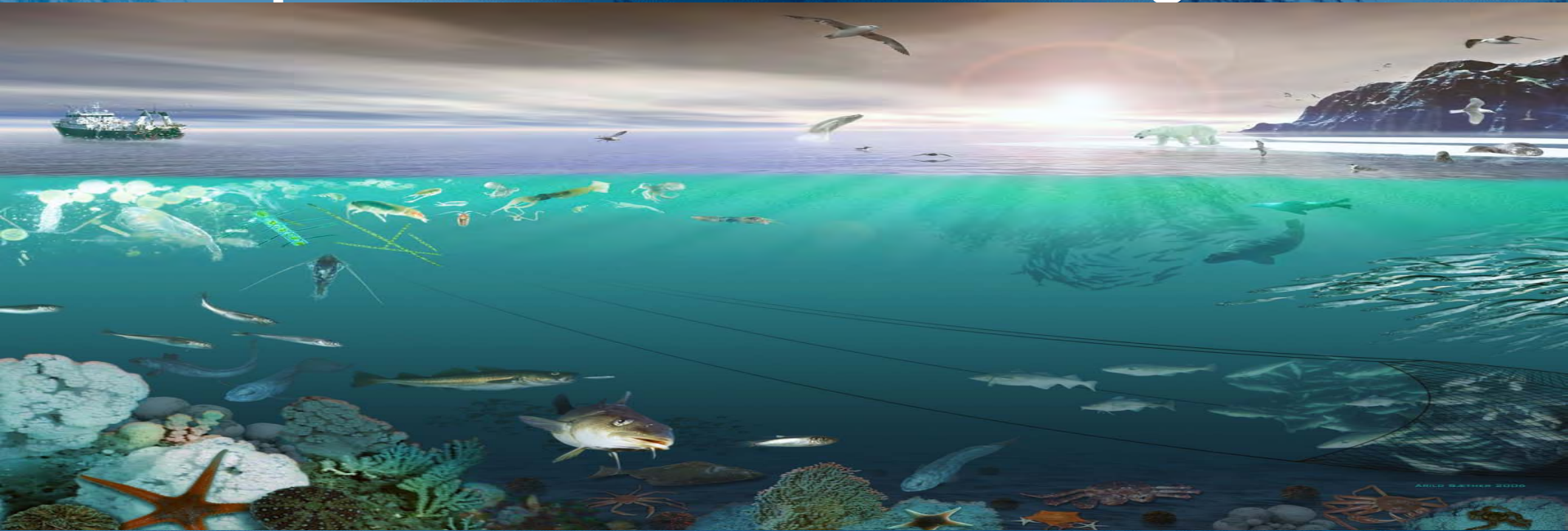


Major human activities affecting Norwegian coastal marine ecosystems; present status and challenges



Erlend Moksness

PICES Annual Meeting - Science Board Symposium
26. October 2009, Jeju, Korea



INSTITUTE OF MARINE RESEARCH
HAVFORSKINGSINSTITUTTET

FUTURE: seeking to understand the responses of marine ecosystems in the North Pacific to climate change and human activities by addressing three major questions:

- 1) how does ecosystem structure and function determine an ecosystem's response to natural and anthropogenic forcing;
- 2) how do physical and chemical processes respond to natural and anthropogenic forcing and how are ecosystems likely to respond to these changes in abiotic processes;
- 3) how do human activities impact coastal marine ecosystems and their interactions with offshore and terrestrial systems.

Implementation Plan

FUTURE Science Program

(Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems)



North Pacific Marine Science Organization
(PICES)

“manage the coastal ecosystems of Norway with competing interests of commercial fishing, tourism, oil and gas development, aquaculture, and conservationists.”

Content:

- **Key process and habitat**
- **Areas of conflict**
- **Development of Management Plans & MSP**
- **Development of ESE Models**
- **Conclusion**
- **Relevance for FUTURE**

North Pacific Marine Science Organization

A New Science Program for PICES

FUTURE

Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems

Vision

To *understand* and *forecast* responses of North Pacific marine ecosystems to climate change and human activities at basin and regional scales, and to broadly *communicate* this scientific information to members, governments, resource managers, stakeholders and the public.

