

The use of the ecosystem approach in designing and monitoring MPAs – with focus on fisheries

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The MPA process in Norway

National plan for protection of the marine environment

Biodiversity perspective

2001: 36 areas recommended as MPAs

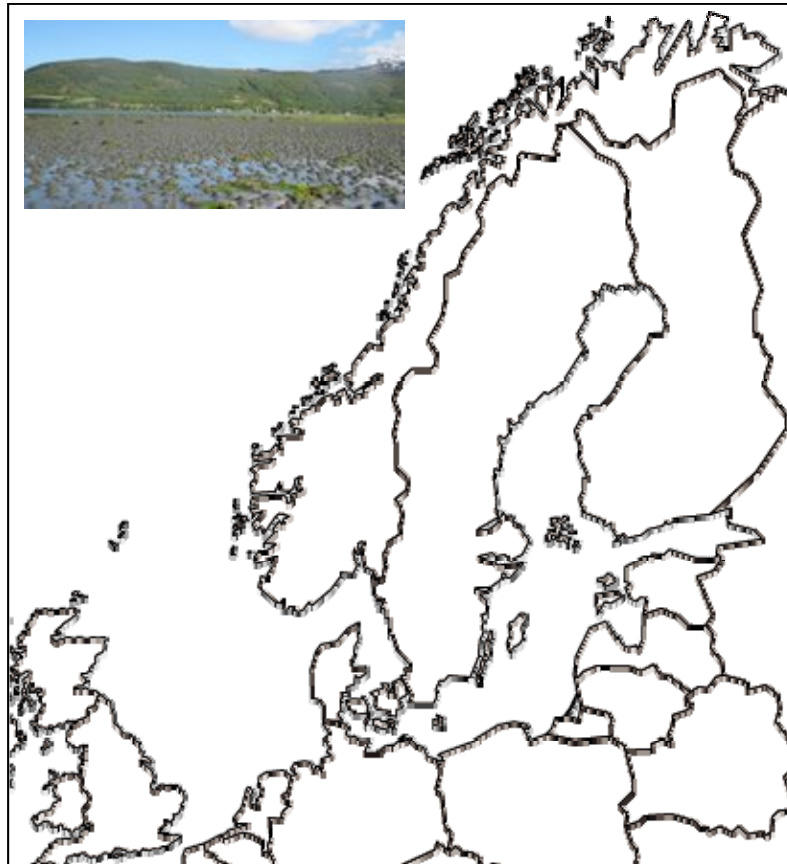
2011: hearings for 17 areas (phase 1)

Mainly deals with habitat protection

Coastline: 25.000 km

Longest fjord: 200 km (1300 m deep)

Fine-scale (30-60 km) population structure in fish such as coastal cod



Cold water corals

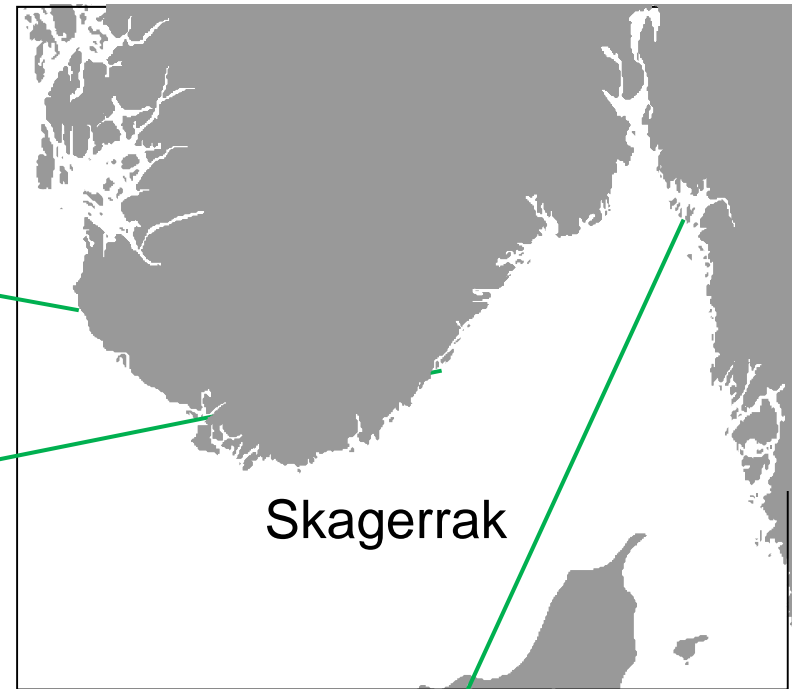


The MPA process in south Norway

Jæren (168 km²)



