

# Dsolve

Centre for Research-based Innovation

-

Biodegradable plastics for marine applications

Annual Report

2025

Photo: Kristine Cerbule



Norwegian Centre  
for Research-based  
Innovation



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# Summary

The Centre for Research-based Innovation (CRI) Dsolve continues focusing on the challenges and negative environmental effects produced by marine plastic littering and ghost fishing from fisheries and aquaculture industries. Our consortium has during the last year tested new biodegradable materials having the potential to replace ordinary plastics for applications for fisheries and aquaculture.

Based on the report (March 17<sup>th</sup>) from the evaluation panel produced during the underway evaluation of Dsolve, the consortium has addressed these recommendations in communications and meetings between industry partners and research areas. The evaluation panel pointed especially at more focus on “low-hanging fruits” like adjustments to existing gear and equipment to reduce ghost fishing, following up results that have innovation potential by reactivating the Living Labs concept to facilitate valuable discussions on how to stimulate innovations, addressing both opportunities and barriers, increased focus on fostering the co-operation with international industry partners, publications and education.

There is a consensus within Dsolve that we must keep a high focus on our vision and goals to develop technologies and new products, improve the existing governance framework and foster innovations that enable plastic value chains to become more circular and resource efficient. A transition in fisheries and aquaculture towards the uptake of new biodegradable materials is challenging and time-consuming. Users need convincing results and proof that new materials are efficient and durable during service time, and accessible at a reasonable cost. The supply industries understandably ask for guarantees that their products will have a market. However, the Dsolve team is convinced that it is necessary to reduce the negative impacts on marine ecosystems due to long-term macro- and micro plastic pollution from fisheries and aquaculture and ghost fishing caused by lost fishing gear. Our aim is in line with the UN sustainable development goals (SDGs) 12 (responsible consumption and production) and 14 (life below water). To ensure that the value chains developed address SDG 13 (climate action), a value-chain perspective is an important part of the research work. Dsolve is designed to address the challenges described above.

The Dsolve Consortium decided at the end of 2024 to include three new partners in the project to enhance testing of biodegradable materials. The new partners are fisheries and aquaculture company Br. Karlsen, Øystein Enoksen with coastal longliner “Vardøyfisk II” and Brynjar Bangsund with mechanized coastal longliner “Østkapp” and they have contributed to the consortium as intended.

Our scientific coordinator Valentina Pauna and RA 6 leader Hilde Rødås Johnsen have increased the frequency of meetings within the consortium. During the research area leader meetings (1-6) results from laboratory tests and field trials are presented and discussed. The partner meetings start with a presentation from one of the RA's followed by a discussion about the results achieved. Our international partners have participated in several of these meetings. RA-leader and partner meetings are

essential for further communication within Dsolve and the common goals for the development of biodegradable plastics. The meetings also function as arenas for development of ideas for new projects and extended co-operations with industry partners.

The annual meeting during April 2<sup>nd</sup> – 3<sup>rd</sup> was hosted by research partner NORNER AS at their location in Porsgrunn. Our focus in the meeting was on how to respond to recommendations listed in the underway evaluation report. In this process, each RA presented the status and plans for further progress. The National and International Advisory Boards and the Innovation Committee addressed topics on organization, management, funding, internationalization and innovation serving value creation that benefit society. NORNER gave the participants an interesting and educational tour of their facilities with explanations on how various products are manufactured industrially with a focus on biodegradable solutions.

The board meeting during September 23<sup>rd</sup> – 24<sup>th</sup> was hosted by UiT Tromsø. Day one took place in Kystens Hus and the second day at the UiT campus, i.e., in the building of the Norwegian College of Fishery Science. This meeting was also focused on the underway evaluation and discussions about how Dsolve shall address the recommendations from the evaluation panel. The board gave valuable input to a roadmap for further progress, i.e., how to activate industry partners, include recommendations from the advisory boards and innovation committee, and focus on education and researcher training.

Our PhD students Huu-Luat Do (RA 4), Waranya Wataniyakun (RA 2), Dorian Vodopia (RA 5), Erik Johannesen Bakke (RA 4) and Anja Alvestad (RA 3) have participated in various activities during 2025 including courses, scientific production and other outreach activities. Postdoc. Dr. Ngan Le Thi Thanh started her work within RA 4 at the beginning of the year. Further description of their contributions is found under the sections in this report for each research area. PhD student Huu-Luat Do graduated October 1<sup>st</sup> after defending his thesis "Economics of Ghost Fishing: Incentives, Behaviour and Management". The Dsolve family is grateful for his contribution to understanding the underlying mechanisms for uptake of biodegradable materials in fisheries and aquaculture industries.

The UiT MSc course FSK-3624 Marine litter and Arctic fisheries; Challenges and Solutions had 18 students this year, including one from Japan and one from USA. All of them followed the full study program and passed the exam. Teaching was primarily provided by our RA leader team and partners. We got assistance from senior advisor Bo Eide from Tromsø Municipality and the crew of RV "Beret Paulsdatter" during beach cleaning days. Partner NOFI Tromsø AS invited the student group and gave presentations about the company's role in fisheries and aquaculture. The visit ended with an interesting tour in their production facilities in Eidkjosen. Haraldur A. Einarsson (FAO Fisheries division), Dr. Eduardo Grimaldo (FHF-Norwegian Seafood Research Fund) and Gjermund Langedal (the Directorate of Fisheries) gave presentations to

## Summary

the students during seminars. Six of the students that followed the course in 2024 and 2025 are now attached to Dsolve for their Master thesis work. The feedback from students give us energy to continue this type of teaching in coming years to enhance recruitment into research linked to Dsolve.

Our industry partners have produced new types of biodegradable polymers for fibre production based on PBS (polybutylene succinate) and DPET (biodegradable polyester). The new materials are closer to important properties of nylon regarding elasticity and tensile strength than the former PBSAT and PBSA material. New materials have been tested primarily in the mechanized deep sea longline and inshore/coastal fisheries with promising results. The work is funded with support from the Directorate of Fisheries and FHF. Partner NORNER AS received funding from FHF-Norwegian Seafood Research Fund for developing biodegradable escape plates to be tested in snow crab pots. UiT received funding for a two-year networking project (2025-2027) "Collaboration for research and education addressing marine pollution and clean-up operations in the Arctic and sub-Arctic areas" between Norway, Scotland Denmark, Iceland, Greenland and Canada. In addition, the UiT has received funding from FHF for the project entitled "Development of environmentally friendly materials for line and autoline fishing", to be carried out in collaboration with SINTEF Ocean and SINTEF Industry.

We have a visible profile and share our knowledge in different channels, i.e., results from our work are published in open access peer reviewed articles, reports and outreach in the form of presentations (homepages, conferences, SoMe, TV and radio). Our new website (developed by SALT Lofoten AS in collaboration with Webium AS) has become more user-friendly, intuitive and frequently visited. Our primary objective has been to enhance the accessibility and relevance of the Centre's research and activities to our target audience. During 2025, the Dsolve team produced several news articles, book chapters, and presentations about the Centre at national and international events. The Centre administration continues to participate in various arrangements, giving presentations on the progress of Dsolve like for instance at the Lyell Centre Fisheries Conservation Congress (Edinburgh), the ICES-FAO WG meeting of FTFB and at Det Norske Videnskabs Akademi (Oslo). The published results and news are consecutively uploaded on the Dsolve webpage and communicated on social media.

Tromsø, 31. March 2026



**Roger B. Larsen**  
Centre Director

# Vision and Ambitions

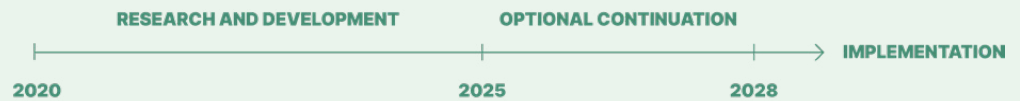
*Vision:*

Reduce plastic litter and associated problems (macro-, microplastics and ghost fishing) caused by the fishery and aquaculture industries.

*Ambition:*

Place Norway at the forefront of research, development, and use of smart biodegradable materials to reduce the global problem of marine litter from fisheries and aquaculture.

## SFI Dsolve timeline



*Illustration: SALT*

# Objectives

**The main objective of CRIDsolve** is to reduce plastic litter and its associated problems such as macro- and microplastics and ghost fishing in the marine environment caused by fishing and aquaculture industries, by replacing the traditional plastics used in gears and gear components with new biodegradable materials. This primary objective will be achieved by accomplishing the following objectives.

## Secondary objectives:

- Develop new smart biodegradable polymers with controllable (non-linear) degradation in the marine environment.
- Develop biodegradable filaments, twines, ropes, and netting for fisheries and aquaculture purposes.
- Create governmental incentives and restrictions to incorporate biodegradable plastics in an ecosystem-based management approach.
- Help to establish a supplier industry that can deliver biodegradable gears and services to the end-user sectors (fisheries and aquaculture).
- Develop sustainable downstream solutions and LCA for biodegradable fishing gear.
- Optimize and validate waste sorting technologies and circular waste processing options for biodegradable materials.
- Educate at least 8 PhD candidates, 2 post docs, and 30 MSc candidates.



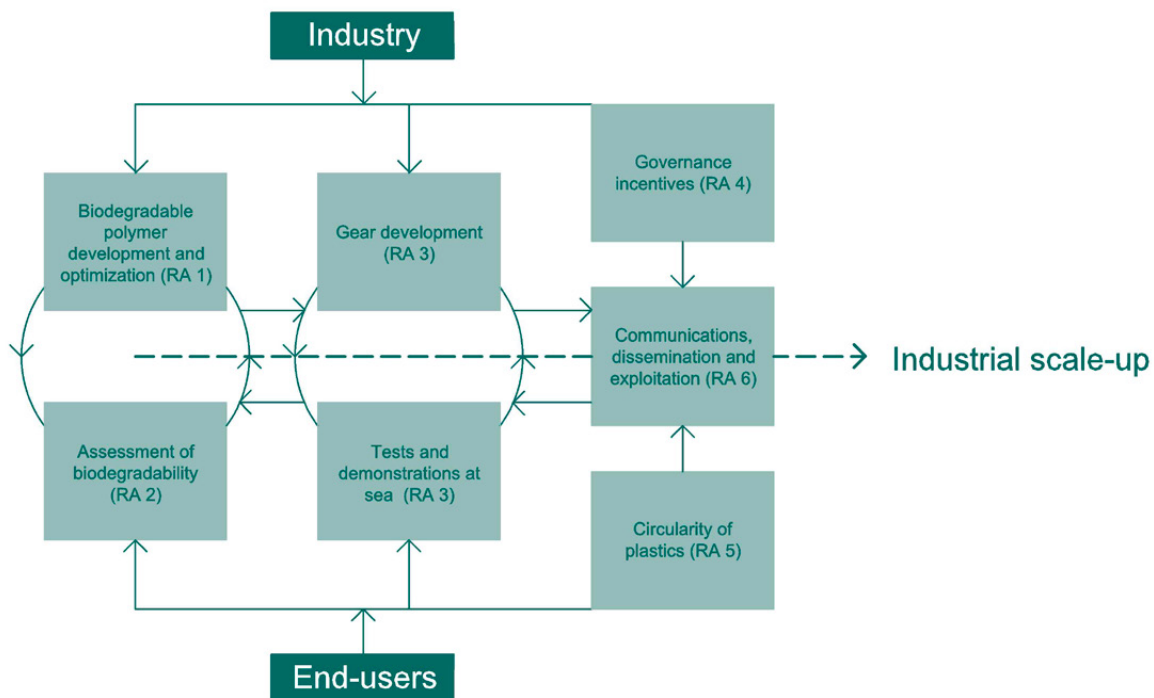
MSc student Martine Støversteen Johansen onboard the trawler Hermes.

Photo: SALT

# Research strategy

## Our main research hypotheses are:

- By replacing traditional non-degradable plastics with smart biodegradable and controllable ones, we can reduce marine litter caused by the fishing and aquaculture industries.
- By reducing ghost fishing and macro- and microplastic pollution, value creation will increase in the fishing and aquaculture industries.
- By introducing effective incentives, the fisheries management can facilitate the use of biodegradable plastics, to enhance the ecosystem-based management approach.
- LCA and new sustainable downstream solutions can facilitate the circularity and sustainability of existing fossil-based non-degradable and biodegradable plastics.
- Dsolve focuses on six Research Areas (RAs) that jointly address these hypotheses:



Specific objectives for the Research Areas (RAs) are:

**RA 1**



**Dr. Ravindra R. Chowreddy**  
Norner Research AS

Develop a range of biodegradable plastic materials with controlled biodegradability and the properties needed for products used in the fishing and aquaculture industries.

**RA 2**



**Dr. Christian W. Karl**  
SINTEF Industry

Create a sustainable framework for testing biodegradability and environmental impact. Lab and field testing will be carried out in conditions representing different marine environmental factors, and marine biodegradation tested in different marine habitats and climate zones. Biodegradable and conventional tools will be compared.

**RA 3**



**Jørgen Vollstad**  
SINTEF Ocean/UiT

Sea trials in the Norwegian, North sea, Baltic and Adriatic Seas including performance, catch pattern, and efficiency analyses of existing and new technology. Obtain data about the performance of biodegradable twines and ropes, the catch efficiency of nets, and how degradation varies in relation to different environmental conditions.

**RA 4**



**Prof. Claire Armstrong**  
UiT Arctic Univ. of Norway

Assess the economic effects of non-biodegradable materials used in fisheries and aquaculture and evaluate costs and benefits on ecosystem services from introducing biodegradable materials in the marine industries. Further analyse institutional incentive mechanisms and assess public support systems to reduce risk and promote implementation of biodegradable innovations.

**RA 5**



**Dr. Cecilia Askham**  
NORSUS AS

Develop sustainable circular solutions for existing non-degradable and future biodegradable fishing gear. The goal is to develop environmentally sustainable value chains which also take the level of circularity into account.

**RA 6**

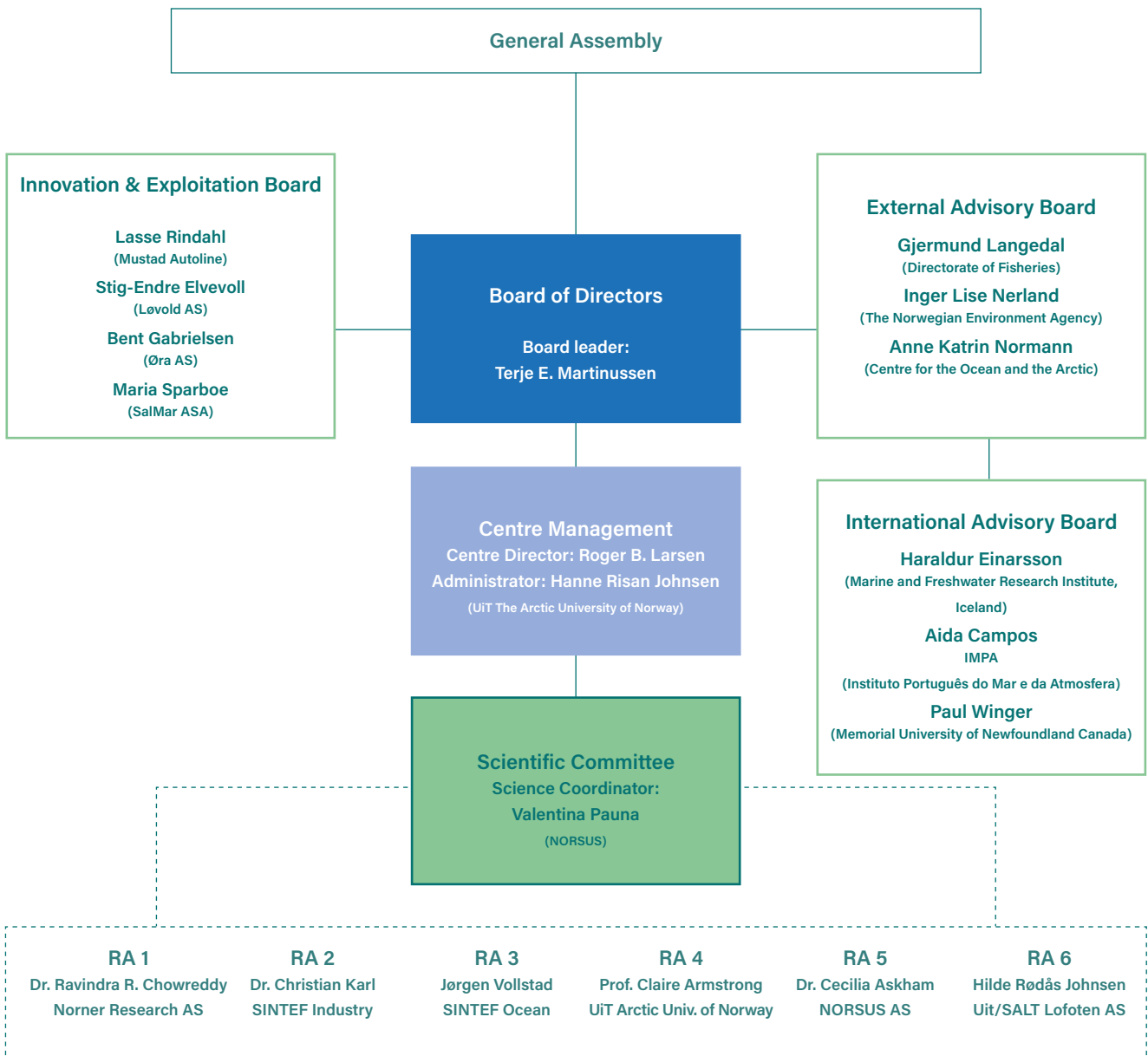


**Hilde Rødås Johnsen**  
UiT/SALT Lofoten AS

Develop sustainable circular solutions for existing non-degradable and future biodegradable fishing gear and aquaculture equipment. The goal is to develop environmentally sustainable value chains which also take the level of circularity into account. RA5 will contribute iterative sustainability knowledge to the Dsolve team about the innovative value chains being developed.

# Organisation

The figure below describes the Centre's organisation. The General Assembly consists of representatives from each partner and has the uppermost decision-making power in the Centre. As from 2022 all partners have permanent representation in the Centre's board, including research partners and the host institution (UiT). The Centre Board is advised by the Innovation and Exploitation Board (IEB), the External Advisory Board (EAB) and the International Advisory Board (IAB), which members are selected amongst experts within industry, policy and bioeconomy, governance institutions, public organisations, NGO's and marine research. The IAB members have comprehensive networks and expertise as members of ICES (the International Council for the Exploration of the Sea) and the FAO (Food and Agriculture Organisation of the United Nations).