January 2008

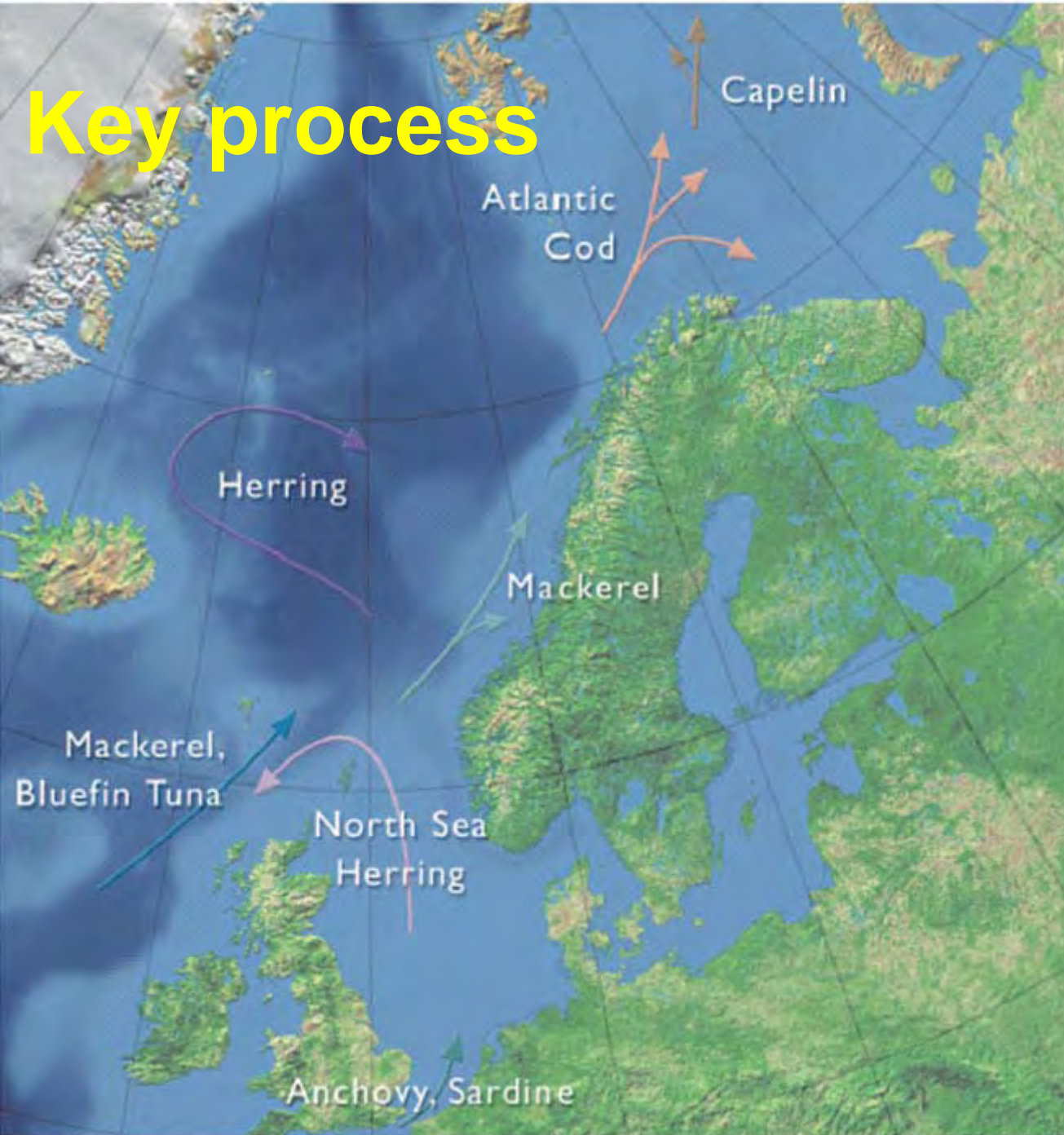
Final
[Version 7]

Scientific Priorities:

Ecological interactions and connections between estuarine, coastal and offshore waters, the western and eastern Pacific, and the northern and equatorial Pacific;



Key process



Spawning area

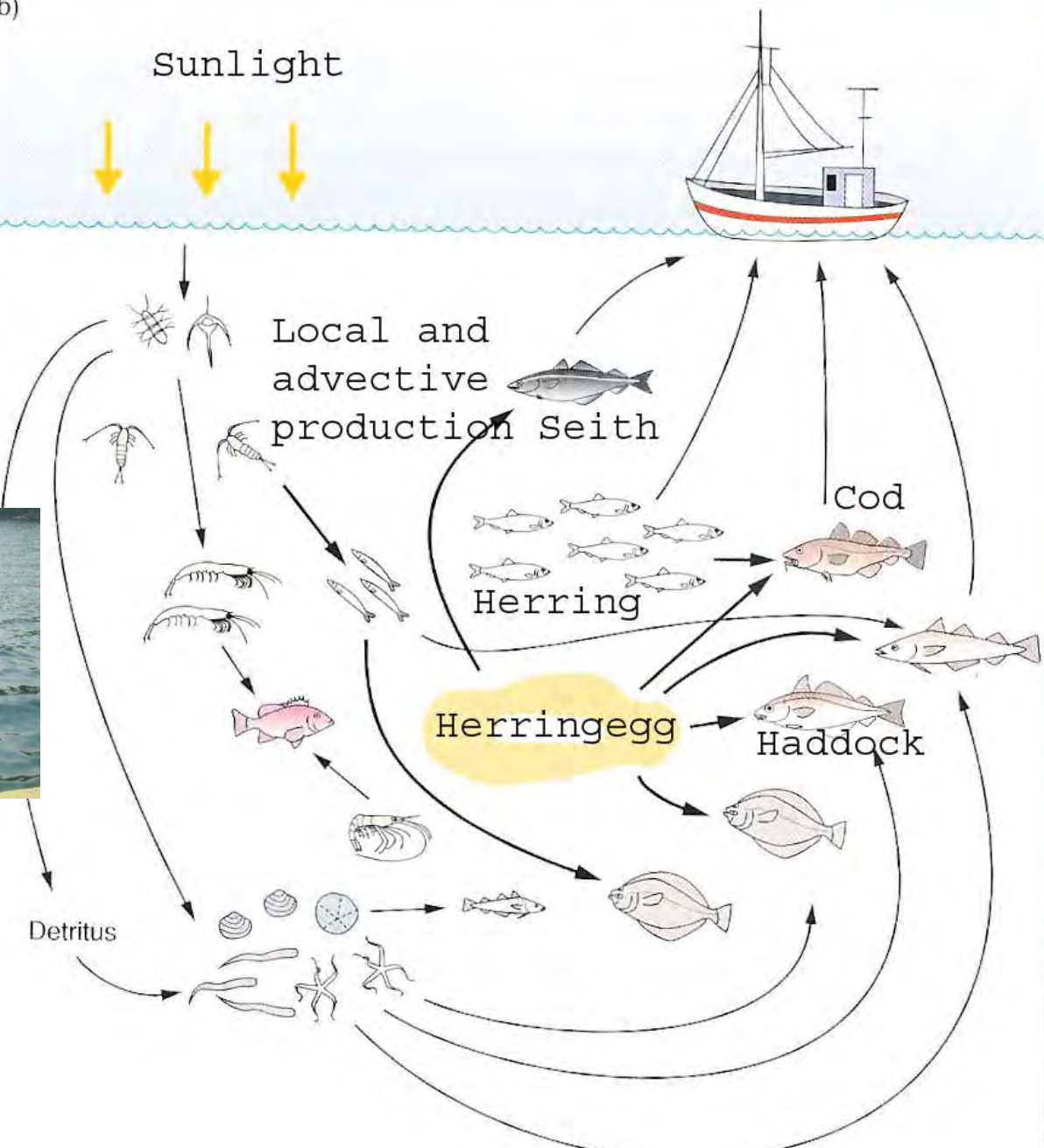
Nursery area

Feeding area





b)