Transect Skagerrak (692 km²)



Hvaler National Park(354 km²)



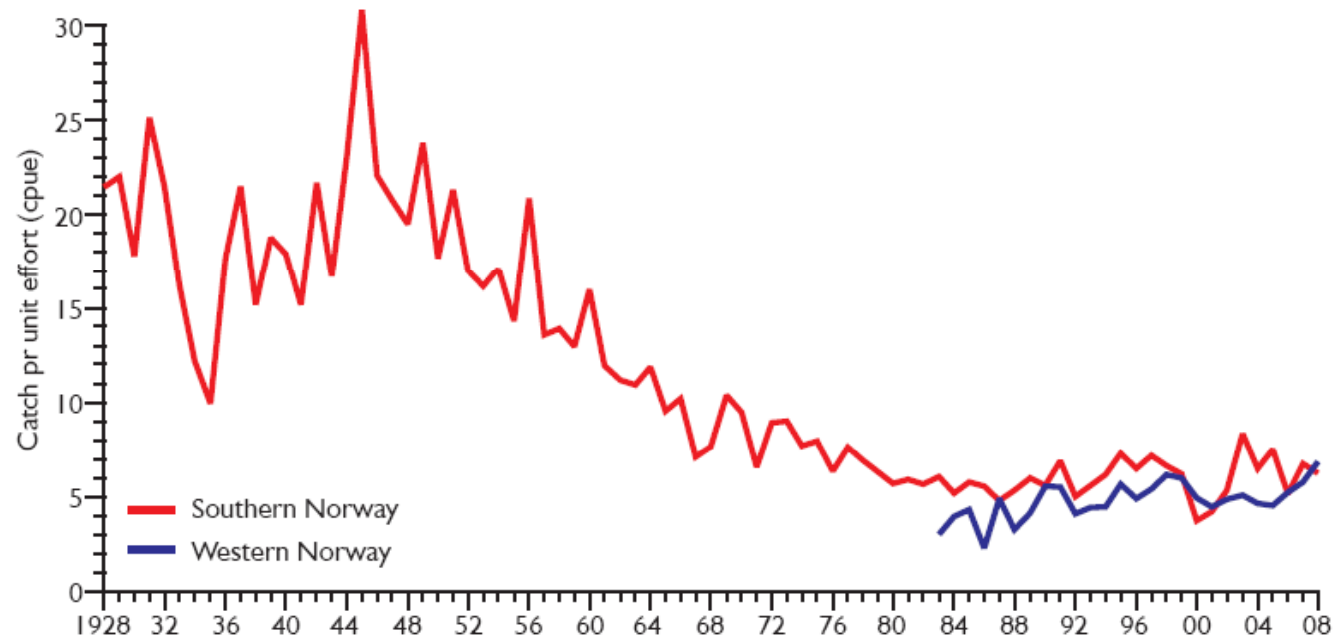
The MPA process in Norway - fisheries



Photo: Øystein Paulsen, IMR



European lobster population decline in Norway



Lobster reserves in Skagerrak

Four reserves established in 2006 after public hearings and involving commercial fishers (but not recreational fishers..)

