Norwegian kelp forests: Ongoing and future research needs

NIVA – research for a substanable future

- NIVA has >30 years of experience with kelp forest studies
- Three sections with major research efforts linked to **kelp forest ecology**, **ecosystem services**, and the role of kelp in **climate mitigation** (>25 employs)
- NIVA is partner innumerous international and national networks related to Blue Forest and Blue Carbon economy

NFR Oslo, 1 March 2017 by Kasper Hancke, Hartvig Christie, Hege Gundersen, et al.



Images by SES and NIVA (Gitmark)

Major running kelp projects with NIVA involved: (has been many since 1990'es)

- **KELP-EX (NFR-marinforsk, 2016-18)** - Export of kelp biomass to the deep sea environments
- **KELPPRO (NFR-havbruk2, 2017-20)** – Environmental impacts from kelp industrial production
- **TARE (RFFNord, 2017-20)** – Restauration of kelp forest ecosystems
- **MERCES-WP3 (EU, 2016-20)** – Restauration of kelp and coastal reforestation
- **Nordic-IPBES (Nordic Council of Ministers/MDIR, 2016-18)** Biodiversity and ecosystem services in coastal ecosystems
- **Reduction of sea urchins and recovery of kelp beds (Framsenteret, 2016-18)**
- **Norwegian Blue Forest Network (Government budget, 2013-19)**
- **National mapping program (Ministry of Trade, Industry and Fisheries and Ministry of Climate and Environment, 2013-19)**
- **KelpFate (NIVA-GB, 2017)** Fate of kelp depositions for coastal ecosystems
- **RestoreFunctions (NIVA-SIS, 2017**) Methodology and knowledge for restoration of aquatic ecosystem functions
- **ECODOM (NIVA-SIS, 2016-17)** Effects of pCO2 and ocean darkening on kelp and urchins interactions

- Many minor regional and commercial funded projects

Research focus on: Kelp forest ecology, Kelp reforestation

67º50' N

Norwegian Sea

1990-2015
530 km

63º30' N

+ ocean warming

Processes:

- **Kelp forests are recovering**
- **Sea urchins decline**
- **Oceans warm**
- **Crabs increase**

North Sea

~8000 km2 of barren grounds potentially regrowth
- equivalent to a gain of **36 million tons CO_2** fixation

(Gundersen et al 2011, 2015)

Photo: KM Norderhaug


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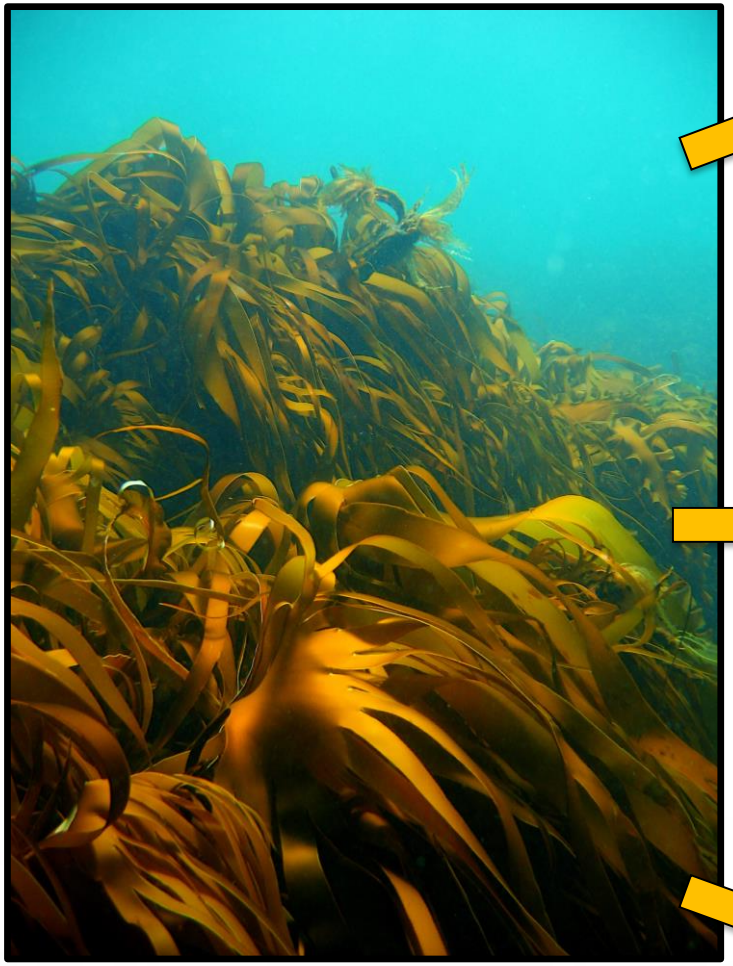
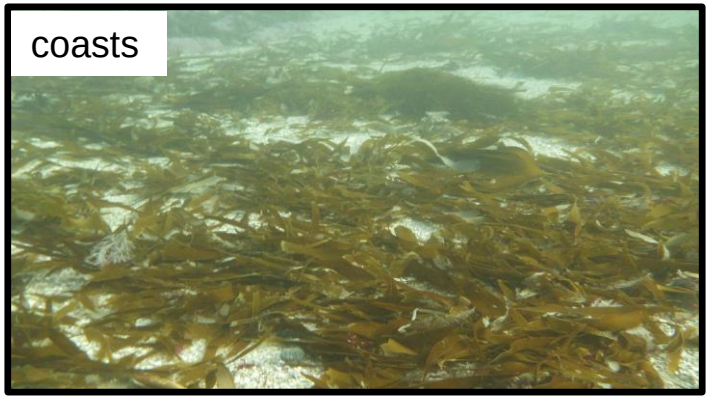
The carbon budget

