



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 CO<sub>2</sub> story

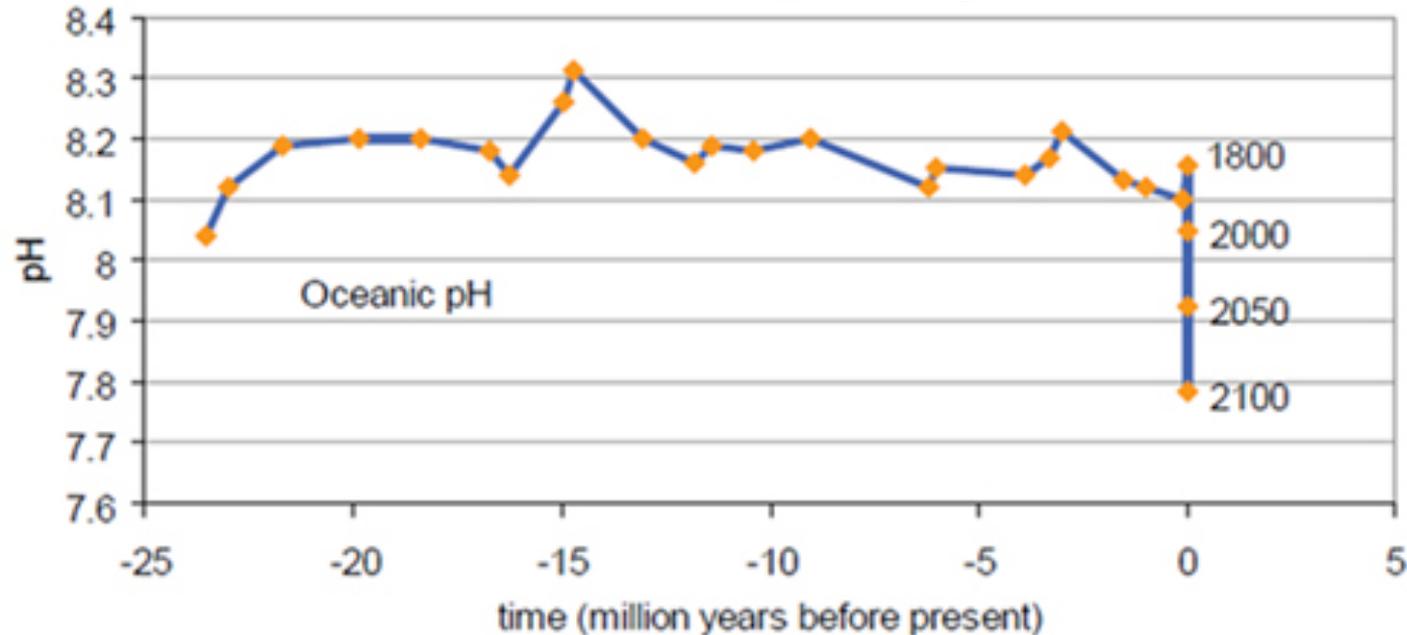


Figure 1. Past and contemporary variability of marine pH. Future predictions are model derived values based on IPCC mean scenarios (from Turley *et al*, 2006. Cambridge University Press, 8, 65-70).

