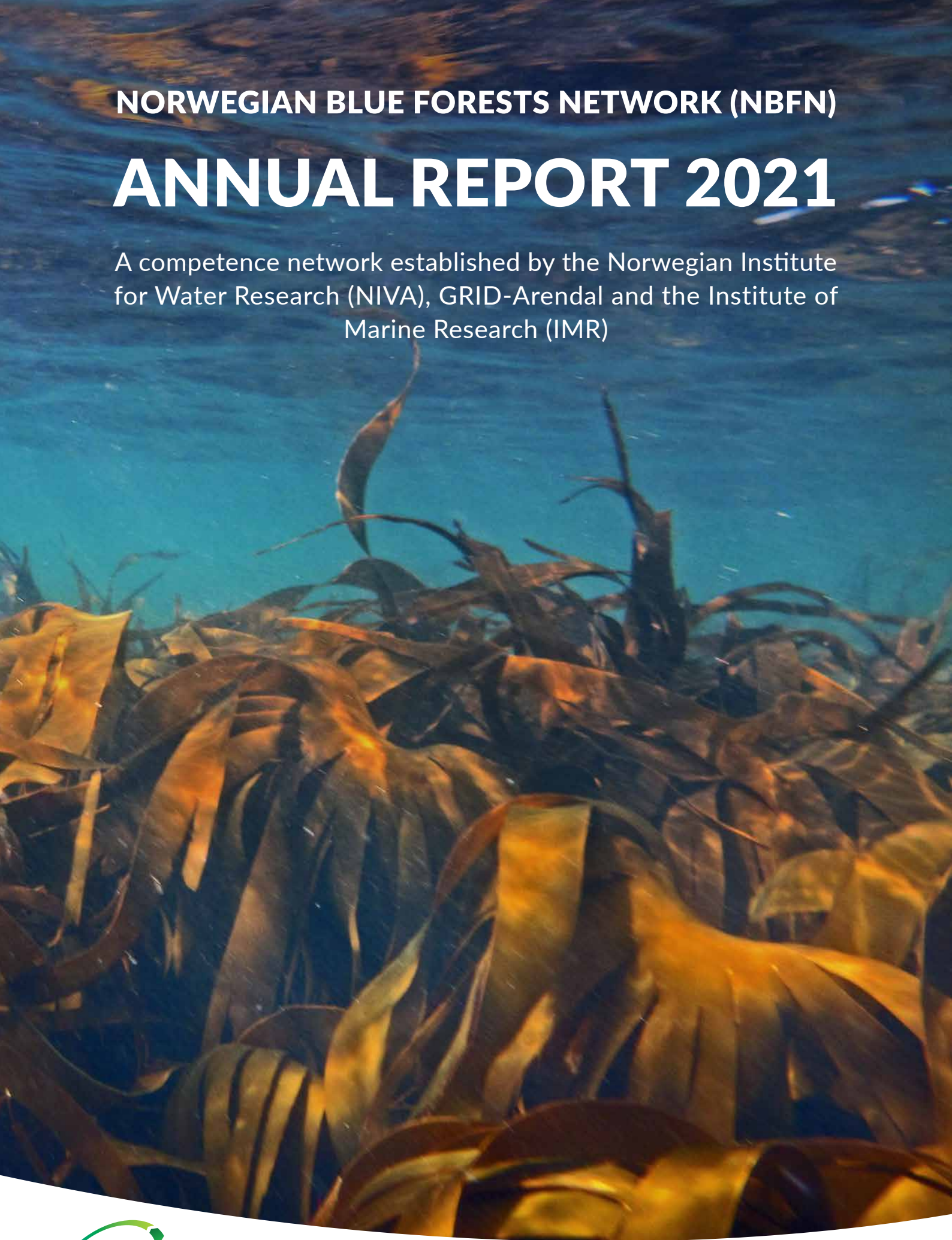


NORWEGIAN BLUE FORESTS NETWORK (NBFN)

ANNUAL REPORT 2021

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

Norwegian Blue Forests Network

GRID ARENDAL
A UNEP Partner

HAVFORSKNINGS INSTITUTTET

NIVA
Norsk institutt for vannforskning

Letter from the Board and Project Leader

2021 was an exciting year for the Norwegian Blue Forests Network.