From: Kystøkologi, Universitetsforlaget, Oslo. 1998

North Pacific Marine Science Organization

A New Science Program for PICES

FUTURE

Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems

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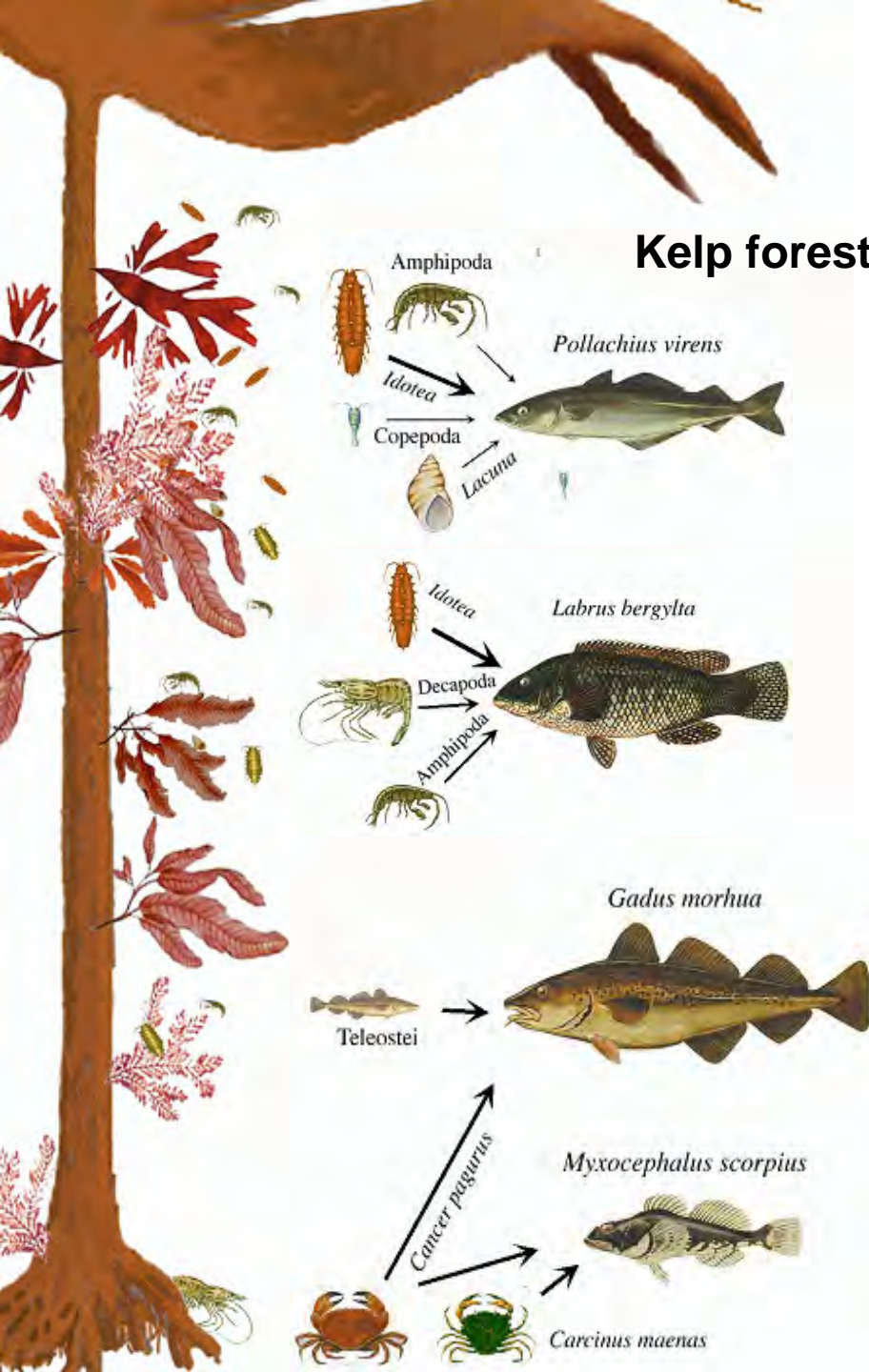


High priority research topics:

The role of coastal zone habitat in population dynamics of commercially exploited species;

Key habitat

Kelp forests create habitats for numerous organisms



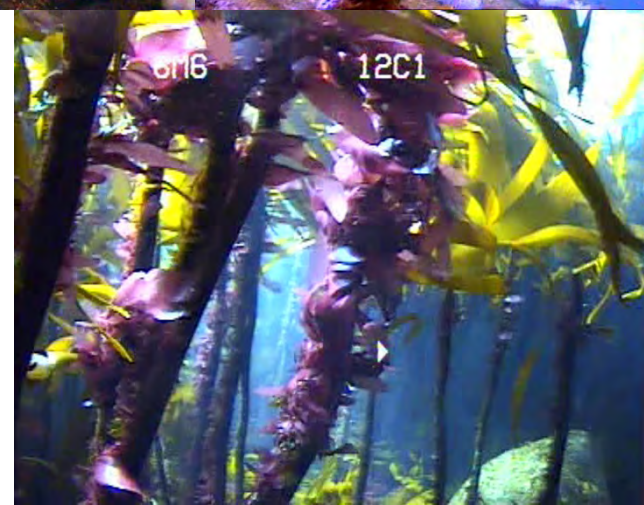
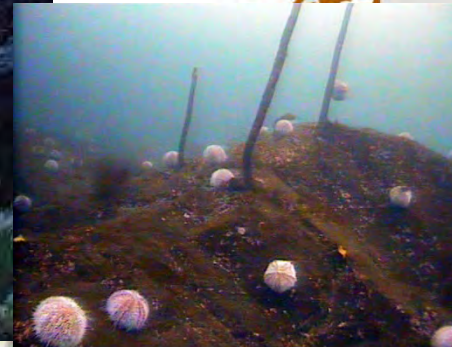
~300 species of macroalgae and animals are registered in Norwegian kelp forests

