



4th Nordic Conference on Climate Change Adaptation, Bergen, 28-30 August 2016

Co-production of Ocean Acidification knowledge for adaptive co-management of the coastal zone.

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Today's presentation

1. Ocean Acidification in brief
 1. what is it and why is it a problem
 2. dealing with coastal OA – the perils of silo governance of the coastal zone

2. Research Objectives & Design
 1. theoretical perspectives
 2. cases

3. Where are we?

Ocean acidification – the other CO₂ story

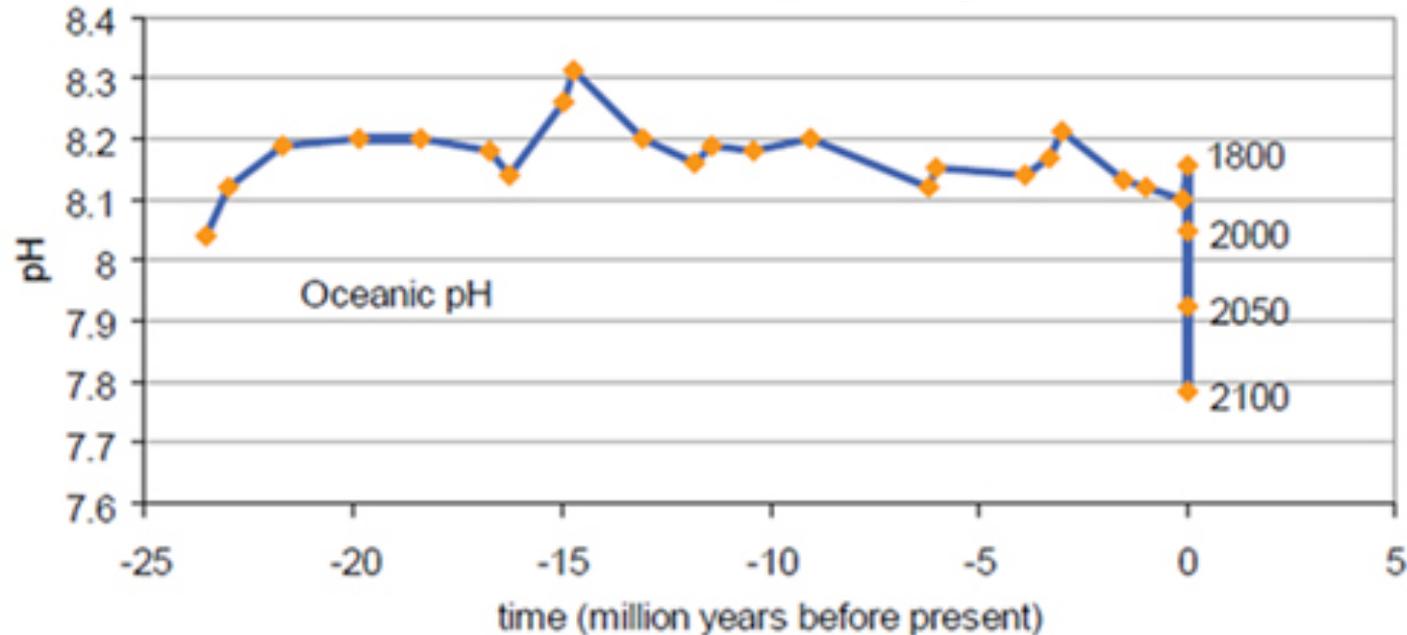


Figure 1. Past and contemporary variability of marine pH. Future predictions are model derived values based on IPCC mean scenarios (from Turley *et al*, 2006. Cambridge University Press, 8, 65-70).

- Projected oceanic pH values for 2050 are lower than for the last 25, probably 55 million years
- Present rate of pH decrease is likely unprecedented in the last 300 million years (Honisch *et al.*, 2012)

