



The Polar Front in the Integrated Management Plan for the Barents Sea

By

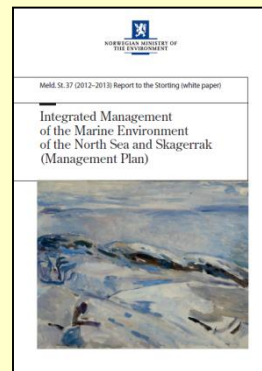
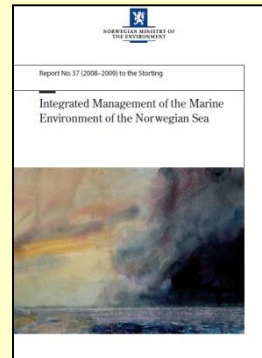
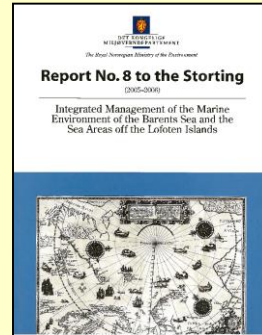
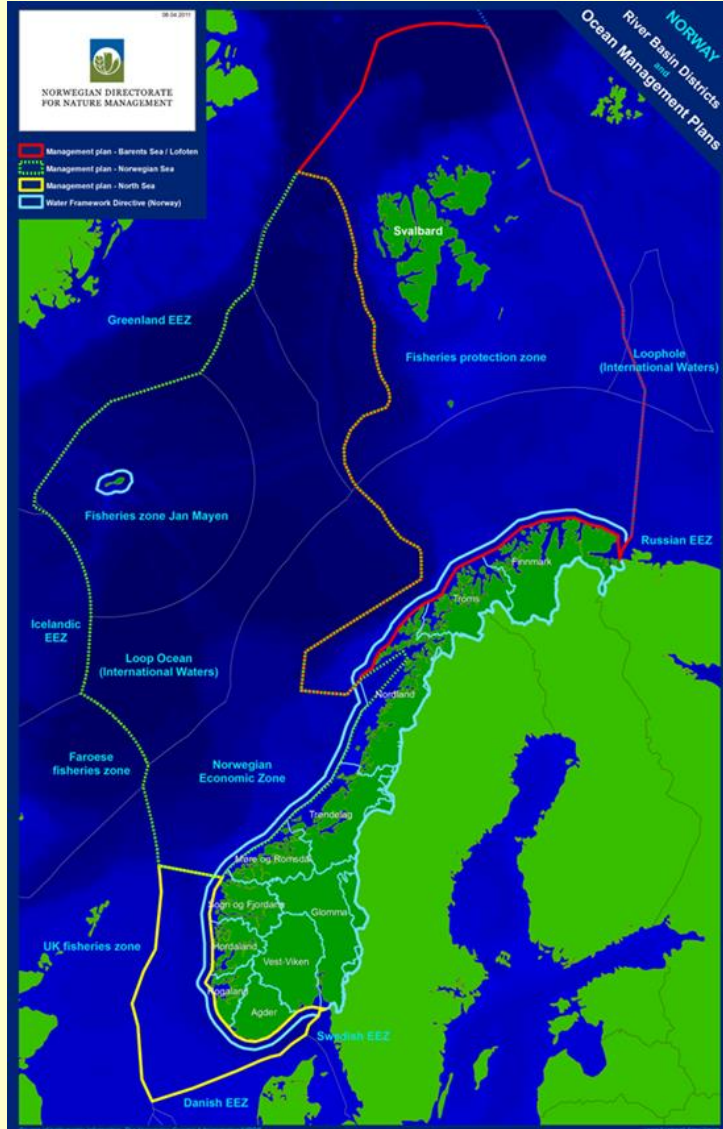
Cecilie H. von Quillfeldt

Norwegian Polar Institute

Tromsø, 23 November 2021

Background

Management plans for Norwegian Sea areas



- Integrated Management plan for the Barents Sea and Lofoten (2006):

Updated in 2011, Revision in 2020

- Integrated Management plan for the Norwegian Sea (2009):