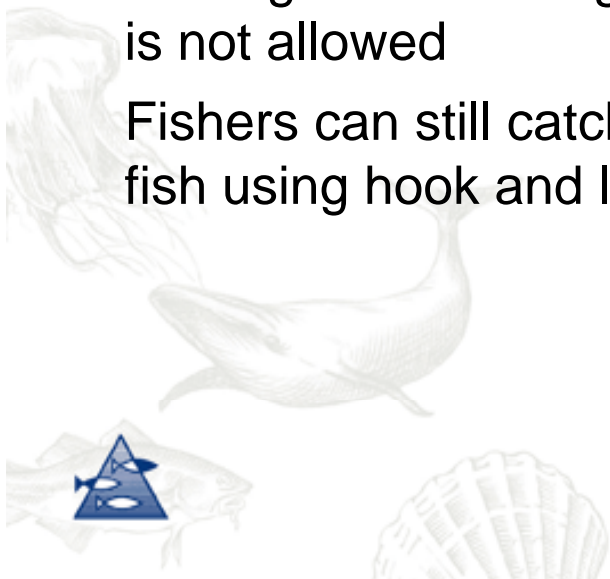
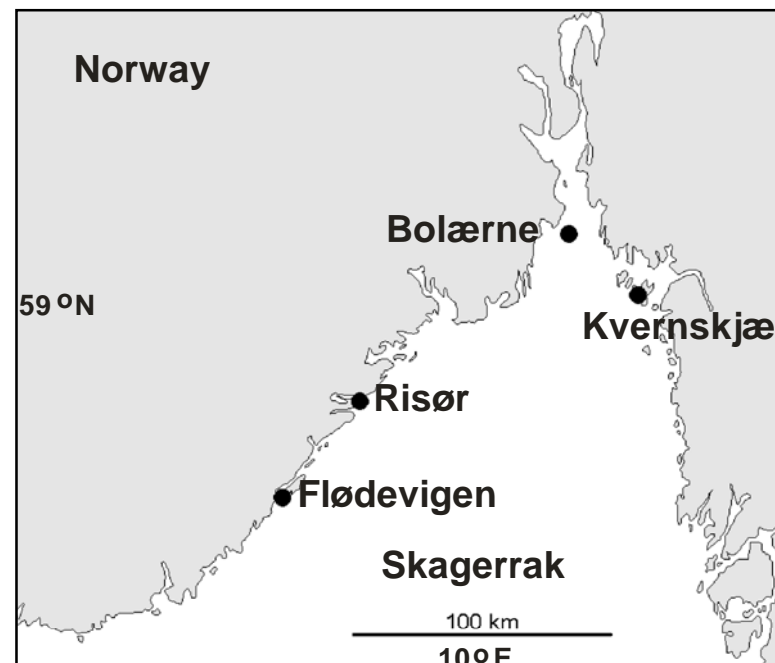
About 1 km² each

Mainly for research purposes

Monitored annually by IMR

Fishing with standing gear (nets, traps) is not allowed

Fishers can still catch cod and other fish using hook and line



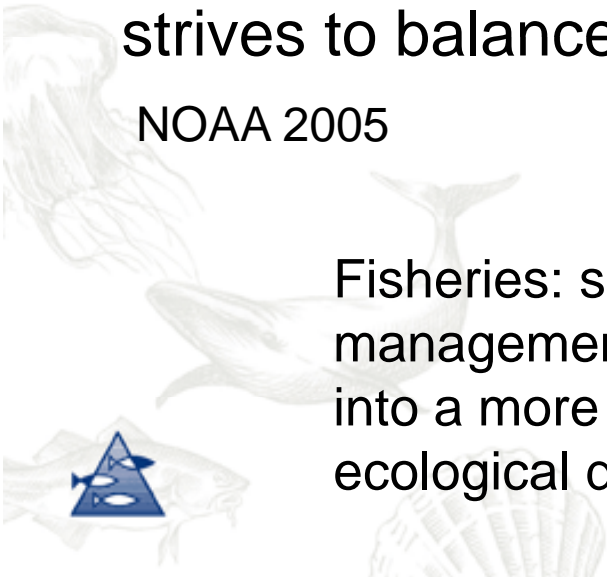
The ecosystem approach

“An **ecosystem** is a geographically specified system of organisms, including humans, the environment, and the processes that controls its dynamics”

“An **ecosystem approach** to management is management that is adaptive, specified geographically, takes into account ecosystem knowledge and uncertainties, considers multiple external influences, and strives to balance diverse social objectives”

NOAA 2005

Fisheries: single-species
management incorporated
into a more holistic
ecological discipline



Designing and monitoring MPAs in an ecosystem perspective

- The BACIP design (Garry Russ, 2002)

