Added values from the large-scale and long-lasting program for mapping marine habitats

Merverdi av storskala og langvarig innsats for kartlegging av marin natur

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Geological Survey of Norway (NGU)
Norwegian Institute for Nature Research (NINA)
SINTEF Ocean

The National program for mapping of marine habitats and key areas (2004-2019)

- Aims to provide local managers with maps (naturbase.no, kart.fiskeridir.no)
- Field mapping county-by-county (2007-2019)
- Habitats and key areas selected for mapping and valuing

Funded by: The Ministry of Climate and Environment (KLD) and the Ministry of Trade, Industry and Fisheries (NFD)
Mapping by: NIVA, IMR and NGU

Added values and spin-offs

The program has developed methodology for mapping and modelling and sampled data used to more than just producing maps. Here we will present some of the spin-off projects and results.

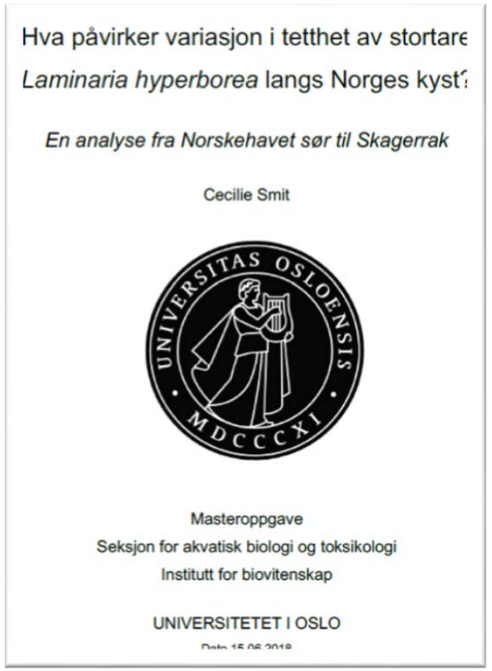
Added values and spin-offs

Data sets	Methodology	Publications/science

• Kelp coverage, height
• Kelp assoc. epiphytic algae
• Eelgrass coverage and bed structure
• Carbonate sand deposits
• Oyster beds
• Scallop beds
• Fish egg densities
	• Protocols for sample design and field work
	• SDM methodology (substrate, kelp, fish spawning grounds)
	• Delineation techniques
	• Drone based image analyses
	• Valuation criteria
	• DNA methodology for egg species and egg development stage identification
		• Seagrass
		  • Changes in the distribution
		  • Distribution, structure and function
		• Kelp – sea urchins dynamics
		• Environmental conditions
		  • The ecological relevance of different wave exposure models
		• Oyster beds
		  • Larvae drift and distribution of Pacific oyster
		• Fish
		  • Finding cod egg development stages based on DNA
		• The effect of scale and quality
		• Etc.

The impact of environmental variables on kelp coverage

Master thesis (UiO): Coverage of *Laminaria hyperborea* kelp (canopy) along the Norwegian Sea, the North Sea and the Skagerrak coast against terrain and environmental variables


Hva påvirker variasjon i tetthet av stortare *Laminaria hyperborea* langs Norges kyst?