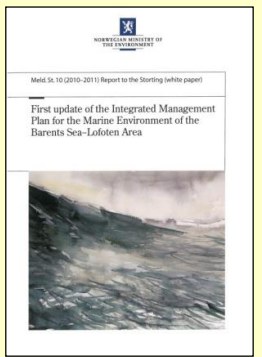
Updated in 2017, Updated 2020

- Integrated Management plan for the North Sea – Skagerrak (2013)

Updated 2020

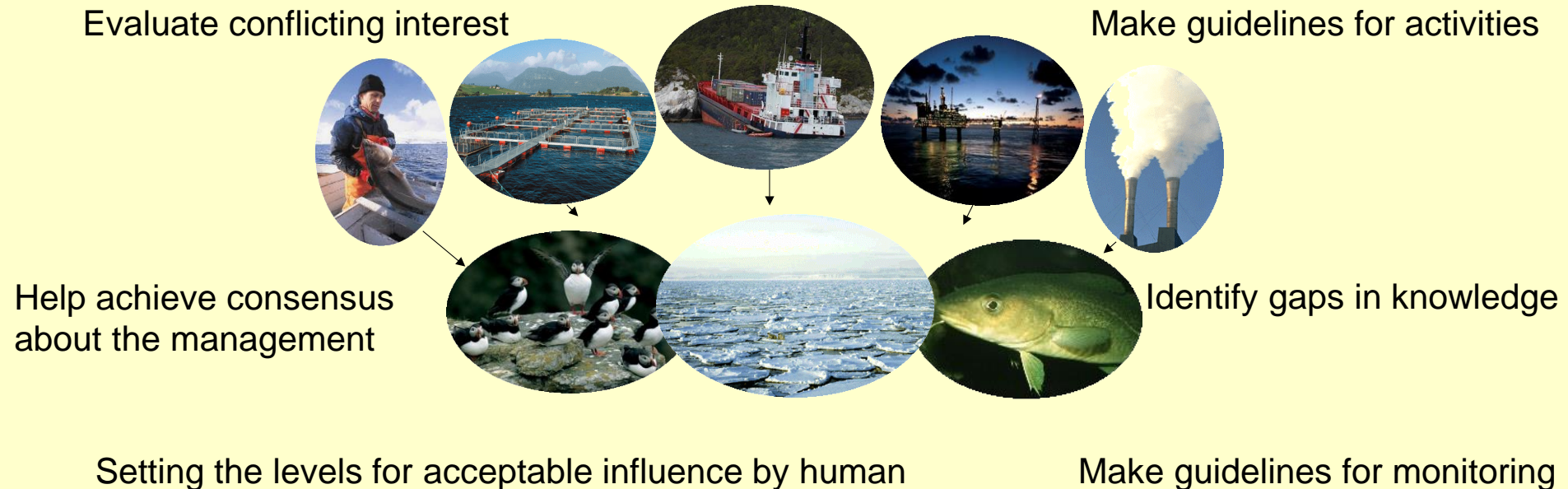
Updates every four year, revisions every 12 year.

Last update/revision of all plans: 2020.