As from 2023 Terje E. Martinussen has been the leader of the board, while Dr. Valentina Pauna from NORSUS has had the role as Scientific Coordinator of CRI Dsolve. Terje E. Martinussen has long experience from the seafood industry and research from previous executive positions within amongst other, the Norwegian Seafood Council, UiT and Nofima (former Fiskeriforskning). Valentina Pauna is a senior researcher at NORSUS with a focus on plastics, specifically micro- and nanoplastic pollution. She holds a B.Sc. in Chemistry from Colorado State University, USA, M.Sc. in Climate Science and Solutions from Northern Arizona University, USA, and a Ph.D. in Environment, Resources and Sustainable Development from the University of Naples, Parthenope, Italy.

The CRI partners are presented at pages 18 and 19 and includes several industry partners from both the fishery and aquaculture sectors, as well as research partners, fishery organisations and authorities' representatives. The number of partners has remained unchanged in 2025. The members of the centre board are presented below.



Members of the board, administration, Research Coordinator and some of the students affiliated with Dsolve, gathered at the Norwegian College of Fishery Science in Tromsø 23.- 24 September

*Photo: Ivan Tatone, UiT*

## Members of the Centre Board 2025

ROLE	MEMBER OF CENTRE BOARD	AFFILIATION
<b>Leader of the Board</b>	Terje E. Martinussen	Private
<b>Host Institution</b>	Terje Aspen	UiT-BFE
<b>Research Partners</b>	Thor Kamfjord	Norner Research AS
	Ingunn Holmen	SINTEF Ocean AS
	Ben Alcock	SINTEF Industry AS
	Cecilia Askham	NORSUS AS
<b>Industry and organisations</b>	Bent Gabrielsen	Øra AS
	Asmund Birkeland	Opilio AS
	Lasse Rindahl	Mustad Autoline AS
	Terje Lindal	Mørenot AS
	Håvard Olsen	Kvarøy Fiskeoppdrett AS
	Gunnar Kupaen	Nofi AS
	Benedicte Nielsen	The Norwegian Fishermen's Sales Organisation
	Martin Solhaug	Martin Solhaug AS
	Rune Sand	Tustern AS
	Kristian Kalgraff	Legøy Rederi AS
	Signor Antonsen	Hermes AS
	Maria Pettersvik Arvnes	The Norwegian Fishermen's Association
	Stig-Endre Elvevoll	Løvold AS
	Brynjnar Bangsund	Brynjnar Bangsund ENK
	Øystein Enoksen	Øystein Enoksen ENK
	Rita Karlsen	BR Karlsen AS
	Ståle Dyb	KS Loran AS
Maria Sparboe	SalMar AS	
<b>Observer</b>	Hilde Albech	The Research Council of Norway



Centre leader Roger Larsen at the annual meeting  
Photo: Hilde R. Johnsen, UiT/SALT



Research status presented by RA leaders Jørgen Vollstad (RA3) and  
Christian W. Karl (RA2) at the annual meeting  
Photo: Hilde R. Johnsen, UiT/SALT



## **Annual meeting and General assembly**

The 2025 annual meeting and general assembly of CRI Dsolve was successfully held in Porsgrunn 2<sup>nd</sup>– 3<sup>rd</sup> of April. The meeting gathered 27 partner representatives, including members of the National and International Advisory Board, Research Area leaders and PhD candidates, and additionally digital representation from South-Korean and national partners. The meeting was hosted by research partner Norner Research AS, who shared valuable insights into their expertise in polymer research and innovation, including polymer synthesis, characterization, application testing, lifetime predictions, and the qualification of plastic materials for various industrial applications, such as fishing and aquaculture. They also addressed issues related to microplastics and marine littering. On the second day, the participants were given a guided tour of Norner`s impressive lab facilities, providing new insight in the practical work on testing and developing biodegradable plastic materials within the Dsolve project. This opportunity was highly appreciated by all participants and fostered a valuable common understanding within the consortium of the complexity of the polymer research.

Further the annual meeting discussed the results of the Norwegian Research Council underway evaluation that took place in February and plans to follow up the recommendations from the evaluation panel. Plans for the final three-year period of the CRI were discussed, and in addition, future activities beyond the centre period were added to the agenda. Research status within the various Research Areas (RA1 – RA6) were presented by RA leaders and the PhD candidates, and the innovation potential discussed, including the potential for knowledge development and policy development.

The gathering also included a joint dinner and offered a valuable possibility to interact with CRI partners and get input from both the National and the International Advisory Board.

## **International cooperation**

CRI Dsolve participate and contribute in several international cooperations within amongst other fishery technology and environmental research. National and international scientists and students from Research Area 3 are members of the ICES-FAO working group on Fisheries Technology and Fish Behaviour (FTFB) and provide contributions to the annual meetings in the form of presentations, posters and topic group reports. In the thematic network on Arctic plastic pollution of UArctic several scientists and students have participated in meetings and research cruises during the project period. These activities are also presented on the CRI website. Both fora led to networking and teambuilding for extended mobility and research collaboration.

Research Area 4, as part of the Dsolve project, collaborates with the University of Wyoming and Appalachian State University, supported by their funding, to conduct a lab experiment with students at the University of Wyoming. The research focuses on enforcement mechanisms for adopting sustainable practices, particularly the use of biodegradable fishing gear. Additionally, through the North2North mobility grant, a collaboration has been established with the University of Alberta to study

consumer preferences for seafood products caught using biodegradable fishing gear, employing choice experiments, funded by the Norwegian Retailer`s Environment Fund. These collaborations contribute to Dsolve`s broader research agenda and are expected to result in scientific publications. Research Area 4 also works closely with environmental economists engaged in blue economy research, including the Environment for Development (EfD) Initiative, established by the University of Gothenburg, which connects over 15 research centres worldwide.

Research Area 5, through Dr. Cecilia Askham and Dr. Valentina Pauna, have close collaborations with the UNEP LC-Initiative, The MarILCA project (to include the impacts of marine littering into LCA methodology), the SETAC plastics interest group and the Plastic Footprint Network (PFN), specifically focussing on fishing and aquaculture littering. These collaborations include working on scientific papers relevant for Dsolve.



The annual meeting 2025 gathered participants from both industry and scientific partners for joint discussions.  
*Photo: Norner*

In the context of ongoing international collaboration between the partners from the four testing sites (SINTEF Ocean (Norway), DTU (Denmark), Thünen Institute of Baltic Sea Fisheries (Germany), and University of Split (Croatia) in Research Area 2, led by Dr. Christian W. Karl, samples will be evaluated after a period of three years in the sea, followed by a subsequent analysis after three to five years. The results of these evaluations will be disseminated as peer-reviewed publications. Additionally one scientific research article related to Waranya Wataniyakun`s PhD thesis at UiT has been published together with the French Research Institute for Exploitation of the Sea (Ifremer) and one book chapter has been published together with the Icelandic Marine and Freshwater Research Institute (MFRI). New collaborations with partners from outside Norway concerning the investigation on the degradation behaviour of biodegradable plastics are to be deepened, and further investigations will be carried out if deemed necessary.

## Recruitment

The process of announcing an additional postdoc for RA3 and PhD candidates for RA2 and RA3 started early in 2025. However, due to challenges in identifying qualified candidates the evaluation has been delayed, this means that these positions will start from March 2026.

During 2024 and 2025 six MSc candidates have become part of our centre and they are all supervised by Dsolve personnel and partners.

# Partners

## Host Institution



**UiT - The Arctic University of Norway** As hosts institution, UiT contributes to the CRI with expertise in Arctic and marine biosciences, economy, and subjects relevant to the fisheries and the aquaculture industry, as well as infrastructure for lab testing and fishing gear trials. UiT is leading Research Area 4 Governance incentives, Research Area 6 Communication, Dissemination and Exploitation, and is involved in Research Area 3 Tests and demonstrations at sea.

## National Research Partners



**Norner Research AS** contributes to the CRI with expertise in Polymer R&D services, material and analytical testing, evaluation of physical and chemical properties, environmental influence on material properties, and plastic processing techniques. Norner is leading Research Area 1 Biodegradable polymer development and optimization.



**SINTEF Ocean** contributes to the CRI with expertise in ocean-based industries, including fishery and aquaculture, and with R&D infrastructure. Sintef Ocean is leading Research Area 3 Tests and demonstrations at sea, and has been head of the Scientific Committee of CRI Dsolve. Additionally, SINTEF Ocean contributes to Research Area 2.



**SINTEF Industry** contributes to the CRI with expertise in the entire value chain from manufacturing to finished product, for all types of plastics, including thermoplastics, plastics composites, elastomers, and gels. Sintef Industry is leading Research Area 2 Assessment of biodegradability- A framework for testing biodegradability and environmental impact (lab and field trials).

## NORSUS

**NORSUS AS** contributes to the CRI with expertise in LCA for analysis of environmental and resource efficiency for products and services. NORSUS is leading Research Area 5 Sustainability of bio-based, biodegradable, and non-degradable plastics for fishing gear and aquaculture equipment and has also the role as Science Coordinator of the CRI.

## International Research Partners



**DTU-Aqua (Denmark)** Research, advice, and monitoring on fisheries and environment in the Baltic Sea. Contributes to Research Areas 2 Assessment of Biodegradability and 3 Tests and demonstrations at sea.



**Thünen Institute of Baltic Sea Fisheries (Germany)** Research, advice, and monitoring on fisheries and environment in the Baltic Sea. Contributes to Research Areas 2 and 3 Tests and demonstrations at sea.



**University of Split (Croatia)** Research, science, and innovation within oceanography and fishing, nautical science, and a range of other specific disciplines. Contributes to Research Areas 2 Assessment of Biodegradability and 3 Tests and demonstrations at sea.

## International Industry Partners







**LG Chem (South Korea)** Supplier of biodegradable polymers and fishing gear. Contributes to the CRI with materials for testing and expertise on biodegradable plastics.






**S-EnPol (South Korea)** Supplier of biodegradable polymers and fishing gear. Contributes to the CRI with materials for testing and expertise on biodegradable plastics.



## National Industry partners - suppliers

 <b>Nofi Tromsø AS</b>	Supplier of fishing gear. Contributes to the CRI with expertise on fishing gear, and in particular nets.
 <b>Mørenot Fishery AS</b>	Supplier of applications to the fisheries and aquaculture industry. Contributes to the CRI with expertise on fishing gear and aquaculture equipment.
 <b>Løvold AS</b>	Supplier of applications to the fisheries and aquaculture industry. Contributes to the CRI with expertise on fishing gear and aquaculture equipment, and in particular ropes.
 <b>Mustad Autoline AS</b>	Supplier of fishing gear. Contributes to the CRI with expertise on fishing gear, and in particular longlines.




## National Industry partners - users

<b>Øra AS (coastal gillnetting)</b>	Contributes to the CRI through full-scale tests of biodegradable fishing gear at the 11 m coastal gillnet-vessel "Karoline".
<b>Tustern AS (demersal seining)</b>	Contributes to the CRI through full-scale tests of biodegradable fishing gear at the 27,5 m seine-vessel "Fortuna".
 <b>Hermes AS (demersal trawling)</b>	Contributes to the CRI through full-scale tests of biodegradable fishing gear at the 70 m trawler "Hermes".
<b>Legøy Rederi AS (gillnetting)</b>	Contributes to the CRI through full-scale tests of biodegradable fishing gear at a 15 m coastal gillnet-vessel.
<b>Martin Solhaug - Vibeke Cathrin AS (traditional longlining)</b>	Contributes to the CRI through full-scale tests of biodegradable fishing gear at the 15 m coastal longliner "MS Vibeke Cathrin".
<b>Opilio AS (snowcrab potting)</b>	Contributes to the CRI through full-scale tests of biodegradable fishing gear at the snowcrab vessel "Northeastern".
<b>Loran AS (mechanized longlining)</b>	Contributes to the CRI through full-scale tests of biodegradable fishing gear at the mechanized longliner "Loran".
 <b>Kvarøy Fiskeoppdrett AS</b>	Contributes to the CRI as end user within salmon farming. Owns and operates two ordinary salmon farming licenses and one R&D license.
 <b>SalMar ASA</b>	Contributes to the CRI as end user within salmon farming. SalMar ASA is the world's second largest breeder of salmon, and produces in Norway, Shetland, Orkney Islands, Iceland and Scotland.
<b>BR·KARLSEN BR Karlsen AS</b>	Contributes to the CRI as a vertically integrated end-user within traditional whitefish production and aquaculture.
<b>Brynjar Bangsund ENK (mechanized longlining)</b>	Contributes to the CRI through full-scale tests of biodegradable fishing gear at the coastal longliner "Østkapp".
<b>Øystein Enoksen ENK (traditional longlining)</b>	Contributes to the CRI through full-scale tests of biodegradable fishing gear at the mechanized longliner "Vardøyfisk II".




## Organisations

 <b>Norges Fiskarlag</b>	(The Norwegian Fishermen's Association) Contributes to the CRI as representative for Norwegian fishers. Participate in Research Area 6 Communication, dissemination, and Exploitation.
 <b>Norges Råfisklag</b>	(The Norwegian Fishermen's Sales Organisation) Contributes to the CRI as representative for Norwegian fishers. Participate in Research Area 6 Communication, dissemination, and Exploitation.

## External Advisory Board

 <b>Senter for Hav og Arktis</b>	Contributes to the CRI with expertise on blue sustainability in the arctic and partnerships for sustainable blue business.
 <b>Miljødirektoratet</b>	Contributes to the CRI as representative for Norwegian authorities with authority on environmental management and legislation.
 <b>Fiskeridirektoratet</b>	Contributes to the CRI as representative for Norwegian authorities with authority on fishery and aquaculture management and legislation, and expertise on retrieval of lost fishing gear.

## International Scientific Advisory Board

 <b>Institute for the Ocean and the Atmosphere, Portugal</b>	Contributes to the CRI with expertise in ocean science and technology research.
 <b>Marine and Freshwater Research Institute, Iceland</b>	Contributes to the CRI with expertise in marine and freshwater research.
 <b>Memorial University of Newfoundland, Canada</b>	Contributes to the CRI with expertise in fishery research.

# Scientific activities and results

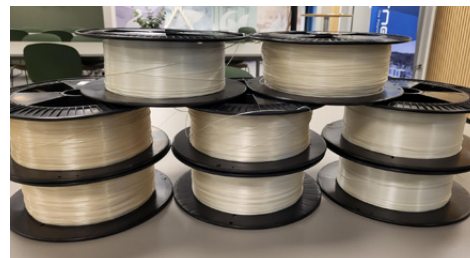
## RA 1

### Biodegradable Polymer Development and Optimization

#### Objectives and motivation

The main objective of Research Area 1 (RA 1) is to develop a range of biodegradable plastic materials with the properties needed for products used in the fishing and aquaculture industries (e.g., twines and netting, ropes, gillnets, coatings, pots and traps, foils and boxes, pipes, and connectors). The developed materials should meet a range of processing and performance requirements, including biodegradability.

The motivation behind RA 1 is that conventional plastic materials used in the construction of fishing gear and aquaculture equipment are not biodegradable and remain in the aquatic environment when lost during operation. This leads to plastic pollution, microplastic formation, and ghost fishing issues. Utilizing biodegradable plastic materials in fishing gear and aquaculture equipment would reduce plastic pollution and ghost fishing due to their shorter lifespan. None of the commercial biodegradable plastics meet both the performance and marine biodegradability requirements needed for fishing gear and aquaculture equipment. Therefore, RA 1 in the Dsolve project intends to develop a range of biodegradable alternative materials that will meet the requirements of both performance and marine biodegradability for the fabrication of fishing gear and aquaculture equipment.



Left: Dsolve partners and researchers visiting the lab of Norner during the 2025 Annual Meeting.  
Photo: SALT

Right: Biodegradable monofilaments produced from formulations developed in RA1  
Photo: Norner Research AS

#### Key research tasks

##### The overall key research tasks of RA 1:

- Selection, identification, sourcing, and suitable modification of biodegradable plastic materials for marine fishing and aquaculture applications.
- Development of biodegradable materials with optimal processability and performance for various applications, such as fibres (twines, netting, ropes, etc.), injection moulding (pots, traps, boxes, etc.), and coatings (steel rope coatings).
- Investigation of potential microplastic formation from the biodegradable plastics and prediction of the degradation products.
- Establish collaborations with material suppliers to ensure the availability of biodegradable plastics for the project.
- Development of new material and design concepts to meet the requirements of marine biodegradability, processability, and performance for marine fishing and aquaculture applications.

## The key research tasks prioritised in 2025:

- Conduct desktop study to evaluate commercial bioplastics and provide recommendations for material development tailored to various applications within the Dsolve project.
- Scout and source alternative commercial bioplastics for further materials development in fibre, moulding, and coating applications within the Dsolve project.
- Develop and optimise biodegradable plastic formulations for fibre applications.
- Process and evaluate performance of monofilaments from developed optimal biodegradable plastic formulations.
- Process and supply pilot scale monofilaments for field experiments in RA3 of the Dsolve project.
- Develop and optimise biodegradable plastic formulations for moulding applications.
- Process and evaluate performance of developed optimal biodegradable formulations for moulded/extruded applications.
- Process and supply pilot scale moulded/extruded products (escape gaps for snow-crab pots) for field experiments in RA3 of the Dsolve project.
- Develop biodegradable formulations and evaluate their suitability for metallic wire coatings for rope applications.
- Develop new materials concepts such as incorporating enzymes, water soluble and hydrolysable polymers to enhance biodegradability of already developed formulations.
- Develop new design concepts such as bi-component monofilaments with highly biodegradable core and slow degradable skin, and overmolding concept for injection moulded products with highly biodegradable core and slow degradable skin layer.

## Achievements for 2025

As none of the commercial biodegradable plastics meet all the processability, performance, and marine biodegradability requirements necessary for fishing gear and aquaculture equipment applications, RA1 set out to develop a range of biodegradable blend formulations and compounds using commercial materials.

### Biodegradable plastic materials for fibre applications:

- A variety of biodegradable plastic blend formulations were developed for fibre applications and assessed for their rheological, mechanical, and morphological properties in 2023 and 2024. This work on blend development and characterisation continued into 2025, culminating in over 100 distinct formulations. The results of this development work are presented in technical report D2.5 (Norner Research report# NR260142).
- Among the several developed biodegradable plastic blends, a few selected were further investigated for pilot scale monofilament extrusion and inline stretching. The produced monofilaments were subsequently characterised for their mechanical properties and biodegradability. The outcomes of the monofilament processing trials and mechanical testing are summarised in technical report

D2.6 (NR260143). Some selected monofilaments were further supplied to RA3 of the Dsolve project, where the monofilaments were investigated in field trials for snoods in longline fishing gear.

#### **Biodegradable plastic materials for molding applications:**

- A range of biodegradable plastic blend formulations were developed for moulding applications and assessed for their rheological, mechanical, and morphological properties in 2023 and 2024. This work on blend development and characterisation continued into 2025. The results of this development work are presented in technical report D3.2 (Norner Research report# NR260148).
- A couple of selected bioplastic compounds were further processed on pilot scale and converted into escape gaps by injection moulding for snow-crab fishing pots and are being evaluated in the field trials.