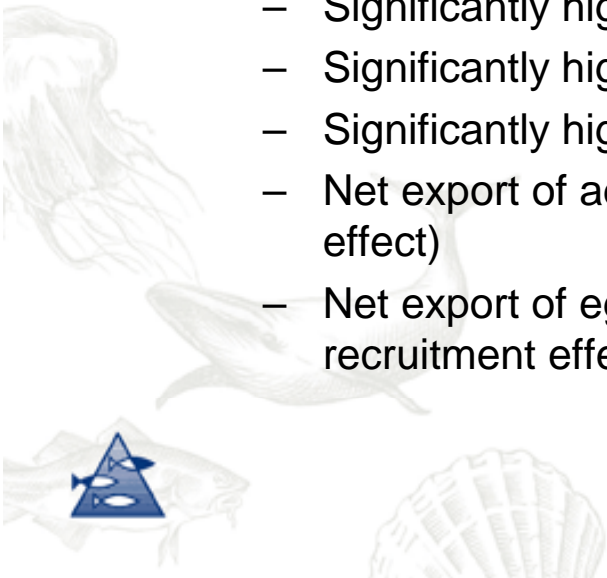
- Before-After-Control-Impact-Pairs

- Document effects of protection
- Control for environmental change
- Important documentation for user groups

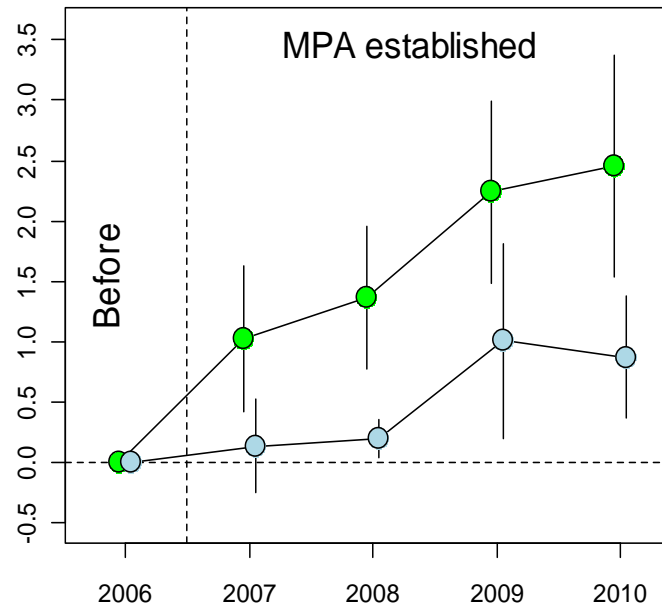
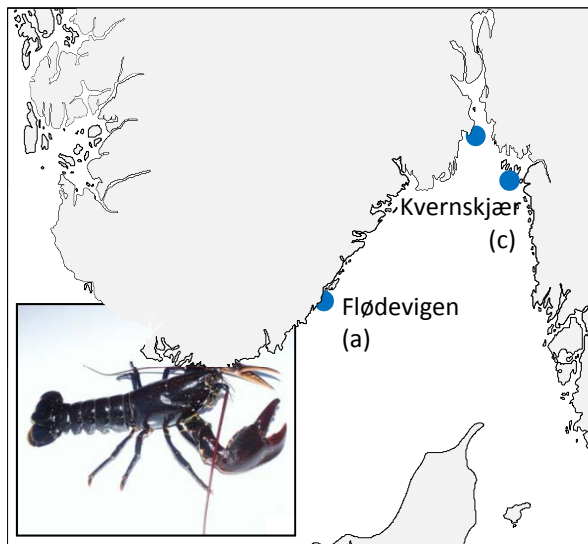


- Expected effects of no-take marine reserves:

- Significantly higher density of target species inside reserves
- Significantly higher mean size/age of target species inside reserves
- Significantly higher biomass of target species inside reserves
- Net export of adults from reserve to fished areas (the spillover effect)
- Net export of eggs/larvae from reserve to fished areas (the recruitment effect)