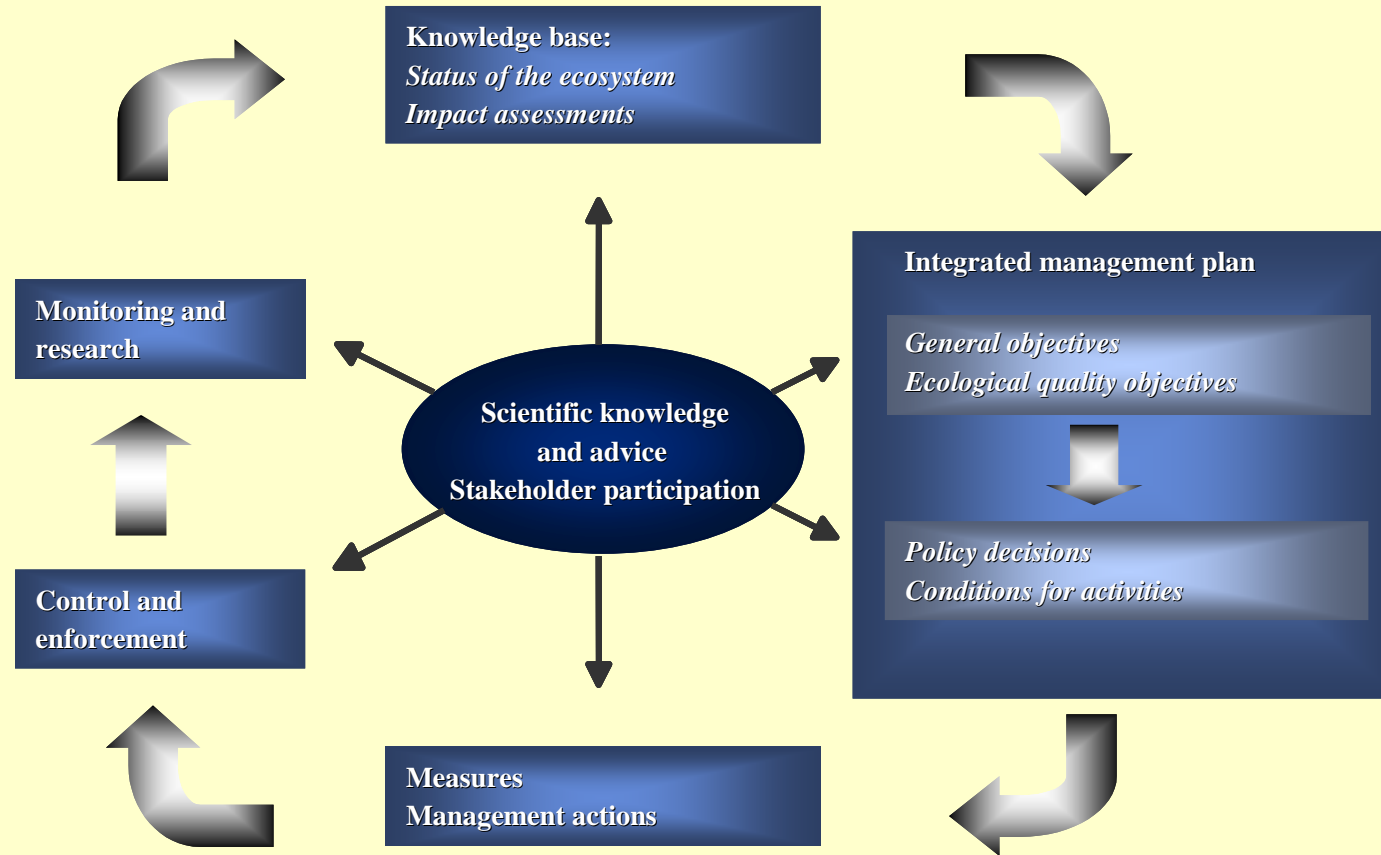
Need for comprehensive, ecosystem-based management

The purpose of the **Integrated Management Plans** is to provide a framework for the sustainable use of natural resources and goods derived from the area and at the same time maintain the structure, functioning and productivity of the ecosystems of the area.