#### **Biodegradable plastic materials for coating applications:**

- A desktop study was carried out to identify plastic coating processes for metallic wires for rope applications. Findings of the desktop study are summarised in deliverable report D4.1 (Norner Research Report #NR260149).
- Technical development work around the materials development for coating applications is kept on hold due to budget limitations. Possible side funding will be evaluated to continue the tasks around the coating applications.

#### **New materials and design concepts**

- In connection with new materials development, a feasibility study was conducted to develop biodegradable materials with superior biodegradability by incorporating enzymes into the bioplastic during 2025. The feasibility study indicated that the concept of immobilizing enzymes into an inorganic host and later into bioplastics successfully activated the enzymatic degradation of bioplastic. This concept will be further evaluated in 2026 and 2027. The results of this study are summarized in deliverable report D5.1.
- In addition, a new design concept of bi-component monofilament was evaluated in pilot-scale monofilament processing equipment to achieve a core-shell concept. The initial results have indicated feasibility. Further development in this direction will be carried out during 2026 and 2027. The results of this study are also summarized in deliverable report D5.1.

#### **New materials sourcing and characterization**

- The bioplastic materials sourced in 2025 were extensively characterized for their thermal and rheological properties. The results of this characterization are summarized in deliverable report D6.4 (NR260144).

Following feedback from the mid-term evaluation, RA1 is optimistic about generating scientific publications based on the technical data produced within the RA1 of the Dsolve project. So far, RA1 has published one article and made contributions to a joint manuscript. Furthermore, two additional manuscripts are currently in their

final stages of preparation, and the results collected provide further opportunities for future publications. RA1 will continue to focus on cross-collaboration with other research areas of the Dsolve project to generate joint publications. Moreover, the upcoming field trials on materials developed in RA1 are expected to generate further publishable results, reinforcing RA1's commitment to advancing research outputs. In addition to publication efforts, RA1 is actively exploring new avenues for additional funding to support ongoing and future research activities. This proactive approach has already yielded success, with RA1 securing one additional FHF project focused on evaluating biodegradable escape gaps for snow crab fishing pots. RA1 remains eager to contribute to and develop new collaborative projects in order to support the Dsolve goal of maintaining Norway's leading position in sustainable fishing. In summary, RA1 is committed to maximising the project's impact through publications, the securing of new funding, and ongoing collaborative research.

#### **Technical internal reports:**

1. Chowreddy, R., Summary of bioplastic modifications evaluated to meet the requirements of fibres, Norner Research AS, Report# NR260142, Deliverable D2.5, 19.02.26
2. Chowreddy, R., Summary of 3rd round of fibre spinning trials and testing on modified bioplastics, Norner Research AS, Report# NR260143, Deliverable D2.6, 19.02.26
3. Chowreddy, R., Summary of bioplastics modifications for moulding applications, Norner Research AS, Report#NR260448, Deliverable D3.2, 20.02.26
4. Chowreddy, R., Desktop study - Overview of plastic coating processes for marine metallic ropes, Norner Research AS, Report#NR260449, Deliverable D4.1, 20.02.26
5. Chowreddy, R., Intermediate report with a summary of technical development work on new material and design concepts, Norner Research AS, Deliverable D5.1, Under preparation
6. Chowreddy, R., Summary of characterization results of bioplastics sourced in 2025, Norner Research AS, Report#NR260144, Deliverable D6.4, 19.02.26

#### **Publications:**

One manuscript was submitted for publication in 2025, and another 2 manuscripts are under development for submission.

#### **Guest Lectures:**

1. Chowreddy, R, Guest lecture on topic "Biodegradable plastics as an alternative materials for fishing applications" for the course FSK-3624: Marine litter and Arctic Fisheries: Challenges and Solutions (25.09.24)

### Objectives and motivation

In Research Area 2, assessment of biodegradability, the degradation behaviour of fishing gear or other equipment for marine applications made of biodegradable polymers will be investigated in more detail. These fishing gears should have the same or better mechanical properties and fishing efficiency as the non-biodegradable plastics. These common polymers currently used in the fishing and aquaculture industries include primarily polyamide (PA). Gillnets made from synthetic materials are durable and have high tensile strength, which becomes problematic when lost at sea as they contribute to ghost fishing. Issues such as ghost fishing, marine plastic pollution, shipping risks, and the introduction of synthetic materials into the marine food chain have become much more acute with the increase in fishing activity. In recent years, biodegradable gillnets (e.g. made of PBSAT and PBSA) that can be degraded by naturally occurring microorganisms in seawater have been increasingly discussed and researched as a replacement for conventional PA gillnets. The catch efficiency of these nets made of biodegradable polymers is in some cases comparable to nets made of PA. However, significant research is still needed to improve the mechanical properties, catch efficiency and biodegradability of these gillnets and other devices of interest for future applications. In addition, the degradation of biodegradable polymers with controllable and nonlinear degradation profiles that exhibit stable mechanical properties during their lifetime and degrade rapidly thereafter will be investigated.

Based on the degradation results, RA2 will work closely with academic and industrial partners to make biodegradable plastics commercially available and economically accessible.

### Key research tasks

This Research Area focuses on investigating modified and unmodified biodegradable polymers for fishing gear with the same or better mechanical properties and catch efficiency as the non-degradable plastics currently used by the fishing and aquaculture industries. The physical and chemical integrity and degradation of biodegradable and conventional nets and twine will be evaluated in different laboratory tests and field investigations over an extended period of 3–5 years. The influence of UV radiation and temperature on accelerated weathering tests in the laboratory will be compared with field studies and experiments conducted under controlled laboratory conditions. The work plan provides a more detailed description of the activities planned to achieve these objectives. The following main tasks are relevant:

- Task 2.1 Investigation of the marine biodegradation of gillnets and twines with PBSAT as test and PA6 as control material in situ in different marine habitats and in different climate zones (Skagerrak Sea, North Sea, Baltic Sea, Adriatic Sea, and Norwegian Sea) to cover a wide temperature range from 4 to 27°C and analyses the samples.

- Task 2.2 Investigation of the biodegradation in laboratory systems (controlled conditions) consisting of natural seawater. Analysis includes monitoring microbial biodegradation, performing microbiome analyses, and analysing the materials (chemical and physical properties) during and after degradation.
- Task 2.3 Evaluation of the effects of UV radiation with simultaneous changes in temperature, humidity, and pollutants (and the combination of these factors) on the physical properties of PBSAT nets and yarns and PA6 as control.

### Achievements for 2025

- The samples described in RA 2.1 were collected yearly in June/July (2022–2025) and analysed up to 36 months after collection from all testing sites in Norway, Denmark, Germany and Croatia. The RA 2.1 report, which provides a detailed description of the samples collected from the testing sites, has been finalised. A scientific article based on the results of the testing sites after 36 months will be finalized in spring 2026 as part of Waranya Wataniyakun` s PhD Thesis. Figure 1 shows a temperature logger and monofilament samples fixed in a pot from the Norwegian testing site in the vicinity of Trondheim.
- Accelerated weathering experiments of the monofilaments (PA6 as a reference and PBSAT and PBSA as biodegradable polymers) were carried out in RA 2.3 previously. The methods (chemical, physical, surface, friction and wear characterisation) selected for this purpose are important for the entire Research Area in the future (especially for the field experiments in RA 2.1 and the laboratory experiments in RA 2.2). A test report based on the ageing results have been finalised, which summarises the results of the analyses from the lab-based degradation studies in task 2.3. A scientific publication based on the main accelerated ageing results from the report in task 2.3 was published in 2025: [↻ Degradation Behaviour of Biodegradable and Conventional Polymers for Gill Nets, Exposed to Accelerated Aging | ACS Applied Polymer Materials](#)
- Initial analyses of samples from the laboratory experimental setup in RA 2.2 after 36 months have been carried out. A manuscript for a scientific article is in preparation.



Fig. 1: Temperature logger and monofilament samples fixed in a pot.

Photo: SINTEF Ocean

## Dissemination and public outreach RA 2

### Publications

- One scientific research article as outcome from Task 2.3 has been published: [↻ Degradation Behaviour of Biodegradable and Conventional Polymers for Gill Nets, Exposed to Accelerated Aging | ACS Applied Polymer Materials](#)
- One scientific research article related to Waranya Wataniyakun's PhD thesis (at UiT) has been published: [↻ Biodegradable fishing gears: A potential solution to ghost fishing and marine plastic pollution - ScienceDirect](#)

Figure 2 shows SEM and light microscopy pictures of PBSAT and PA6 monofilament specimens which were subjected to artificial aging that replicates outdoor conditions. Exposure to this condition for 1000 hours resulted in the development of a network of small cracks in the PA6 samples, extending both longitudinally and transversely to the fibre axis on one side of the fibre (refer to Fig. 3 1c). In addition to this, a progression of longitudinal cracks was observed, initially detected after 600 hours. After 1000 h, the PBSAT sample exhibited fine longitudinal cracks along the fibre axis and slight surface changes on one side. However, these changes were not visible as fine cracks but rather as a textural change (see Figures 1f, Karl et al, ACS Applied Polymer Materials, 2025). The findings demonstrated that the ageing process exerts a negligible influence on the tensile modulus of both PA6 and PBSAT, with an enhancement in tensile modulus observed after one thousand hours of ageing, reaching 21% and 5% for PA6 and PBSAT, respectively. However, a discernible influence on the elongation at break was evident, with a reduction of approximately 67% and 91% observed for PA6 and PBSAT, respectively. Furthermore, tribological tests of the monofilaments demonstrated that the PBSAT monofilament exhibited higher levels of wear and abrasion under dry conditions when compared to PA6; however, under seawater lubrication, the wear and friction force of both PBSAT and PA6 monofilaments were comparable. The findings of this study demonstrate that biodegradable PBSAT materials have the potential to substitute for non-degradable PA6 in gillnets.

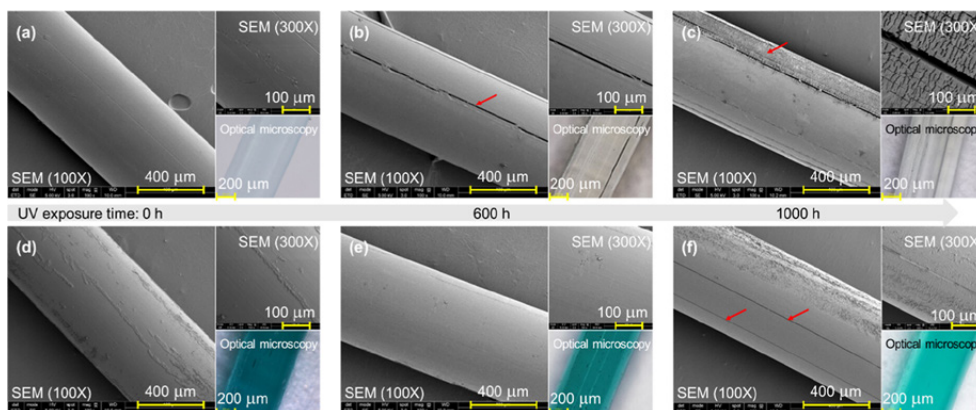


Fig. 2 Scanning electron microscopy (SEM) and optical microscopy were employed to analyse the samples (PA6 and PBSAT) before and after UV exposure. The arrows in Figures b and f denote longitudinal cracks, while the arrow in Figure c indicates extensive surface cracks. The ageing times for these samples were 0 hours (a,d), 600 hours (b,e), and 1000 hours (c,f). No discernible discoloration was observed in any of the samples, as evidenced by the insets in the optical microscopy images (Karl et al., ACS Applied Polymer Materials, 2025).

Two book chapters as scientific research articles in the book “Managing Marine Plastic Pollution in Norway - Sustainable Circular Economy Solutions for Fisheries and Aquaculture” (mainly from the SHIFT-Plastics project) have been accepted in 2025:

⇒ <https://www.routledge.com/Managing-Marine-Plastic-Pollution-in-Norway-Sustainable-Circular-Economy-Solutions-for-Fisheries-and-Aquaculture/Walnum-Palmer-Abbs-Deshspande/p/book/9781041018810>

- Chapter 8: ⇒ [The environmental impact of HDPE mechanical recycling: Case studies from the Norwegian aquaculture industry - Pavel Stránský, Tazrin Ahmed, Christian W. Karl, Fredrik Mürer](#)
- Chapter 9: ⇒ [The role of recycling and biodegradable materials in aquaculture and fisheries: Challenges and potential solutions - Christian W. Karl, Fredrik K. Mürer, Hanne H. Hatlebrekke, Eduardo Grimaldo, Haraldur A. Einarsson, Roger B. Larsen, Eli F. Ullern, Henrik B. Lund](#)

Adopting a transdisciplinary approach, the book integrates academic perspectives and engages in collaborative efforts with industry and public entities to improve plastic handling practices within the fisheries and aquaculture sectors. This encompasses a variety of scientific disciplines, such as technological science, policy science, economics, environmental science, design thinking and systems thinking.

### Popular science:

- Podcast: Biodegradable plastics in aquaculture with UiT, SINTEF, Salmar and NORSUS (in Norwegian): 134. [↻ Kan nedbrytbar plast fungere i oppdrettsnæringa? - Smart forklart | Acast.](#)
- Technical journal with UiT and SINTEF (in Norwegian): [↻ Halvgått løp for nedbrytningsdugnad.](#)
- Popular science contribution with UiT and SINTEF (in Norwegian): [↻ Slik vil forskere hindre plastforurensing fra fiskeri- og havbruk \(2024\)](#)
- Popular science contribution with UiT and SINTEF (in English): [↻ How scientists will prevent plastic pollution in the ocean.](#)

### Conference contributions and guest lectures:

- C. W. Karl, S. Hakvåg, Degradation behaviour of biodegradable and conventional monofilaments under marine field and laboratory conditions, EPF European Polymer Congress, Groningen/The Netherlands, June 2025
- C. W. Karl, Synthetic fibres (materials) used in fisheries and aquaculture, 90 min guest lecture in the course FSK-3624 Marine litter and Arctic Fisheries: Challenges and Solutions (12.09.25)

Anna-Maria Persson and Christian Karl (both SINTEF, polymer and composite materials) attended the NCMT's plastic and composite conference in Fredrikstad in November 2025 together with Cecilia Askham and Nora Løvdal Gamnes (both NORSUS). Cecilia Askham presented a selection of findings from Dsolve concerning LCA. Over 130 participants were present and received information on various topics. The NCMT (Norwegian Circular Materials Technology) industry cluster, which Anna-Maria organized together with other stakeholders, is an important annual conference that brings together the Norwegian composites industry focusing on increased development and transition to circular value chains.

In light of the mid-term evaluation, the studies conducted under RA 2 have resulted in a more profound comprehension of the processes that lead to the degradation of materials. A series of investigations have been conducted into the hydrolytic degradation and degradation under accelerated ageing conditions that simulate outdoor conditions. The results of these investigations have been published. Recent studies have indicated the occurrence of leaching harmful substances from certain materials frequently employed in the domains of fisheries and aquaculture. As a component of the three-year field study, the degradation of the monofilaments utilised will be subjected to a more thorough examination, with the objective of identifying additives that may be released from the products. These results will provide a foundation for subsequent collaboration with other work packages.

## Related projects:

POCOplast KSP: Pathways to sustainable post-consumer plastics in aquaculture

SHIFT-PLASTICS (KSP): Shifting to sustainable circular value chains for handling plastics in the fisheries and aquaculture sector.

PLASTICENE (KSP): Development of tools for increased resource utilisation, circularity and regulatory support of plastic use in Norway

In-No-Plastic (EU): Innovative approaches towards prevention, removal and reuse of marine plastic litter

Development of environmentally friendly materials in line/autoline fishing (FHF)

## Recruitment

New PhD position advertised, assessment of candidates initiated (in 2025).



Anna-Maria Persson (SINTEF),  
Christian Karl (SINTEF),  
Cecilia Askham (NORSUS)  
and Nora Løvdal Gamnes  
(NORSUS, from left to right) at  
the NCMT conference 2025 in  
Fredrikstad.  
*Photo: SINTEF Industry*

### Objectives and motivation

This research area is dedicated to developing, testing, validating, and optimizing biodegradable fishing and aquaculture gear for specific applications. Before large-scale production, commercialization, and practical uptake can take place, the industry requires solid, evidence-based scientifically documented results. Identifying specific needs, developing suitable products, and conducting extensive testing and documentation are crucial.

The shift from conventional petro-based materials to biodegradable alternatives must account for key factors such as performance (including catch patterns), durability, handling and maintenance costs, and efficiency assessments of both existing and emerging technologies. To evaluate these aspects, sea trials are conducted primarily in Norway, providing crucial data on the performance of biodegradable twines and ropes for active and passive gears, the catch efficiency of gillnets, longline and pots, and how material degradation varies under different environmental conditions. These insights will help extend findings to other fisheries and contribute to the broader adoption of biodegradable fishing gear worldwide.

As highlighted by the underway-evaluation panel, it is essential to disseminate progress and new findings from field trials through publications and popular science formats, such as reports and news articles. Within Research Area (RA) 3, we have actively shared our latest results through peer-reviewed articles, popular science publications, and outreach in the form of presentations for fisheries organizations amongst others, articles on the Dsolve webpage, and updates on social media platforms. We have also organized and participated in RA leader meetings and partner workshops, following the living-lab concept. Additionally, we contributed to academic activities by delivering lectures for an ongoing UiT course on marine littering, supervising a MSc student, and leading a writing session for PhD students. We have also increased collaboration across the Research Areas and developed new biodegradable products that would not have been possible without strong cooperation and cross-group efforts.

### Key research tasks

- Task 3.1: For gillnets (inshore and deep-sea gillnetting), find a combination of strength/elasticity and capture efficiency comparable to or better than existing and commonly used nylon twines during multiple trials conducted on board commercial gillnetters.
- Task 3.2: Develop biodegradable materials (cage-netting and escape mechanisms) to be used in commercial pot and trap fisheries targeting various crab species and lobster, including recreational pot fisheries.
- Task 3.3: Develop biodegradable ropes, twines from, mono- and multifilaments, and other components for coastal and deep sea longlines to replace nylons and polyester as material for snoods (branch lines) and ropes connecting line sections in mechanized longlining
- Task 3.4: Identify several possibilities for replacing PE, PA, PP and PES fibres with biodegradable fibres for use in twines, ropes, and netting for all fishing gears and aquaculture.
- Task 3.5: Full-scale tests of alternatives to “dolly-ropes” made from PA/PE/PET

monofilaments and other types of chafing mats for use in demersal (bottom) trawling.

## Organisation

The project is built on close cooperation between research institutions, fishing gear manufacturers and commercial partners in fisheries and aquaculture. The organization reflects a strong integration of scientific and industry expertise, ensuring that both academic perspectives and operational experience are represented in the consortium. This structure promotes mutual understanding, efficient communication, and alignment between research objectives and industry needs.