- 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

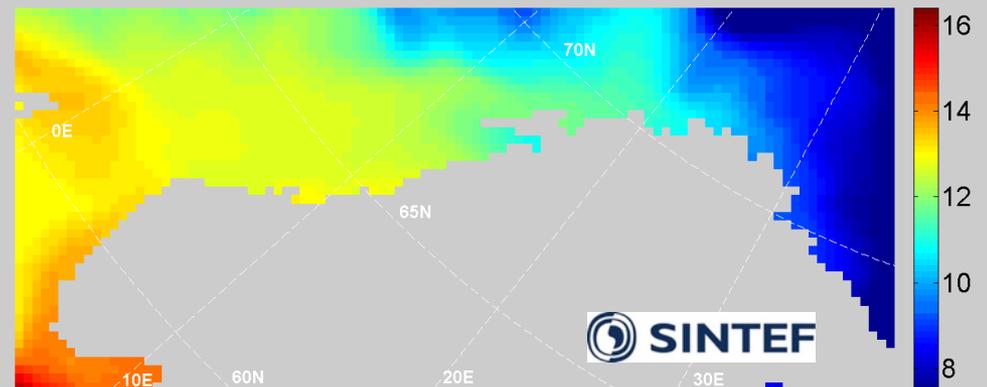
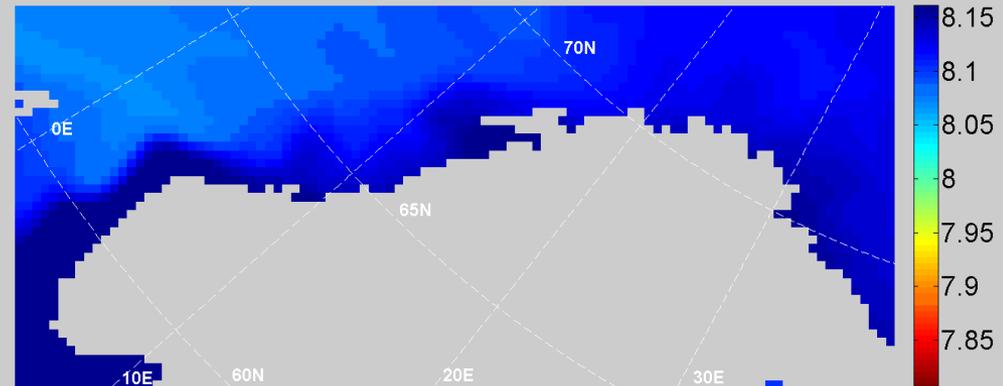
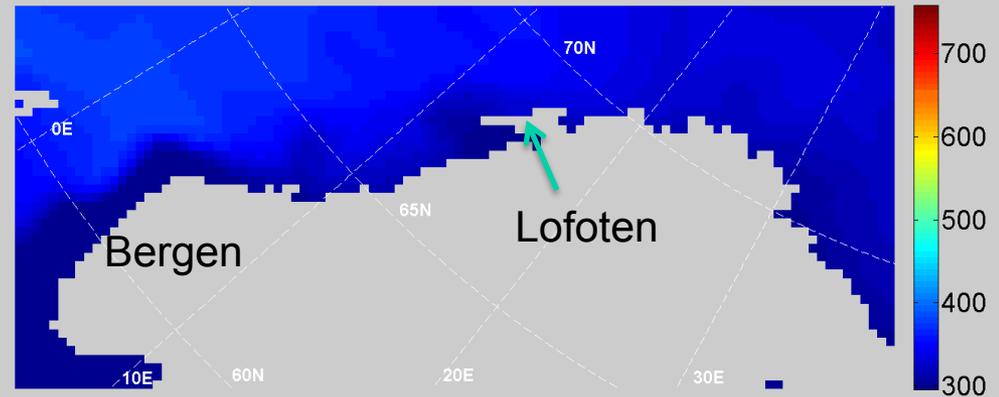
*Slagstad et al., 2005, 2011, 2015*

SINMOD surface ocean pCO<sub>2</sub>  
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.

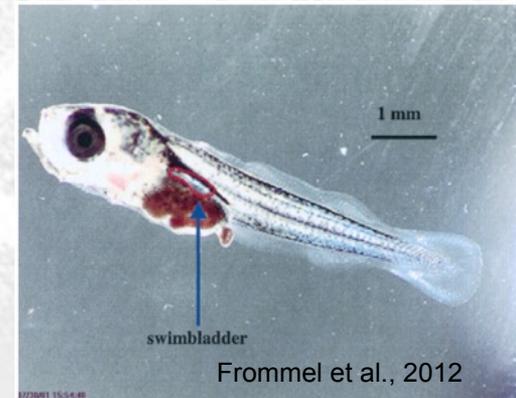
Acidification occurs in tandem with  
ocean warming by ~2 degC by  
2050 and ~3 degC by 2100.