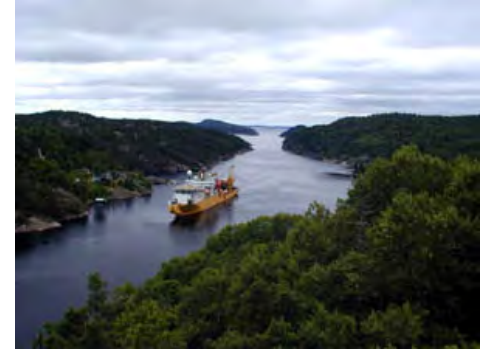
~8000 specimens of animals (mainly small crustaceans and gastropods) associated with each kelp plant on average .

-Nursery and feeding grounds for many species of fish and seabirds.

-Number of associated species and specimens increases with the age of the kelp plants.

Kelp forest *Laminaria hyperborea*





Areas of conflict

- Spawning and nursery areas
- Kelp harvest
- Fishing activity
- Fish farming
- Sea ranching
- Oil drilling
- Wind energy
- Transport (incl. Oil)



Management Plans & Marine Spatial Planning (MSP)



Offshore

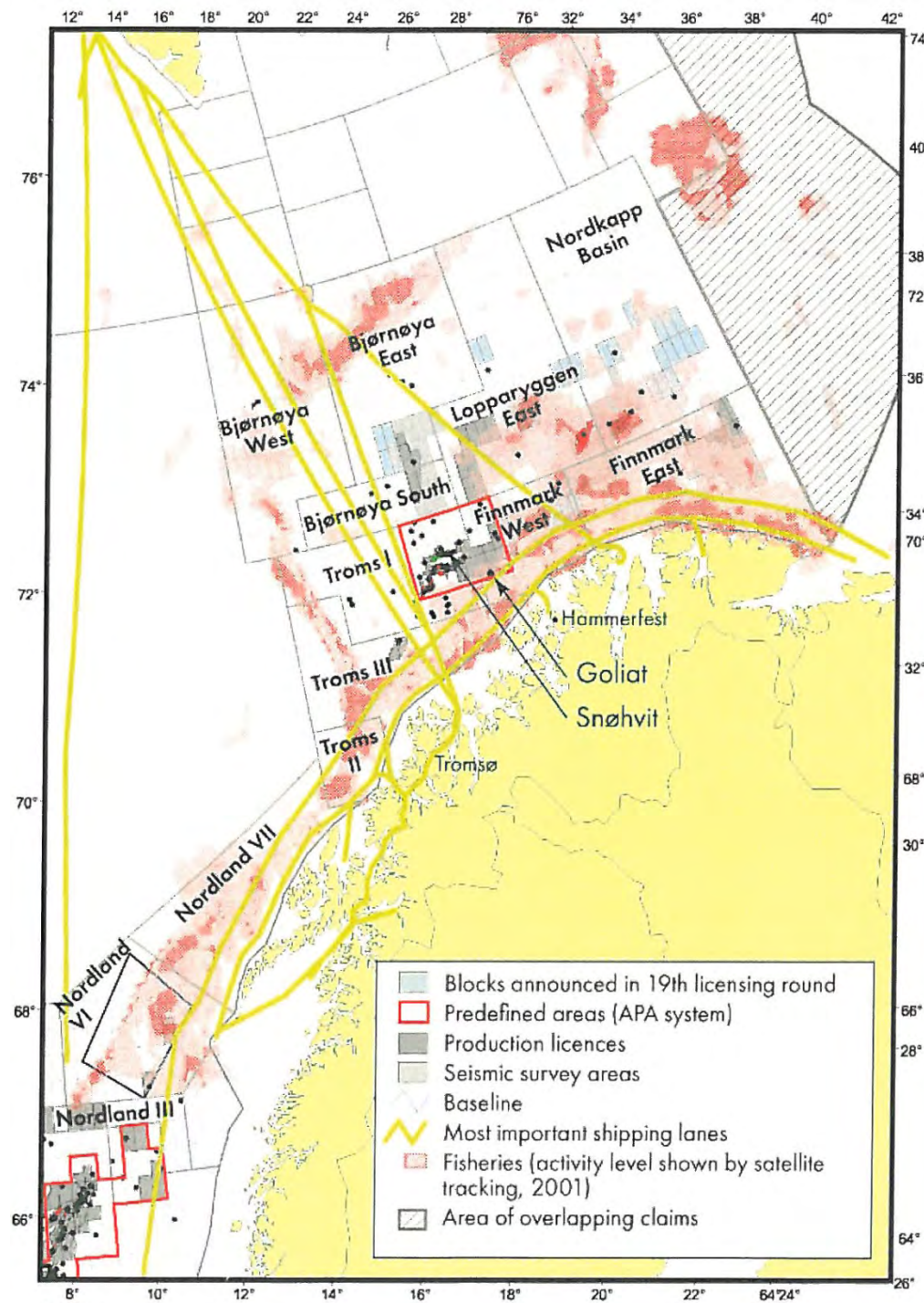
Barent Sea

Management Plan

Integrated Management of the Marine Environment of the Barents Sea and the Sea Areas off the Lofoten Islands

Contains elements as:

- Fisheries
- Oil & gas
- Transport (2010)



