

**NORWEGIAN BLUE FORESTS NETWORK (NBFN)**

# **ANNUAL REPORT 2018**

A competence network established by the Norwegian Institute for Water Research (NIVA), GRID-Arendal and the Institute of Marine Research (IMR)



# Highlights from the Norwegian Blue Forests Network in 2018

## **New knowledge of what happens to the kelp when it dies: Positive results from a climate perspective**

In 2018, researchers from the Norwegian Blue Forests Network carried out a groundbreaking research project to increase the understanding of what happens within the world's kelp forests when the kelp leaf detaches at the end of the growing season. This research has shown that one of the largest global consumers of kelp, the sea urchin, eats the kelp and converts it to tiny fragments with high dispersal abilities. This is of great global interest as it provides further insights into the role of the world's kelp forests in the global carbon cycle. The findings of the study, reported in Scientific Reports, published by Nature, show kelp carbon's potential to spread to other ecosystems, such as the deep sea, and is accumulated there and then becomes a part of the global carbon sink.

## **Blue growth from blue forests: Examples from Norway, Greece and the United Kingdom**

The interest in sustainable blue growth supported by blue forests is increasing. As a result, this topic was chosen as the theme of the 2018 Arendalsuka NBFN event. The goal was to raise awareness and highlight the potential for using kelp and seagrass as raw materials for innovative products. Two companies were invited to showcase cutting-edge solutions and innovations. The British company

Skipping Rocks Limited presented edible Ohoo liquid containers made from brown algae. The Greek company Phee presented smart phone cases and other products made from naturally occurring dead seagrass (*Posidonia oceanica*), which is annually washed up on the shores in large quantities around the Mediterranean. There was also a presentation regarding sustainable kelp farming in Norway. State Secretary Rebekka Borsch opened the well-attended event (with over a 100 visitors attended), and said how impressed and inspired she was by the Blue Forest entrepreneurs.

## **Reduced deforestation and forest degradation (REDD+): A high level meeting focusing on how mangroves should be included in REDD+ forests**

NBFN was involved in planning a session for the Oslo Tropical Forest Forum (OTFF) in June 2018. OTFF is an important high-level arena for discussion and policy development for reducing deforestation and forest degradation (REDD+). This session focused on carbon storage capacity of peat bogs and mangrove forests. The purpose of the session was to highlight the importance of such ecosystems in the carbon cycle and discuss how to raise awareness of these relatively small and therefore undervalued ecosystems in national and international REDD+ strategies. Participants in the session included Arlette Soudan-Nonault, Minister of the Environment of the Republic of Congo, and Ola Elvestuen, Minister of Climate and Environment of Norway.





## History behind the establishment of NBFN

The Norwegian Blue Forests Network was established in 2014 and is a joint operation of the Norwegian Institute for Water Research (NIVA), GRID-Arendal and the Institute of Marine Research (IMR). The Network is financed by the Norwegian Ministry of Trade, Industry and Fisheries and is administered by the Institute of Marine Research. The cooperating institutions have both complementing and overlapping expertise, which has proven to be very useful in ensuring a holistic approach to the blue forest issues.

## Significance of the Blue Forest Ecosystems

The term blue forest refers to plants that grow in the marine and coastal zone, for example kelp forests, mangrove forests, various species of seagrass as well as tidal marshes. These blue forest ecosystems provide numerous services both to the marine environment and society. Globally, the ability of blue forests to sequester CO<sub>2</sub> from the atmosphere and store it either as plant biomass or in the sediment, is perhaps the most important ecosystem function. Through photosynthesis, these ecosystems produce energy-rich carbohydrates and oxygen.

More than half of the occurrence of natural carbon is taken up by the ocean, and blue forest ecosystems have proven to be particularly effective for carbon capture, even though they cover only a small part of the Earth's surface area. It is estimated that blue forest ecosystems store five times more carbon per unit area than a tropical rainforest, a service that has now been recognised by the United Nations Intergovernmental Panel on Climate Change (IPCC).