=> **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

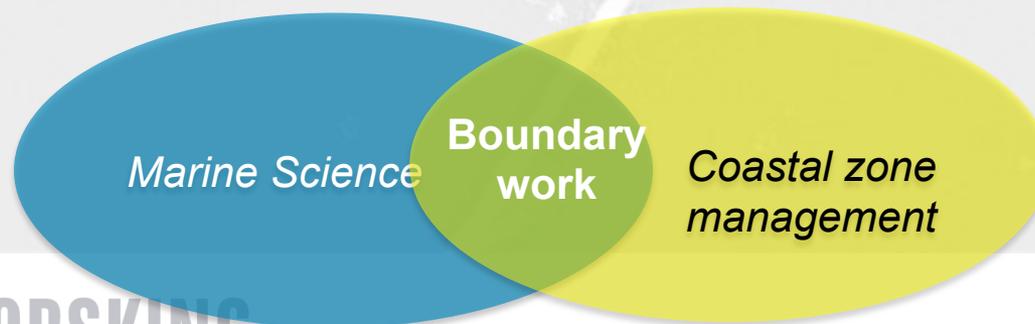
*includes:*

- **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

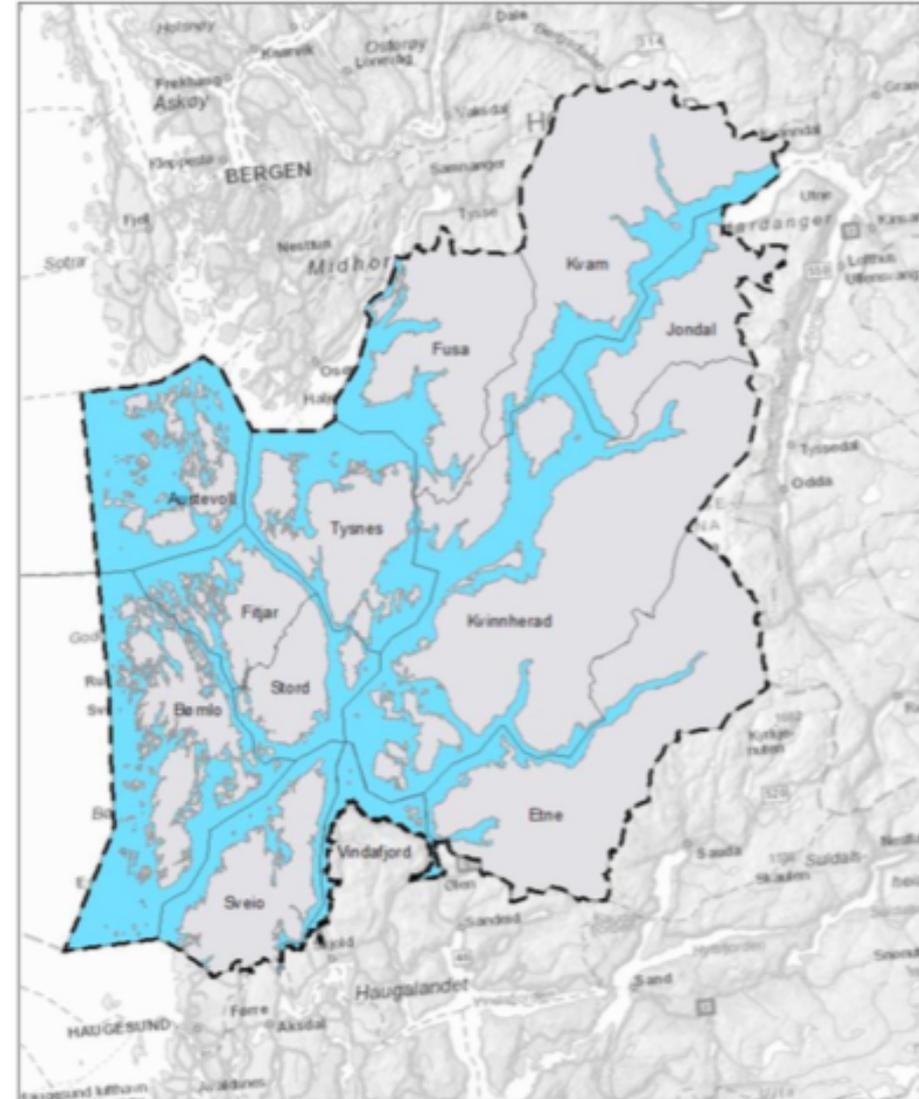