Coastal zone

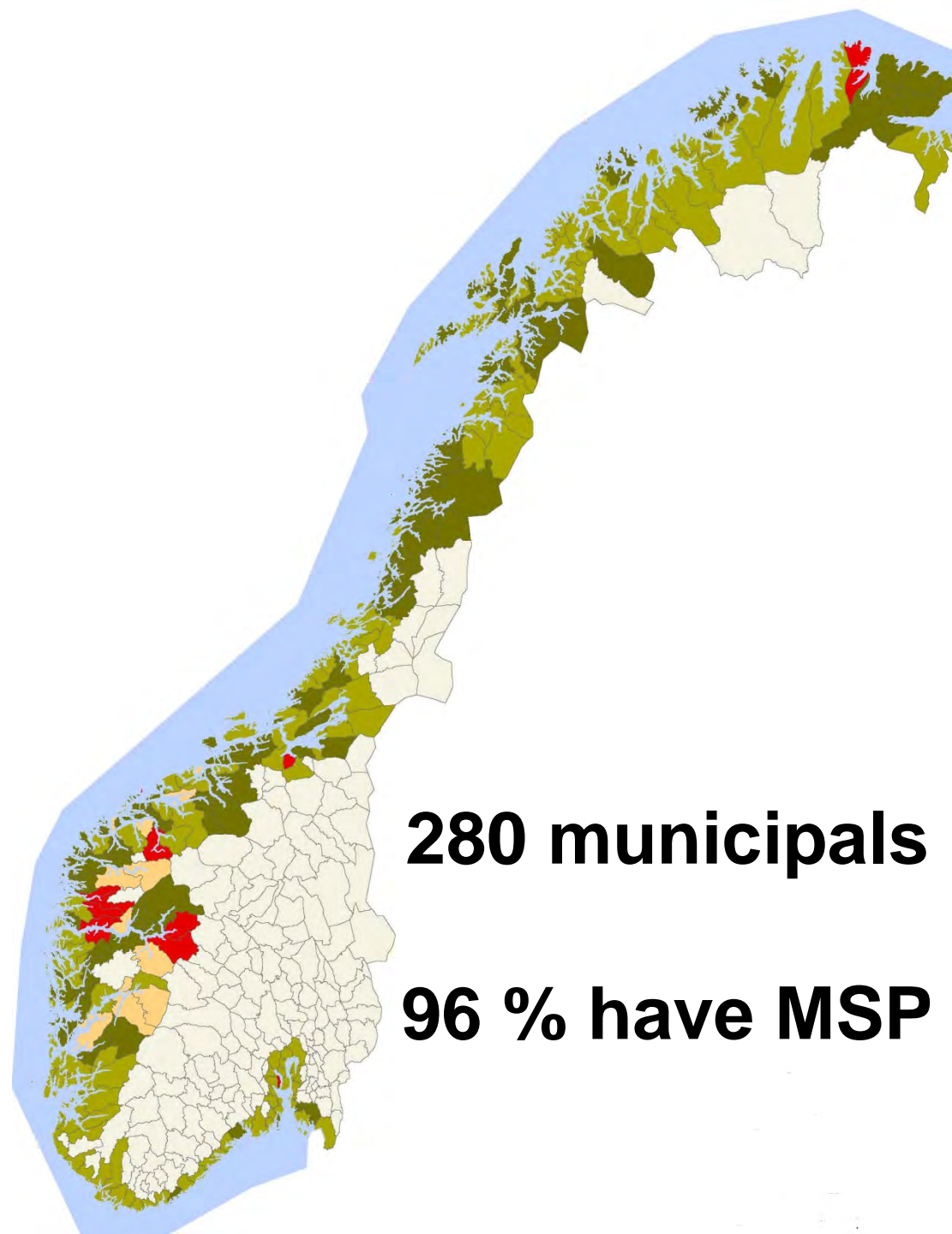
Municipal level

- **MSP**

- Fisheries
- Aquaculture
- Transport
- Tourism
- Energy

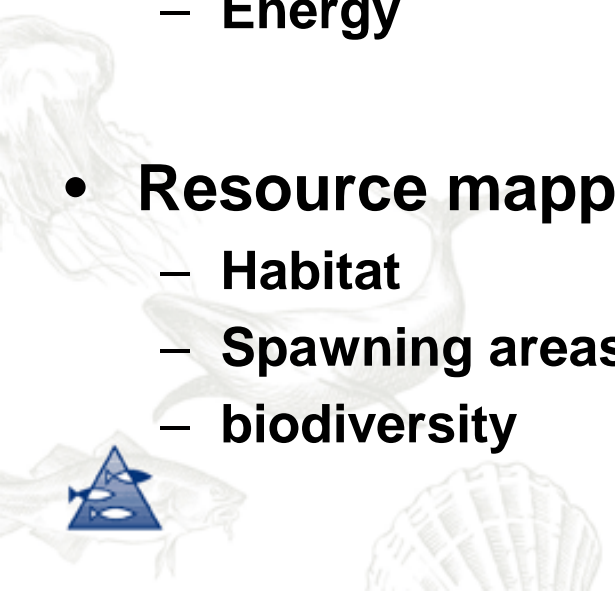
- **Resource mapping**

- Habitat
- Spawning areas
- biodiversity



280 municipals

96 % have MSP



Bremanger municipal, western Norway



Gå til avansert kart

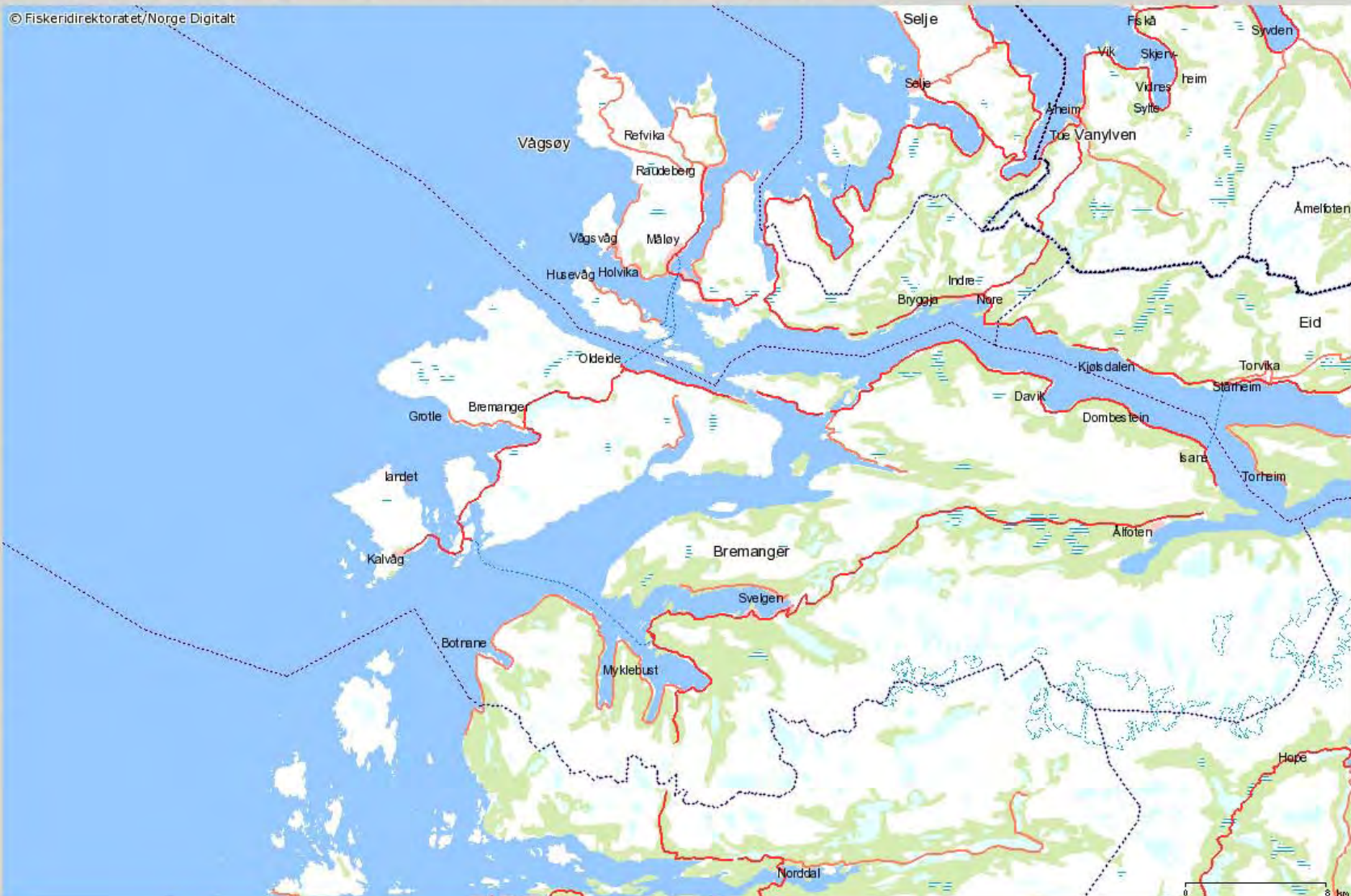
Gå til målestokk
1:190300

Gå til fylke/kommune
Sogn og Fjordane
Bremanger

Velg grunnkart
Grunnkart

Velg kategori
Fiskeridirektoratet

- Akvakulturlokaliteter Søk
- Akva flate fra klarerte ytterpunkt Søk
- Gyteområder Søk
- Oppvekst - beiteområde
- Skjellforekomst
- Låsettingsplasser Søk
- Fiskeplasser - Aktive redskap
- Fiskeplasser - Passive redskap