OA projections for Norway

Regional ocean climate
modelling with SINMOD

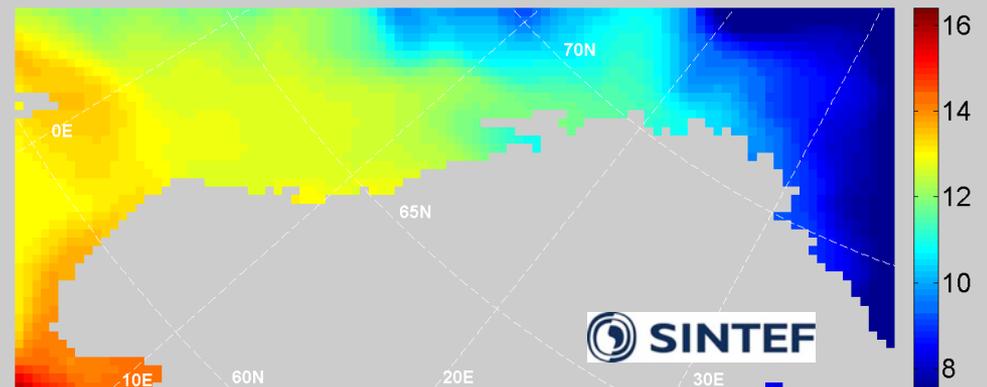
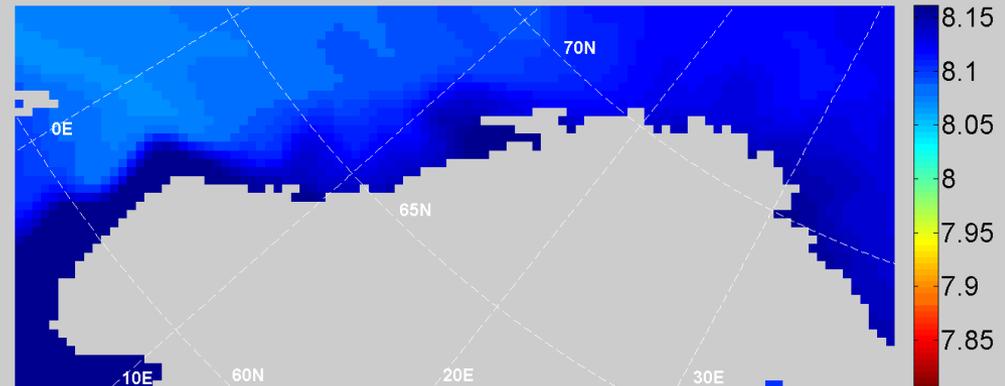
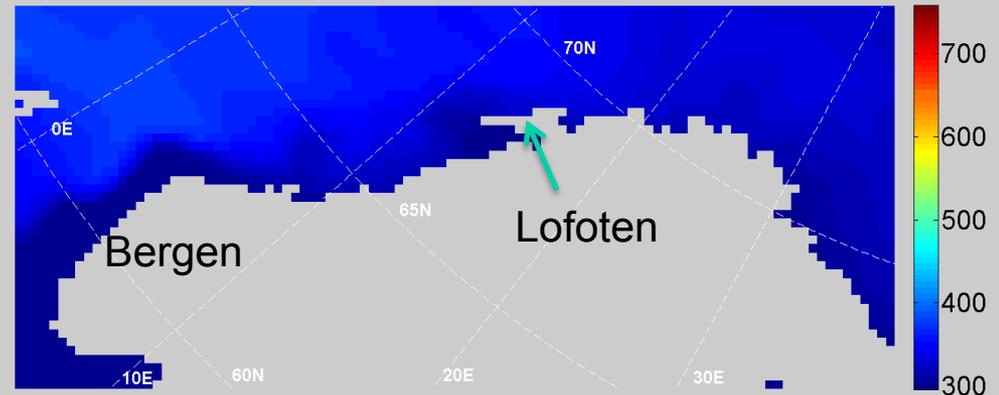
Slagstad et al., 2005, 2011, 2015

SINMOD surface ocean pCO₂
roughly doubles over the century,
reaching ~500 uatm by 2050 and
~700 uatm by 2100.

Surface ocean pH drops by ~0.2
to around 7.95 by 2050 and by
~0.3 to around 7.85 by 2100.

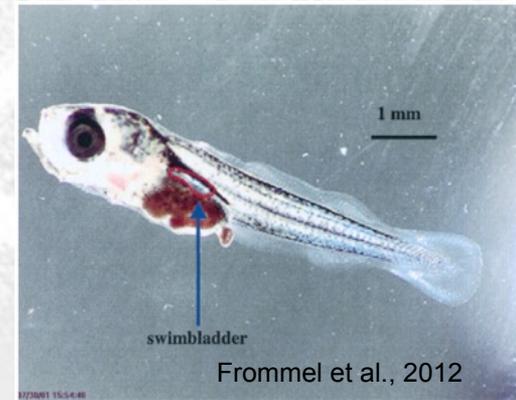
Acidification occurs in tandem with
ocean warming by ~2 degC by
2050 and ~3 degC by 2100.