## Scientific Activities and Results

### Longline fisheries

During 2025, comparative field trials were undertaken to evaluate biodegradable materials against conventional synthetic materials (i.e., polyamide and polyester) in both coastal longline and autoline commercial fishing operations. During 2025, field trials were conducted to evaluate the performance of biodegradable materials compared to commonly used non-biodegradable materials (polyamide and polyester) in commercial coastal and deep-sea longline fishing operations.

### Trials in coastal longline fishery

In 2025, field trials were conducted onboard the commercial longline vessel “Vardøyfisk II”, building on previous results showing a potential for using biodegradable snood line materials in coastal longline fisheries in Norway and Croatia (see Cerbule et al., 2022 and 2023). The aim of this study was to compare performance of two different biodegradable plastic materials in snood lines when exposed to longer fishing period in terms of catch efficiency for cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). The performance of biodegradable materials in snood lines under commercial fishing conditions was tested during January–February and November–December, 2025 using materials supplied by S-EnPol and Norner AS. These materials were compared to standard 1.0 mm nylon snoods. The current preliminary results indicated that biodegradable snoods could achieve a similar fishing efficiency as longlines with nylon snoods. The results are important for understanding the technical feasibility of biodegradable snoods in commercial longline fisheries.

### Trials in deep-sea longline fishery

Field experiments were conducted onboard a deep-sea longline vessel “Loran”. The aim of these experiments was to evaluate the potential of using of biodegradable plastic material compared to conventional polyester snoods in deep-sea longline fisheries with respect to catch efficiency, snood loss, and mechanical properties. In addition, two biodegradable alternatives (cotton and wood-fibre based) were tested as potential substitutes for the nylon twine used to connect mainline sections. Our preliminary results indicate that bio-PES snoods could achieve a comparable fishing performance to polyester snoods for both cod and haddock. The probability of snood loss was low

(approximately 2%) across all material types, with no significant differences between bio-PES and polyester. These trials highlighted the need for standardized attachment methods and further long-term testing to evaluate durability under commercial conditions.

### **MV Vardøyfisk II**



**Off to sea to test biodegradable  
snoods in longline fishery.**

*Photo: SINTEF Ocean*

Field trials in 2025 were conducted onboard the commercial longline vessel Vardøyfisk II, building on previous experimental work. Two trial periods were carried out (January–February and November–December) to evaluate the performance of biodegradable snoods under commercial fishing conditions. Two different biodegradable monofilament materials were tested: PBSA supplied by S-EnPol (1.0 mm and 1.1 mm), and a 1.0 mm biodegradable monofilament developed by Norner AS. Standard 1.0 mm nylon snoods were used as reference. The PBSA snoods were tested in both periods to assess the effect of storage between fishing seasons, while the Norner material was tested in November – December. All experimental longline fleets were implemented in normal fishing operations, alternating biodegradable and nylon snoods to allow direct comparison of catch efficiency.

Results show that PBSA-based snoods achieved catch efficiency comparable to nylon for both cod and haddock in both trial periods. There was substantial overlap in catch rates and length distributions, and no systematic reduction in performance was observed. Importantly, storage of PBSA snoods between seasons did not result in measurable changes in catch efficiency, indicating operational stability over time. The Norner biodegradable snoods likewise showed strong overlap with nylon in terms of size selectivity and catch composition, suggesting that material substitution did not alter the size structure of the catch.



**The Autoline vessel Loran.**  
*Photo: SINTEF Ocean*

Overall, the results support the technical feasibility of biodegradable snoods in commercial longline fisheries, while highlighting specific material and design improvements to be addressed in future development work.

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**The automatic line-hauling system on board the Autoline vessel Loran.**  
*Photo: SINTEF Ocean*

Importantly, storage of PBSA snoods between seasons did not result in measurable changes in catch efficiency, indicating operational stability over time. The Norner biodegradable snoods likewise showed strong overlap with nylon in terms of size selectivity and catch composition, suggesting that material substitution did not alter the size structure of the catch.

Overall, the results support the technical feasibility of biodegradable snoods in commercial longline fisheries, while highlighting specific material and design improvements to be addressed in future development work.

### **MV Loran**

Field experiments were conducted onboard the Autoline vessel Loran to evaluate PBSAT as a biodegradable alternative to conventional polyester snoods in Autoline fisheries. The trials compared bio-PES and polyester with respect to catch efficiency, snood loss, mechanical properties (breaking strength and elongation). Two test magazines (2048 hooks in total) were integrated into ordinary fishing operations, with biodegradable and polyester snoods alternated under controlled conditions. In addition, two biodegradable alternatives (cotton and wood-fibre based) were tested as potential substitutes for the nylon twine used to connect mainline sections (i.e., 40-60 sections with 1000-1100 hooks in each).

Results indicate that bio-PES snoods achieved catch efficiency comparable to polyester for both cod and haddock. The probability of snood loss was low (approximately 2%) across all material types, with no significant differences between bio-PES and polyester.

Overall, the results support the technical feasibility of bio-PES as a replacement for polyester in Autoline fisheries, while highlighting the need for standardized attachment methods and further long-term testing to evaluate durability under commercial conditions.



Catch-efficiency tests onboard  
the coastal vessel Karoline.  
Photo: SINTEF Ocean

### Gillnets

Gillnet trials with biodegradable materials were continued onboard the commercial vessel Karoline, building on annual experiments conducted since 2016 (except for 2021–2023). Earlier trials (2016–2020) on species like cod, saithe (*Pollachius virens*) and Greenland halibut (*Reinhardtius hippoglossoides*) showed that biodegradable gillnets performed 10–20% lower than conventional nylon nets in terms of both catch numbers and fish size. Improved biodegradable cod gillnets were provided and tested during the 2024 and 2025 winter seasons.

Results from winter 2025 show that biodegradable nets caught approximately the same number of cod as nylon nets in both fleet configurations. In one fleet (0.7 mm twine), the biodegradable nets even caught slightly more fish by numbers. However, average fish size was consistently smaller in the biodegradable nets, resulting in lower total catch weight compared to nylon. The results therefore confirm comparable catch rates in terms of numbers, but differences in size distribution and economic value remains.

Differences in net colour (blue biodegradable vs green nylon) may have influenced visibility and catch dynamics under varying light conditions. At the same time, the reduced elasticity of biodegradable material likely contributes to lower retention of

the largest cod. No further gillnet trials are planned for 2026 due to lack of material supply despite recent results indicate a need for continued testing of improved material properties.

### Seine ropes

During 2024–2025, systematic documentation of wear and lifetime of conventional demersal seine ("flydragging"/Scottish seine) ropes were monitored on board the commercial vessel Fortuna. This represents the first structured logging of haul frequency, fishing conditions, and rope performance over time, providing a critical reference baseline for evaluating functional requirements and expected service lifetime of both conventional and future biodegradable alternatives. The crew recorded data on fishing area, seabed conditions, and haul duration for each haul. Rope diameter and elongation were regularly measured by Research Area 3 personnel from SINTEF.

After 268 hauls, the rope diameter had decreased from 58 mm to 48–49 mm. Measurements show a significant reduction in diameter during the first 20–40 hauls, primarily caused by stretching of the ropes, followed by gradual wear from seabed contact. The ropes are expected to remain operational throughout 2026. This data sampling is essential for understanding microplastic formation from demersal seine ropes and for establishing performance benchmarks necessary for the development of environmentally friendly alternatives.

⇒ [Langtidsmålinger av snurrevadtøi gir viktig forskningsgrunnlag | Dsolve](#)

Conventional demersal seine  
rope with steel core.  
Photo: SINTEF Ocean



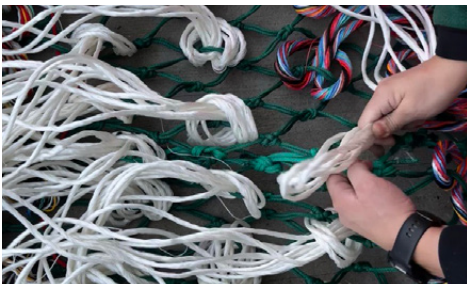
### Bottom trawling

During a five-week period in November 2025, a Master's student affiliated with RA3 conducted field trials onboard the commercial bottom trawler Hermes. The objective was to evaluate two biodegradable alternatives — cowhide and bio-based PES — as potential replacements for conventional monofilament PA/PE/PP "dolly ropes" used as chafing gear. Chafing gear protects the codend of a demersal trawl from abrasion and damage, thereby reducing gear wear and potential loss of fish. Vessel Hermes operates a twin-trawl system, and it was therefore possible to directly compare biodegradable materials and conventional "dolly ropes" within the same haul under identical fishing conditions. The test setup consisted of two chafing mats (52 × 52 meshes; 155 mm mesh size; double 5 mm PA braided twine; approx. size 7.5 m × 2.6 m during operation), onto which the different chafing materials were attached to the mat.

The trials showed that cowhide wore down significantly faster than conventional dolly ropes and is therefore considered unsuitable for use in this application. In contrast, the bio-PES material demonstrated high abrasion resistance with minimal visible wear, indicating promising suitability as an alternative chafing material. However, operational challenges were identified related to attachment methods, as the bio-PES fibres were relatively slippery and tended to loosen from knots during use. Further development should therefore focus on improved attachment while preserving the material's favorable abrasion properties.

The results are not yet available.

### ⇌ [MSC Student on Research voyage in the Barents Sea - Dsolve](#)



MSc student Martine Støversteen Johansen preparing a chafing mat with "dolly ropes" combined with bundles of biodegradable fibres for testing onboard the bottom trawler Hermes.  
*Photo: SINTEF Ocean*



Preparation of biodegradable chafing mat as potential replacements for conventional monofilament PA/PE/PP "dolly ropes".  
*Photo: SINTEF Ocean*

## Snow crab pots

Snow crab (*Chionoecetes opilio*) in the Norwegian sector of the Barents Sea is commonly captured using conical pots. During December 2024 we conducted experiments to evaluate whether use of escape gaps can reduce the bycatch of undersized crabs in this fishery onboard UiT research vessel “Helmer Hanssen” and commercial snow crab fishing vessel “Vima” (Opilio AS). The results showed that pots with escape gaps significantly reduced the capture of undersized crabs compared to pots that used only netting mesh selection. This result can be important for the commercial fishery, especially considering areas with larger abundances of small snow crabs, where improved size selection could result in reduced workload for catch sorting and potential crab mortality due to the associated handling.

Further work regarding development of biodegradable materials for producing escape gap plates is in progress. This would aim at reducing present levels of plastic pollution and potential continuous capture of snow crab (“ghost fishing”) in case of snow crab pot losses due to faster degradation of the material. In 2025, to estimate how the amount of lost gear can affect the ghost fishing rates in snow crab pot fishery, we conducted a study calculating different snow crab pot loss scenarios and associated economic implications. The results showed that given the substantial number of pots on snow crab fishing vessels, even small variations in ghost fishing pots could result in considerable differences in ghost fishing amounts and the associated environmental effects.

⇒ <https://linkinghub.elsevier.com/retrieve/pii/S016578362500253X>

⇒ [Escape gaps in snow crab pots can help reduce bycatch | Dsolve](#)

⇒ <https://www.nature.com/articles/s41598-025-99749-4>

⇒ <https://dsolve-sfi.no/en-ny-studie-fra-dsolve-setter-sokelys-pa-omfanget-av-spokelsesfiske-i-snokrabbefisket>

## Seaweed aquaculture

During laboratory trials were conducted in 2025 to evaluate biodegradable twines for use in seaweed aquaculture. Eight candidate materials (including cotton, nettle, wool, jute, viscose, and kuralon) were assessed for mechanical properties (breaking strength and elongation), biodegradability, and biological performance indicators such as seedling catchment, attachment, and early growth. The objective was to identify materials that are strong and flexible enough to withstand marine conditions, non-toxic to seedlings, commercially feasible, and capable of degrading before harvest (6–7 months), without degrading prematurely.

During laboratory tests we examined changes in strength and elongation over immersion time in seawater (up to 12.5 weeks). No consistent reduction in mechanical performance was observed during this period, although variability between materials was substantial. Cotton exhibited the highest tensile strength, while nettle was the weakest; wool showed the greatest elongation. Parallel biological assessments showed differences in seedling catchment and early growth, with further quantitative analysis ongoing.



Selected biodegradable twines were wrapped around standard carrier ropes and monitored for seedling development. After 37 days, cotton, viscose, and kuralon showed the most promising growth and density, while wool, nettle, and jute performed less well. No visible degradation was observed at this stage. Based on these results, the most promising materials will be tested in full-scale sea trials to evaluate biomass yield, holdfast transfer to carrier ropes, and degradation over a complete cultivation cycle.

Seedling string made from cotton (to the right), viscose (in the middle), and also wool, show promising results, and are among several materials to be tested further in Norwegian seaweed cultivation

*Photo: SINTEF*

∞ [Developing biodegradable seeding strings for a cleaner seaweed industry - Dsolve](#)

## Recruitment

Martine Støversten Johansen - The Faculty of Biosciences, Fisheries and Economics (BFE), Norwegian College of Fishery Science, UiT. Project period: 2025-2026.

This master's thesis focuses on evaluating the performance of dolly ropes made from biodegradable materials in comparison to those made from traditional plastics.

Tom-Erik Eilertsen - The Faculty of Biosciences, Fisheries and Economics (BFE), Norwegian College of Fishery Science, UiT. Project period: 2025-2026.

Thesis under RA5 (NORSUS) and the Directorate of Fisheries dedicated to analyses from retrieval operations from Greenland halibut gillnet fisheries.

Eirik Høybakk - The Faculty of Biosciences, Fisheries and Economics (BFE), Norwegian College of Fishery Science, UiT. Project period: 2025-2026.

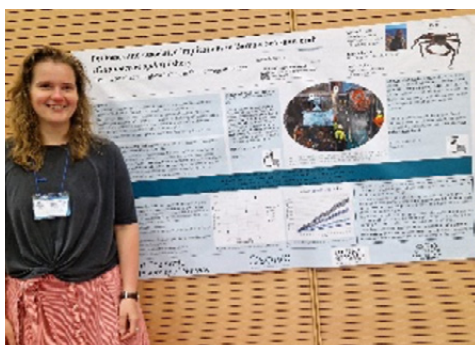
Thesis under RA5 (NORSUS) and dedicated to work on characterizing/modelling of local and global ghost fishing gears.

## Communications and dissemination activities

15<sup>th</sup> to 21<sup>st</sup> of May 2025, representatives from SINTEF Ocean and UiT participated in the ICES-FAO Working Group on Fishing Technology and Fish Behaviour (FTFB) meeting in Sicily, Italy, contributing to the topic group on Abandoned, Lost or Otherwise Discarded Fishing Gear (ALDFG). The topic group focused on reviewing and discussing gear designs and modifications aimed at preventing ghost fishing, improving gear stewardship through marking and tracking technologies, and supporting responsible handling of recovered and end-of-life fishing gear. Furthermore, several Dsolve members joined the ToR “Develop a guide that outlines essential safety requirements to prevent a loss of fishing gear”.

The project was represented through participation from Dsolve, including the presentation of two posters related to work in RA3: one addressing marine littering from longline fisheries and one focusing on fishing pots. The meeting provided an important platform for exchange with international experts and for situating project results within ongoing global efforts to reduce the impacts of ALDFG.

⇒ [Dsolve with strong presence at the ICES/FAO Annual Meeting in Italy - Dsolve](#)



RA3 were represented with two poster presentations at the ICES/FAO Working Group on Fishing Technology and Fish Behaviour (FTFB) meeting in Sicily, Italy – presented by Kristine Cerbule (t.l) and Anja Alvestad (t.r). An additional poster was presented by RA5.

*Photo: Dsolve*

In 2025, PhD candidate Anja Alvestad delivered a guest lecture titled “Practical use of biodegradable fishing gear” as part of the UiT master’s course FSK-3624 Marine Litter and Arctic Fisheries: Challenges and Solutions. The lecture presented results from fishing gear trials conducted within the Dsolve project and contributed to course discussions on the potential and limitations of biodegradable materials in fisheries. The activity supported knowledge transfer to graduate students and shared insights from ongoing project research and field-based experience.

During Lofotfishing 2025, Dsolve presented project results and showcased biodegradable materials in a dedicated panel discussion hosted at SALT’s premises in Svolvær. The event attracted a big audience and facilitated engaged discussions among industry representatives, researchers, and other stakeholders.

In June 2025, the project contributed to a roundtable session on plastics governance held at UiT The Arctic University of Norway as part of an intensive teaching week focused on marine pollution. The roundtable brought together researchers and students to discuss global and local dimensions of the plastics problem, with particular attention to governance, technology, equity, and implementation challenges in different sectors.

As part of this session, PhD student Anja Alvestad, delivered a short oral contribution titled "Development and testing of biodegradable gear for fisheries and aquaculture, and the challenges of implementation." The presentation aimed at project-related research and field experience from collaboration with commercial fisheries and industry partners. The session was discussion-based and facilitated exchange between researchers and participants on the role of applied research and innovation in addressing marine plastic pollution.