## Sunnhordland and Lofoten

+ knowledge exchange  
with a Scottish case

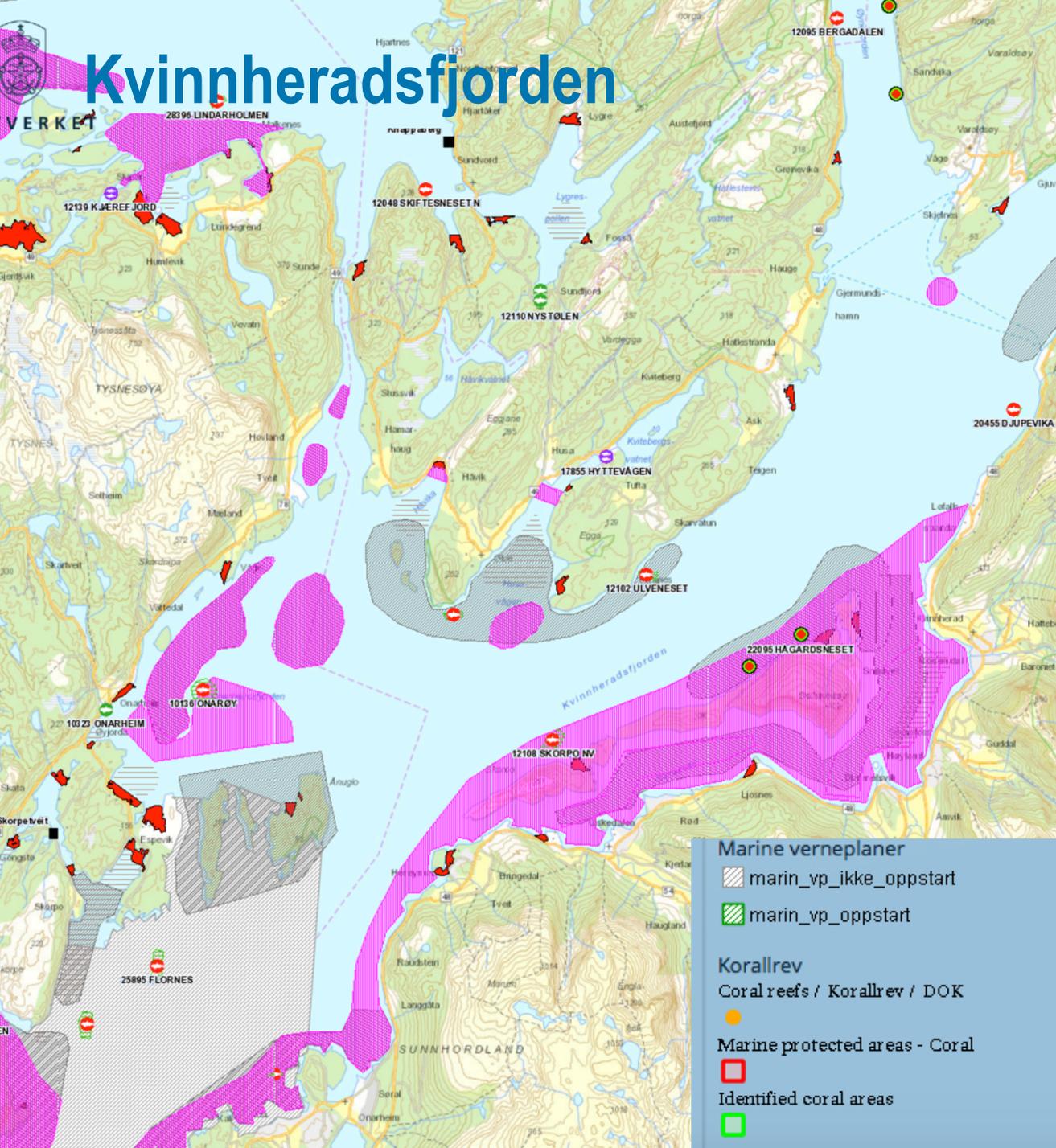


# Sunnhordland

- **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, krepser, 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