The focus on coastal ecosystems, including blue forests, is growing in Norway and globally. Indeed, 31 side events at UNFCCC COP26 were about oceans, blue forests, and coastal and oceanic blue carbon. Blue forests are not only recognised as a nature-based solution to the climate and environmental crisis, their many other ecosystem services are increasingly appreciated – from fostering biodiversity to contributing to a sustainable, blue economy.

At the same time, blue forests across the globe continue to abate. Many of Norway's blue forests also show patterns of decline. Encouragingly, national and local governments alike are taking steps to protect and restore coastal ecosystems. However, the scale of these efforts is often not yet sufficient to halt, let alone reverse, these trends.

Given this changing landscape, we began the year by sharpening our strategy (a copy of which is available at https://nbfn.no/strategy2021). Our revised mission is to *"Be the best source of reliable and up to date knowledge on Norwegian blue forests in order to raise awareness, offer solutions, inspire ecosystem-based policymaking and encourage the sustainable use of blue forests in Norway and beyond."* To achieve this, we will focus on three interrelated tasks:

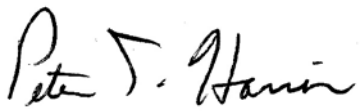
1. **Gather:** Synthesise latest research on blue forests
2. **Share:** Share blue forests knowledge and expertise
3. **Convene:** Bring the spectrum of actors interested in blue forests together

In 2021, we undertook a number of activities under each of these pillars – including our second annual Blue Forest Week and our first ever policy brief. We are grateful to our colleagues and peers both within and outside the network that have contributed their time and expertise.

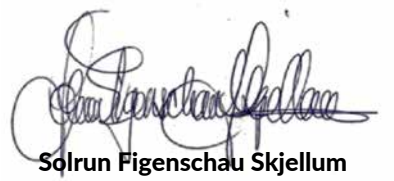
We look forward to continuing this important work in the year to come.



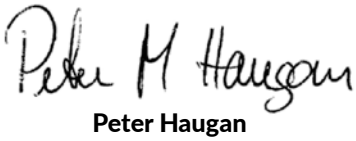
Cecilie Wathne
Project leader of the Norwegian Blue Forests Network



Peter Harris
NBFN Board Chair and Managing Director of GRID-Arendal



Solrun Figenschau Skjellum
NBFN Board member and Research Director at the Norwegian Institute for Water Research (NIVA)



Peter Haugan
NBFN Board member and Programme Director at the Institute of Marine Research (IMR)

Pillar 1: Gather

Synthesize latest research on blue forests

NBFN launched our first policy brief

Key takeaway: Further loss of blue forests will have a ripple effect on biodiversity



In celebration of the International Day for Biological Diversity, the Norwegian Blue Forests Network (NBFN) launched a policy brief on 22 May 2021 on the importance of blue forests for biodiversity.

Blue forests are among the most biodiversity-rich ecosystems in the world. Thousands of species depend on blue forests for spawning, nursery, habitat, protection and food. However, these ecosystems often receive less focus than terrestrial forests or coral reefs.

The policy brief concluded with the following messages: i) further loss of blue forests will have a ripple effect on biodiversity; ii) blue forests need to be increasingly prioritized in relevant policies to help achieve the United Nations Sustainable Development Goals; and iii) coastal ecosystems should be highlighted in the Post-2020 Global Biodiversity Framework. A copy of the brief can be found here.

The first global kelp assessment report is nearly complete

Key takeaway: While gaps remain, we have enough scientific evidence to justify policy outcomes and changes

NBFN and the United Nations Environment Programme (UNEP) convened a global network of kelp experts to produce the first ever global report on kelp forests. The report synthesizes the state of knowledge on kelp ecology; the stressors and threats facing these ecosystems; how kelp protection fits into international policy and law; and how we can best manage and restore these forests. Key outputs include the first digital map of the known distribution of kelp forests across the globe.

To produce the report, researchers from around the world, including specialists in ecology and ecosystem services, management and policy, were brought together. In total, over 60 experts from 15 countries were engaged as authors and reviewers.