Blue forests also serve as a vital habitat for various species of fish and crustaceans that are consumed by the surrounding communities. They thus provide the foundation for livelihoods and healthy nutrition for coastal communities around the world. The mangrove forests in tropical waters protect against coastal erosion and, like kelp forests, are important habitat for a wide variety of animals and plants.

Worldwide, blue forest ecosystems are being degraded or destroyed due to human activities. Protection, restoration and sustainable use need to be key elements in the policy, management and use of these ecosystems.

## Overall Goal of the Network

The Norwegian Blue Forests Network aims to strengthen overall expertise in Norway, and to contribute to increased awareness and understanding of the importance of well-functioning blue forests nationally and internationally.

## Priority areas in 2018

The Network's priority areas are:

1. WP1 To increase knowledge and awareness about the importance of blue forests
2. WP2 To perform research in order to enhance knowledge about the blue forest
3. WP3 To offer expert support for management and policy making

Below is a brief overview of activities within each priority area.

# Main projects in 2018

## WP 1

### Knowledge and awareness of the importance of blue forests

In 2018, we set ambitious goals to raise awareness and increase the knowledge around blue forest ecosystems. Blue forests play a critical role in supporting human well-being and driving economic growth through the valuable services and goods they provide, such as food, clean water and climate regulation. In order to increase the level of protection and conservation of these ecosystems, and drive sustainable management and development, decision makers, managers, as well as the general public need up-to-date and accurate scientific information that can be brought together and understood in a coherent and integrated manner. For this reason, communication channels were utilised, including videos, flyers and brochures, roll-ups, popular science articles in local newspapers, and an Arendalsuka event, while continuously growing a strong digital presence through social media and website.

#### Project 1. Outreach and communication

The goal of this year's outreach activities was to increase the visibility of the Network while enhancing our branding, and ensuring delivery of consistent and targeted messages. Our

number of Twitter followers increased by 30% and we gained more and visitors to our recently developed website. After the great success of last year's video on seagrasses, we created two new videos, one about the importance of kelp forests, and another about the sustainable growth in blue forests. This year, we also produced several news stories about projects we have developed and co-financed, and the events we organised or participated in. As well, NBFN delivered lectures to primary school children in Arendal to highlight the importance of marine ecosystems for climate change mitigation.

#### Project 2. Raet National Park Ecosystem Services Assessment

The Network has finalised a report on the ecosystems services provided by blue forests in Raet National Park, after consultation with the board and local stakeholders. The report includes short texts and illustrations highlighting the blue forest ecosystems. The report will be launched in the beginning of 2019 and will be available in the Parks' visitor centre, where tourists and the local community can learn about the value of the marine ecosystems.



NBFN has been giving lectures on the importance of coastal ecosystems in reducing the effects of climate change at schools in Arendal.