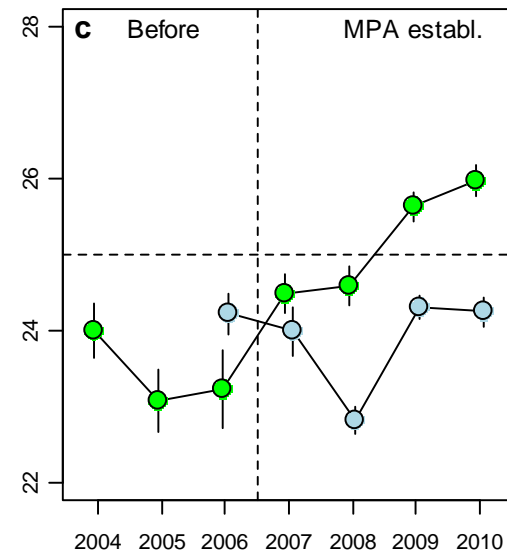
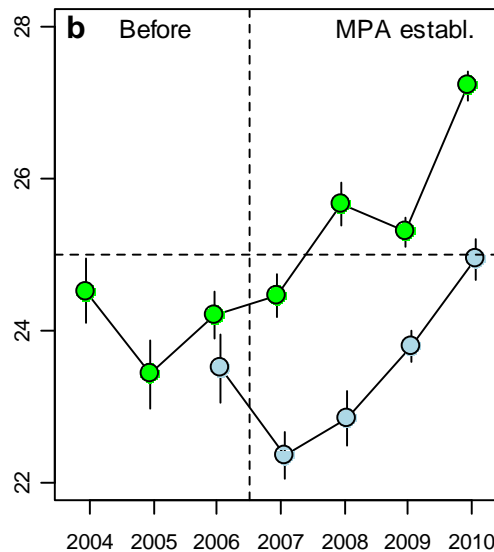
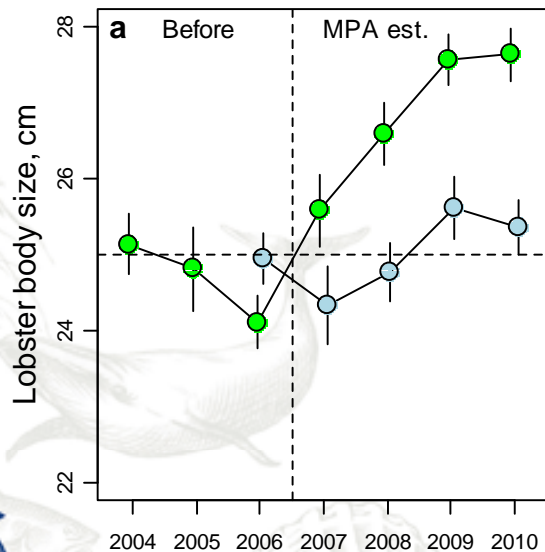


Before-After-Control-Impact design: lobster reserves in Skagerrak, north-eastern North Sea