Highlights from the report were shared at a pre-launch event during Blue Forest Week 2021. The final report will be published and launched in the first half of 2022. The objective of the report is to provide an "A to Z" guide to kelp forests in order to provide a scientific justification for blue forests policy outcomes and changes.



The international network of authors and reviewers contributing to the UNEP and NBFN global kelp assessment

The report will be an official United Nations Decade of Ocean Science for Sustainable Development publication. One scientific publication has already been submitted for this work; see Valckenaere et al. (forthcoming) in the publication list for details.

A synthesis study on macroalgae carbon sequestration is complete

Key takeaway: Norway's extensive kelp forests are a hotspot for regional carbon sequestration

Over 30 kelp ecologists have worked together to produce a more accurate global estimate of macroalgae carbon sequestration. The work began with a EuroMarine workshop in 2019 and a subsequent NBFN-sponsored workshop in 2020. Using a combination of literature surveys and biophysical and spatial models, researchers have produced three complementary outputs: i) a global overview of the distribution and extent of macroalgae; ii) a global model of net primary production for brown and red macroalgae; and iii) a global model estimating the transport of macroalgal carbon to the deep sea and deep fjord habitats, where it can be sequestered. These data will provide the first spatially explicit maps of carbon-sink potential for kelp and macroalgal forests globally, which is critical information for policymakers and managers of blue carbon.

Each output is being turned into a journal article. The first paper by Duarte et al. (forthcoming) is in the second round of review. The second paper by Pessarrodona et al. (forthcoming) is also in the second round of review, with a preprint version available here. The third paper is in preparation. Each output was in part made possible with funding from NBFN.

NBFN launched its blue forests policy landscape mapping

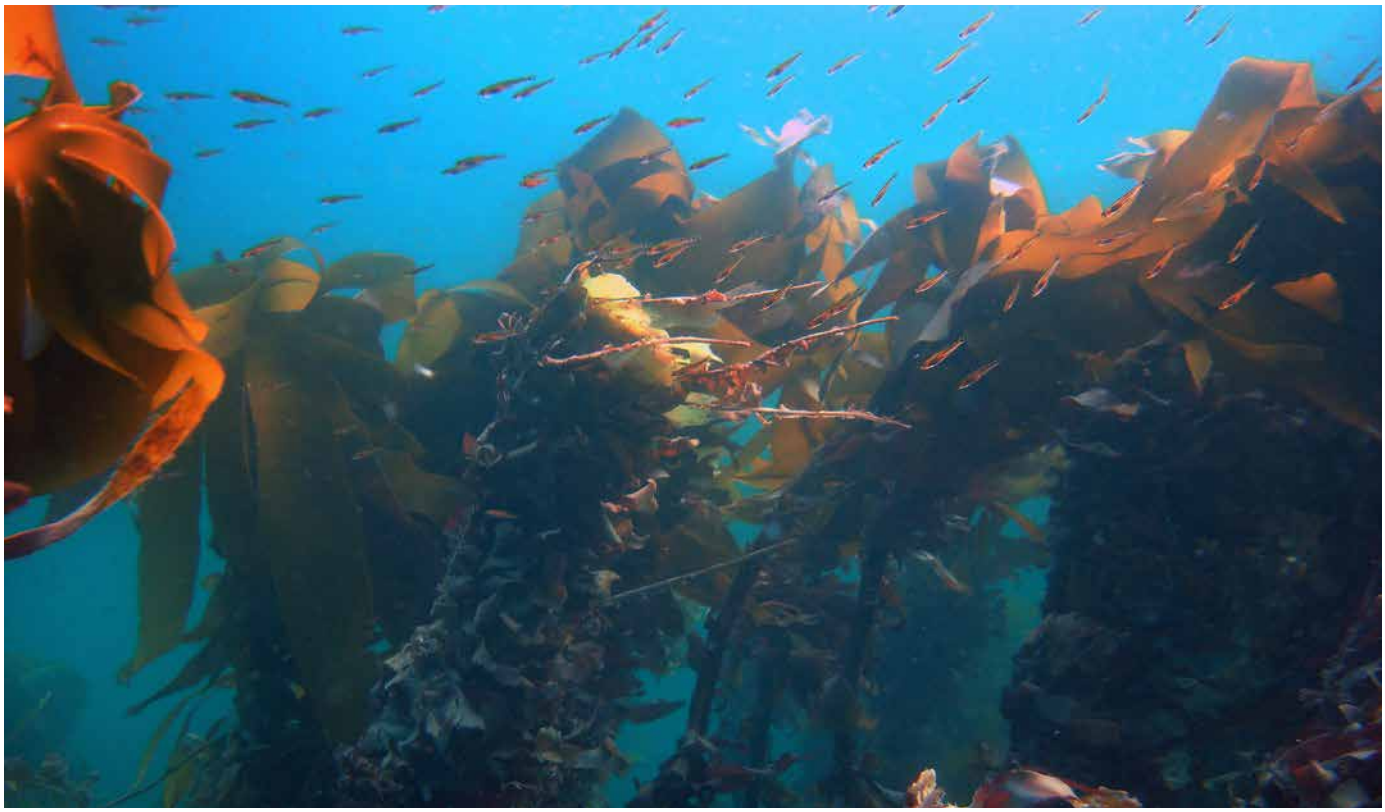
Key takeaway: Interest in these ecosystems is growing; Norway has an important role to play