En analyse fra Norskehavet sør til Skagerrak

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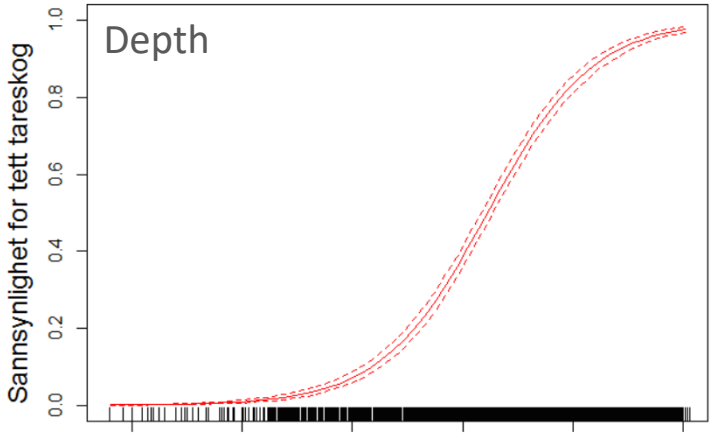
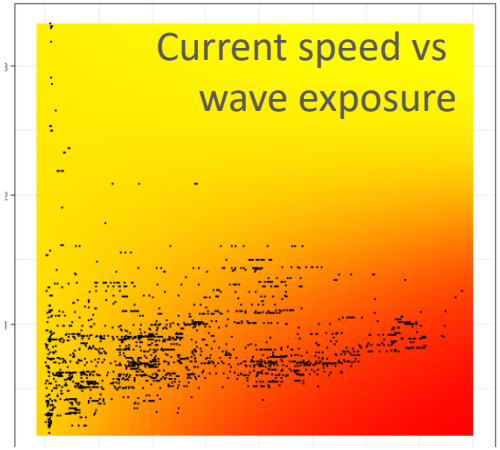
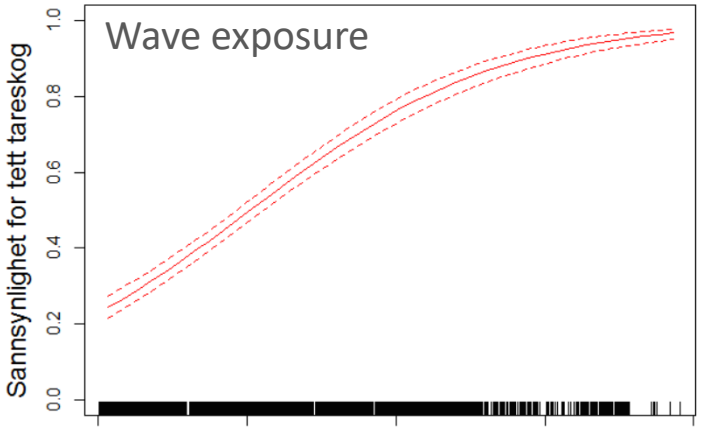
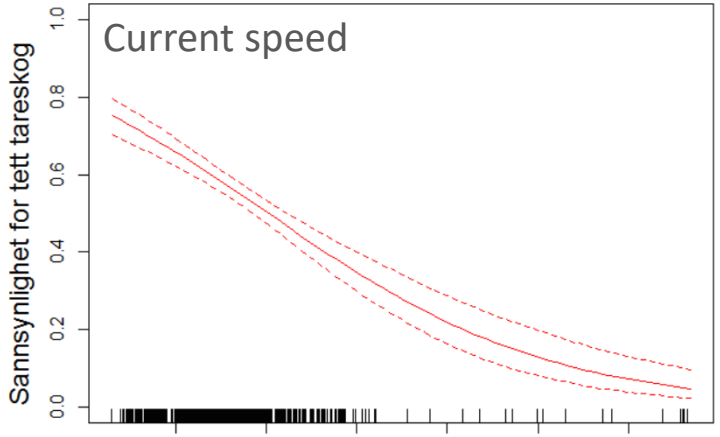
UNIVERSITETET I OSLO