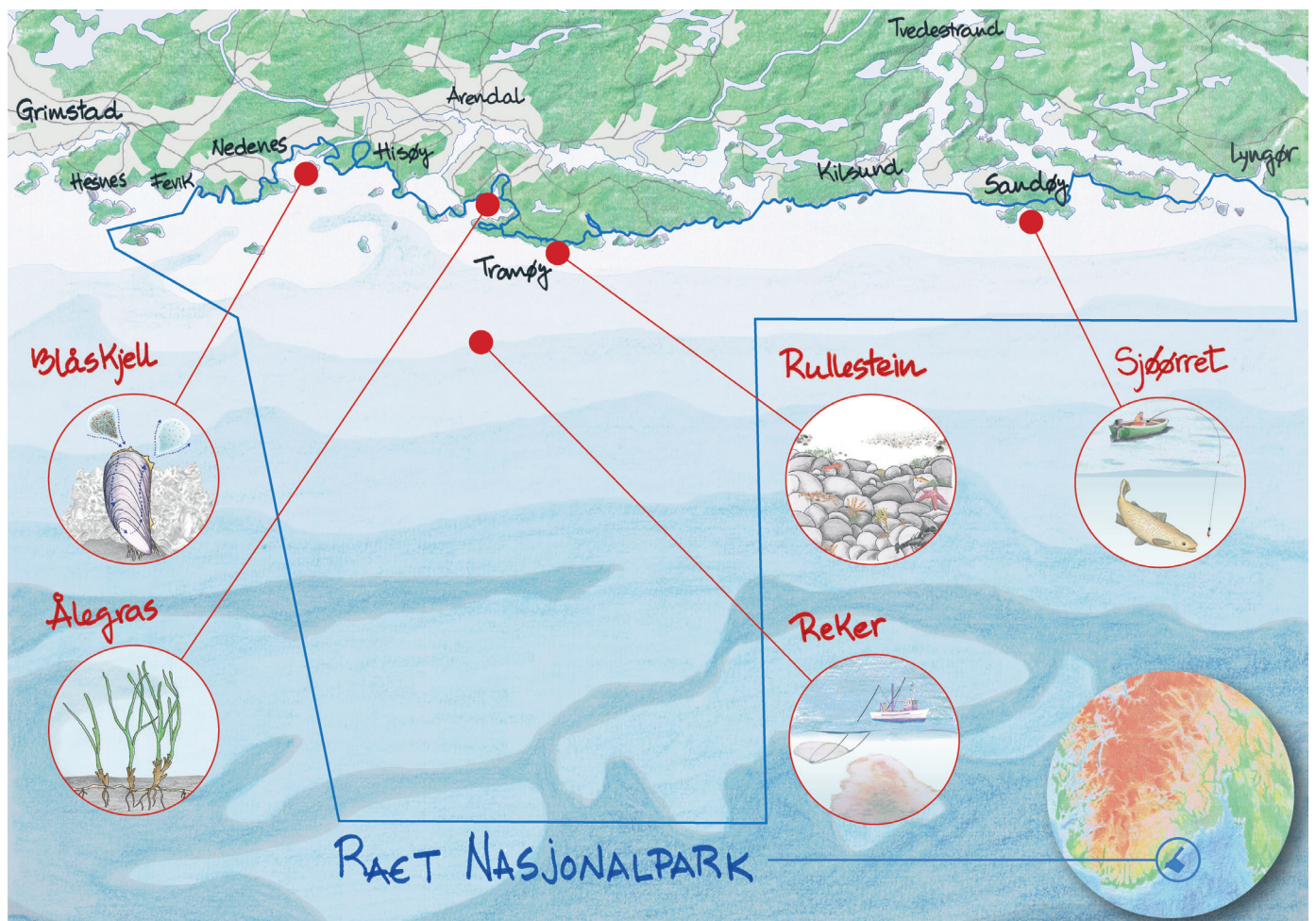


Figure from the NBFN report on the ecosystem services of Raet National Park



Seaweed used in food during NBFN's Arendalsuka event

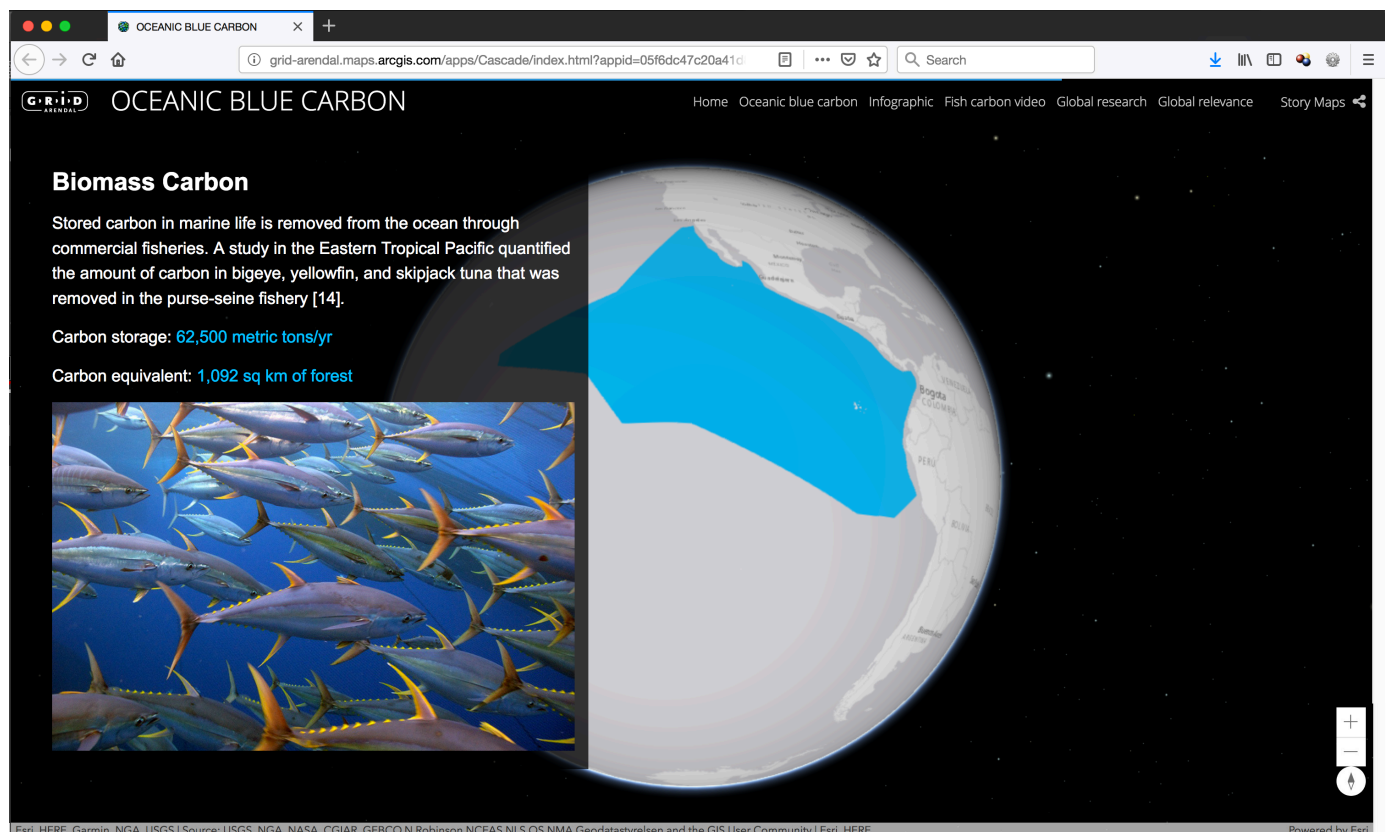
### Project 3. Arendalsuka event: Sustainable growth in blue forests

Following the success of “Blå Skog, Jazz & Tapas” in 2017 and the Blue Forests Breakfast in 2016, the 2018 event was organized to highlight innovative thinking on the use of marine resources, blue economy and growth, outlining the reasons why seaweeds and seagrasses are both ecologically and commercially important. External speakers included

small-scale entrepreneurs and innovators, who make food that contains seaweed, create plastic-free packaging with low environmental impact, and use seagrass that is washed ashore as a primary raw material. The event was well attended and received positive feedback from attendees including politicians, researchers and representatives from non-governmental organizations and the media.

### Project 4. Oceanic Fish Carbon Assessment

The story map “Oceanic Blue Carbon: How Marine Life can Help to Combat Climate Change” was launched at the Eye on Earth Summit in Abu Dhabi in October 2018. The story map describes the various ways that marine life contributes to carbon storage in the ocean and illustrates the latest science on the subject. The launch of this story map was shared through news stories published by the NBFN, UN Environment, and the Global Environment Facility. In these releases, the concept was endorsed by Ronald Jumeau, Permanent Representative to the United Nations and Ambassador for Climate Change for the Republic of Seychelles, who stated the following: “Recognising the role marine life may play in mitigating climate change may help small island developing states, especially those who are large ocean nations, include ocean actions in their Nationally Determined Contributions under the Paris Agreement. Seychelles believes that the sustainable management of life in our ocean is critically important in our fight against climate change. Given the dire warnings from the recent IPCC report, can we afford not to explore this option?”