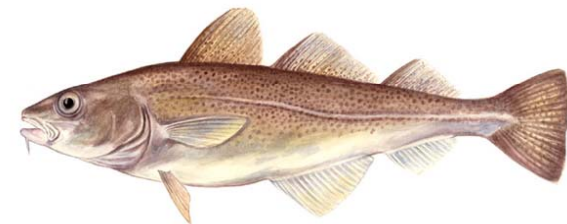
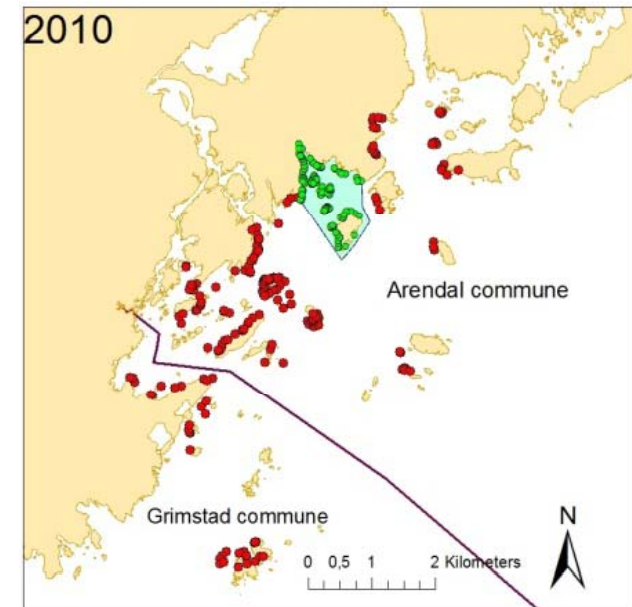
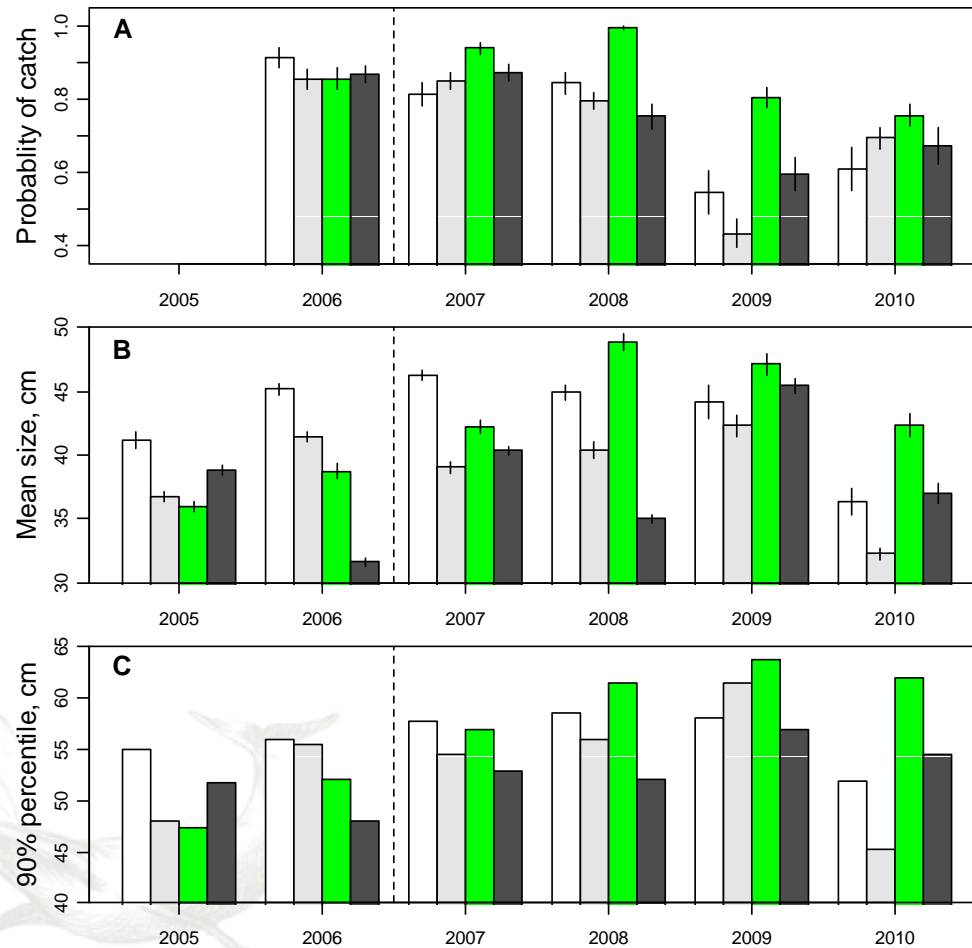
← $\approx 250\%$