## Scientific publications

### Cerbule et al., 2025 - gillnets:

- ∞ [Comparison of fishing performance of biodegradable and nylon gillnets with different twine diameter - ScienceDirect](#)
- ∞ [Comparison of fishing performance of biodegradable and nylon gillnets with different twine diameter - Dsolve](#)

### Cerbule et al., 2025 - escape gaps:

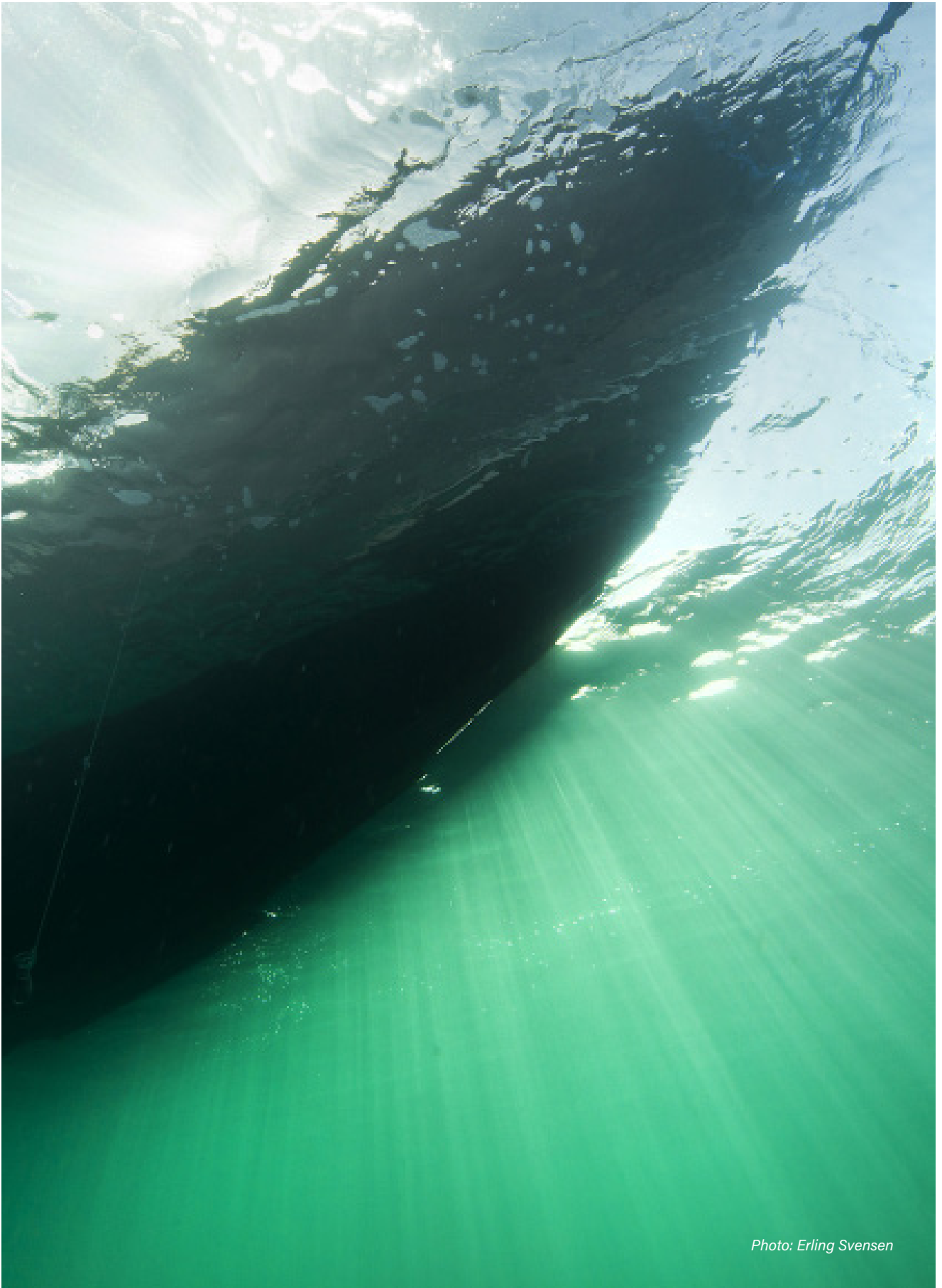
- ∞ [Use of escape gaps in Barents Sea snow crab \(\*Chionoecetes opilio\*\) fishery: Can it reduce bycatch of undersized crabs? - ScienceDirect](#)
- ∞ [Escape gaps in snow crab pots can help reduce bycatch - Dsolve](#)

### Cerbule et al., 2025 - pot losses:

- ∞ [Pot losses and associated implications in Barents Sea snow crab fishery | Scientific Reports](#)
- ∞ [New study estimates the extent of ghost fishing in the snow crab fishery - Dsolve](#)

From Vardø.  
Photo: SINTEF Ocean





*Photo: Erling Svensen*

## Objectives and motivation

The central objectives of Area 4 are to:

4.1 Assess economic effects of non-biodegradable materials used in fisheries and aquaculture.

4.2 Determine costs and benefits related to ecosystem services from introducing biodegradable materials in the fisheries and aquaculture industries.

4.3 Investigate institutional incentives to increase the use of biodegradable applications used in marine industries and help supporting the public support systems to reduce risk and promote implementation of biodegradable innovations.

The motivation for these objectives is to broaden our understanding of the consequences of non-biodegradable materials in fisheries and aquaculture to also include economic aspects. Furthermore, this work will provide input into how these consequences could be lessened by governance actions.

## Key research tasks

- Task 4.1 Economic effects of non-biodegradable materials used in fisheries and aquaculture.
- Task 4.2 Costs and benefits related to ecosystem services from introducing biodegradable materials in the fisheries and aquaculture industries.
- Task 4.3 Institutional incentives to increase the use of biodegradable applications used in marine industries and help supporting the public support systems to reduce risk and promote implementation of biodegradable innovations.

## Key research tasks in 2025

Research Area 4's research tasks are closely linked to the objectives. Early tasks have therefore focused on ghost fishing, as a central consequence of non-biodegradables in fisheries, specifically involving gathering relevant knowledge and data, especially to determine the costs of non-biodegradable fishing gear. Though some research regarding fisheries remains, with new personnel hired (a post doc and a PhD), the focus of Area 4 is gradually shifting over to plastics related to aquaculture:

- Finalise and publish papers on fisheries and plastics.
- Carry out survey of general public (funded by The Retailers Environmental Fund Handelens Miljøfond) on the willingness to accept compensation by fishers for using pay for management leading to use of biodegradable fishing gear.
- Develop scientific papers based on general public survey.
- Develop popular science article based on output from research.
- Literature review of plastic emissions in aquaculture.
- Develop survey of public willingness to pay for reduced microplastics in aquaculture.

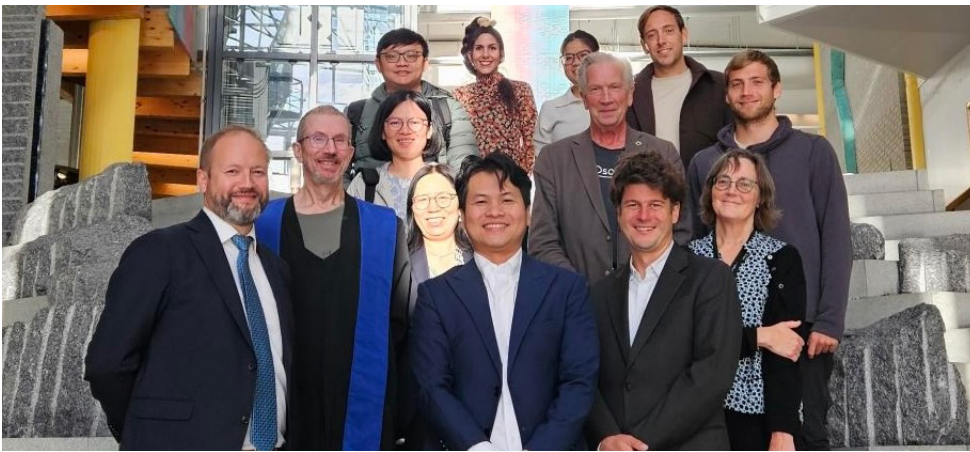
Responding to the underway evaluation RA4 and RA5 have started joint meetings to both inform about respective research and to identify research issues of common interest and relevance to the different members of the two RAs. This is also followed up in the joint PhD and PD meetings.

## Achievements in 2025

### Publications

#### Published and accepted papers

- ∞ [Bakke, Pham, Armstrong Norwegian aquaculture management and non-point source pollution. Aquaculture Economics and Management, 2025](#)
- ∞ [Do, H. L., & Cherry, T. L. \(2025\). Ghost fishing and the voluntary adoption of biodegradable gear. Resource and Energy Economics, Volume 84.](#)
- ∞ [Do, H. L., & Armstrong, C. W. \(2025\). Navigating transition: understanding fishers' perceptions of biodegradable fishing gear adoption. Journal of Environmental Economics and Policy, 1-18.](#)



Huu-Luat Do  
defended his  
PhD thesis at  
October 1<sup>st</sup> at UiT  
in Tromsø  
Photo: Dsolve

#### Presentations:

- Huu-Luat Do: PhD Defence, UiT The Arctic University of Norway, October 1<sup>st</sup>, 2025
  - Trial lecture:** "Leveraging social norms for more sustainable harvesting"
  - Thesis title:** "Economics of Ghost Fishing: Incentives, Behaviour and Management"
- Huu-Luat Do: "A bio-economic model of ghost fishing with an application to the Norwegian snow crab fishery" at the 26<sup>th</sup> BIOECON Conference in Cambridge September 1<sup>st</sup>-2<sup>nd</sup>, 2025.
- Huu-Luat Do: "Ghost fishing and the voluntary adoption of biodegradable gear" The International Conference on Economics, Law and Government (ELG 2025) Resilience, Sustainability and Digital Transformation in a Changing World: Perspectives from Southeast Asia. Ho Chi Minh City, Vietnam, August 1<sup>st</sup>-2<sup>nd</sup>, 2025.
- Erik Johannesen Bakke: "The Norwegian Traffic Light System's impact on non-point source pollution. Nordic Annual Environmental and Resource Economics (NAERE) Workshop, Copenhagen, Denmark, June 25<sup>th</sup>-26<sup>th</sup>, 2025.
- Huu-Luat Do: Refundable deposits and the adoption of biodegradable fishing gear: An experimental investigation. Nordic Annual Environmental and Resource Economics (NAERE) Workshop, Copenhagen, Denmark, June 25<sup>th</sup>-26<sup>th</sup>, 2025.

### Newspaper articles:

⇒ [Spøkelsesfiske koster – men vil fiskere bytte til bionedbrytbar redskap? | Fiskeribladet](#)

### Key researchers and personnel

Dag Standal

Claire Armstrong

Ngan Thi Thanh Le (post doc)

### PhD candidates and Master students at UiT

PhD student Huu-Luat Do

PhD student Erik Johannesen Bakke

### Some brief information from the published papers in 2025:

Do, H. L., & Cherry, T. L. (2025). Ghost fishing and the voluntary adoption of biodegradable gear. *Resource and Energy Economics*, Volume 84.  
⇒ <https://doi.org/10.1016/j.reseneeco.2025.101534>

This paper studies whether biodegradable fishing gear can be voluntarily adopted by commercial fishers when it may reduce catch efficiency—and therefore competitiveness. We run a survey experiment with Norwegian fishers (telephone survey, n=800) where the relative catch efficiency of biodegradable gear is randomly varied (equal, 20% less, 50% less). Fishers then choose whether they would adopt unconditionally, adopt conditionally (depending on what others do), or not adopt.

Results show strong baseline support when biodegradable gear performs like conventional gear: ~53% of fishers state they would adopt unconditionally if efficiency were equal. But willingness to adopt unconditionally falls sharply as efficiency declines (~22% at 20% less efficient; ~16% at 50% less efficient). At the same time, fishers increasingly shift toward conditional adoption, especially “I will adopt only if everyone adopts,” indicating a clear collective action/competitiveness channel: when unilateral adoption is costly, fishers want assurance that competitors face the same conditions.

The paper also documents motivations: environmental protection is the dominant reason among adopters, while economic/competitive concerns (catch efficiency, costs) dominate among non-adopters. Policy implications are that widespread transition is most plausible via a combination of (i) continued R&D to improve performance and (ii) policies that coordinate adoption and reduce competitive disadvantage (e.g., broad rollouts, incentives).



New Post Doc Ngan Thi Thanh Le.

Photo: UiT

Do, H. L., & Armstrong, C. W. (2025). Navigating transition: understanding fishers' perceptions of biodegradable fishing gear adoption. *Journal of Environmental Economics and Policy*, 1–18. <https://doi.org/10.1080/21606544.2025.2471112>

This paper investigates why acceptance remains a barrier to biodegradable fishing gear adoption, focusing on how fishers' views are shaped by economic incentives and behavioural factors. Using interviews with Norwegian fishers, the study unpacks the origins of opposition and the conditions under which fishers would be more willing to switch from conventional to biodegradable gear.

A core finding is that both incentive-based and behavioural drivers matter, but behavioural factors are especially influential: perceived social support/peer acceptance, beliefs about environmental benefits, and broader attitudes toward the transition strongly affect adoption intentions. At the same time, clear economic mechanisms remain central—fishers emphasize performance/efficiency, costs, and practical feasibility—so the transition is more likely when incentives align (e.g., support schemes) and performance uncertainty is reduced.

The policy message is that progress requires more than technology alone: adoption can be accelerated by combining (i) credible performance demonstration and development, (ii) economic support (e.g., subsidies or compensation), and (iii) measures that build social legitimacy and peer acceptance—so switching does not feel like a unilateral competitive sacrifice.

### **Some results from the general public survey**

To complement the fisher survey and provide an indication of broader societal preferences, we conducted a nationwide public survey on attitudes toward lost fishing gear and potential management responses in the snow crab fishery. The public survey was implemented as a discrete choice experiment (DCE) on management options to reduce impacts of ghost gear. Before respondents completed the choice cards, the questionnaire included a short set of attitudinal questions to document baseline concern about lost fishing gear and the perceived importance of taking strong action. These items provide useful context for how respondents approach the choice tasks and indicate whether the issue is viewed as salient.

Figure 3 summarizes responses to two such questions. Overall, respondents report high levels of concern about lost fishing gear, with most selecting at least moderately concerned and a substantial share selecting very or extremely concerned. A similar pattern is observed for the perceived importance of taking all possible measures: responses are concentrated in the higher categories, while only a small minority report low importance and relatively few select unsure. Together, these results suggest that respondents entered the choice tasks with a clear recognition of the problem and broad support for active management.

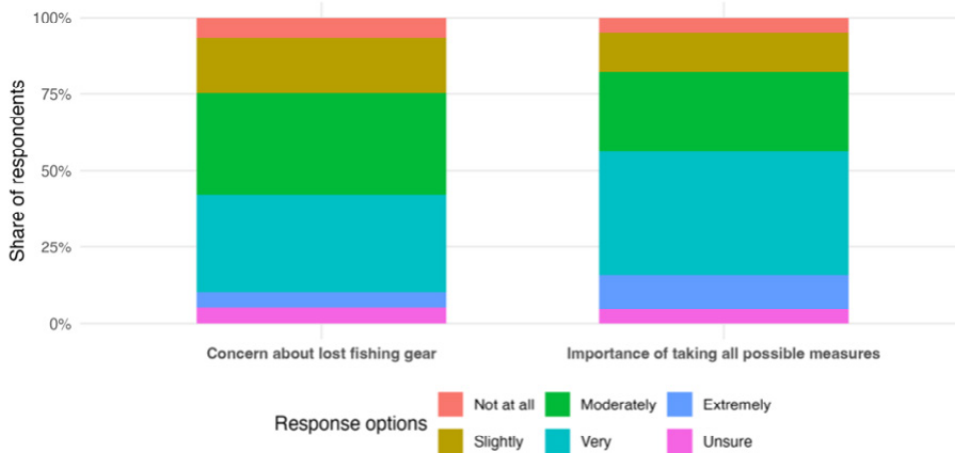


Figure 3: Distribution of responses to two attitude questions in the public survey: concern about lost fishing gear and the importance of taking all possible measures.

To support interpretation and policy relevance, the preference estimates from the choice cards were translated into annual willingness-to-pay (WTP) measures (Figure 4). WTP is expressed in Norwegian kroner per person per year and reflects the additional income tax respondents would be willing to pay annually (over the proposed policy period) to finance measures that reduce ghost fishing and related impacts in the snow crab fishery. The results indicate that respondents place substantially higher value on improvements in environmental quality related to reducing ghost fishing than on positive impacts on the snow crab stock. Annual WTP rises steeply as environmental quality improves—from NOK 246 for moving away from the poorest conditions to NOK 618 for a moderate improvement—and exceeds NOK 1,000 per person per year for good and very good environmental outcomes (NOK 1,051 and NOK 1,181, respectively). In contrast, willingness to pay for crab stock improvement is very small (NOK 12.9 per person per year), suggesting

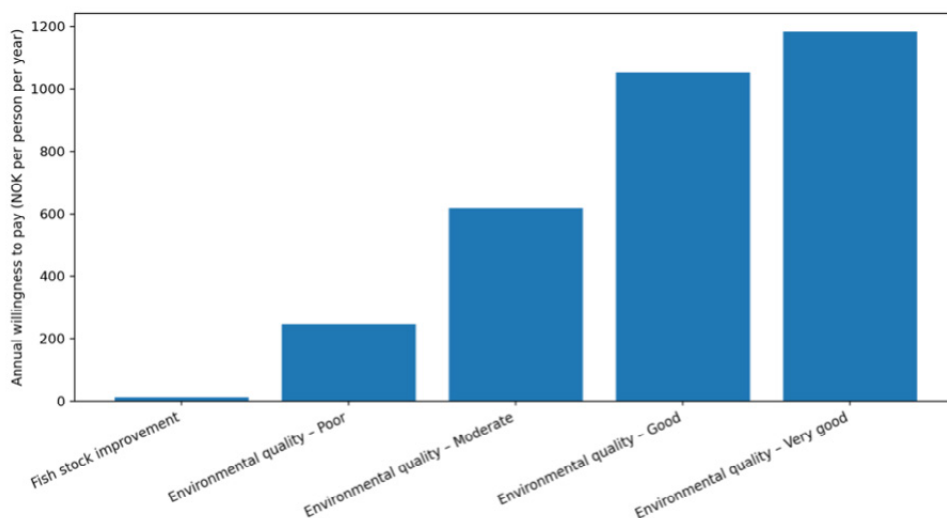


Figure 4: Annual willingness to pay (NOK/person/year) for crab stock improvement and environmental quality improvements in the snow crab fishery.

that the public primarily values policies that deliver direct environmental and animal welfare benefits rather than changes in crab stock levels. This of course may reflect the fact that the snow crab is an invasive species but nonetheless illustrates the general public's concern for distant natural environments that may be impacted by ghost fishing.

**Some initial results from the aquaculture and plastics literature review**

Kicking off Area 4's research into plastics in aquaculture, a literature review was carried out, giving an overview of this research the last 20 years. As can be seen from Figure 5, the research has gradually become more focused, with micro plastics especially entering into research on this topic after 2012.

Overall, most of the studies focus on microplastics, which account for approximately 80% of all studies.

Nano plastics are beginning to appear, but studies are limited by detection methods. Interestingly, macro plastics seem less studied, despite their visibility and relative ease of identification.

Publications are heavily concentrated on environmental science, with Marine Pollution Bulletin and Science of the Total Environment as leading journals, whereas aquaculture-focused journals, such as Aquaculture, contain relatively few studies.

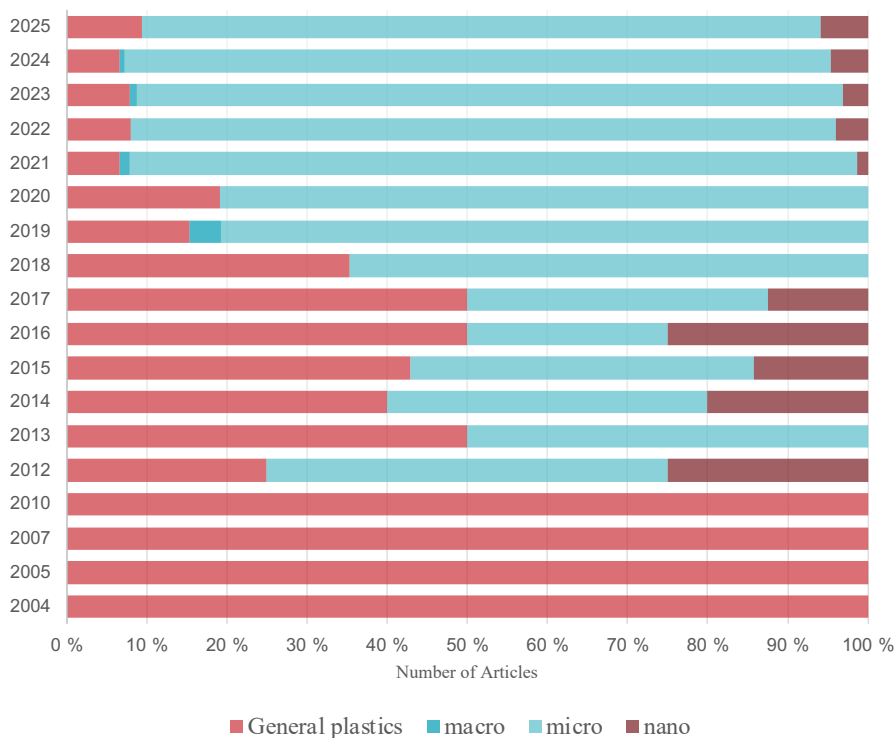


Figure 5: Annual published articles containing plastic size classes in aquaculture.