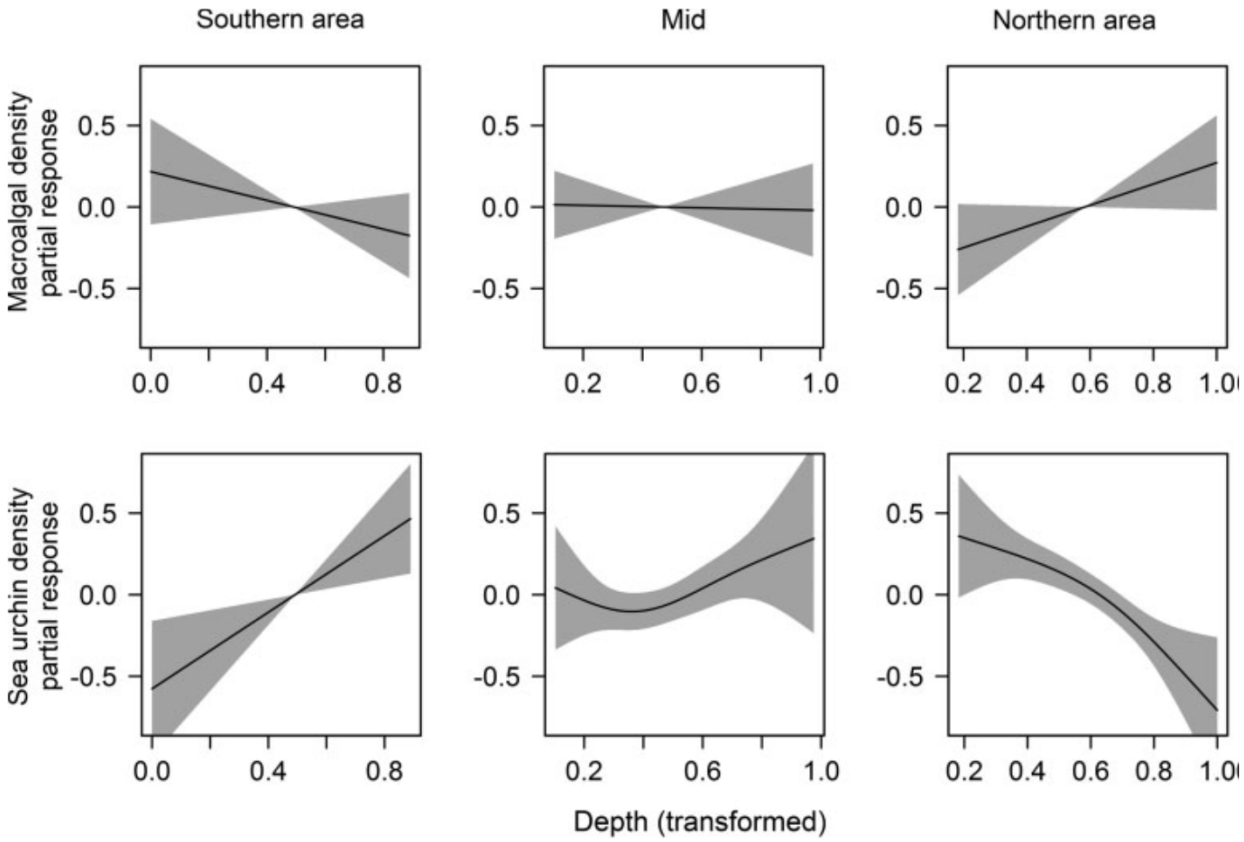








Red sea urchins, environmental variables and kelp associated epiphytic algae

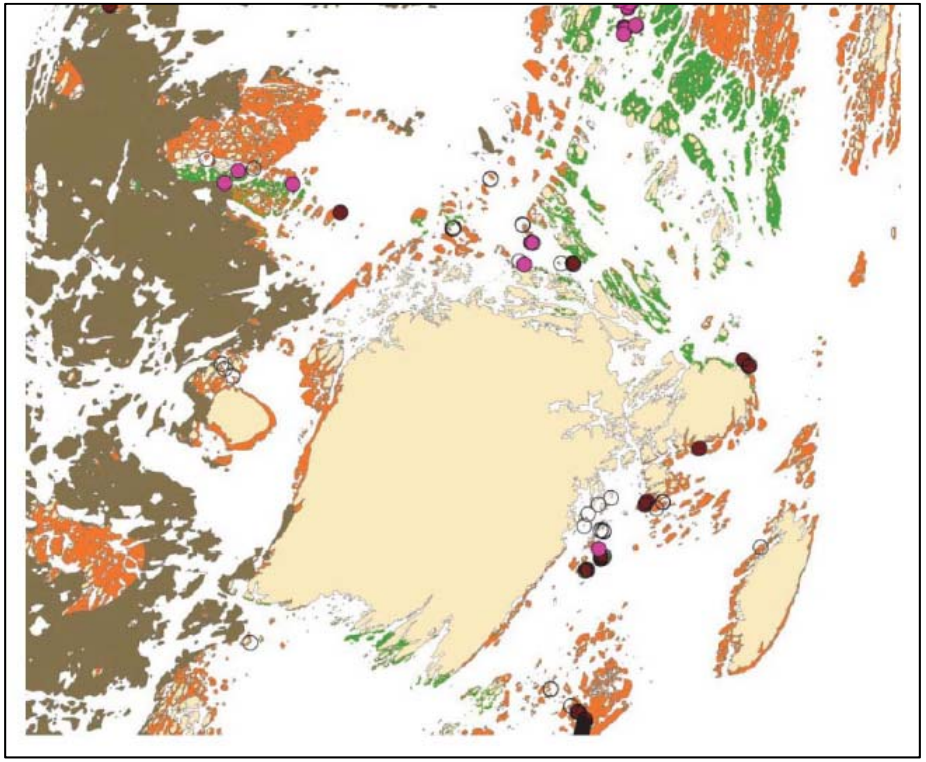


The impact of red sea urchins (*Echinus esculentus*) and environmental variables on kelp (*Laminaria hyperborea*) stipe associated epiphytic algae coverage

Bekkby T, Angeltveit G, Gundersen H, Tveiten L, Norderhaug KM. 2014. Marine Biology Research 11: 375-384

Methods for distribution modelling

Modelling carbonate sands deposits, kelp forests, seagrass sampling design, etc..