=> **Multiple stressors**



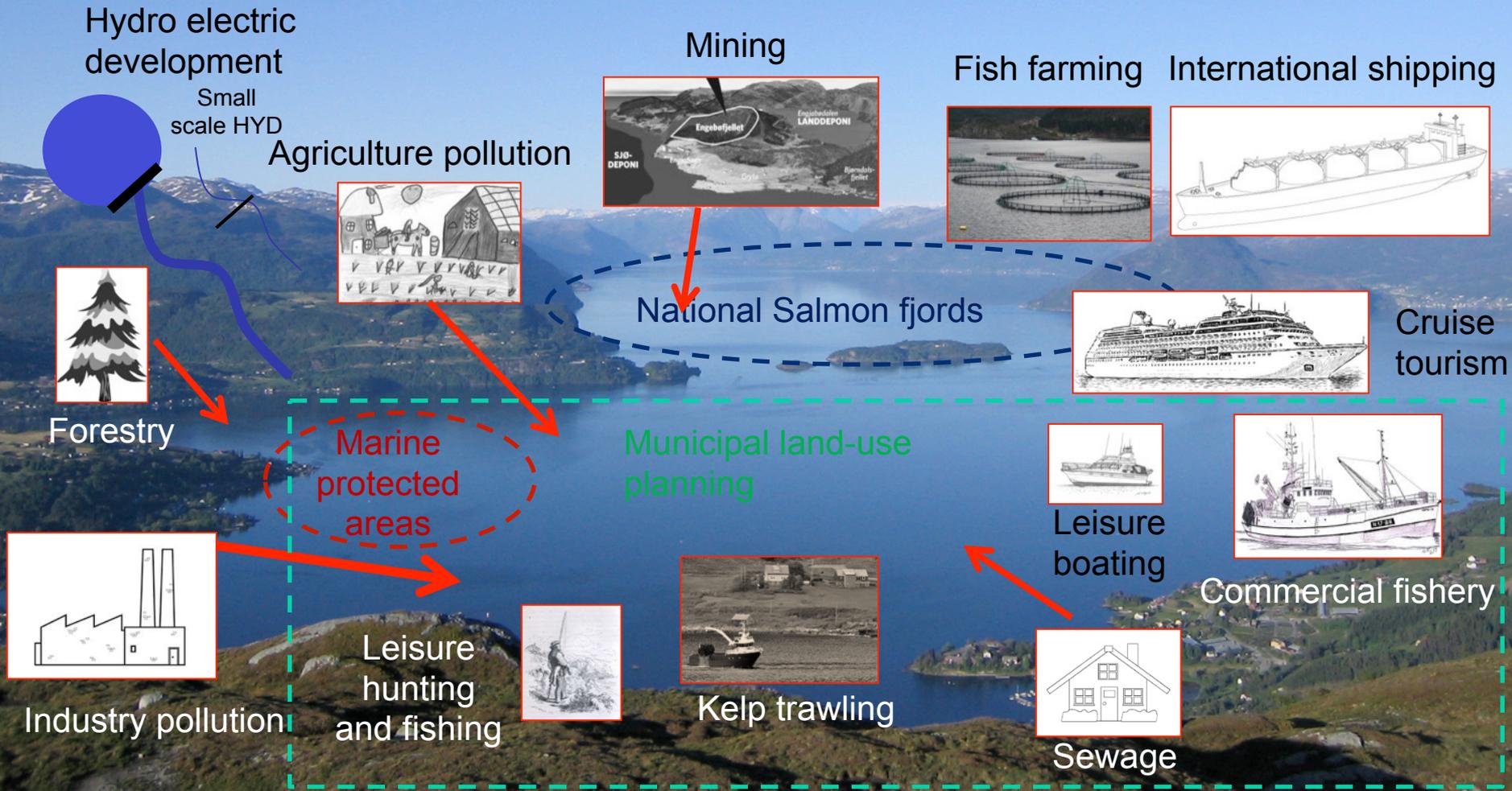
OA impacts and multiple stressors

- **OA could:**
 - Negatively affect cod larvae
 - Increase harmful algae bloom
 - Benefit kelp growth (and farming)
 - Reduce cold water corals
- **OA levels and impacts unknown in coastal regions**
- **Interacts with other stressors & ocean warming**



Activities that impacts the coastal system

(at least – some of them!)