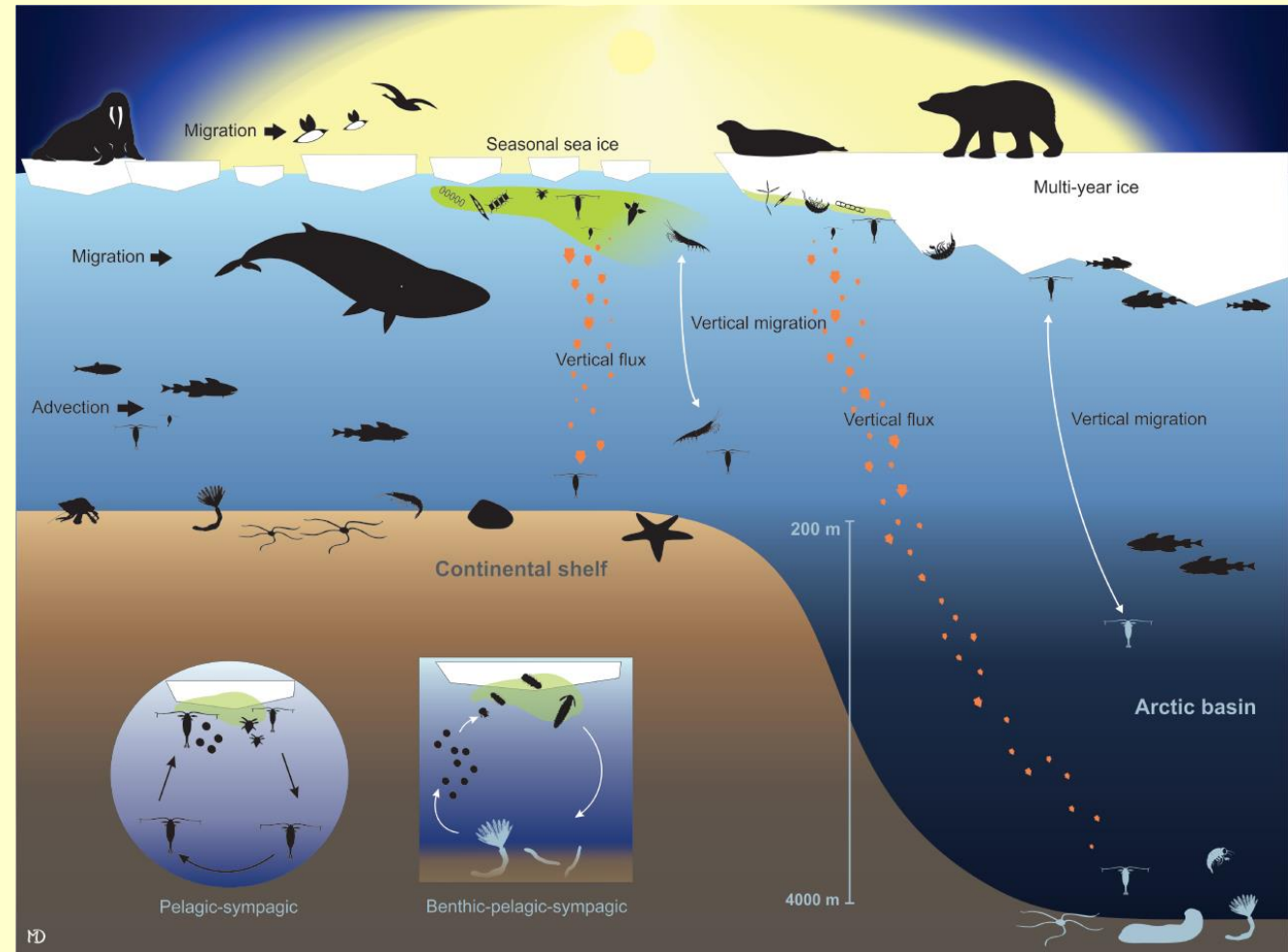
- This requires close coordination between the objectives of the management plan and the legislation that applies to the geographical area of the plan.