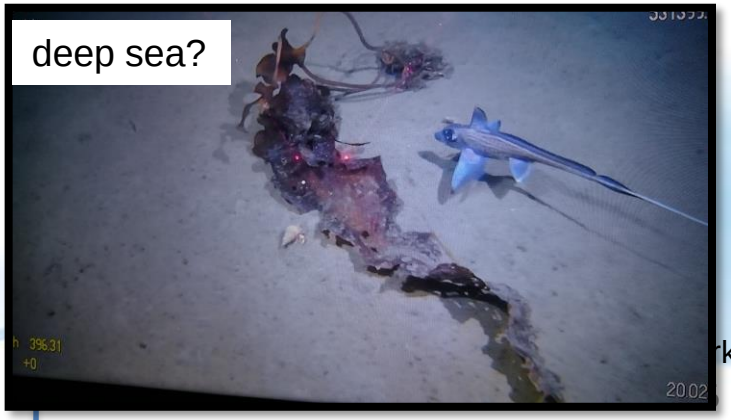
Production: 150 – 512 g C m^{-2}

(Krumhansl & Scheibling 2011)



Photographs: K. Filbee-Dexter and T Bakken



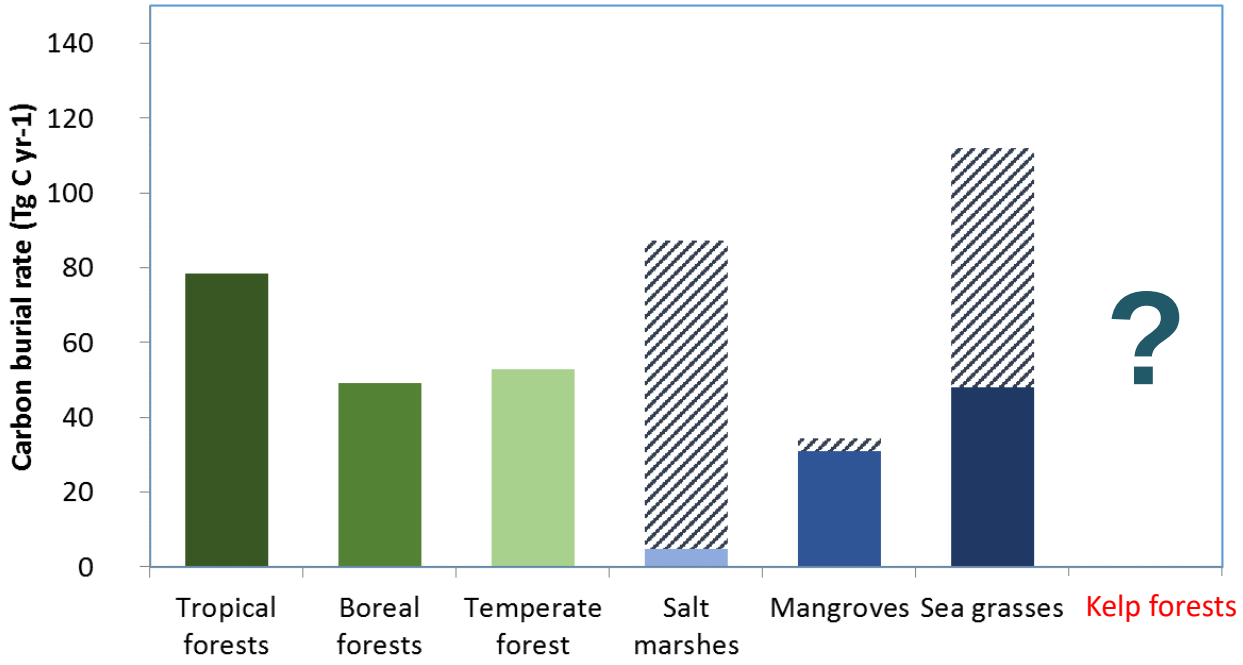


Blue carbon sinks are built by plants and trees (otherwise known as angiosperms such as mangroves, salt-marsh plants and seagrasses) but the coastal ocean also contains vast areas covered by algal beds. Most macroalgal beds (including kelp forests) do not bury carbon, as they grow on rocky substrates where burial is impossible.