The public Coastal Zone Management actors

- aiming at Integrated Coastal Zone Management, but stuck in silos?

Government actors

1. **The county governor:** supervises and checks municipal plans; approves aquaculture permits, approve discharge permits, control pollution levels.
2. **The county council:** Coordinat local and regional planning authorities; regional coastal zone plans, approve aquaculture permits
3. **Directorate of fisheries:** Approves municipal plans, approves aquaculture permits, manage fisheries
4. **The Coastal Administration:** Approves municipal plans, approve aquaculture permits, manages coastal public infrastructure
5. **The Food Authority:** Approves aquaculture permits
6. **Norwegian Water and Energy Directorate:** Manages rivers, hydropower and flood protection.
7. **EU Water directive:** requires action if water quality is critical

+ several more

Marine spatial planning = municipal spatial planning

The marine part of the municipal spatial plan can regulate most marine spatial activity and measures that affect the coastal zone.



Municipal land-use plan

Objectives

Understand how coastal zone governance and management can effectively respond to ocean acidification (OA).

1. Increase our knowledge and understanding of how OA may impact coastal areas in Norway.
2. Make OA an governable policy issue through development of boundary arrangements for co-production of OA knowledge.
3. Assess the benefits of adaptive co-management for governing OA impacts through studying existing coastal zone management.
4. Contribute to new models for adaptive coastal zone management.

Methods & approach

- Stakeholder involvement throughout project (multiple workshops, data sampling by users, interviews)
- OA measurements and modelling (marine science WP)
- Assessment of current coastal management (litt review + interviews)
- Knowledge exchange with Scotland through workshops.



Photo: I. Husabø



Photo: E. Yakushev

Adaptive Co-Manangement

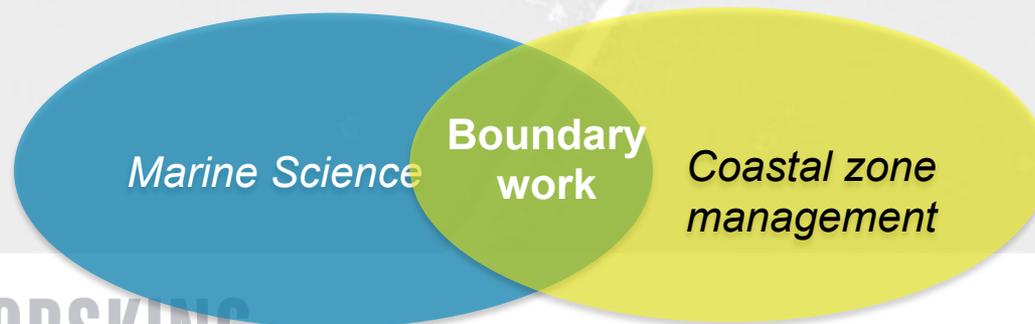
includes:

- **adapting to new knowledge, new uncertainties and new challenges that arise from OA and climate change**
- **making use of multiple perspectives and knowledge forms, focus on social learning, learn from mistakes and experiences**
- **flexible governance networks with varying degree of formal institutionalization**
- **the combination of multiple perspectives and co-production and generation of knowledge through iterative learning**

(Armitage et al. 2007, Plummer and Baird 2013)

Producing knowledge for sustainable development

- new insights generated by science do not automatically result in better policy
- For knowledge to result in action it must be *credible, salient and legitimate* (Cash et al. 2003)
- Requires *communication, translation and mediation*