Oceanic Blue Carbon Storymap, developed partly with support from NBFN

## WP 2

# Research Activities

WP 2 focused on developing new knowledge about the importance of blue forests, as well as action-oriented projects to improve the management of blue forests in Norway and internationally. In 2018, three activities were focused on kelp

forest and four activities on seagrass. Seagrasses and kelp forests are the most important types of vegetation for the storage of carbon along the Norwegian coast, and a significant proportion of Europe's total blue forests are found along our coast



### **Blue carbon in kelp forests**

#### **Project 1. Transport of Kelp Fragments (KelpFLOAT)**

The goals of KelpFLOAT is to quantify the transport of kelp material out of kelp forests and determine where the detached kelp typically accumulates in large quantities. To achieve this, a dispersion model was created to investigate where detached kelp material ends up. Particles that represented kelp fragmented by sea urchins were released at Malangen kelp forest in Troms. A fine-scale (160 m) three-dimensional power model was used to simulate where the different particles would end up. They were modeled to have been discharged from forests throughout a whole year to determine how the particle type, size, source and time of discharge affect the final location of the particles. By identifying storm activity, it was also possible to obtain a better understanding of how storm events affect the fate of the kelp particles. By dropping particles from areas where

kelp forests are grazed by sea urchins, we calculated how sea urchins affect the amount of kelp transported to other ecosystems. Kelp particles that are transported to deep water are considered to be stored for a long time. The proportion which is transported to deep water, and what conditions affect this proportion (type and size of particle, place, time, storm) will provide important information about the role of the kelp forest in carbon storage. We have used both theoretical and field-measured sinking speeds in simulations. The theoretical sinking speeds are used to calculate the effect of sea urchin grazing on how far away from the kelp forests the detached kelp particles can be transported. By catching and "shredding" the kelp leaves through grazing to small fecal particles full of tiny kelp particles, and at low sinking rates, the sea urchins are able to multiply the range of detached kelp particles. The fate of the various particles remains to be analysed given different scenarios with regard to storms, seasonal variations in growth and the release of the kelp leaf (which occur every spring) and the degree of decay, based on field-measured sinking speeds.

## Project 2. Burial of Kelp Carbon in Sediments (BURSE)

The goal of BURSE is to quantify kelp carbon which is buried in sediments in deep water and thus disappears from the carbon cycle. In 2018, a scientific research cruise took place outside of Malangen, Tromsø using the the Institute of Marine Research's vessel Kristine Bonnevie. The goal was to map the location of kelp on the seafloor with the remote-controlled underwater vessel (ROV) Aglantha. Sediment cores were extracted and then dated and analysed for organic content in the search for kelp carbon. To distinguish kelp carbon from other carbon, the results from Malangen were compared with results from another fjord, Kaldfjorden, which has little kelp present. Our hypothesis is that data from Kaldfjorden can serve as a reference for sediment from Malangen. The results from BURSE will be published as a scientific article.

*The remotely operated underwater drone Aglantha outside Malangen, Troms, Norway in June 2018*



Kjell Magnus Norderhaug, Havforskningsinstituttet



## Project 3. Large-scale Blue Carbon Budget (SUKER)

The goal of the SUKER project is to measure the turnover of kelp carbon throughout the northern hemisphere. We have quantified residence time and turnover rates of kelp by conducting a field experiment involving researchers from 7 countries and 13 institutions. We focused on sugar kelp as far as possible because of its wide-spread distribution. Sugar kelp breakdown was consistent across its global reach, about 50% biomass loss in 90 days. Exceptions included areas east of the US and Portugal where the loss was greater (75% loss in 40 days). Annual and invasive kelp

species were broken down faster than sugar kelp, while more robust species were generally broken down more slowly, but had different biomass losses. While the biomass in the Arctic increased by 20%, it completely disappeared in southern parts of Europe. Isotope analyses are now being carried out. Preliminary results indicate that kelp is slowly breaking down in northern latitudes and therefore has greater potential for carbon capture in deep areas than in low latitudes.