← $\approx 75\%$



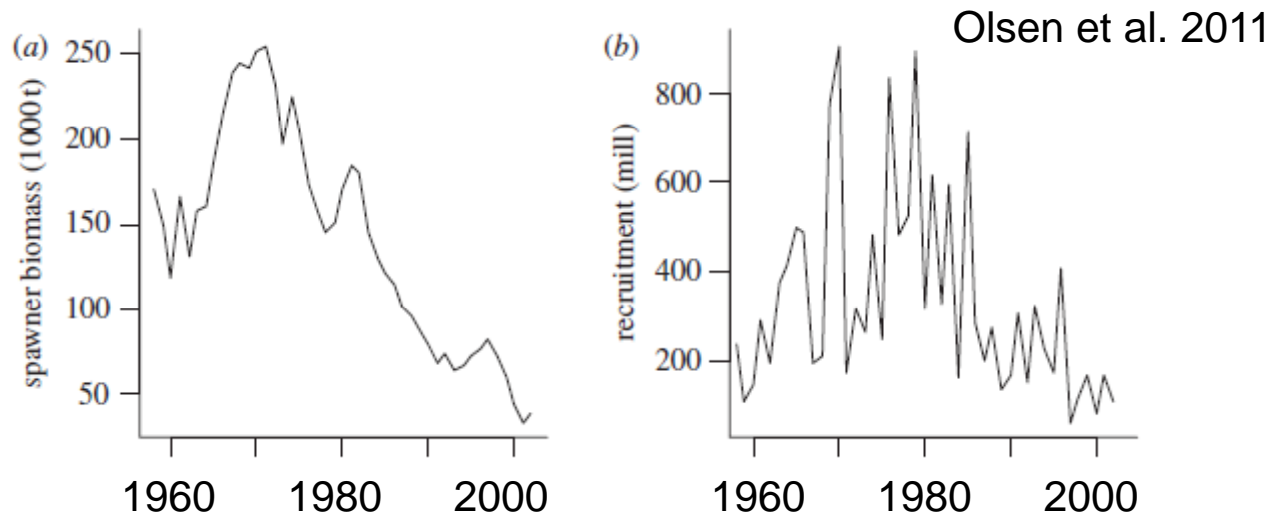
MLS

Lobster reserve effects on Atlantic cod



North Sea ecosystem and MPAs in relation to fisheries

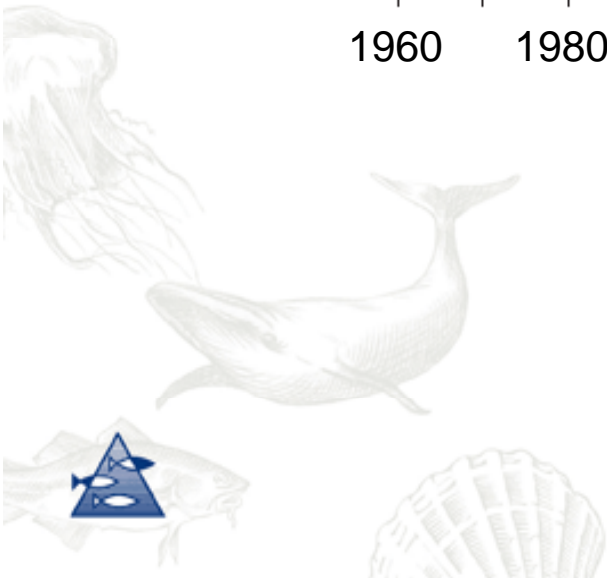
Declining fish stocks, such as cod



Thurstan et al. 2010: Landings per unit fishing power reduced by 17-fold over the past 118 years

Ecosystem changes related to climate (Beaugrand et al. 2003)

MPAs could be very helpful for understanding causes of fish decline and potential for recovery



Action items for ecosystem-based fisheries science

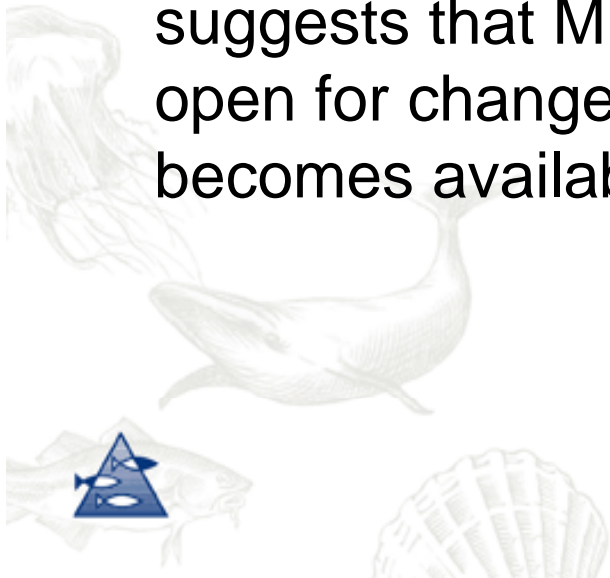
Francis et al. (2007 – Fisheries): Bridging the gap between general principles and specific methodologies for implementing the ecosystem approach



Keep a perspective that is holistic, risk-averse, and adaptive

MPAs can contribute to a holistic and risk-averse management by protecting parts of ecosystems - depending on the actual regulations

An adaptive trial-and-error strategy suggests that MPA design should be open for changes as new information becomes available