The cases

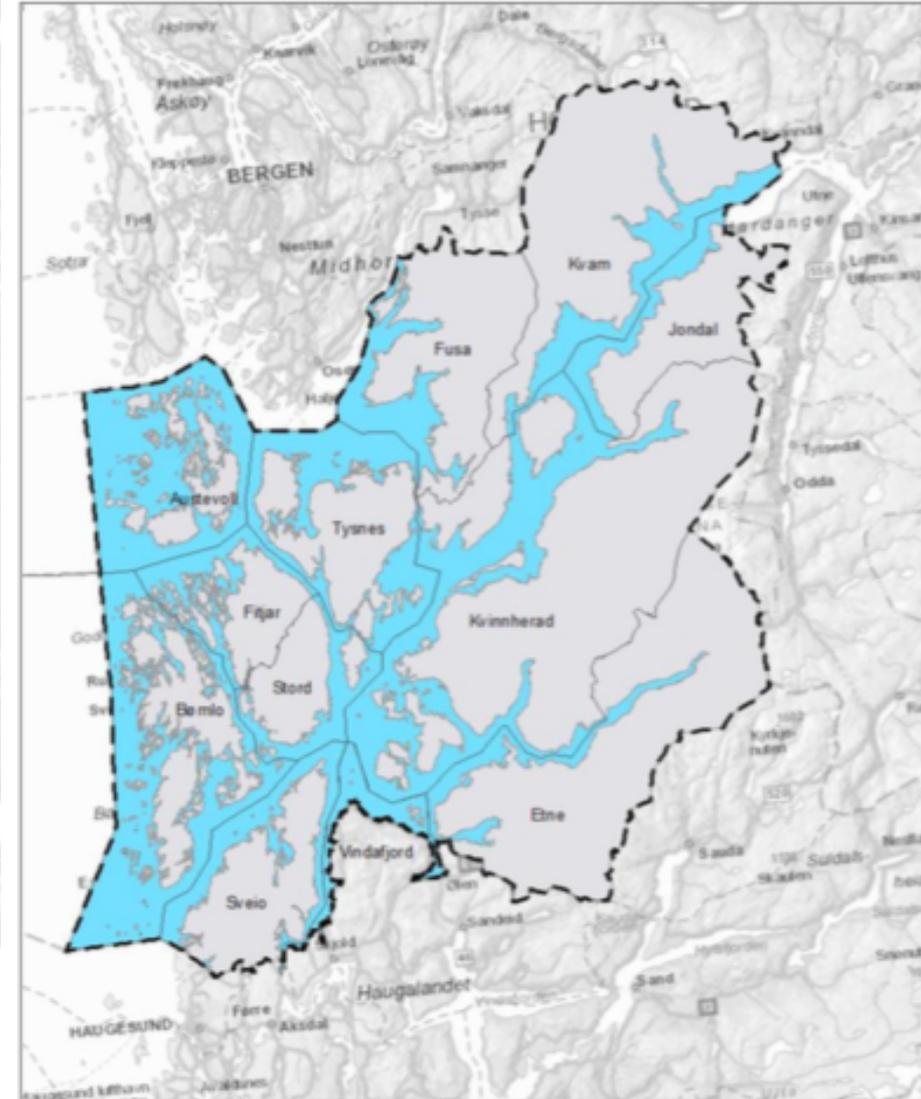
Sunnhordland and Lofoten

+ knowledge exchange
with a Scottish case

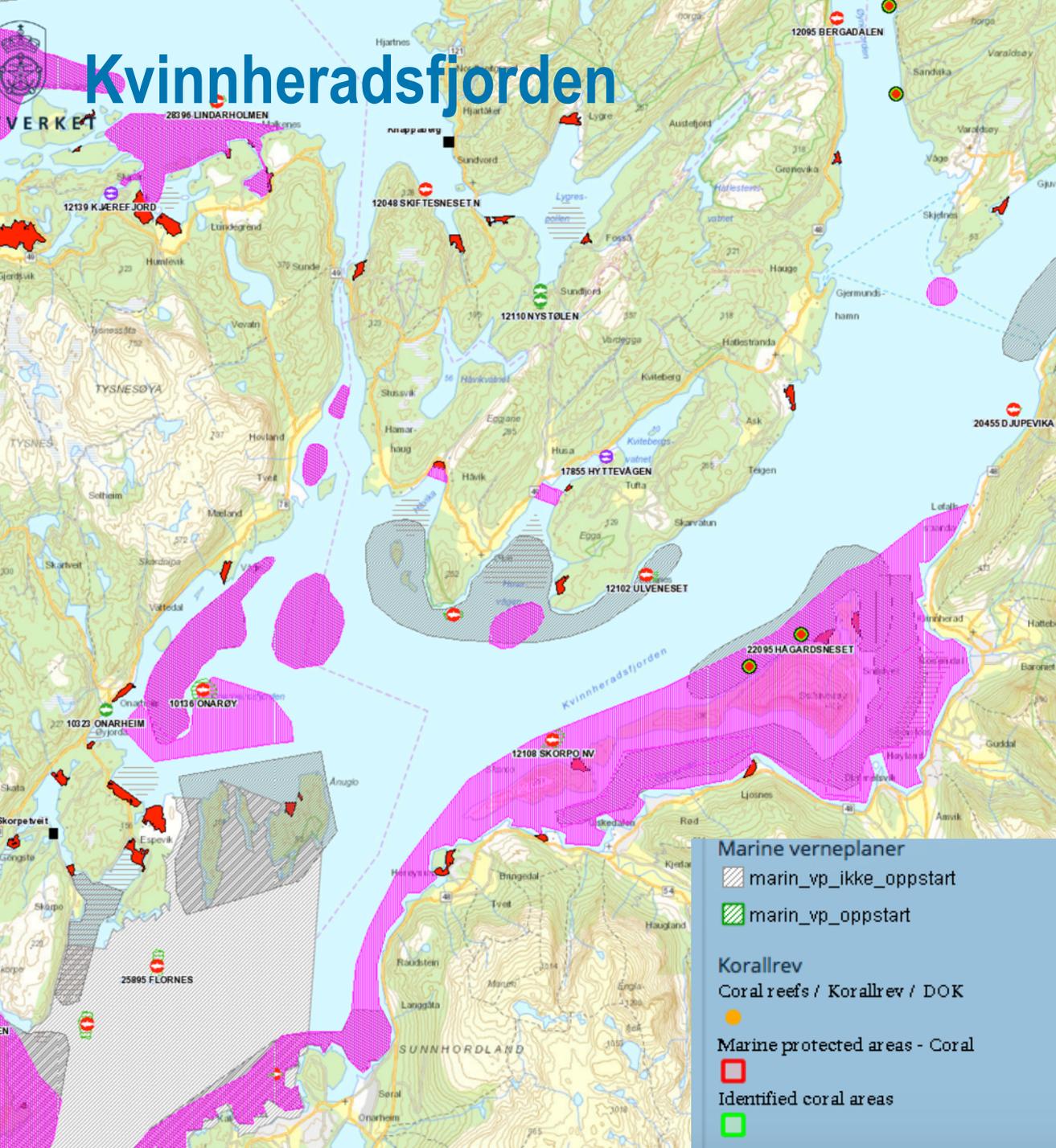


Sunnhordland

- **Regional coastal zone plan currently under approval.**
- **Competing user interests**
- **Highest density of aquaculture in Norway**
- **Two sites designated for future Marine Protected Area**



Kvinheradsfjorden



Akvakulturanlegg med innehaver

- Matfisk laks, ørret, regnbueørret
- Stamfisk laks, ørret, regnbueørret
- Settefisk laks, ørret, regnbueørret
- Andre arter
- Slaktemerd
- Bløtdyr, krepserdyr, pigghuder
- Forskning, undervisning, visning

Akvakultur - flater

- Akva flate fra klarerte ytterpunkt

Sjølaksefiskeplasser

- Innmeldt i Finnmarkseiend.
- Godkjent
- Innmeldt
- Godkjent i Finnmarkseiend.