SUKER is a unique experimental study conducted as a global research collaboration funded through the NBFN as well as with co-financing from participating institutions.

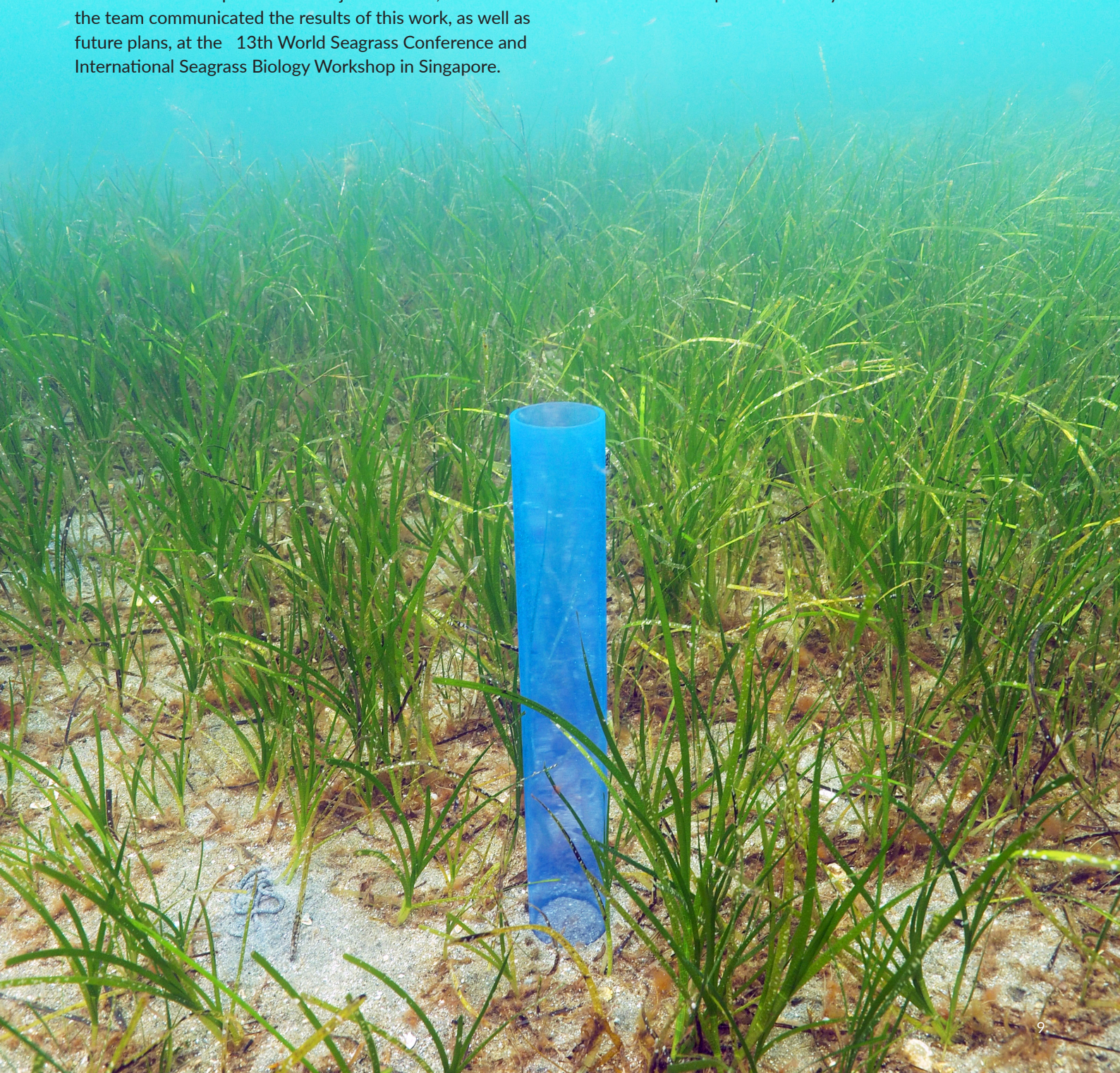
## **Blue carbon in seagrass**

### **Project 1. Seagrass meadows and ecosystem services (SEAME)**

Coastal vegetated ecosystems play a fundamental role in carbon storage. Seagrass habitats are highly productive ecosystems and most act as net sinks of carbon. Although the contribution of seagrasses to global oceanic carbon storage has been quantitatively acknowledged, most estimates come from just a few sites and seagrass species. In 2017, the Network started an exciting project to quantify the carbon stocks in seagrass meadows in Southern Norway and to provide an estimate of their carbon storage capacity at the national level. This year, the biogeochemical analyses were completed, and the members of the team are now preparing to report the first of its kind investigation of carbon stocks to a peer-reviewed journal. Also, members of the team communicated the results of this work, as well as future plans, at the 13th World Seagrass Conference and International Seagrass Biology Workshop in Singapore.

### **Project 2. SEAME Extended**

In SEAME Extended, we want to compare the historical storage of blue carbon inside and outside the seagrass meadows. By age-determining layers in the sediment cores and their carbon content, the goal is to calculate the storage rate over a period of 100 years or longer. This project will provide information on how much is stored in mud protected for wind exposure, and how much they will potentially save in the future. Sampling was performed in September at half of the sites and revealed a need for further development of method and tools to secure undisturbed sediment cores for comparable age determination between sites. Samples from 2018 are under analysis for carbon content. Tools are now designed and new collection is planned in early 2019.



# Knowledge Support for Administration and Policymaking

All NBFN members are organisations that focus on developing and applying knowledge in their national and international activities. A key objective of NBFN is to further our knowledge on blue forests, their ecosystem functions and their management. This is to support key national and international actors in their efforts to design policies and management regimes for the