- Korallrev - vern
- Laksefjorder Søk
- Statistikk - Hovedområder Søk
- Statistikkområder - lokasjoner Søk
- Høsteplan tare Søk





Added: Salmon fjord



Added: Spawning area for fish



Added: Locations for holding fish



Added: Locations for salmon farming





Added: Areas for kelp harvesting



National programme for mapping of Coastal marine habitat

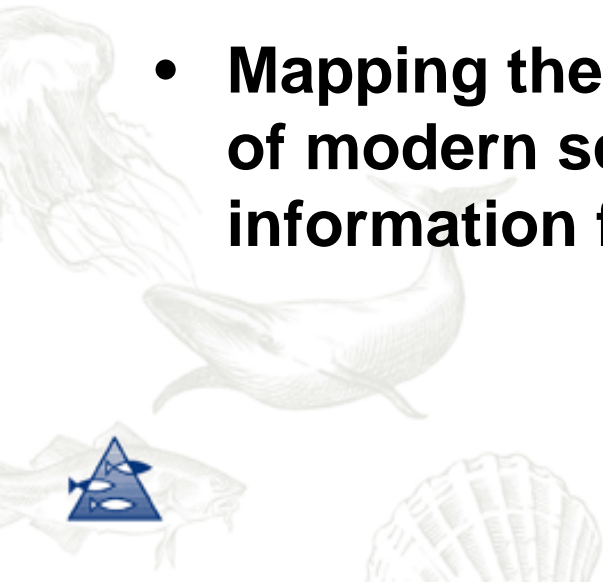
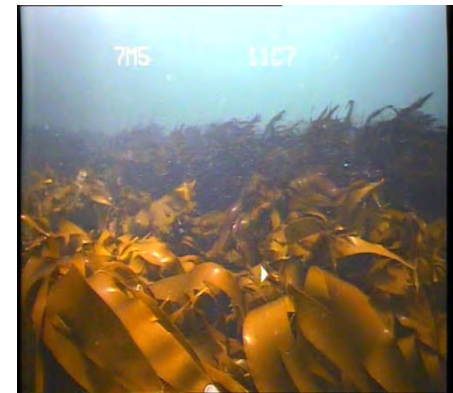
- **15 key habitats, as:**

- Spawning areas for fish
- Larger populations of oyster and clams
- Large kelp-forests
- Eelgrass-meadows



▪

- **Mapping the different habitats combining a set of modern scientific approaches with ecological information from the fishermen**



Why is this important ?