Fiskeplasser aktive redskap

- Fiskeplass - aktive redskap

Fiskeplasser passive redskap

- Fiskeplasser - passive redskap

Fiskerihavner

- Fiskerihavner
- Fiskerihavn

Låsettingsplasser

- Låsettingsplasser

Gyteområder

- Gytefelt

Marine verneplaner

- marin_vp_ikke_oppstart
- marin_vp_oppstart

Korallrev

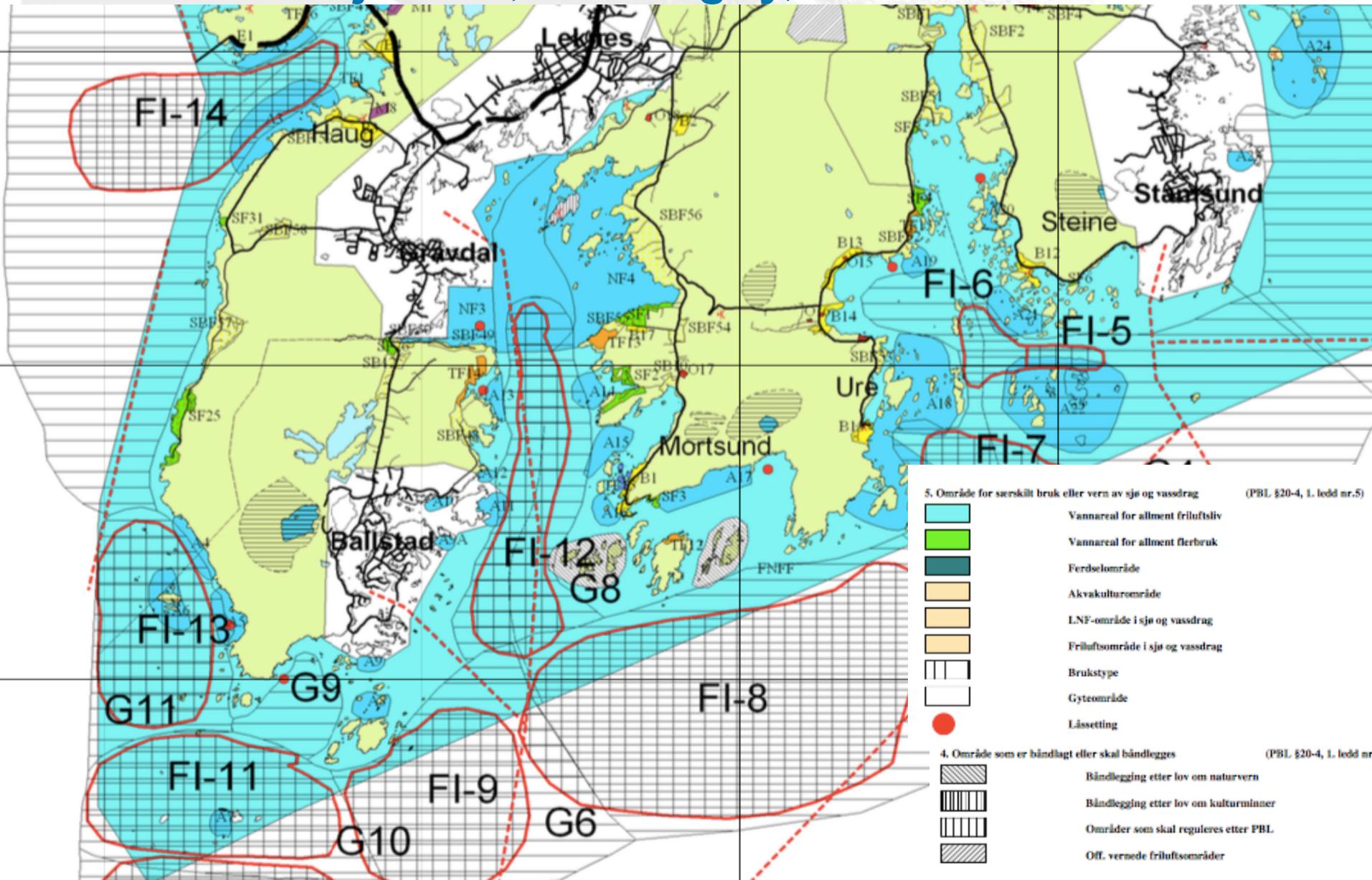
Coral reefs / Korallrev / DOK

- Marine protected areas - Coral

Identified coral areas

- Identified coral areas

Buksnesfjorden, Vestvågøy, Lofoten



Issues and challenges identified through three stakeholder input workshops

- **Pinpointing of case study sites, incl OA sampling sites**
- **Importance of piggy backing on the regional Water directive work**
- **Prospects for kelp production should be investigated**
- **Challenging to establish regional coastal zone plans.**
- **Aquaculture industry need to get more knowledge of OA impact, particularly regarding wild salmon smolt.**

Next stage

- **Establish user water sampling routines and initiate.**
- **Get OA modeling scenarios for the case study sites.**
- **Analyze the current coastal zone management system and assess potential to cope with OA.**
- **Prepare second round of stakeholder workshops for discussing OA scenarios.**



Thank you for listening!

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