NBFN celebrated Earth Day by launching a landscape mapping of blue forests policy on 22 April.

Within Norway, interest in blue forests is growing. However, the domestic and international initiatives and projects supported by the Norwegian Government have yet to be condensed into a singular strategy. Within this context, a series of stakeholder interviews were conducted to identify relevant projects and to gain an understanding of the potential opportunities and perceptions regarding blue forests policy in Norway.

The report presented a first-level landscape map and dataset of the blue forest projects supported by the Norwegian Government. Projects in 25 countries around the world, with a combined budget of approximately 327 million Norwegian kroner, were identified and reviewed. Interviewees emphasized the unique position and expertise Norway holds to lead efforts in establishing international guidelines for the sustainable management of kelp harvesting, as well as for the protection and restoration of kelp forests worldwide.



The report was produced by GRID-Arendal with funding from NBFN and the United Nations Environment Blue Forests Project. A copy of the report can be found here.

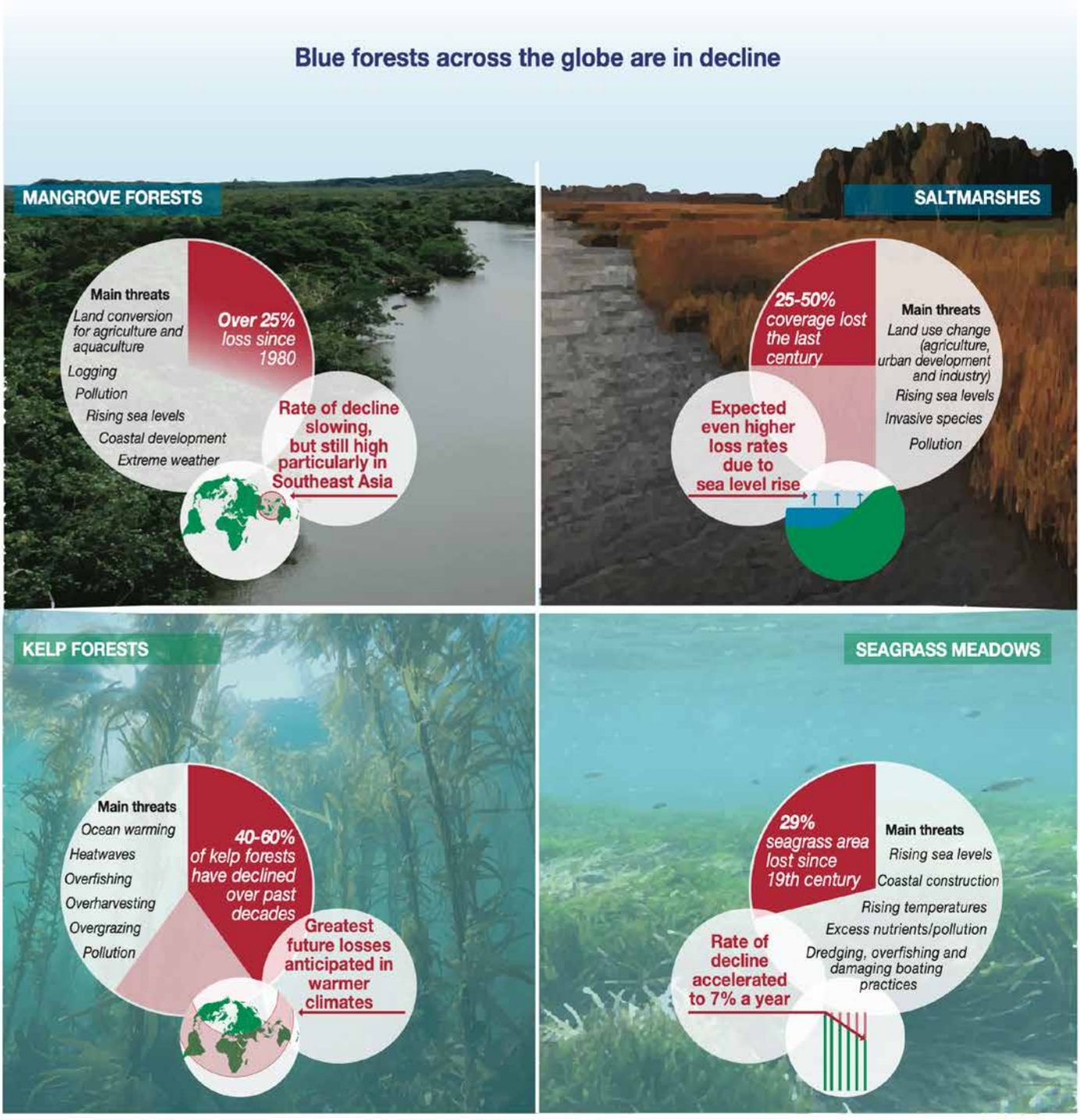
NBFN developed a range of visual products to convey knowledge

In addition to synthesizing the latest research and presenting it in scientific and popular publications, NBFN produced a series of visual knowledge products.

Two infographics were produced for inclusion in the policy brief: one on how blue forests magnify diversity, and one on how blue forests across the globe are in decline.