sustainable use and protection of blue forests. We therefore try to identify the needs for expertise among the national and international administrative and policy-making bodies. In 2018, the Network focused on supporting the government in raising blue forests on the international REDD agenda by contributing to the government's high-level conference, the Oslo Tropical Forest Forum: REDD + Exchange and, in particular, the event that dealt with ecosystems with high carbon storage and how to integrate these in REDD+ strategies.

### **Project 1. Support for the development and implementation of a session on high carbon ecosystems under the Oslo Tropical Forest Forum: REDD + Exchange**

Oslo Tropical Forest Forum: REDD + Exchange (OTFF: RE) is an important arena for discussion and policy development when it comes to reducing deforestation and forest degradation. The aim of the forum is to identify remaining challenges ten years after the reduction of emissions from deforestation and forest degradation



*Climate and Environment Minister Ola Elvestuen was one of the speakers and panellists in the session on high carbon ecosystems at the Oslo Tropical Forest Forum.*

in developing countries (REDD +) was included in the climate negotiations and to promote strategies for mobilising forest ecosystems to help reach the ambitions in the Paris-agreement and many of the UN Sustainable Development Goals. Following up on a workshop organised by NBFN in collaboration with the Ministry of Climate and Environment in the autumn of 2017, NBFN helped to design a session focusing on peatlands and mangrove forests. The purpose of the session was to highlight their importance in the carbon cycle and discuss ways to increase awareness of about these relatively small and undervalued areas in national and REDD+ strategies. Participants in the session were Arlette Soudan-Nonault, Minister of Environment and Tourism of the Republic of Congo, Ola Elvestuen, Minister for Climate and Environment of Norway, Catherine Lovelock, Professor, University of Queensland, Daniel Murdiyarso, Senior Researcher, CIFOR and Nazir Foad, Indonesia Peatland Restoration Agency. Through this session, the interest in including these two high-carbon ecosystems in REDD + strategies was significantly increased in the countries concerned.

### **Project 2. International Networking**

Compared to 2017, 2018 has been a year with fewer international engagements.