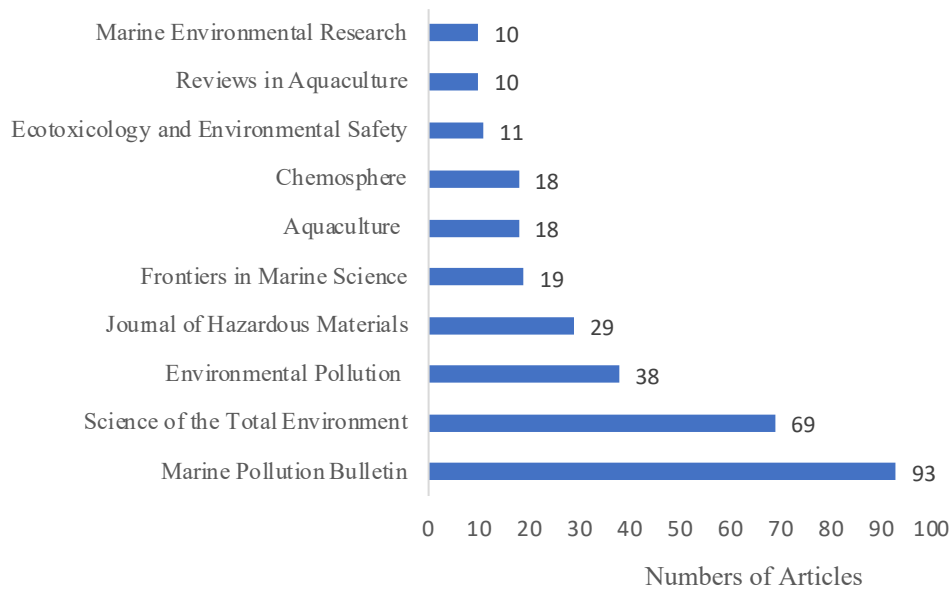


Figure 6: Top 10 Journals on Aquaculture and Plastics (2000-2025)

Geographically, China leads by far with 274 journal publications on the topic, as can be seen in Figure 7. European countries provide 110 of the journal publications in the dataset, with researchers in Norway publishing 11 of the publications.

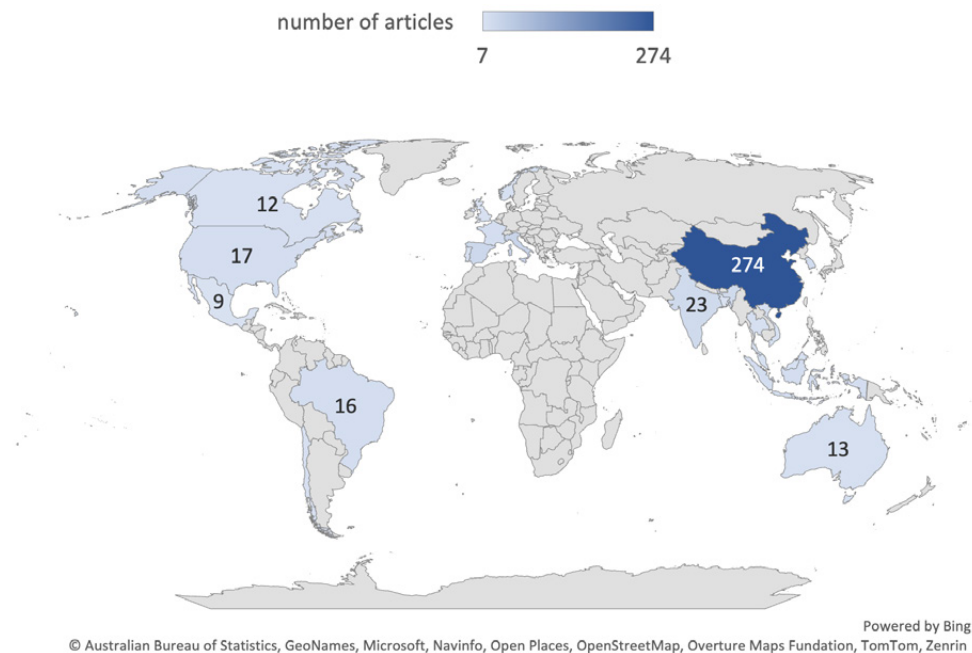


Figure 7: The number of Research Articles on Plastics and Aquaculture per Country (2000-2025)

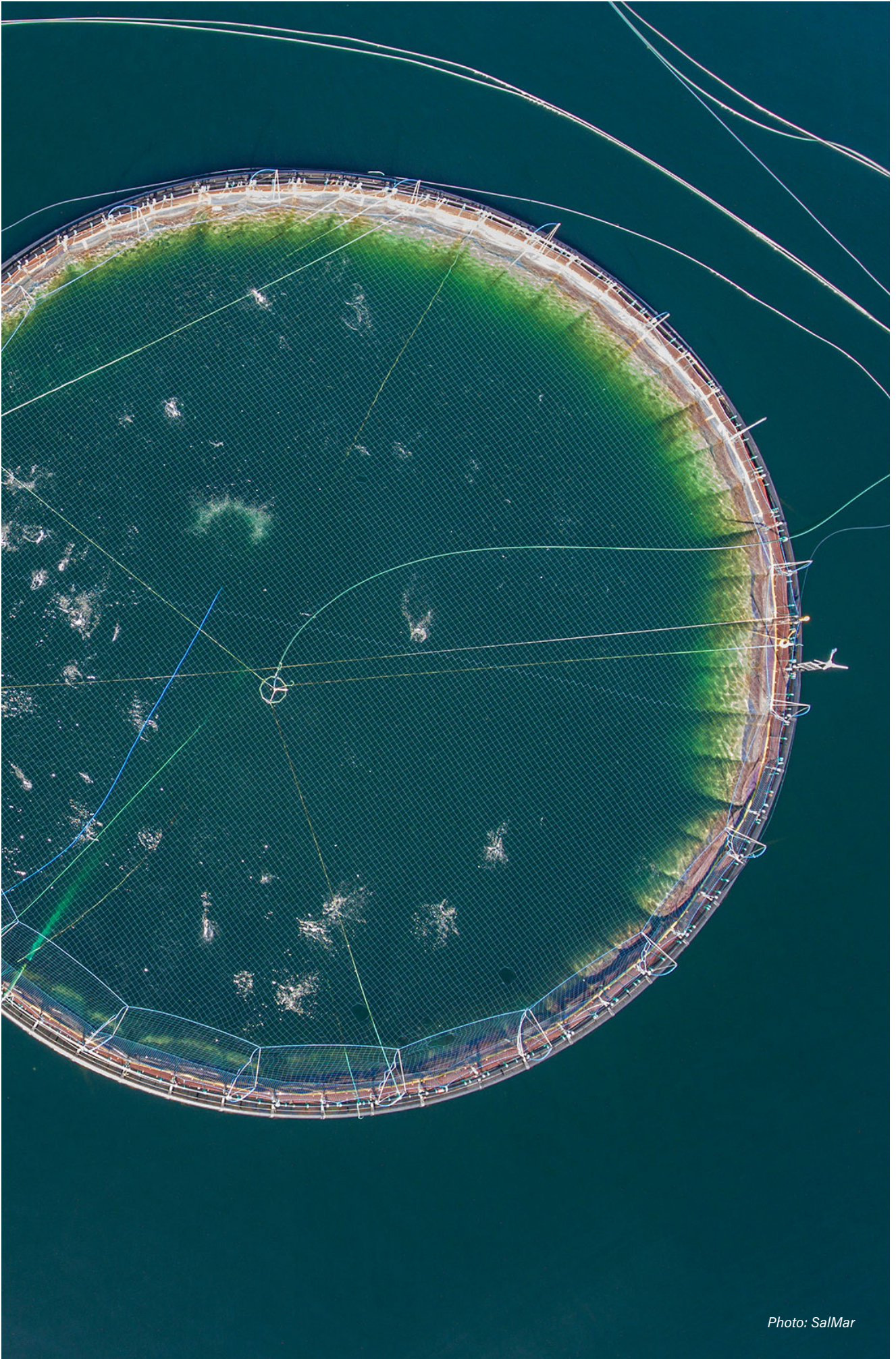


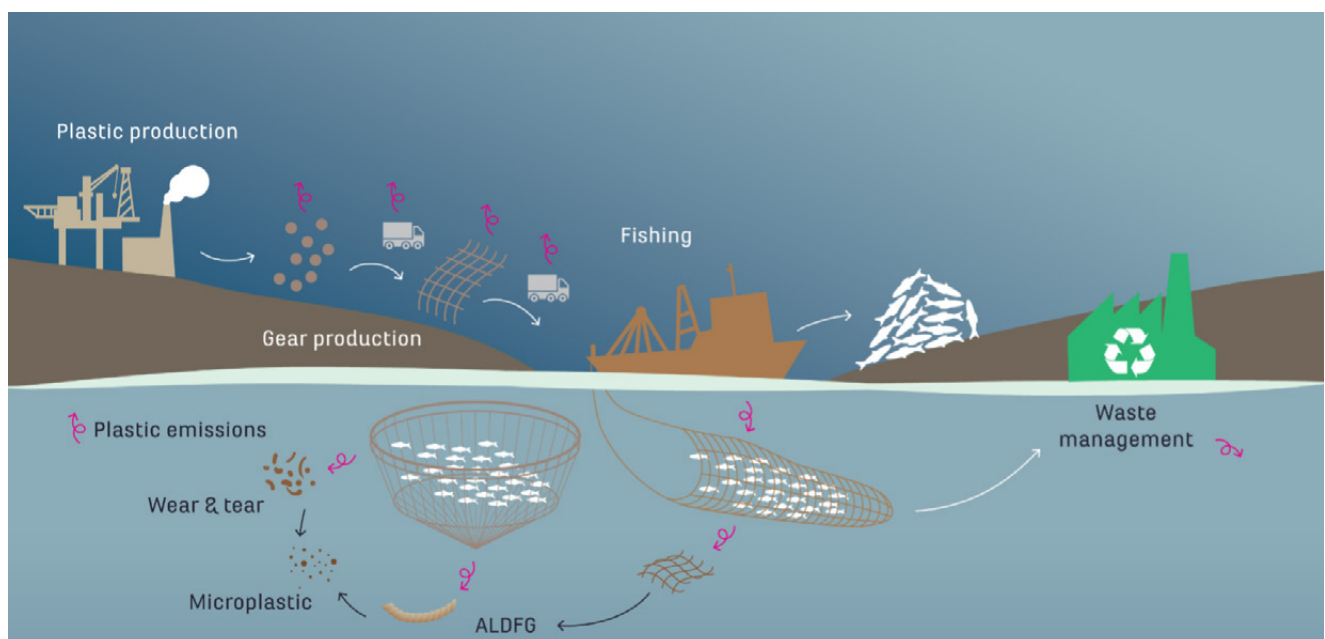
Photo: SalMar

### Objectives and motivation

Ghost fishing and plastic littering caused by losses of gear from fishing and aquaculture are environmental problems causing impacts on marine ecosystems. These impacts are only partially understood and due to the longevity and strength of this gear, these problems accumulate over time, meaning that the impacts from these losses are felt for the long lives of the durable materials they are made from.

Knowledge about the recyclability of the plastics used in field trials and developed in RA 1, alongside LCA-based sustainability information, will contribute to developing sustainable circular downstream solutions for existing fossil-based, non-degradable and future bio-based and biodegradable plastic fishing gear and aquaculture equipment will benefit the fishing and aquaculture industries and marine ecosystems.

Understanding key aspects of the value chains involved, analysed using life cycle assessment (LCA), will enable the value chain partners involved in Dsolve to understand the positive and negative impacts associated with different materials that can be used to develop innovative solutions to the ghost fishing challenge.



**Plastic emissions included in the Dsolve project environmental LCA (E-LCA) model**  
 (Concept and illustration a collaboration between Cecilia Askham, NORSUS and Natalie Borgersen Illustration & Design)

## Key research tasks

- Define the status quo for the material flow of fishing gears on a national and regional level to document the proportion of used fishing gear delivered for further processing and depositing, loss of mass due to wear, and both documented and undocumented loss of gear.
- Perform LCA assessments of specific fishing gear systems and materials, taking into account the entire value chain from production to end-of-life in order to:
  - Develop circular value chains
  - Enable increased and environmentally beneficial recycling
  - Assess the potential leak of plastics in the sea from both non-degradable and degradable plastics, and their potential environmental effects.
  - Provide information and new knowledge in order to achieve interactive processes for developing sustainable systems.
- Identify research gaps.
- Contribute to development of the LCA methodology to include plastic losses and marine litter, in collaboration with MarLCA (<https://marilca.org/>), as well as contribute to the UNEP Life Cycle Initiative GLAM (Global Guidance for Life Cycle Impact Assessment Indicators and Methods).

## Achievements for 2025

In 2025 Norner carried out successful recyclability trials for several materials. These materials included virgin resins used to produce nets, gillnet materials before (unused) and after field trials (collaboration with RA3). They shredded and washed the net materials, performed compounding and made test specimens by injection moulding. The properties of these specimens were then tested to see whether their properties had changed. The properties deemed most relevant to test the recycled materials suitability for future use as raw materials in a second life cycle were tested. The tests were successful and will be submitted in the form of a paper to a relevant, peer-reviewed scientific journal in 2026.

NORSUS has contributed to the Springer Handbook of Circular Plastics Economy. Our contributions are to the chapter Consideration of plastic emissions in life cycle assessments published online in 2025. The international writing team for this book chapter is Daniel Maga (Fraunhofer UMSICHT, Germany), Ian Vazquez-Rowe (Pontificia Universidad Católica del Perú, Peru), Francesca Verones (NTNU, Norway), Anne-Marie Boulay (Polytechnique Montreal, Canada), Elena Corella-Puertas (Polytechnique Montreal, Canada) and Cecilia Askham (NORSUS, Norway).

Work has progressed on a scientific paper to document the plastic impacts related



Photo: Norner Research

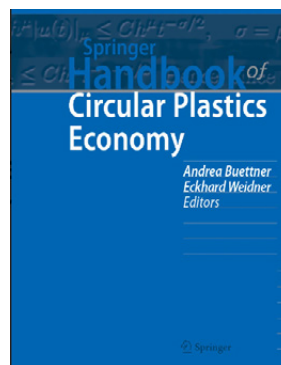


Photo: Ravindra Chowreddy, Norner Research

to conventional fishing gear, including the latest methodological developments to include impacts on the marine environment resulting from microplastic emissions to the marine environment resulting from abandoned, lost and discarded gear (ALDFG)

Dorian Vodopia's PhD work has progressed well in 2025, resulting in a second published paper "Ghost fishing catch estimates based on annual retrieval operations in Norwegian waters" in Fisheries Research.

RA5 has advertised and successfully recruited a PhD candidate to work on the theme "degradation of plastics in the Marine environment and their inclusion in life cycle impact assessment (LCIA)". The candidate will start working on their PhD in March 2026.



Website screenshot  
Springer Nature link

Nora Løvdal Gamnes completed her master's thesis work "Modelling Marine Ecotoxicity Impacts of Fishing Gear: A Case Study of the Norwegian Fishing Sector" and her master's programme at NTNU in 2025. She has since secured employment at NORSUS and joined the Dsolve CRI project team working on RA5. Her main focus in the autumn of 2025 and in 2026 will be writing a scientific paper based on further development of her master's thesis.



Screenshot NORSUS

In November Cecilia Askham presented "How can decision-makers weigh up plastic losses against climate change?" at NCMT - Norwegian Circular Materials Technology's Plastic and Composite conference 2025. This presentation covered how to include the impacts of plastic pollution in life cycle impact assessments, as well as fresh results from the CRI Dsolve project, where

recent assessments of cod fished with gillnets have incorporated plastic waste considerations. She also highlighted the significant amount of research still needed in this field.



Photo: Jon Hermansen

Valentina Pauna (NORSUS) has contributed to the peer-reviewed Plastic Footprint Network Guidelines Module on macroplastic – fishing gear published online in December 2025.



Screenshot from PFN module  
Macroplastic Fishing Gears  
2025

NORSUS researchers Cecilia Askham, Mafalda Silva and Valentina Pauna collaborated with other researchers involved in the Marine Litter Impacts in LCA project under the United Nations environment programme's (UNEP's) life cycle initiative on the paper Expanding Life Cycle Impact Assessment to account for marine plastic emissions: a case study for the fishing industry which was accepted for publication in 2025, but will appear in its published form in 2026 in the International Journal of Life Cycle Assessment.

The MarLLCA project encourages early-stage scientific collaboration to share knowledge and give input to each other's work. With this in mind, Nora Løvdal Gamnes presented her work in progress on the paper with the working title "Ecotoxicity impacts of plastic additives in fishing gear and implications for LCIA." Some good questions and comments from the MarLLCA Scientific committee will contribute to strengthening the work before it is submitted for review in a scientific journal in 2026.

The scientific activities and results performed in 2025 are listed below:

- Norner carried out recyclability trials for biodegradable materials pre- and post-field trials (collaboration with WA3 and NORSUS).
- Plastic Footprint Network Guidelines Module on macroplastic – fishing gear published in December 2025.
- Master's thesis Modelling Marine Ecotoxicity Impacts of Fishing Gear: A Case Study of the Norwegian Fishing Sector in June 2025.
- FORN220, Lecture: LCIA in Practice, plastics (Cecilia Askham, NORSUS), Norwegian University of Life Sciences (NMBU), April 2025.
- FSK-3624, Lecture: Life Cycle Assessment and Circularity of plastics (Cecilia Askham, NORSUS), The Arctic University, UiT, online, October 2025.
- «Hvordan skal beslutningstakere veie opp plast på avveie mot klimaendringer?» (translation: How can decision-makers weigh up plastic losses against climate change?) was presented by Cecilia Askham at NCMT's Plast- og komposittkonferansen 2025 (translation: the Plastics and Composite conference 2025) in Fredrikstad.
- Consideration of plastic emissions in life cycle assessments, published in the Springer Handbook of Circular Plastics Economy, June 2025
- RA5 leader Cecilia Askham contributed to the podcast Smart forklart – Kan nedbrytbar plast fungerer i oppdrettsnæringa? (translation: Can biodegradable plastic function in the aquaculture industry?)
- Review of weighting methods for life cycle impact assessment under GLAM was published in The International Journals of Life Cycle Assessment in December 2025. DOI: <https://doi.org/10.1007/s11367-025-02564-2>
- Ghost fishing catch estimates based on annual retrieval operations in Norwegian waters was published in Fisheries Research in December 2025. DOI: <https://doi.org/10.1016/j.fishres.2025.107599>
- Presentation of Ecotoxicity impacts of plastic additives in fishing gear and implications for LCIA to the MarLLCA Scientific Committee, online, December 2025.