Predicted kelp recovery and sea urchin persistence

Orange = Kelp recovery

Green = Sea urchin persistence

Brown = Areas that have never been grazed

Spin-off example

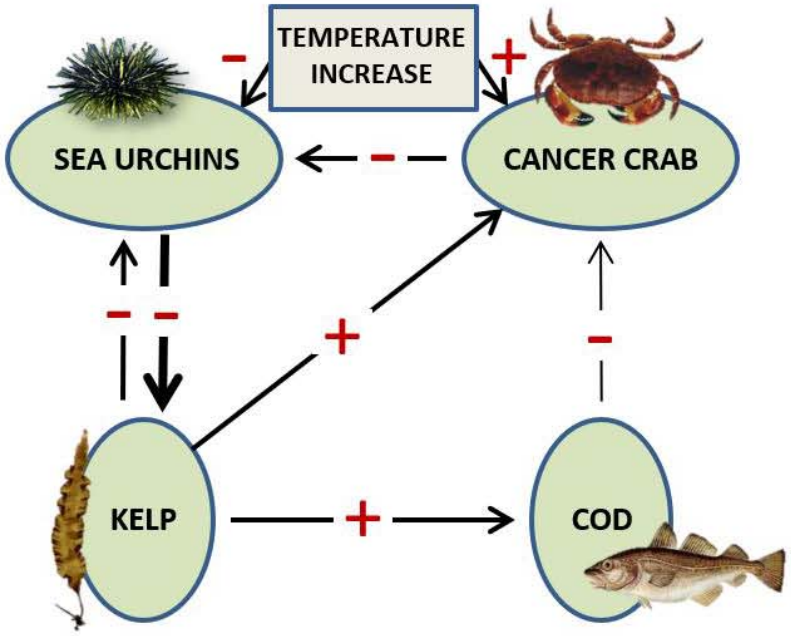
Models on environmental conditions and distribution of kelp (*Laminaria hyperborea*), sea urchins (*Strongylocentrotus droebachiensis*) and areas of recovery

Rinde E, Christie H, Fagerli CW, Bekkby T, Gundersen H, Norderhaug KM, Hjermann DØ. PLoS ONE 9:e0100222

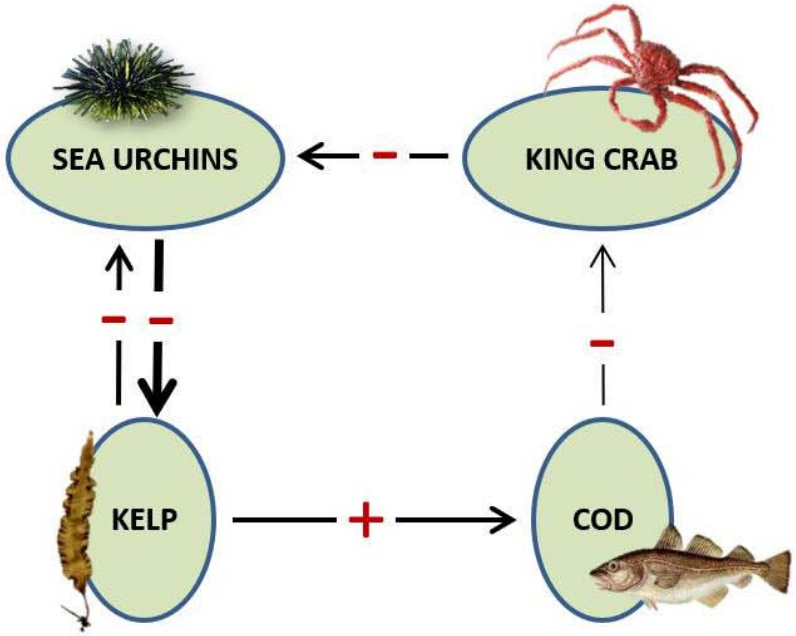
Multitrophic interactions, temperature increases and the recovery of kelp

Cod and crab impacts the sea urchin – kelp dynamics and thereby the recovery potential of kelp forests.