NBFN also commissioned GRID-Arendal to develop three animation videos. The animated videos covered the following topics: What are blue forests? Why are blue forests useful? and, How are blue forests threatened? A Norwegian-language version of each video will be available in 2022.

Lastly, as part of Blue Forest Week, the Norwegian Institute of Water Research (NIVA) put together a "potpourri" video on the range of kelp ecosystem services. The video drew on experts from Bellona, the Institute of Marine Research (IMR), the Norwegian Institute for Nature Research (NINA) and the Norwegian University of Life Sciences (NMBU), in addition to those from NIVA.



Pillar 2: Share

Share blue forests knowledge and expertise

NBFN hosted an event at Arendalsuka

Key takeaway: Blue forests have the potential to take off as a new industry, but cultivation and harvesting must be sustainable



NBFN was once again present at Arendalsuka (the Arendal Week festival) in August. This year, the network hosted an event on blue forests as a new industry onboard the sailboat Statsraad Lehmkuhl.

Interest in the cultivation of macroalgae is increasing in Norway and globally. Indeed, it has been projected that Norway can produce as much as 20 million tonnes of macroalgae a year by 2050. By comparison, national production was just over 178 tonnes in 2018.

The seminar raised the following four questions: i) Is there potential for a blue forests industry? ii) Is commercial and sustainable use of natural blue forests possible? iii) What are the environmental consequences of the commercial cultivation of blue forests? and iv) How can Norway contribute to a sustainable global blue forests industry?