Together with Nordic colleagues, NBFN was contacted by the Blue Carbon Initiative (BCI), one of the world's leading networks for blue carbon knowledge and policy development, requesting support their first Nordic meeting in 2019. This meeting will be held in Copenhagen with members of the NBFN sitting on the Organising Committee.

NBFN also contributed to the establishment of the International Seagrass Experts Network (ISEN) in 2018. ISEN was established during a workshop entitled Towards an International Seagrass Science, Policy and Conservation Agenda, which was held at the International Seagrass Biology Workshop from 13-15 June 2018 in Singapore. ISEN is a consortium of experts and practitioners who will focus on ensuring that seagrass ecosystems are more broadly integrated into protection and management discussions.

# Reports, news articles and other communication products in 2018

## Scientific papers

Filbee-Dexter K, Foldager Pedersen M, Fredriksen S, Norderhaug KM, Rinde E, Kristiansen T, Albretsen J, Wernberg T (2018). Carbon export is facilitated by marine shredders transforming kelp detritus. *Oecologia*. (Submitted)

Wernberg T, Filbee-Dexter K (2018) Grazers extend blue carbon transfer by slowing sinking speeds of kelp detritus. *Scientific Reports* 8:17180. <https://www.nature.com/articles/s41598-018-34721-z>

## Publications

New flyer presenting NBFN (English): [http://dev.grida.no/nbfn/flyer2018/NBFN\\_flyer2018\\_eng\\_hires.pdf](http://dev.grida.no/nbfn/flyer2018/NBFN_flyer2018_eng_hires.pdf)

New flyer presenting NBFN (Norwegian): [http://dev.grida.no/nbfn/flyer2018/NBFN\\_flyer2018\\_nor\\_hires.pdf](http://dev.grida.no/nbfn/flyer2018/NBFN_flyer2018_nor_hires.pdf)

News article NBFN (Norwegian). Ny viktig puslespillbrikke lagt om tarens rolle i karbonkretsløpet. Maria Potouroglou, 225 Nov 2018. <http://nbfn.no/2018/11/ny-viktig-puslespillbrikke-lagt-om-tarens-rolle-i-karbonkretsløpet/>

News article NBFN (English). New Insight into the Fate of Blue 'Kelp' Carbon. Maria Potouroglou, 225 Nov 2018. <http://nbfn.no/en/2018/11/new-insight-into-the-fate-of-blue-kelp-carbon/>

News article in Science Nordic, September 18 (English). Marine forests – Nature's own carbon capture and storage. Dorte Krause-Jensen, Carlos Duarte, Helene Frigstad. <http://sciencenordic.com/marine-forests-natures-own-carbon-capture-and-storage>

News article NBFN (Norwegian). Et surere hav får denne taren til å vokse. Maria Potouroglou, april 2018. <http://nbfn.no/2018/04/et-surere-hav-far-denne-taren-til-a-vokse/>

News article Forskning.no (Norwegian). Et surere hav får denne taren til å vokse. Liv Mildrid Melkild Avset. <https://forskning.no/2018/04/vil-klimaendringene-positivt-pa-norske-tareskoger/produsert-og-finansiert-av/norsk-institutt-for-vannforskning>

News article NBFN (Norwegian). Tareskogane nesten borte i Skagerrak. Maria Potouroglou. <http://nbfn.no/2018/01/tareskogane-nesten-borte-i-skagerrak/>

## Videos and interactive media

Video about seagrasses (2017): <https://vimeo.com/232961427>

Video about kelp forests: <https://vimeo.com/273840074>

Video about blue growth and blue forests: <https://vimeo.com/296394701>

Video about Fish carbon: <https://vimeo.com/295991431>

Oceanic Blue Carbon Story Map: <http://www.grida.no/publications/417>

Video recording of the session High carbon stock ecosystems: Incorporating mangroves and peatlands into REDD+ strategies, at Oslo Tropical Forest Forum 2018, facilitated by NBFN; <https://www.youtube.com/watch?v=zzydjoRKMKI>