Southern kelp recovery area



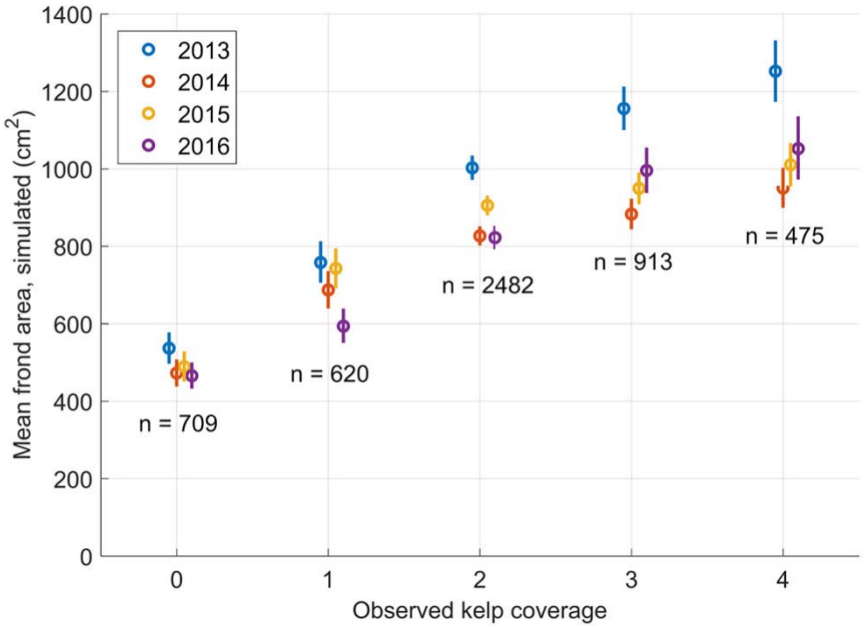
Northern kelp recovery area

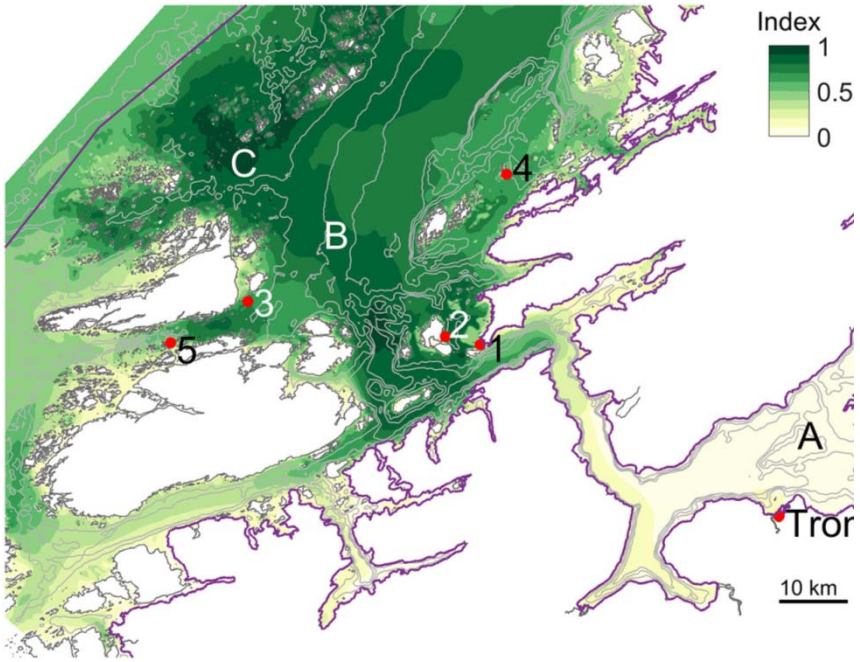


Christie, Gundersen, Rinde, Norderhaug, Fagerli, Bekkby, Gitmark, Jørgensen, Pedersen. 2019. Ecology and Evolution. DOI: 10.1002/ece3.4963

The potential for kelp farming in Norway

Spatial index for the cultivation potential of *Saccharina latissima* kelp





Broch, Alver, Bekkby, Gundersen, Forbord, Handå, Skjermo, Hancke. 2019. Frontiers in Marine Science 5:529

Summing up

The program had a communication plan (mainly for media)
The program had **no** publication plan
Most of the science came from *ad hoc* plans and "accidental" findings

TOTAL: 398 items presenting the program

- In media: > 170
- Reports and peer-reviewed papers: 71
- Presentations: 118
- Posters: 10
- Blog/Other: 28

Lessons learned

- Policy makers want their products to be **quality assured** – peer-reviewed publication ensures that
- Programs/projects we know will go on for years should have a **binding funding plan** so that students (both Masters and PhDs) can be involved
- All large-scale and long-term program should have an *a priori* **plan for scientific publication** and have funding for this
- Scientists will search for scientific questions to answer in every task