## The PhD work in 2025

Dorian Vodopia completed his midterm evaluation in 2025, as well as all of the courses he needed to get the required amount of ECTS credits for his PhD. This year has also seen Dorian publish a peer-reviewed paper with the title “Ghost fishing catch estimates based on annual retrieval operations in Norwegian waters” in Fisheries Research (DOI: 10.1016/j.fishres.2025.107599). He has also contributed to Master student education at UiT in 2025. This has involved co-supervision of master’s student Tom Erik Eilertsen, developing the project plan and protocol and preparation for data collection for the 2025 ALDFG retrieval operation conducted in collaboration with the Norwegian Directorate of Fisheries. Dorian has also co-supervised Eirik Høgbakk in his Master’s work. Dorian’s Master student supervision has been under Centre leader Professor Roger Larsen’s mentorship.



Screenshot from CRI Dsolve`s website



Filming of a five-minute television segment for Croatian National Television (HRT).  
Photo: HRT

Dorian has worked on a paper with the working title “Global ghost fishing characterization model for derelict bottom set gillnets” will be submitted in 2025. This paper also includes a specific set of characterisation factors for the Norwegian marine environment, making the characterisation factors he has developed both globally and nationally applicable. These factors will enable the E-LCA model developed by NORSUS in RA5 to include ghost fishing effects of ALDFG. This work has been the main aim for Dorian’s PhD, so we are very excited about this development and keen to follow the peer-review process coming in 2026. Dorian has also been working on his paper related to fieldwork in Croatia in collaboration with the University of Split, “Ghost fishing impacts of gillnets and fish traps in the Northern Adriatic Sea”. In Croatia he has assisted Associate Professor Jure Brčić (University of Split) by scuba diving to monitor gillnet twine degradation in Brijuni, Croatia during the summer, 2025.

In addition to his own research, Dorian has also contributed work to a paper by Dr. Naiara Casagrande at the Marine Research and Environmental Risk lab (Marlab) at the Nova university, Lisbon, Portugal. This paper has the working title "Characterisation Factors of Plastic Additives Leaching to Aquatic Species from Ingested Plastic Particles."

Dorian Vodopia has also been very active in communicating and disseminating his PhD work and the work of Dsolve in 2025, including presenting "Ghost fishing impacts in Norwegian waters and the Northern Adriatic Sea" at the FTFB 2025 meeting in Sicily. Croatian national television also made a 5-minute segment in their programme featuring Dorian and Dsolve very prominently, including the importance of retrieval of lost and derelict gear from the ocean in both Norway and Croatia.

### **International Cooperation**

Cecilia Askham continues her work as co-chair of the weighting subtask under the UNEP LC-Initiative GLAM project. Valentina Pauna continues her co-chair role in the SETAC plastics interest group and will continue to contribute to the Plastic Footprint Network (PFN) concerning fishing and aquaculture littering.

The MarILCA project collaboration continues with participation by Valentina Pauna, Cecilia Askham and Dorian Vodopia. Nora Løvdaal Gamnes presented her Master's work and the concept for the scientific paper at the MarILCA Scientific Committee meeting in December 2025.

### **Communication and Dissemination Activities**

As shown in the previous scientific activities section, RA 5 work is being disseminated through peer-reviewed publications and conferences, as well as popular science articles on the Dsolve and NORSUS websites. The international collaboration arenas, such as the GLAM and MarILCA projects under the UN Life Cycle Initiative and SETAC plastic interest group, as well as the PFN, contribute to using the forefront of LCA methodology research in the Dsolve work. The Dsolve work is also disseminated in these fora and thus contributes to moving the research forward internationally. The PhD work on including Ghost fishing in life cycle impact assessment has contributed to several, international communication opportunities. However, we aim to increase our popular science publications in 2026, as we could improve our efforts in this area.

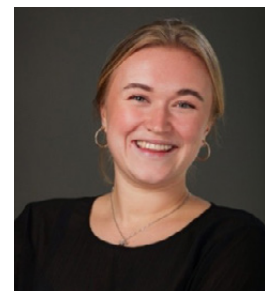
As previously, Dorian Vodopia has communicated his research (popular science communication, public dissemination, and seminar activities at regional universities) in 2025. Some of this communication activity took place in Croatia, as well as Norway.

NORSUS is keeping up our focus on publishing the work done in Dsolve in scientific peer-reviewed journals, this contributes to addressing the evaluation panel feedback. RA5 aims to increase popular science output by linking a popular science publication to every scientific paper, a goal achieved in 2025, however we need to do more, and NORSUS' Communications Advisor (with journalism experience) is helping to enhance this output. Nora Løvdal Gamnes, who completed her master's thesis associated with Dsolve in 2025, is currently working on producing a scientific paper and a popular science article in 2026. NORSUS has also collaborated to define a master's project for a student in collaboration with Salmar and we are hopeful that a student will apply for this in 2026. NORSUS' innovation focus in the Dsolve CRI is on methodological innovation and supporting the other RAs with sustainability information, fostering sustainable innovation in collaboration with other RAs. In 2025, these methodological innovations were shown in the papers published on ghost fishing (Vodopia et al. 2025) and the inclusion of plastic emissions in life cycle assessment (Maga et al. 2025), as well as participation in the MarILCA scientific committee, SETAC plastic interest group and the plastic footprint network. A PhD student recruited in 2025 will collaborate closely with NORSUS and UiT, contributing to increased mobility. RA5 actively pursued a spin-off proposal for educational collaboration and internationalisation in 2025, which was not successful, but feedback will inform a revised proposal in 2026. The team has updated the Dsolve website and other communications to reflect project developments in line with the evaluation panel's suggestions.



Litter sorting following a beach cleanup operation, conducted during September 2025 as part of FSK-3624 (Marine litter and Arctic fisheries: Challenges and Solutions), UiT  
 Photo: Dorian Vodopia

## Key researchers



From the left: Cecilia Askham, Valentina Pauna, Dorian Vodopia, Mafalda Silva and Nora Løvdal Gamnes.

Photos: NORSUS

## Objectives and motivation

Research Area 6 (RA6) will develop and carry out a dynamic plan for outreach through communication, dissemination and exploitation of results to maximize the impact of the CRI. Dialogue with affected industries and stakeholders through seminars, workshops, and networking is particularly emphasized. Further dissemination will be through a publicly accessible website <https://dsolve-CRI.no/> and social media, as well as publications in specialized journals and magazines, presentations, press releases, popular science publications, podcasts, video and other media productions. The Research Area is led by UiT and carried out in cooperation with Salt Lofoten AS (SALT).

The results of CRI Dsolve will provide valuable scientific knowledge on biodegradable products necessary for the sustainable, circular economy. The work undertaken by Dsolve is essential for advancing the research, innovation, documentation and design of these novel products. The resulting innovations will be important to enhance Norway's leading position in global fishery and aquaculture and reflect its ambition to be at the forefront of research and innovation on marine plastic pollution.

Through the activities in RA6, the CRI has adopted a comprehensive communication approach, aimed at maximizing the visibility of the Centre, its goals, challenges and results. The communication agenda aims to make the results visible to stakeholders, including the industrial and the scientific community, authorities, policy makers, and the public. The concrete objectives of RA 6 can be described as:

- Develop and apply actions to maximize the impact of CRI research.
- Ensure a wide dissemination and uptake of results for the CRI.
- Ensure a close relationship between the academic community and industrial partners and facilitate the exploitation of results and the transfer of technology.

A dynamic dissemination and exploitation plan (DEP) was developed in a preliminary phase of the CRI and is regularly updated throughout the Centre's life span. The main communication activities for each year are described in the respective annual plans and publication plans, including a) the participation in conferences, trade-fairs and in national and international exhibitions; b) specifications about the promotion channels to be used; c) timing for outreach activities and raising awareness of the results, and d) partners responsible for the various activities. An updated implementation plan for the period up to and including 2027 was presented for the evaluation panel by September 2024, addressing previous feedback from the EAB (2023) on communication, and form the basis for the annual plan of 2025. This includes 5 annual digital Partner Workshops to improve communication and knowledge sharing within the consortium, continuously publication online and on social media, as well as 1-2 webinars and events aimed at industry actors, manufacturers and suppliers, research and academia, authorities and decision-makers, and environmental stakeholders.

The main action points in the evaluation are further addressed as following; website and social traffic are being monitored as described below and a new Comm/Diss tracking system is developed and implemented in 2025 to monitor outreach toward target groups, we continue to engage with social media through a dedicated social media publishing plan, and the focus on contributing to articles in industry-relevant publications and magazines is increased. As the focus on policy briefs is expected to increase in the last half of the project period, RA6 will contribute to the dissemination of policy briefs through press releases and other relevant activities.

The key research tasks for RA 6 and achievements in 2025 are presented below.

### **Key Research tasks**

- Dissemination
- Communication
- Exploitation of results

### **Achievements for 2025**

#### **Dissemination Activities**

- Communication & Dissemination Plan 2021-2028
- Social media strategy/publication plan, and annual plan 2025
- Newsletters
- Web site and social media updates

The CRI website has been continuously updated and developed throughout 2025, with news from the Centre and research results continuously published on the site, with both scientific and popular science articles. A total of four newsletters has been produced and distributed in both Norwegian and English language, with the possibility to sign up on the CRI website. The newsletters contain updates on the work and progress of the CRI. A social media strategy and publication plan have been carried out, with news from the Centre activities published on Facebook and LinkedIn continuously throughout the year. Social media publications have been targeted towards industry stakeholders, as well as the scientific community, and the public. In addition to Dsolve`s own social media channels, selected news has been shared in relevant Facebook groups for fishers and industry. Partners are tagged in social media posts for sharing and audience building, and posts boosted when relevant. Social media reach is monitored through the Facebook and LinkedIn insight systems, while the website traffic is monitored using the subscribed monitoring system Plausible. In addition, an internal comm/diss tracking routine is developed and carried out in 2025 for the registration of dissemination and communication activities carried out by the research partners.

## Communication activities

- Social media (SoMe) and web production; Facebook, LinkedIn
- Podcast
- Popular science articles
- Media contact and press releases
- Partner workshops
- Fact sheet and flyers

Social media content, such as videos, news reports from the project, updates from research activities and field trials, meetings and events, is produced continuously throughout 2025, and published on Facebook and LinkedIn (see above). A total of five partner workshops has been organized throughout the year and hosted by the respective research areas RA1 – RA5. These digital partner workshops invite everyone involved in the project, both research- and industry partners, nationally as well as internationally, to join for regular research updates and discussions.

CRI Dsolve launched a new [podcast episode](#) at the trade fair Aqua-Nor in August. The podcast, produced by research partner Sintef in their series “Smart forklart”, includes representatives from RA2 and RA5 in addition to Centre leader and Industry partner SalMar ASA, discussing the topic “Can biodegradable plastic work in the aquaculture industry?” By the beginning of December, the episode was downloaded more than 3000 times, and in addition, a popular science article summarizing the podcast was published on the Dsolve website by the end of the year. A promotion video for the podcast was produced and showed on screen during Aqua-Nor at the Sintef stand and shared in Dsolve- and Sintefs respective social media channels, with several thousand views.

Further a popular science article discussing fishermen’s adaption of biodegradable fishing gear is published in [forskning.no](#) in 2025, in cooperation with RA 4. In addition, several research-publications and summaries are shared on the CRI website and social media throughout the year. Fact sheets, flyers and other info-material are produced when needed for promotion of CRI Dsolve on conferences and events.



Director of the Norwegian Directorate of Fisheries Mr. Frank Bakke-Jensen was amongst the participants in the panel discussion hosted by CRI Dsolve during Lofotfishing.

*Photo: SALT*

## Exploitation of results

- Annual Report 2024
- News articles
- Research Summaries (popular science)
- Conferences and events

Results from the CRI have been presented by research partners (RA1- RA5), and the centre leader, at several national or international conferences, meetings, workshops and events in 2025, and disseminated on the Dsolve website. Additional news articles presenting results of the CRI have been continuously produced and published on the Dsolve website and social media throughout the year, including research summaries of scientific articles made for popular science purposes. RA 6 has further been responsible for summarizing the Dsolve annual report.



*Photo: Screenshot from the Dsolve promotion video at Aqua-Nor*

An open evening seminar was organized in cooperation with The Norwegian Fishermen's Association during the trade fair Lofotfishing in March, discussing a.o.t the topic "Are the fishing gears of the future biodegradable?" The seminar gathered around 60 participants, including several stakeholders- and authority representatives. The Dsolve Industry partners Mustad Autoline and the the director of the Norwegian Directorate of Fisheries Mr. Frank Bakke-Jensen participated in the panel discussion, which was led by the Fishermen's Association. Outcomes of the CRI towards the aquaculture industry were discussed in a podcast launched and promoted at the trade fair Aqua-Nor, as described above. Samples of biodegradable fishing gear were further demonstrated by RA 3 at the annual meeting of the sales organisation Norges Råfisklag in Tromsø 13<sup>th</sup>-14<sup>th</sup>. in cooperation with RA6. The annual meeting gathers fisher representatives from several fishermen associations.

The various conferences and events where Dsolve have been presented throughout the year are further described in the reporting of each research area (RA1-RA5), and in the report summary.

## Some of our Dissemination activities in 2025

### Annual Meeting Norges Råfisklag

Sintef Ocean researcher Jørgen Vollstad (RA3) met with fishermen and key industry representatives to showcase biodegradable fishing gear at the Annual Meeting of Norges Råfisklag in Tromsø on May 13<sup>th</sup>-14<sup>th</sup>. Vollstad, who leads Sintef's work on testing biodegradable fishing gear at sea, showcased material samples – including biodegradable gillnets, and shared insights into the latest research developments and hands-on experiences from field trials. The audience showed strong interest in the development of new fishing gear solutions, contributing valuable feedback and insightful questions to the ongoing project.



Photo: Norges Råfisklag

### Course focusing on impacts from marine littering

For the second year in a row, UiT the Arctic University of Norway invited students to the master's course FSK-3624 Marine Litter and Arctic Fisheries: [Challenges and Solutions to increase knowledge about marine pollution](#). This year, 18 students participated in the course, which also included a two-day beach clean-up along Rebbenesøya in Troms in September. Several Dsolve partners, including RA6, contributed with lectures as a part of the course.



To the left: A large section of a bottom trawl deep into the soil.

To the right: Students sorting bottles, containers, boxes, floats, boots, etc. found at the beach clean-up, as part of the course.

Photos: Roger B. Larsen, UiT

### Podcast

How can plastic waste in aquaculture be reduced, without compromising operations, safety, or the environment? This was discussed in a new episode of the podcast series "Smart forklart" (Sintef), launched at the trade fair Aqua-Nor August 18th.

### Seminar during Lofotfishing

Are the fishing gears of the future biodegradable? RA6, together with the Norwegian Fishermen's Association, gathered around 60 participants for an evening debate seminar during the trade fair Lofotfishing 20<sup>th</sup> of March - including several industry stakeholders and authority representatives.



# Personnel

## Key Researchers

NAME	INSTITUTION	MAIN RESEARCH AREA
Roger B. Larsen	UiT	Centre leader
Claire Armstrong	UiT	Leader RA 4. Bioeconomic modelling
Hilde Rødås Johnsen	UiT	Leader RA 6
Valentina Pauna	UIT/NORSUS	Research Coordinator
Ravindra Reddy Chowreddy	Norner Research AS	Leader RA 1
Vihn Cao	Norner Research AS	Polymer rheology (RA1)
Siw Fredriksen	Norner Research AS	Sustainable feedstocks and bioplastics (RA1)
Hany Anwar	Norner Research AS	Polymer modifications, additives (RA1)
Christian Karl	SINTEF Industry	Leader RA 2. Materials and nanotechnology, polymer and composite materials, degradation of polymers, friction and wear, microplastics
Stephan Kubowicz	SINTEF Industry	Microplastics/polymer characterization
Anna-Maria Persson	SINTEF Industry	Polymer characterization (RA 2)
Bjørnar Arstad	SINTEF Industry	Polymer characterization (RA 2)
Szymon Bernat	SINTEF Industry	Polymer characterization (RA 2)
Lisbet Sørensen	SINTEF Ocean	Analytical chemistry (RA 3)
Amaia Igartua	SINTEF Ocean	Environmental chemistry (RA 3)
Sigrid Hakvåg	SINTEF Ocean	Microbial biodegradation and microbiome analyses (RA3)
Heidi Moe Føre	SINTEF Ocean	Structural engineering (RA 3)
Dag Standal	SINTEF Ocean	Governance (RA4)
Cecilia Askham	NORSUS	Leader RA 5, Board member (from August 2025)
Mafalda Silva	NORSUS	RA 5
Nora Løvdal Gamnes	NORSUS	RA5
Ellen-Marie Forsberg	NORSUS	Board member (until July 2025)
Francesca Verones	NTNU	Supervision RA 5
Jørgen Vollstad	SINTEF Ocean	Leader RA 3, Fishing gear
Ludvig Kraag	DTU Aqua	Fishing Gear
Esther Savina	DTU Aqua	Fishing Gear, Gillnets
Rikke P. Frandsen	DTU Aqua	Fishing Gear/Fisheries
Jure Brčić	University of Split	Fishing Gear/Fisheries
Mirela Petrić	University of Split	Fishing Gear/Fisheries
Željka Trumbić	University of Split	Fishing Gear/Fisheries
Svjetlana Krstulović Šifner	University of Split	Fishing Gear/Fisheries
Juan Santos	Thünen Institute	Fishing Gear Technology
Daniel Stepputtis	Thünen Institute	Fishing Gear Technology