Maintain old-growth age structure in fish populations

Naturally selected for long life-spans

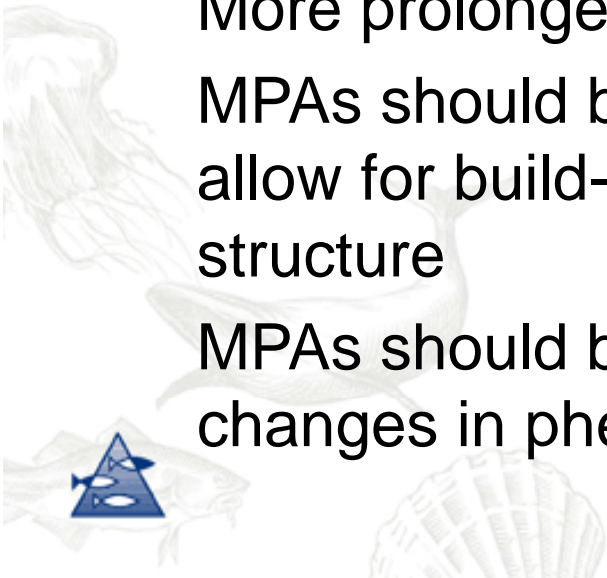
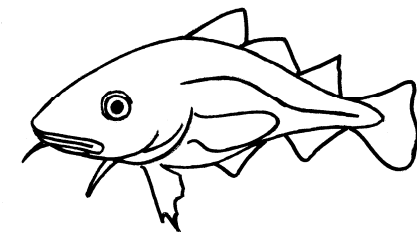
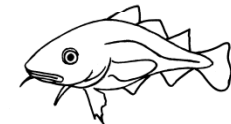
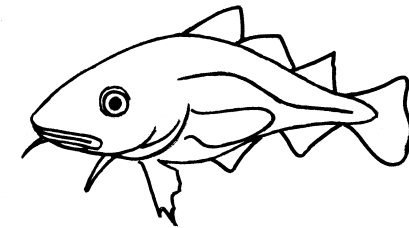
Environmental unpredictability (bet-hedging)

Bigger fish are highly fecund and may produce high-quality offspring

More prolonged spawning seasons

MPAs should be designed so that they allow for build-up of old –growth age structure

MPAs should be monitored to detect changes in phenotypic diversity

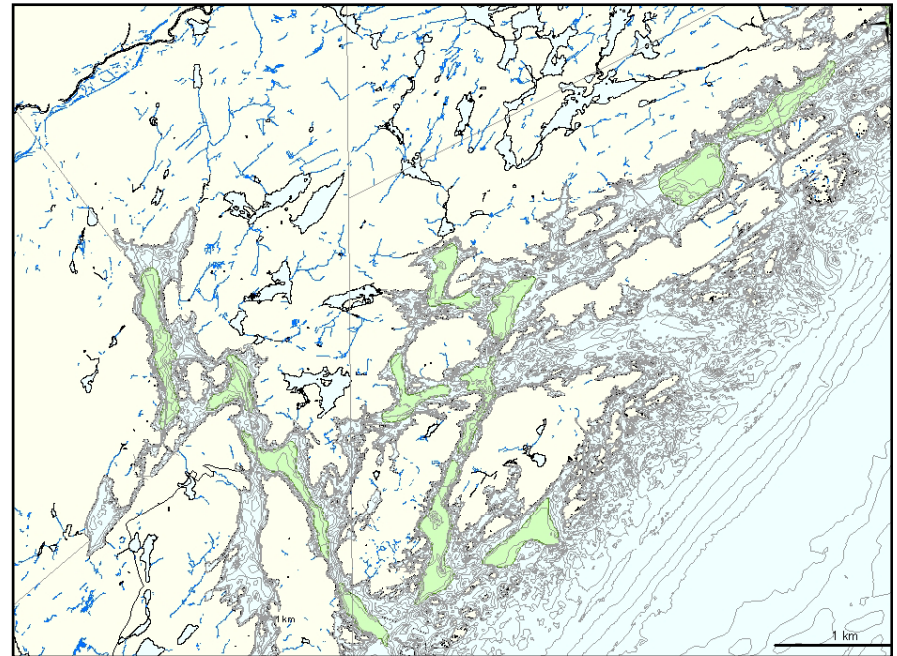


Characterise and maintain viable fish habitats

No habitat – no fish

Identify areas needed for stock
integrity: spawning sites, nursery
habitats

Cod spawning areas



Account for evolutionary change caused by fishing

Harvesting may cause evolutionary, as well as ecological, changes in wild populations

Can happen on a contemporary time frame and cause reduced productivity

Properly designed MPAs could help to counter evolutionary change caused by fishing



Summary

MPAs may be viewed as large-scale field experiments

Before-After-Control-Impact experimental design to quantify ecosystem-effects of MPAs

Specific action items for using the ecosystem approach in designing and monitoring MPAs could involve:

- Keeping an adaptive, trial-and-error, strategy
- Maintaining big and old fish (phenotypic diversity)
- Characterising and maintaining viable fish habitats
- Accounting for evolutionary change caused by fishing

