscine Orthoreovirus-1 (PRV-1) Infection During Pre-smolt Stages of Atlantic Salmon (Salmo salar)	H. Craig Morton
10.00	Does PMCV primarily infect salmon?	Espen Rimstad
10.15	PMCV infection results in presence of defective genomes including deletions	Aase B. Michaelsen
10.30	A time-course study on the host responses induced at different time points post PMCV infection	Amr Ahmed Abdelrahim Gamil
10.45	Decreased Water Temperature Enhance Efficient Piscine orthoreovirus Genotype 3 Replication and Severe Heart Pathology in Experimentally Infected Rainbow Trout	Juliane Sørensen
11.00 -11.25	Coffee break	
11.25 – 11.30	**Information from Committee**	Sonal Patel
11.30 -12.45: ***Session IV***	**Disease control strategies – including biosecurity and vaccination**	**Chair: Tore Hovland**
11.30	Genome sequencing for epidemiological studies of SAV2 and SAV3 in Norway	Dan MacQueen
11.45	Effect of Vaccines Against PD on Viral Shedding and Disease Transmission from Atlantic Salmon in Seawater Challenged with SAV, Subtype 2	Ragnar Thorarinsson
12.00	Usage and general extrapolation to field experience to date of a DNA PD vaccine in Norway	Antonio Ramiro Dominguez
12.15	Effect of a vaccine against CMS	Marius Karlsen
12.30	Closing remarks	Paul Negård
12.45 – 13.30	Lunch	
13.30	**End of day 2**	

5 Appendix 2 – Program TriNation 2024, Bergen

TriNation 2024 24th-25th April 2024, Quality Hotel Edvard Grieg, Bergen		
Wednesday April 24th	**Registration and coffee 09.30 - 10.30**	
Program Day 1	**10.30-17.15**	
1030	Practical information	Sonal Patel, NVI, Secretary, TriNation
1035	***Welcome***	Tore Hovland, Aqua Kompetanse, President, TriNation
10.45-11.30 Session I	***Situation updates***	Chair: Marit Stormoen
1045	Norway	Hilde Sindre, Norwegian Veterinary Institute, Norway
1100	Ireland	Susie Mitchell, Pharmaq Analytiq, Ireland
1115	Faroe Islands	Debes Christiansen, Food and Veterinary Agency, Faroe islands
1130	Scotland	Silvia Soares, Marine Directorate, Scotland
1145	Session discussion – open for questions from Slido	
1200-1215	Coffee break	
1215-1330 Session II	***Experiences from industry***	Chair: Susie Mitchell
1215	Scottish experience - Pancreas Disease & Hydrozoan Blooms	Kimberley McKinnell, Bakkafrost Scotland
1230	Managing CMS in Scotland	Ralph Bickerdike, Scottish Sea Farms, Scotland
1245	An atypical course of Cardiomyopathy syndrome in Farmed Atlantic Salmon fed a clinical nutrition diet	Julia Mullins, Skretting, Norway
1300	Fish health insights through monitoring blood	Chris Mitchell, WellTech, Scotland
1315	Session discussion – open for questions from Slido	
1330-1415	Lunch break	
1415-1515 Session III	***Biosecurity and control strategies***	Chair: Tore Hovland
1415	The successful story of combatting PD in Production Area 7 (Mid-Norway)	Anne Lene Dale, Aqua Kompetanse, Norway
1430	PD in Production Area 8 (Mid-Norway)	Kristin Ottesen, HaVet, Norway
1445	Modelling spread of PD using water contact integrated in a three-dimensional hydrodynamic model	Erlend Mundal, Aqua Kompetanse, Norway
1500	The effect of synchronized fallowing in open sea cage farming of Atlantic salmon	Marit Stormoen, Norwegian University of Life Sciences, Norway

1515	Session discussion – open for questions from Slido	
1530-1545	Coffee break	
1545-1630 Session IV	Open discussion with questions from Slido	Moderators: Sonal Patel and Sven Martin Jørgensen
1545-1555	Biosecurity measures in Norwegian Salmon production	Randi Grøntvedt, Sjømat Norge, Norway
1630-1715 Session IV	***Disease control Strategies***	Chair: Kimberley McKinnell
1630	Susceptibility of brown trout (salmo trutta) to piscine orthoreovirus genotype 3 (PRV-3)	Niccoló Vendramin, DTU AQUA, Denmark
1645	Fish pathogens surveillance during complex disease outbreak in RAS by high-throughput microfluidic qPCR	Juliane Sørensen, DTU AQUA, Denmark
1700	Genomic analysis reveals low genetic diversity and no continuous reintroduction of piscine myocarditis virus (PMCV) in Faroese farmed salmon	Maria Marjunardóttir Dahl, Faroese National Reference Laboratory
1715	End of day 1	
1900	Dinner at Venue	

Thursday 25th April	**Registration and coffee 08.45 - 09.00**	
Program Day 2	**09.00-13.10**	
0900-1030 Session IV contd	***Disease control Strategies, continued***	Chair: Samantha White
0900	Functional consequences of PMCV infection in Atlantic salmon Michael Frisk, University of Oslo	Michael Frisk, University of Oslo, Norway
0915	Effect of pancreas disease vaccines on infection levels in Atlantic salmon challenged with salmonid alphavirus, genotype 2	Ragnar Thorarinsson, Elanco Animal Health, Norway
0930	Introducing dbDNA – the foundation for a new wave of innovation in aquaculture vaccines	Ian Thompson, Touchlight Aquaculture Ltd, UK
0945	Blood based biochemistry in Atlantic salmon- prognostic tool for myopathies?	Martin Huun-Røed, Patogen, Norway
1000	Comparison of whole blood transcriptome responses of Atlantic salmon infected by three Piscine orthoreovirus variants	Thomais Tsoulia, Norwegian Veterinary Institute, Norway
1015	Session discussion – open for questions from Slido	
1030	Coffee break	
1100	**Information from Steering Committee**	Sonal Patel, Secretary, TriNation
1110 -1400: Session V	**New Research**	Chair: Sven Martin Jørgensen
1110	In vivo replication and pathogenicity of PMCV after infection with different doses of heart homogenate	Amr Ahmed Gamil, Norwegian University of Life Sciences, Norway

1125	PMCV – characteristics of the virus that may affect the outcome of CMS	Aase Mikalsen, Norwegian University of Life Sciences, Norway
1140	Genomic tracking of the spread of piscine myocarditis virus (PMCV) in farmed salmon	Mingli Zhao, Royal Vet college, Scotland
1155	Deciphering the molecular basis of PMCV infection and the disease, CMS	Espen Rimstad, Norwegian University of Life Sciences, Norway
1210	Salmonid alphavirus accumulates specific genome deletion variants to high frequencies during replication in cell culture	Turhan Markussen, Norwegian University of Life Sciences, Norway
1225	Viral genomic surveillance - supporting disease control in Atlantic salmon aquaculture	Bertie Knight, University of Edinburgh, Scotland
1240	Session discussion – open for questions from Slido	
1250	Summing up	Chris Mitchell, Wellfish Tech, and Paul Savage, Agri-Food and Biosciences Institute (AFBI)
1310	Lunch	
1400	**End of day 2**	