The event brought together the following speakers: Tanya Bryan, Senior Programme Officer at GRID-Arendal; Helene Frihammer, Regional Director of NHO Vestlandet; Ruth Grung, Member of the Labour Party and the Standing Committee on Energy and the Environment; Kasper Hancke, Senior Researcher at NIVA; Peter Haugan, Programme Director at IMR; Sigrid Z. Heiberg, foreign policy spokesperson for the Green Party; Solrun Figenschau Skjellum, Research Director at NIVA; and Stig Traavik, Director of Climate, Energy and Environment at the Norwegian Agency for Development Cooperation (Norad). It was chaired by Kaya Asdal, Associate Expert at GRID-Arendal.

The venue was filled to maximum capacity. A recording of the seminar is available here.

NBFN launched a new website

In September, NBFN launched a new website. The website was updated to be both visually appealing and user-friendly. In addition to restructuring the website, new pages featuring blue forests content were developed. The most substantive page, Blue Forests Basics, includes introductory-level information on blue forests, featuring subpages on each blue forest ecosystem (mangrove forests, seagrass meadows, salt marshes, kelp and rockweed).

The goal is for the website to become a blue forests knowledge hub. As such, the number of content pages will be expanded in 2022. We will develop pages on climate change, blue carbon, the blue economy, coastal protection and ecosystem-based management, and blue forests restoration.

NBFN employed a range of methods to further dissemination and outreach

NBFN continued to make extensive use of social media to expand out outreach. We posted 107 tweets on Twitter, with our following increasing by nearly 100 users this year. We had over 9,000 visits to the NBFN Twitter account, and our presence on Facebook reached approximately 1,250 users. We also created a YouTube account, where recordings of Blue Forest Week can continue to be viewed and shared well beyond the event.

In addition to social media, the policy brief was transformed into an editorial which was printed across two pages in the Norwegian newspaper Dagbladet. NBFN outputs were also shared at relevant formal and informal events. The landscape mapping report was, for example, presented at a webinar hosted by the Norwegian Environment Agency on Salt Marshes in the Nordic Region.

The construction of a wave tank was commissioned to demonstrate how blue forests and coastal ecosystems can protect coastal communities from the impacts of storms. This installation is portable and can be used at conferences and other in-person events. A demonstration was given during Blue Forest Week.

Pillar 3: Convene

Bring the spectrum of actors interested in blue forests together

We hosted Blue Forest Week 2021

Key takeaway: The momentum and knowledge required to protect and restore blue forests is growing



NBFN held the second annual Blue Forest Week on 16–18 November. The theme for the conference was "solutions": What is currently being done to protect and restore blue forests? And how can these efforts be scaled up and replicated? The three-day, open-access digital event was made possible by 49 speakers from 26 different institutions, who shared their expertise and insights through presentations, talks, interviews and panel discussions. We had speakers from the public sector, private sector, academia and civil society.

The conference began by examining global pledges and plans and what they mean for blue forests. Henrik Hallgrim Eriksen, Norway's chief negotiator for international climate negotiations, Gaute Voigt-Hanssen, Norway's chief negotiator to the Convention on Biological Diversity, and Angelique Pouponneau, the Chief Executive Officer of the Seychelles Conservation and Climate Adaptation Trust, set the stage by sharing their insights from COP15 and COP26. NBFN's Board Chair then moderated a panel discussion "A call to action for blue forests – how can Norway contribute internationally?", with panellists from Norad, World Wildlife Fund-Norway and GRID-Arendal. The session was followed by a pre-launch of the NBFN and UNEP global kelp assessment report. Takehiro Nakamura from UNEP and Peter Harris from GRID-Arendal opened the pre-launch by providing an overarching framework for the report. Linda Jonsson then moderated a Q&A with selected authors.

On the second day, we took a closer look at the status and importance of blue forests. The day began with a talk on blue forests in the platform of the new Norwegian Government by the Minister of Fisheries and Maritime Affairs, Bjørnar Selnes Skjæran. Following a series of presentations, Hege Gundersen from NIVA and Anne Lene Dale from Kystvett AS co-moderated a panel discussion on the complementarities and trade-offs between the various kelp ecosystem services with panellists from Bellona, IMR, NINA, NIVA and NMBU. The day concluded with discussion on blue forests valuation.