-

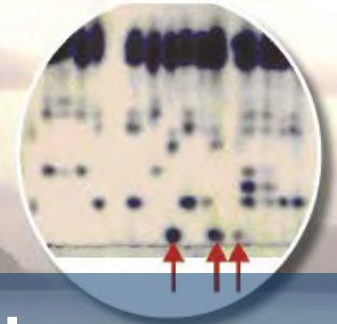
two examples



Oil spill - "Full City" 31 July 2009

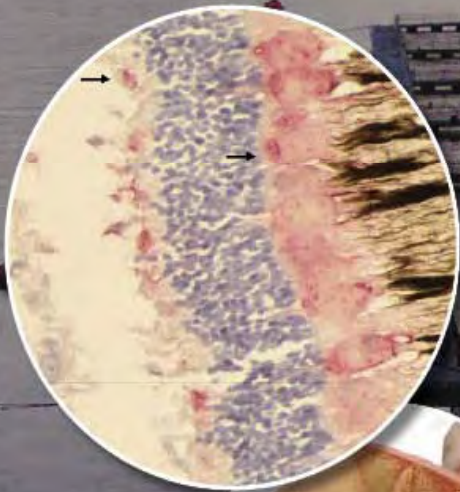


Aquaculture



**Within 2017:
1,2-1,5 mill ton salmon/trout and
50 000 ton cod**

**Within 2057:
4-5 mill ton salmonides and
1 mill ton cod**



Siting of aquaculture operations

- Increasing competition for space and recipient capacity
- Holistic management tool needed for space allocation and adjustment to carrying capacity
 - **Must include integrated coastal zone planning (GIS, simulation of carrying capacity)**
 - **Must include monitoring of environmental impact**
 - **Must include the major environmental impacts (organic impacts, diseases, medicines etc)**

How to address these interactions in the future ?

Development of ESE Models

Environment (E), Social (S) and Economy (E)



SPICOSA Study Site Applications

- 1 Gulf of Riga
- 2 Gulf of Gdansk
- 3 Oder Estuary
- 4 Himmerfjorden
- 5 Limfjorden
- 6 Sonderled
- 7 Clyde Sea
- 8 Cork Harbour
- 9 Scheldt Delta
- 10 Pertuis Charentais
- 11 Guadiana Estuary
- 12 Barcelona Coast
- 13 Thau Lagoon
- 14 Taranto Mare Piccolo
- 15 Venice Lagoon
- 16 Thermaikos Gulf
- 17 Izmit Bay
- 18 Danube Delta

SSA 7.6 Søndeledfjorden

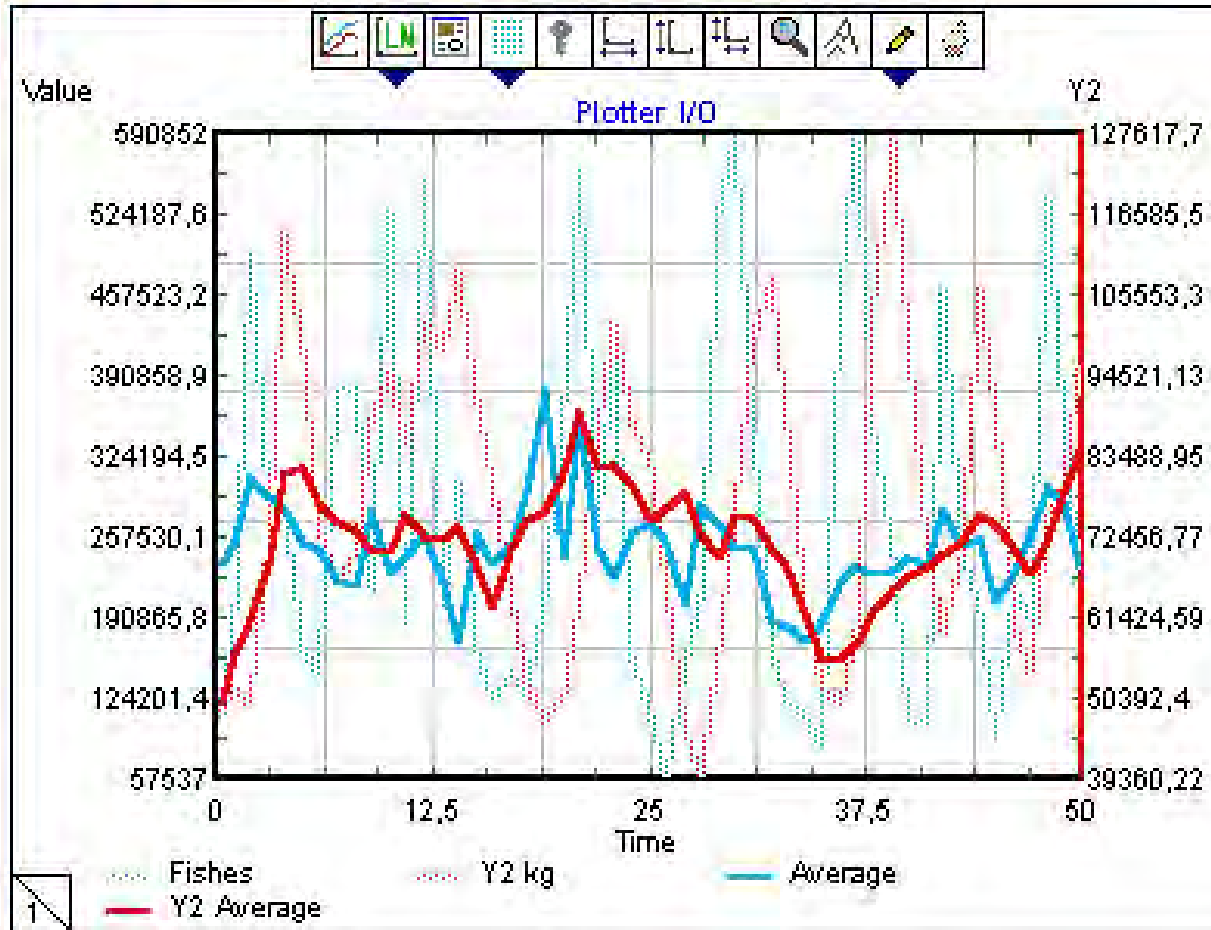


www.spicosa.eu

The Policy Issue:

Increase local economic benefits from tourism, while minimizing negative impacts on local coastal cod stock, and conflicts with local users of the fjord system.