Modified after Nellemann m.fl. 2009

Marine versus terrestrial carbon storage

Globally, the marine carbon sequestration is in scale with the terrestrial

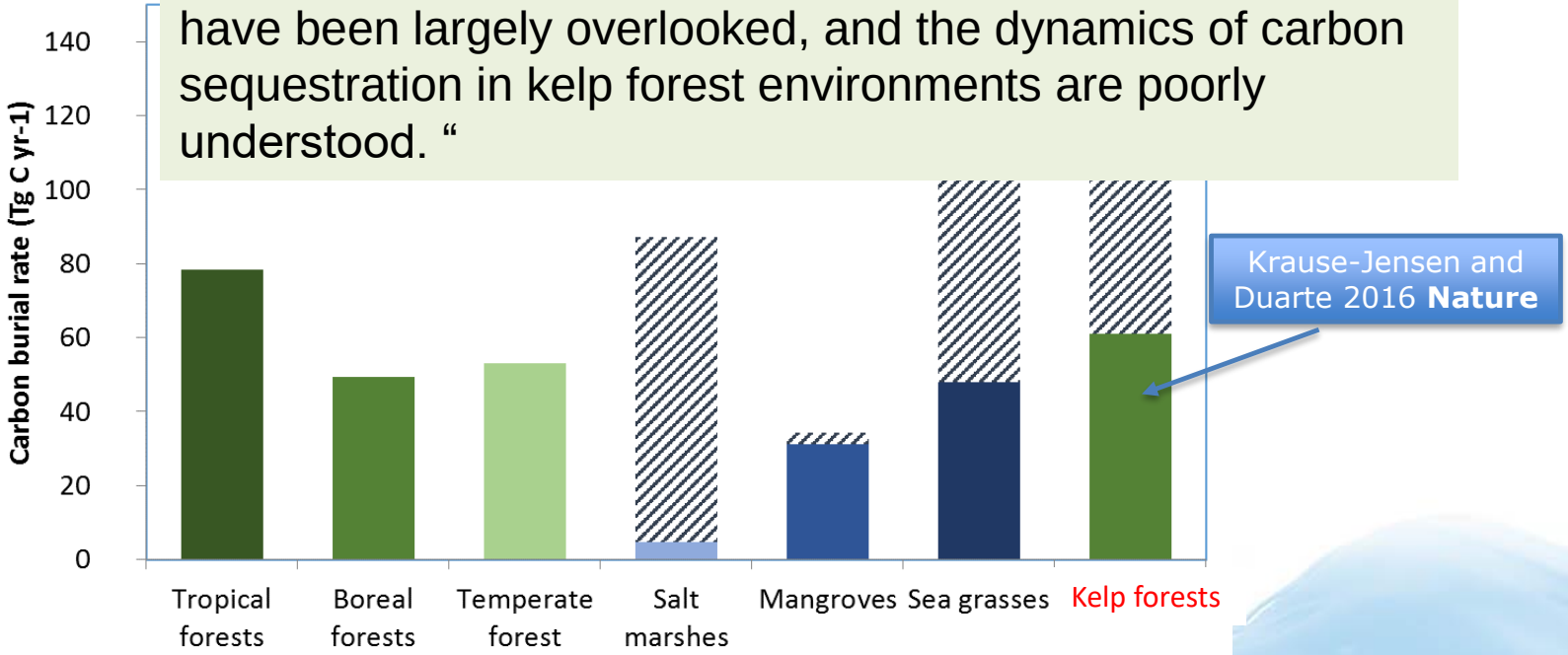


Data from McLeod m.fl. 2011

Marine versus terrestrial carbon storage

Globally, the marine carbon sequestration is in scale with the terrestrial

"The importance of KELP communities as carbon sinks have been largely overlooked, and the dynamics of carbon sequestration in kelp forest environments are poorly understood. "