The final day explored protection and restoration efforts for blue forests. We heard from a range of speakers from the public sector, private sector and academia, including Aleksander Øren Heen, the State Secretary of the Ministry of Climate and Environment, and Are Karlsen, the Mayor of Horten Municipality. In the first session, we examined Norway's new regional water management plans and comprehensive action plan for the Oslo fjord. Through presentations, interviews and a panel discussion, we explored whether these measures are enough for kelp forests, seagrass beds and fish stocks to thrive. In the final session, we examined a range of both Norwegian and international blue forest restoration methods. The conference concluded with a panel discussion on how to upscale blue forest restoration efforts.

Over 190 participants and speakers attended Blue Forest Week. The conference recordings were posted on YouTube, allowing for further outreach. They are available here.



Publications

The following publications were made possible fully or in part with NBFN support. The list includes papers published in 2021 and papers on track for publication in 2022.

Duarte, C.M., Gattuso, J.-P., Hancke, K., Gundersen, H., Filbee-Dexter, K., Pedersen, M.F., Middelburg, J., Burrows, M., Krumhansl, K., Wernberg, T., Moore, P., Pessarrodona, A., Ørberg, S.B., Sousa-Pinto, I., Assis, J., Queiros, A.M., Smale, D., Bekkby, T., Serrão, E.A. and Krause-Jensen, D. (forthcoming). Global estimates of the extent and production of macroalgal forests. Global Ecology and Biogeography.

Feehan, C., Filbee-Dexter, K. and Wernberg, T. (2021). Embrace kelp forests in the coming decade. Science 373(6557), 863. https://www.science.org/doi/10.1126/science.abl3984.

Filbee-Dexter, K., Feehan, C.J., Smale, D., Krumhansl, K.A., Augustine, S., de Bettignies, F., Burrows, M.T., Byrnes, J.E.K., Campbell, J., Davoult, D., Dunton, K.H., Franco, J.N., Garrido, I., Grace, S.P., Hancke, K., Johnson, L.E., Konar, B., Pedersen, M.F., Moore, P.J., Norderhaug, K.M., O'Dell, A., Salomon, A.K., Sousa-Pinto, I., Tiegs, S., Yiu, D. and Wernberg, T. (forthcoming). Cool high-latitude kelp forests display slow kelp decomposition and enhanced carbon-sink potential (preprint). PLOS Biology. https://www.researchsquare.com/article/rs-38503/v1.

GRID-Arendal (2021). Landscape Mapping Blue Forests Policy in Norway. Arendal. https://nbfn.no/landscape2021.

Gundersen, H., Rinde, E., Bekkby, T., Hancke, K., Gitmark, J.K., and Christie, H. (2021). Variation in population structure and standing stock of kelp along multiple environmental gradients and implications for ecosystem services. Frontiers in Marine Science 8(578629). https://www.frontiersin.org/articles/10.3389/fmars.2021.578629/full.

Krause-Jensen, D., Andersen, G.S., Asplund, M.E., Banta, G., Bekkby, T., Brodeur, J.R., Björk, M., Boström, C., Dahl, M., Duarte, C., Frigstad, H., Gullström, M., Gundersen, H., Graversen, A.E.L., Howard, J., Gyldenkærne, S., Holmer, M., Hancke, K., Lutz, S., Marbà, N., Pedersen, M.F., Pedersen, Å.A.B., Pidgeon, E., Ragnarsdóttir, S.B. and Thormar, J. (forthcoming). Nordic blue carbon ecosystems: status and outlook. Frontiers in Marine Science.

Macreadie, P.I., Robertson, A., Spinks, B., Adams, M.P., Atchison, J.M., Bell-James, J., Bryan, B., Chu, L., Filbee-Dexter, K., Drake, L., Duarte, C.M., Friess, D.A., Gonzalez, F., Grafton, Q., Helmstedt, K.J., Kaebernick, M., Kelleway, J., Kendrick, G.A., Kennedy, H., Lovelock, C.E., Megonigal, P.J., Maher, D.T., Pidgeon, E., Rogers, A.A., Sturgiss, R., Trevathan-Tackett, S.M., Wartman, M., Wilson, K.A. and Rogers, K. (forthcoming). Operationalizing blue carbon. Nature Communications.