The aim of the modeling is to make a tool that can help policy-makers and regulators by revealing connections between factors and trade-offs between objectives.



Density (0+1 groups) :	4560,9	Fishes / km ²
BioMass (2-10 groups) :	3,759	Tons / km ²
Commercial fishing :	0,9153	Tons / km ²
Conflict factor :	8,269	
Local income :	65834000	NOK

ExtendSim model interconnects three separate components: Environment (E), Social (S) and Economy (E) - ESE

LOCAL COD REGULATION MODEL

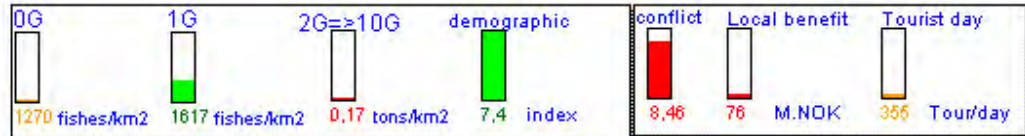


Regulations

- Tourist fisher accommodations
- MPA Habitat
- MPA Cod

Inputs

- Environmental Components (NC)
- Social Components (SC)
- Economy Components (EC)
- Indicators

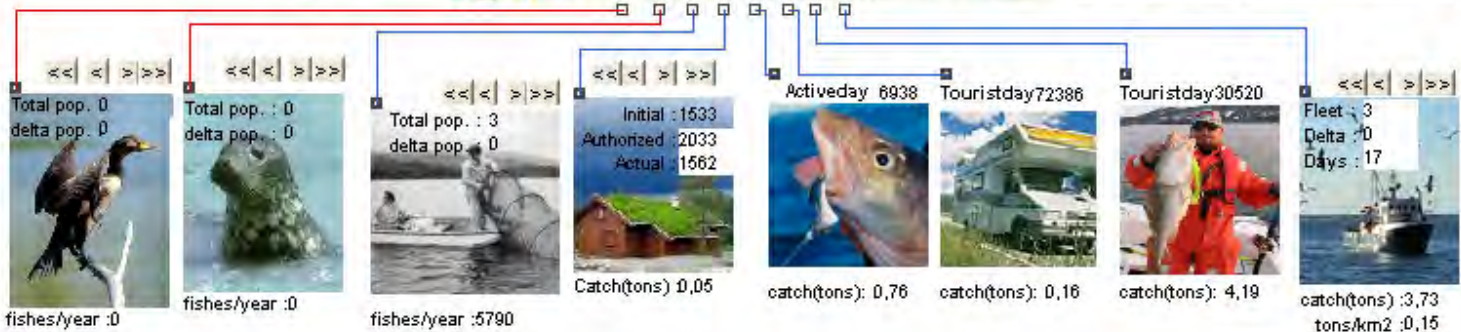


0-group/year : 0
1-group/year : 0

fishes/year : 0

Outputs

- Cod pop. history
- Biomass history
- Tourists history
- Income
- Results



Initialise Model

Pause each step

Developped by www.1Point2.com on IMR specifications



Conclusion

- Study the ecological interactions and connections between estuarine, coastal and offshore waters
- Study the role and functions of coastal zone habitat and its inhabitants
- Management Plans & MSP is needed
- Develop models that link ecological, social and economic aspects of Coastal Zone Systems (ESE)

Relevance for FUTURE:

Develop ESE Models for Coastal Zone Systems

Socio-economic and political factors

- Regional level
- National level
- Local level
- Industries and actors



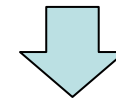
Ecological, Social and Economic (ESE)
model



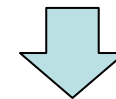
Ecosystem factors

- Offshore
- Coastal
- Terrestrial
- Species
- Habitat

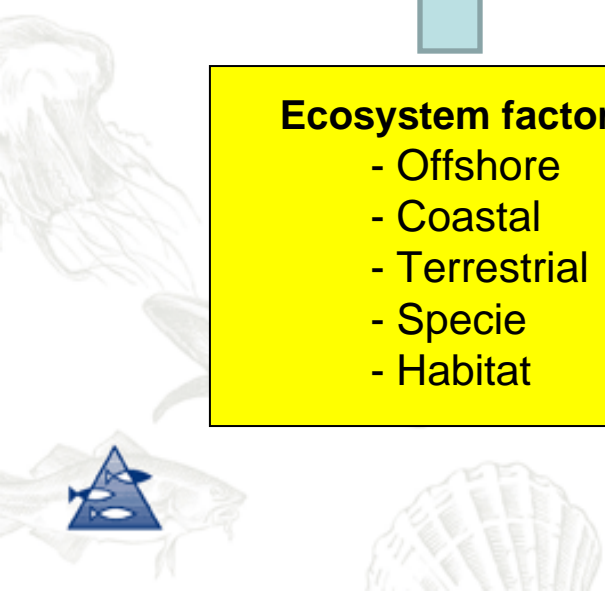
Scenarios



How do human activities impact coastal marine ecosystems and their interactions with offshore and terrestrial systems



Policy-implications





Thank you!