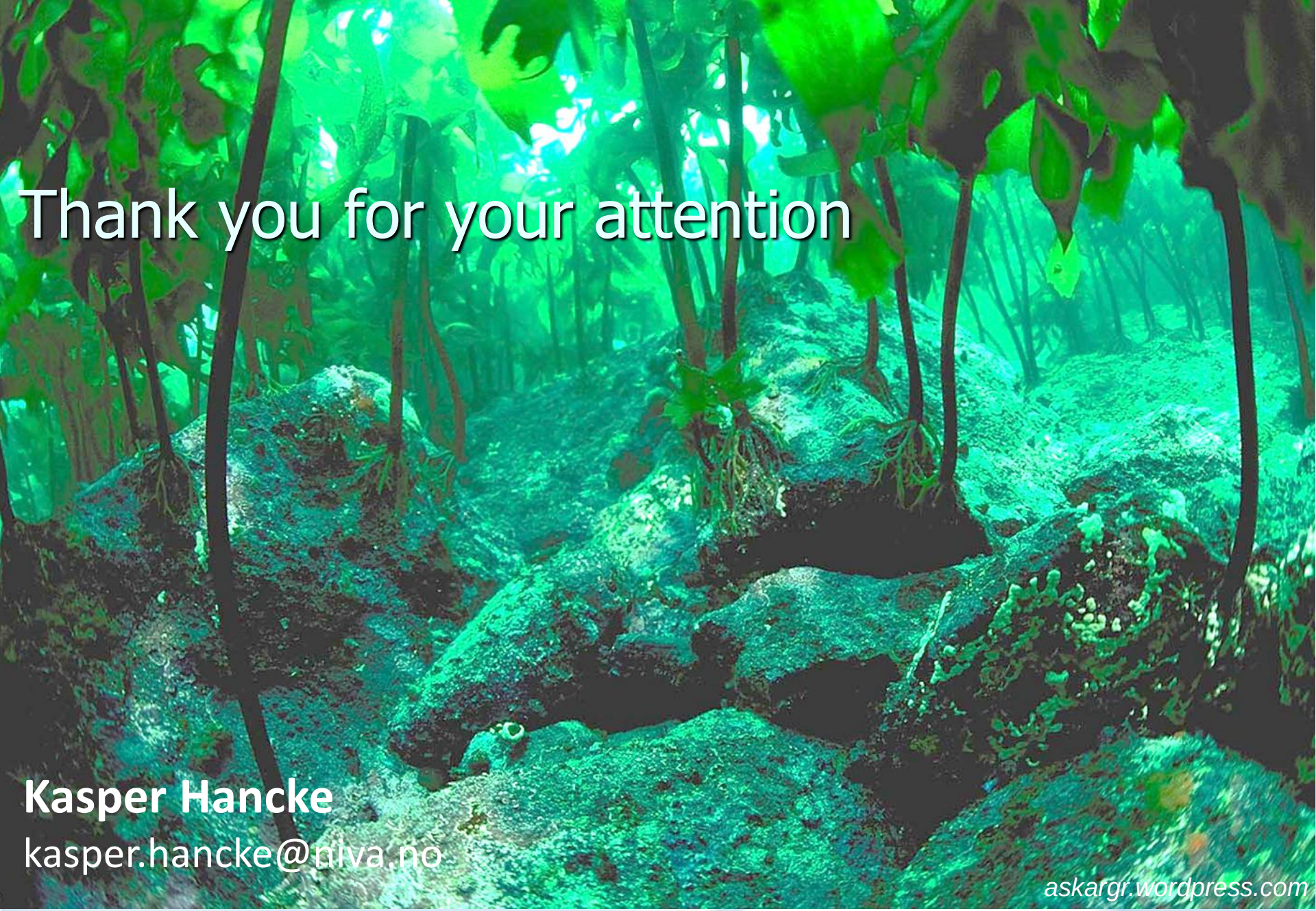
Data from McLeod m.fl. 2011 and Krause-Jensen and Duarte 2016

Benefit of reforestation

- Increased annual primary production (kelp biomass)
- Increasing biodiversity and secondary production
- Habitats for juvenile fish
- More harvestable fish and crabs

Future research needs

- Role of kelp forests in the ‘Blue Carbon’ budget
- Quantitative understanding of kelp carbon capture, turnover and sequestration
- CO_2 capture potential and dynamics
- Quantifying ecosystem services (tourism, harvest, fishery etc.)



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