Norderhaug, K.M., Filbee-Dexter, K., Strand, H.K. and Wernberg, T (2021). Slik kan skogen i havet reddes. Aftenposten Viten. 22 April.

Norwegian Blue Forest Network (2021). Beskytte og Restaurere Blå Skog: En Viktig Løsning for å Redusere Nedgangen i det Biologiske Mangfoldet (policy brief, Norwegian version). Arendal. https://nbfn.no/nb/policybrief.

Norwegian Blue Forest Network (2021). Protecting and Restoring Blue Forests: An Important Solution to Reduce Biodiversity Decline (policy brief, English version). Arendal. https://nbfn.no/policybrief.

Pessarrodona, A., Filbee-Dexter, K., Krumhansl, K.A., Moore, P.J. and Wernberg, T. (2021). A global dataset of seaweed net primary productivity (preprint). bioRxiv. https://www.biorxiv.org/content/10.1101/2021.07.12.452112v1.

United Nations Environment Programme (Manuscript in preparation). Global Kelp Assessment (Title pending). Produced by the United Nations Environment Programme and Norwegian Blue Forests Network. Published by GRID-Arendal, Arendal, Norway. (Draft citation)

Valckenaere, J., Techera, E., Filbee-Dexter, K. and Wernberg, T. (forthcoming). A global legal analysis for kelp forests: too little, (almost) too late. Marine Policy.

Wathne, C., Sander, G., Gundersen, H., Norderhaug, K.M., Lutz, S. and Bryan, T. (2021). Våre blå skoger er i dårlig tilstand. Dagbladet. 2 July.

The following blog post was also produced, based on an NBFN-affiliated paper:

Mickens, A. (2021). Missing the (kelp) forest for the trees: an overlooked factor in blue carbon storage, 28 January. https://oceanbites.org/missing-the-kelp-forest-for-the-trees-an-overlooked-factor-in-blue-carbon-storage. Accessed 10 February 2022.

Talks

The following talks were presented fully or partly on behalf of NBFN:

Bryan, T. (2021). Nordic blue forest management: key messages from Norwegian blue forests network. Presentation at the webinar Salt Marshes in the Nordic Region Miljødirektoratet, 8 June.

Filbee-Dexter, K. (2021). Kelp forests and blue carbon mapping. Keynote talk at the World Wildlife Fund-Canada event Building Connections for Blue Carbon across Canada.

Filbee-Dexter, K. (2021). Macroalgae blue carbon: knowledge gaps and opportunities. Keynote talk at the Blue Carbon session of the Association for the Sciences of Limnology and Oceanography 2021 Aquatic Science Meeting.

Gundersen, H. (2021). Tidevannseng og -sump – en ny men gammel naturtype i Norge. Presentation at Miljøfagkonferansen 2021, Trondheim, 21 October.

Gundersen, H., Rinde, E., Moy, S. and Borgersen, G. (2021). Are there salt marshes in Norway? Yes, there are! Presentation at the webinar Salt Marshes in the Nordic Region Miljødirektoratet, 8 June.

Hancke, K., Gundersen, H., Borgersen, G., d'Auriac, M.A., Kvile, K.Ø., Andersen, G.S., Bekkby, T., Krause-Jensen, D., Boström, C. and Frigstad, H. (2021). A Nordic blue forest carbon budget. Presentation at the Association for the Sciences of Limnology and Oceanography 2021 Aquatic Science Meeting, 24 June.

Karlsson, M., Gundersen, H. and Christie, H.C. (2021). The comeback of kelp: options for using and managing recovering kelp forests in northern Norway. Presentation at the side event The Value of Kelp at Arctic Frontiers 2021 conference, Tromsø, 27 January.

Norderhaug, K.M. (2021). Overfiske og kråkeboller. Invited speaker presentation at the Fjorden Kaller! conference, Oslo, 27 October.

Skjellum, S.F., Gundersen, H., Hancke, K., and Sander, G. (2021). Blå skog – hva nå? Contact meeting about blue forests with the Norwegian Environment Agency, 7 June.



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