## Key Personell

NAME	INSTITUTION	MAIN RESEARCH AREA
Ulf Böttcher	Thünen Institute	Fishing Gear Technology
Hanne Risan Johnsen	UiT	Administration
Terje E. Martinussen		Leader of the board
Terje M. Aspen	UiT	Faculty BFE director, Board member
Ivan Tatone	UiT	Technician, RA 3
Ilmar Brinkhof	UiT	Technician, RA 3
Thor Kamfjord	Norner Research	Board member
Ole Jan Mhyre	Norner Research	Advisor, Technical support
Valeriya Føreland	Norner Research	Administration support
Sveinung Aasetre	Norner Research	Senior Engineer, Compounding and injection molding
Heidi Houghton	Norner Research	Senior Engineer, Mechanical testing
Ingeborg Paus Wik	Norner Research	Senior Engineer, Thermal analysis
Bård Wathne Tveiten	SINTEF Ocean	Board member
Einar Hinrichsen	SINTEF Industry	Board member
Niclas Risvoll	SALT (subcontractor)	Web and graphics RA 6
Anders Balteskard	SALT (subcontractor)	Web and graphics RA 6
Vilde Sørnes Solbakken	SALT (subcontractor)	Communication and outreach RA 6
Helene Skjeie Thorstensen	SALT (subcontractor)	Communication and outreach RA 6
Tomas Brage	SALT (subcontractor)	Communication and outreach RA 6
Malin Jacob	SALT (subcontractor)	Communication and outreach RA 6
Terje Lindal	Mørenot	Fishing gear supplier
Gunnar Kupa	NOFI	Fishing gear supplier
Olav Småbakk	NOFI	Fishing gear supplier
Stig-Endre Elvevoll	Løvold	Gear supplier. Innovation Board
Rune Sand	Tustern	Fisheries
Ståle Dyb	Loran	Fisheries
Sigve Drønen	Opilio	Fisheries
Arne Birkeland	Opilio	Fisheries
Mikal Solhaug	M. Solhaug	Fisheries
Kristian J. K. Kalgraff	Legøy Rederi	Fisheries
Signor Antonsen	Hermes	Fisheries
Jan Roger Lerbukt	Hermes	Fisheries
Åsmund Breivik	Hermes	Fisheries
Brynjar Bangsund	Østkapp	Fisheries
Øystein Enoksen	Vardøyfisk II	Fisheries
Rita Karlsen	BR Karlsen	Fisheries and aquaculture
Randi Karlsen	BR Karlsen	Fisheries and aquaculture
Håvard Olsen	Kvarøy Fiskeoppdrett	Aquaculture
Alf Jostein Skjærvik	SalMar ASA	Aquaculture

## Key Personell

NAME	INSTITUTION	MAIN RESEARCH AREA
Maria Sparboe	SalMar ASA	Aquaculture
Maria Pettersvik Arvnes	The Norwegian Fishermen's Association	RA 6, End users
Benedicte Nielsen	The Norwegian Fishermen's Sales Organisation	RA 6, End users
Thor Kalsaas	The Norwegian Fishermen's Sales Organisation	RA 6, End users
Gunn Norvik	The Norwegian Fishermen's Sales Organisation	RA 6, End users
Lisbeth Drotz	The Norwegian Fishermen's Sales Organisation	RA 6, End users
Aida Campos	IPMA, Portugal	International Advisory Board
Haraldur Einarsson	Marine & Freshwater Research Institute, Iceland	International Advisory Board
Paul Winger	Marine Institute, Memorial University of Newfoundland, Canada	International Advisory Board
Gjermund Langedal	Fiskeridirektoratet	External Advisory Board
Anne Katrin Normann	Senter for Hav og Arktis	External Advisory Board
Bent Gabrielsen	Øra	Fisheries. Innovation Board
Lasse Rindahl	Mustad Autoline	Innovation Board
Jahn N. Hoel	Mustad Autoline	Innovation Board
Jake Chang	LG Chem	Bio-Business development
Ryan Yoon LG Chem Bio-Business development	LG Chem	Bio-Business development
Kim Sei-Hoon	S-EnPol Company	Biodegradable Polymer R&D

*PhD candidates with financial support from the Centre budget in 2025*

NAME	NATIONALITY	PERIOD	SEX M/F	TOPIC
Huu-Luat Do	Vietnamese	2021-2025	M	RA4. Modeling social costs and optimal management of ghost fishing.
Dorian Vodopia	Croatian	2023-2027	M	RA5. Inclusion of ghost fishing and its effects on ecosystems and biodiversity in life cycle impact assessment (LCIA).
Waranya Wataniyakun	Thai	2022-2026	F	RA 2. Marine biodegradation of polymers used for fishing gear.
Anja Alvestad	Norwegian	2023-2027	F	RA3. Performance and mechanical properties of biodegradable fishing gear compared to traditional plastics.
Erik Johannesen Bakke	Norwegian	2025-2029	M	RA4. Environmental and socio-economic consequences of microplastic emissions from aquaculture.

*MSc students*

Name	Period	Sex M/F	Topic
Nora Løvdal Gamnes	2024 - 2025	F	Mapping additives in plastic components of conventional fishing gear to learn how they affect the marine environment.
Martine Støversteen Johansen	2025 - 2026	F	Evaluating the performance of dolly ropes made from biodegradable materials in comparison to those made from traditional plastics.
Eirik Høybakk	2025-2026	M	Characterizing/ modelling of local and global ghost fishing gears.
Tom-Erik Eilertsen	2025-2026	M	Analyses from retrieval operations from Greenland halibut gillnet fisheries

*Post docs*

Name	Period	Sex M/F	Topic
Ngan Thi Thanh Le	2025-	F	RA. 4. Assessing governance incentives to adopt sustainable practices and reduce plastic pollution, with particular attention to aquaculture technologies.

## Accounts

<b>Funding (1000 NOK)</b>	<b>Amount</b>
The Research Council of Norway	16562
The host institution, UiT	8515
Research partners	1258
Industry partners*	9656
Organisational partners	132
<b>Total</b>	<b>36123</b>

<b>Costs (1000 NOK)</b>	<b>Amount</b>
The host institution, UiT	13616
Research partners	12719
Industry partners	646
Organisational partners	132
Equipment	9010
<b>Total</b>	<b>36123</b>

\* Øra AS, Tustern AS, Hermes AS, Opilio AS, Loran AS, Kvarøy fiskeoppdrett AS, Nofi Tromsø, Mørenot Fishery AS, Løvold AS, S-EnPol, SalMar



Photo: Erling Svensen

# Publications 2025

## Scientific publications

Askham, C., Arendt, R., Bachmann, L., Dias, L.C., Amadei, A., Scherer, L., Qian, H., Rupcic, L., Steen, B., Santos, J., Motoshita, M., Telles do Carmo, B.B., Bjørn, A., Yokoi, R., Laurent, A., Sala, S., Miebs, G., Koffler, C., Cinelli, M. Review of weighting methods for life cycle impact assessment under GLAM. *The International Journal of Life Cycle Assessment*, Springer Nature. <https://doi.org/10.1007/s11367-025-02564-2>

Bakke, E.J., Pham, T.T.T., Armstrong, C.W. Norwegian aquaculture management and non-point source pollution. *Aquaculture Economics & Management*. <https://doi.org/10.1080/13657305.2025.2602481>

Cerbule, K., Larsen, R.B., Arya-Schmidt, T., Winger, P.D., Tatone, I., Langedal, G. Use of escape gaps in Barents Sea snow crab (*Chionoecetes opilio*) fishery: Can it reduce bycatch of undersized crabs? *Fisheries Research*. <https://doi.org/10.1016/j.fishres.2025.107516>

Cerbule, K., Larsen, R.B., Vollstad, J., Alvestad, A.H. Comparison of fishing performance of biodegradable and nylon gillnets with different twine diameter. *Regional Studies in Marine science*. <https://doi.org/10.1016/j.rsma.2025.104247>

Cerbule, K., Larsen, R.B., Rijkure, A. Pot losses and associated implications in Barents Sea snow crab fishery. *Springer Nature*. Article number: 14961 (2025) <https://www.nature.com/articles/s41598-025-99749-4>

Do, H. L., & Cherry, T. L. (2025). Ghost fishing and the voluntary adoption of biodegradable gear. *Resource and Energy Economics*, Volume 84. <https://doi.org/10.1016/j.reseneeco.2025.101534>

Do, H. L., & Armstrong, C. W. (2025). Navigating transition: understanding fishers' perceptions of biodegradable fishing gear adoption. *Journal of Environmental Economics and Policy*, 1–18. <https://doi.org/10.1080/21606544.2025.2471112>

Karl, C.W., Bernat, S., Arstad, B., Kubowicz, S., Persson, A-M.M.R, Stenerud, G., Olafsen, K., Comerford, J., Grimaldo, E., Hakvaag, S., Larsen, R.B. Degradation Behaviour of Biodegradable and Conventional Polymers for Gill Nets, Exposed to Accelerated Aging. *ACS Appl. Polym. Mater.* 2025, 7, 2830–2840. <https://pubs.acs.org/doi/10.1021/acsapm.4c03333>

Karl, C.W., Mürer, F.K., Hatlebrekke, H.H., Grimaldo, E., Einarsson, H.A., Larsen, R.B., Ullern, E.F., Lund, H.B., The role of recycling and biodegradable materials in aquaculture and fisheries: Challenges and potential solutions. Book chapter. *Managing Marine Plastic Pollution in Norway*, Routledge (2026). [https://www.taylorfrancis.com/chapters/oa-edit/10.4324/9781003616771-12/role-recycling-biodegradable-materials-aquaculture-fisheries-christian-karl-fredrik-m%C3%BCr%C3%A9r-hanne-hatlebrekke-eduardo-grimaldo-haraldur-einarsson-roger-larsen-elli-ullern-henrik-lund?utm\\_source=researchgate.net&utm\\_medium=article](https://www.taylorfrancis.com/chapters/oa-edit/10.4324/9781003616771-12/role-recycling-biodegradable-materials-aquaculture-fisheries-christian-karl-fredrik-m%C3%BCr%C3%A9r-hanne-hatlebrekke-eduardo-grimaldo-haraldur-einarsson-roger-larsen-elli-ullern-henrik-lund?utm_source=researchgate.net&utm_medium=article) (accepted 2025, published 2026)

Maga, D., Vázquez-Rowe, I., Verones, F., Boulay, A.M., Corella-Puertas, E., Askham, C. Consideration of Plastic Emissions in Life Cycle Assessments. Book Chapter. *Springer Handbook of Circular Plastics Economy*. [https://link.springer.com/chapter/10.1007/978-3-031-66209-6\\_42](https://link.springer.com/chapter/10.1007/978-3-031-66209-6_42)

Pauna, V., Plastic Footprint Network guidelines Module on macroplastic – fishing gear (online publication). [https://www.plasticfootprint.earth/wp-content/uploads/2025/12/PFN\\_module\\_Macroplastic\\_Fishing\\_Gears\\_2025\\_12\\_05-1.pdf](https://www.plasticfootprint.earth/wp-content/uploads/2025/12/PFN_module_Macroplastic_Fishing_Gears_2025_12_05-1.pdf)

Pavel, S., Tazrin, A., Karl, C.W., Mürer, F. The environmental impact of HDPE mechanical recycling: Case studies from the Norwegian aquaculture industry. Book chapter. *Managing Marine Plastic Pollution in Norway*, Routledge (2026). [https://www.taylorfrancis.com/chapters/oa-edit/10.4324/9781003616771-11/environmental-impact-hdpe-mechanical-recycling-pavel-str%C3%A1nsk%C3%BD-tazrin-ahmed-christian-karl-fredrik-m%C3%BCr%C3%A9r?utm\\_source=researchgate.net&utm\\_medium=article](https://www.taylorfrancis.com/chapters/oa-edit/10.4324/9781003616771-11/environmental-impact-hdpe-mechanical-recycling-pavel-str%C3%A1nsk%C3%BD-tazrin-ahmed-christian-karl-fredrik-m%C3%BCr%C3%A9r?utm_source=researchgate.net&utm_medium=article) (accepted 2025, published 2026)

Vodopia, D., Verones, F., Askham, C., Larsen, R.B. Ghost fishing catch estimates based on annual retrieval operations in Norwegian waters. *Fisheries Research*. <https://doi.org/10.1016/j.fishres.2025.107599>

Wataniyakun, W., LeGall, M., El Rakwe, M., Karl, C.W, Larsen, R.B. Biodegradable fishing gears: A potential solution to ghost fishing and marine plastic pollution. *Marine Pollution Bulletin*. <https://doi.org/10.1016/j.marpolbul.2025.117607>

## Technical internal reports:

Chowreddy, R.R., Norner Research AS – Desktop study – Overview of plastic coating processes for marine metallic ropes, NR260149.

Chowreddy, R.R., Norner Research AS – Intermediate report with a summary of technical development work on new material and design concepts (under preparation).

Chowreddy, R.R., Norner Research AS – Summary of bioplastic modifications evaluated to meet the requirements of fibres, NR260142.

Chowreddy, R.R., Norner Research AS – Summary of bioplastics modifications for moulding applications, NR260148.

Chowreddy, R.R., Norner Research AS – Summary of characterization results of bioplastics sourced in 2025, NR260144

Chowreddy, R.R., Norner Research AS – Summary of 3rd round of fibre spinning trials and testing on modified bioplastics, NR260143

## PhD an Master theses

Do, H.L., Economics of Ghost Fishing: Incentives, Behaviour and Management, UiT, October 1st 2025

Gannes, N.L., Modelling Marine Ecotoxicity Impacts of Fishing Gear: A Case Study of the Norwegian Fishing Sector, NTNU 2025.

## Conference contributions and guest lectures

Alvestad, A., Practical use of biodegradable fishing gear, Guest Lecture in the UiT master's course FSK-3624 Marine Litter and Arctic Fisheries: Challenges and Solutions

Askham, C., How can decision-makers weigh up plastic losses against climate change?, Norwegian Circular Materials Technology's Plastic and Composite conference 2025 (11.04.25)

Bakke, E.J, Norwegian aquaculture management and non-point source pollution, The Nordic Environmental and Resource Economics (NAERE) Workshop at DTU, Copenhagen, Denmark (June 25-26, 2025)

Chowreddy, R, Biodegradable plastics properties and applications, Guest Lecture in the UiT Master`s course FSK-2436: Marine litter and Arctic Fisheries: Challenges and Solutions (26.09.25)

Do, H.L, A bio-economic model of ghost fishing with an application to the Norwegian snow crab fishery, and additional panel discussion on the Economics of Marine Debris and Ghost Gear Management, The North American Association of Fisheries Economists (NAAFE) 2025 conference in La Jolla, San Diego, USA (March 2025)

Do, H.L., A bio-economic model of ghost fishing with an application to the Norwegian snow crab fishery, The 26th BIOECON Conference in Cambridge (September 1-2, 2025).

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Johnsen, H., Marine littering from fisheries – Waste management in ports and methodology for registration, guest lecture in the UiT Master`s course FSK-3624 Marine litter and Arctic Fisheries: Challenges and Solutions (22.08.25)

Karl, C.W, Hakvåg, S., Degradation behaviour of biodegradable and conventional monofilaments under marine field and laboratory conditions, EPF European Polymer Congress, Groningen/The Netherlands, June 2025

Karl, C.W, Hakvåg, S., Synthetic fibres (materials) used in fisheries and aquaculture, 90 min guest lecture in the UiT Master`s course FSK-3624 Marine litter and Arctic Fisheries: Challenges and Solutions (12.09.25)

Larsen, R.B., Chowreddy, R., Karl, C.W, Vollstad, J., Armstrong, C.W., Askham, C. ⇒ [Dsolve - Centre for Research-based Innovations - development of biodegradable materials for application in fisheries and aquaculture](#), The ICES/FAO Working Group on Fishing Technology and Fish Behaviour (15.05.25 – 20.05.25)

## Popular Science and Media:

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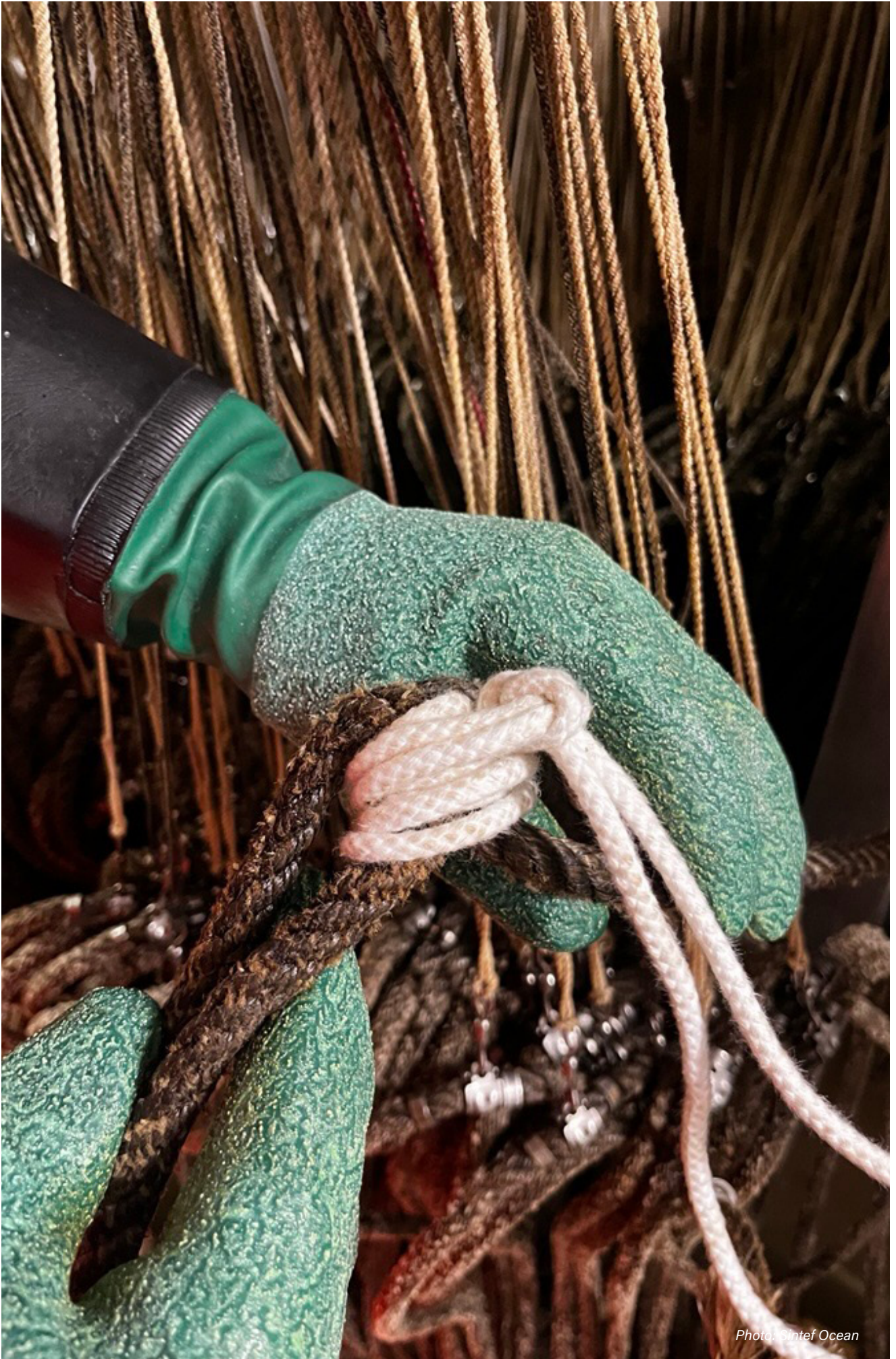


Photo: Sintef Ocean

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