Elements in an ecosystem-based approach to management

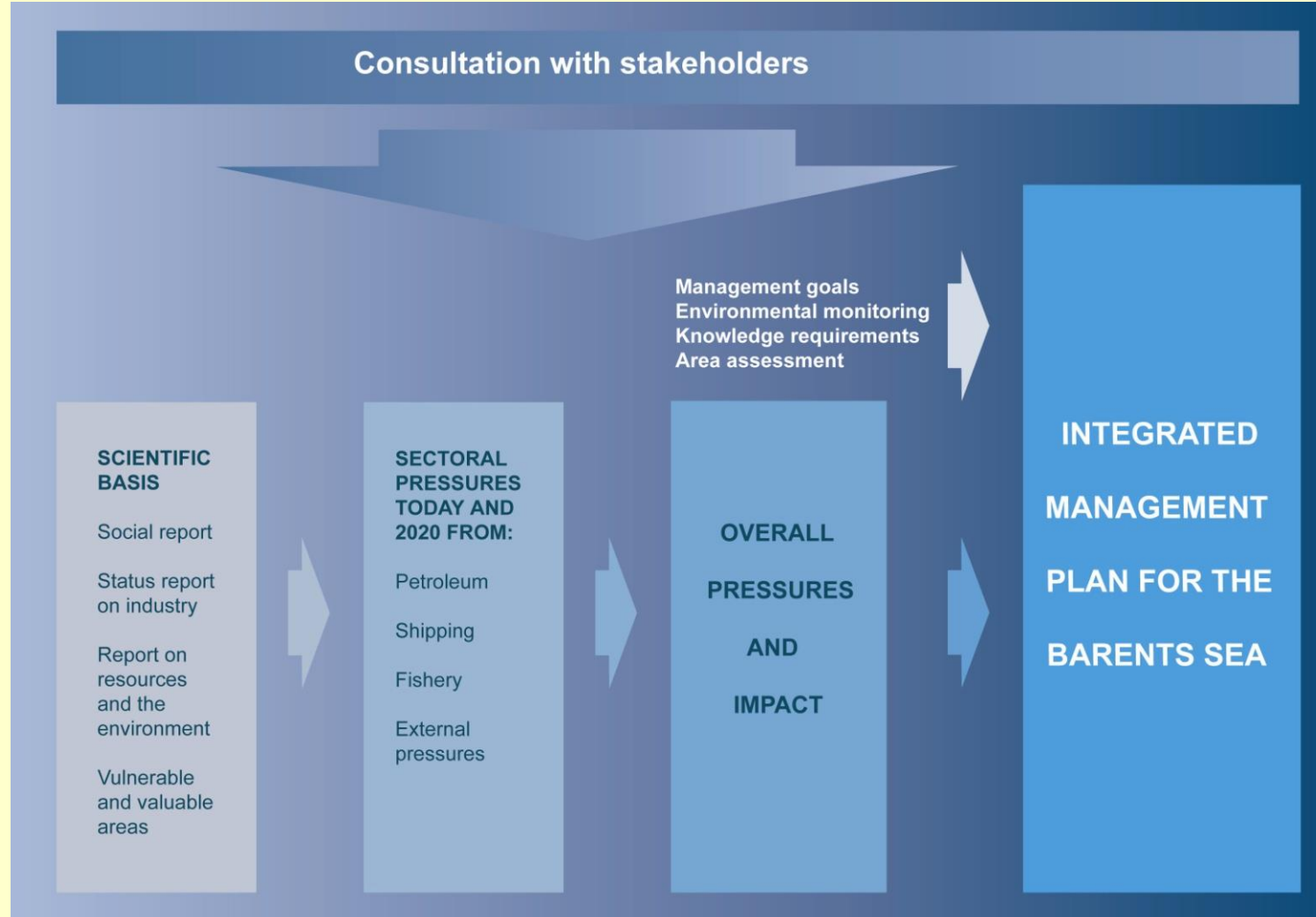


Some challenges

- Will we ever be able to predict ecosystem responses?
- How much do we need to know in order to take sound decisions?