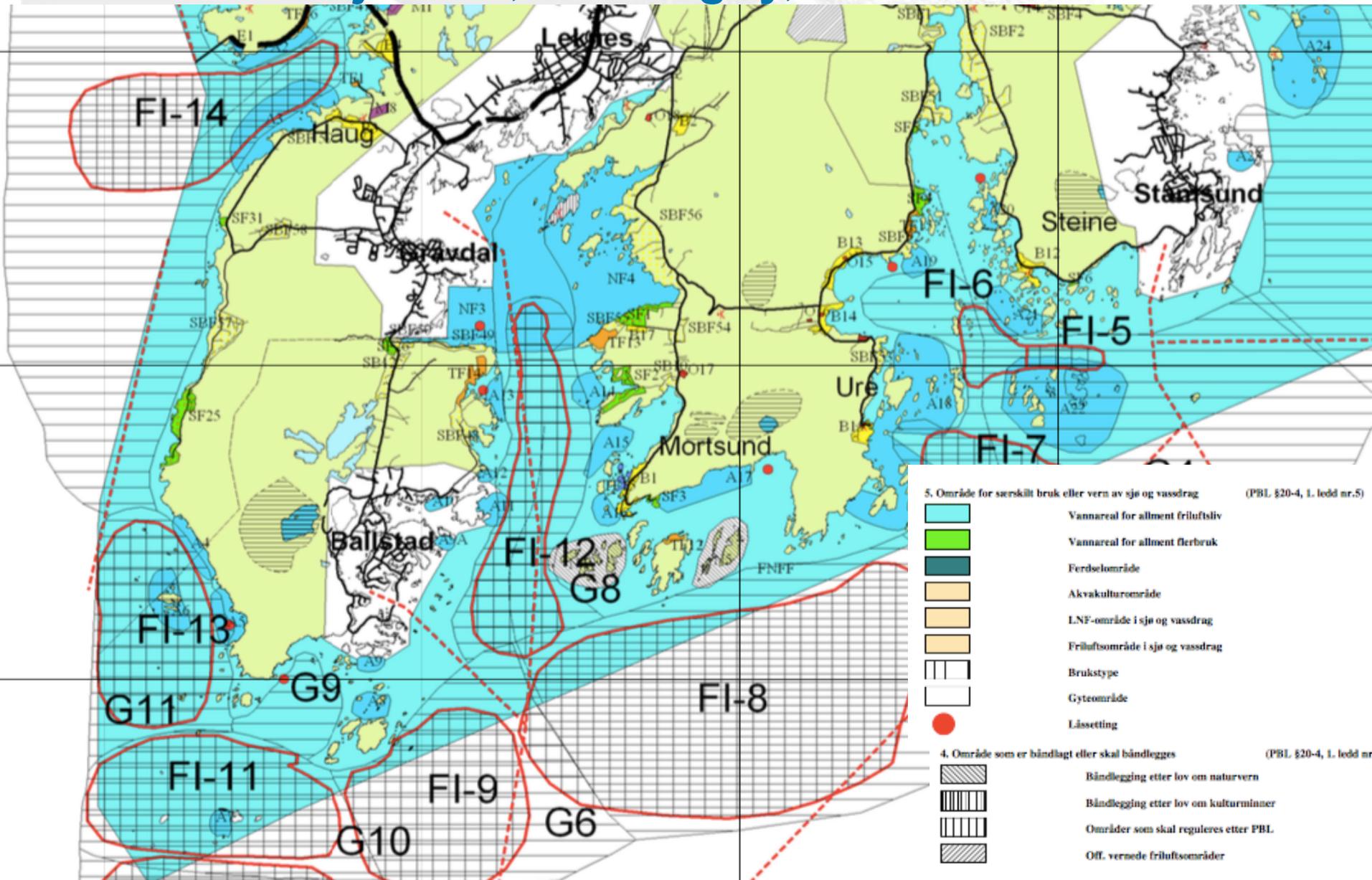
Coral reefs / Korallrev / DOK

- 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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