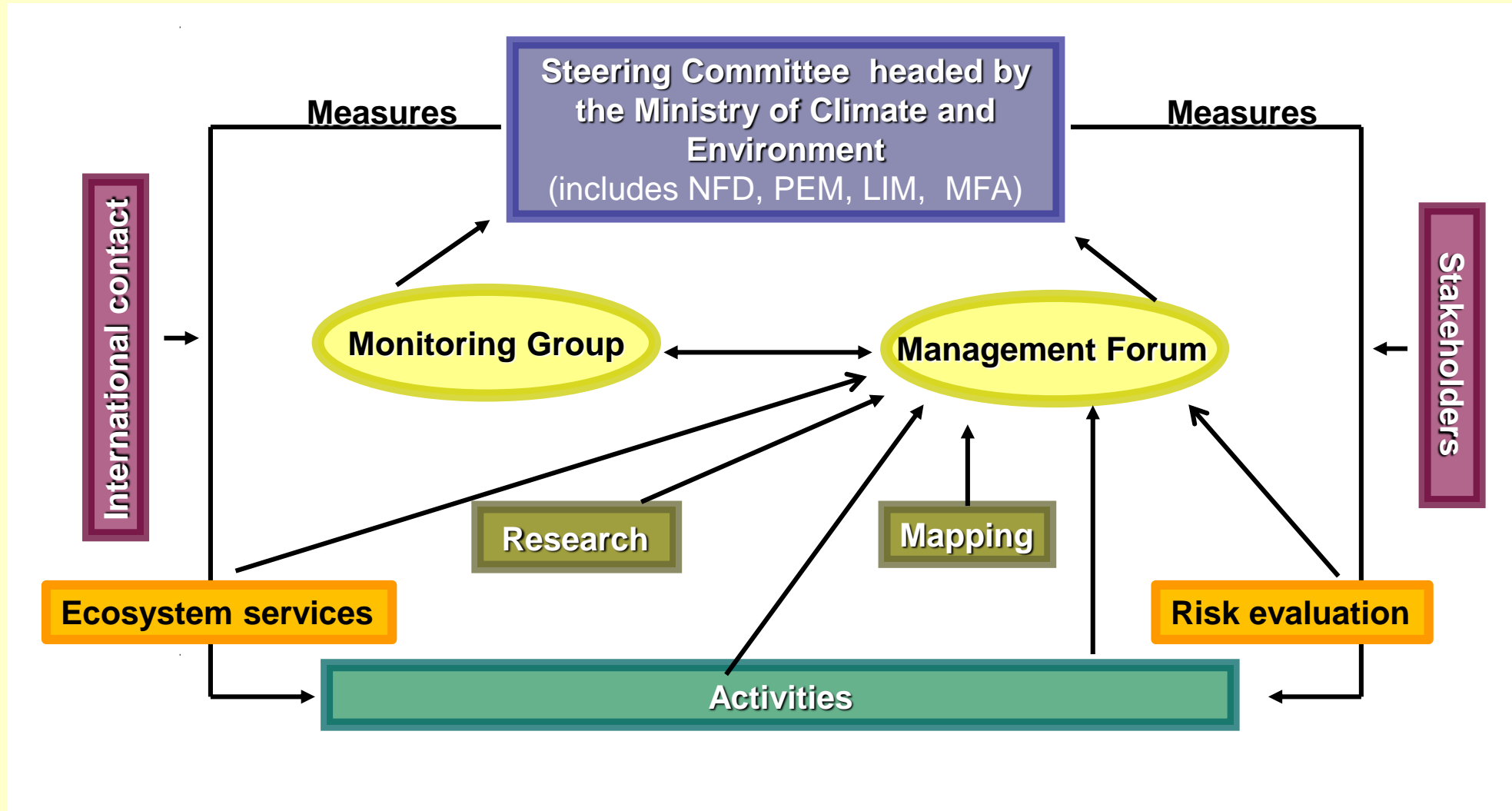


The different steps of the Integrated Management Process



The elements of the system for implementing the management plan

The different groups have a broad membership, with representatives from the relevant public institutions with responsibility for and expertise in the various sectors, but will also draw on expertise from other sources as necessary.



Who?

The target audience

- The management plans are intended to be instrumental in ensuring that **business interests, local, regional and central authorities, environmental organisations and other interest groups** all have a **common understanding** of the goals for the management of Norwegian sea areas.
- Strengthening **international cooperation**: share experience gained through the present management plans in the work on integrated management of the marine environment within the framework of the **OSPAR** Commission and the EU, **ICES, Arctic Council, bilateral Norwegian-Russian processes** etc.
-

What?

The ecosystem approach

- **The ocean environment**

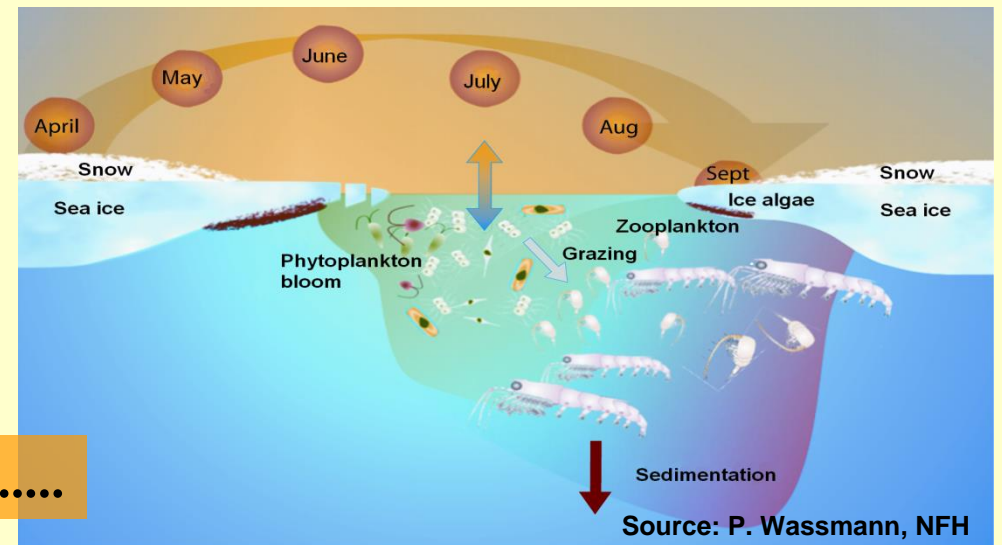
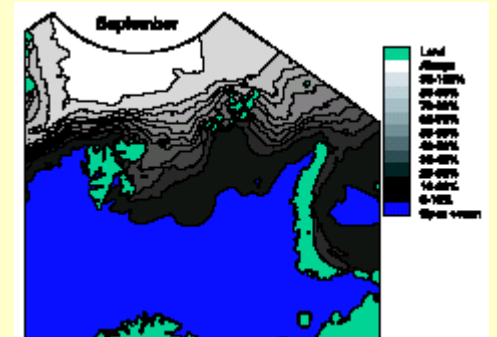
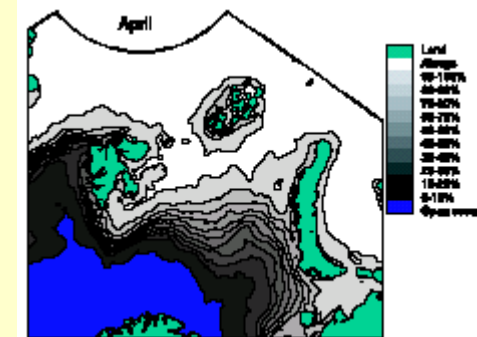
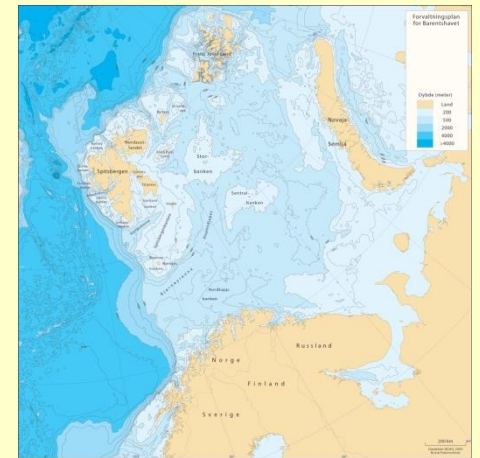
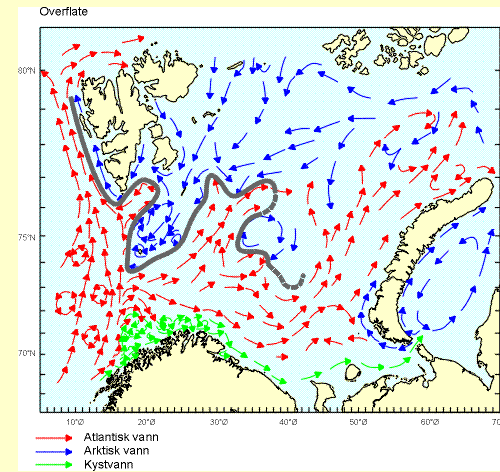
- Ocean current
- Water masses (physical + chemical properties)
- Sea ice
- Ocean floor topography/condition

- **Biology**

- Productive areas
- Dynamics/Processes
- Transport of organisms to the area
- Migration in/out

- **Activities and impact factors**

- Climate
- Ocean acidification
- Pollution
- Fisheries
- Petroleum
- Shipping
- Introduced species



... have to be considered together in a management plan

Class Asteroidea



Class Scyphozoa



Class Malacostraca



Class Anthozoa



Class Gastropoda



Other groups

Class Osteichthyes



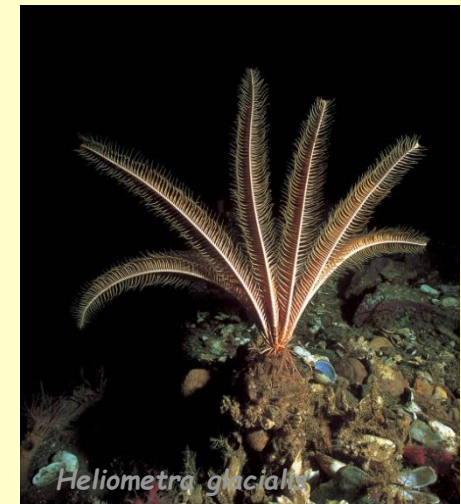
Class Demospongia



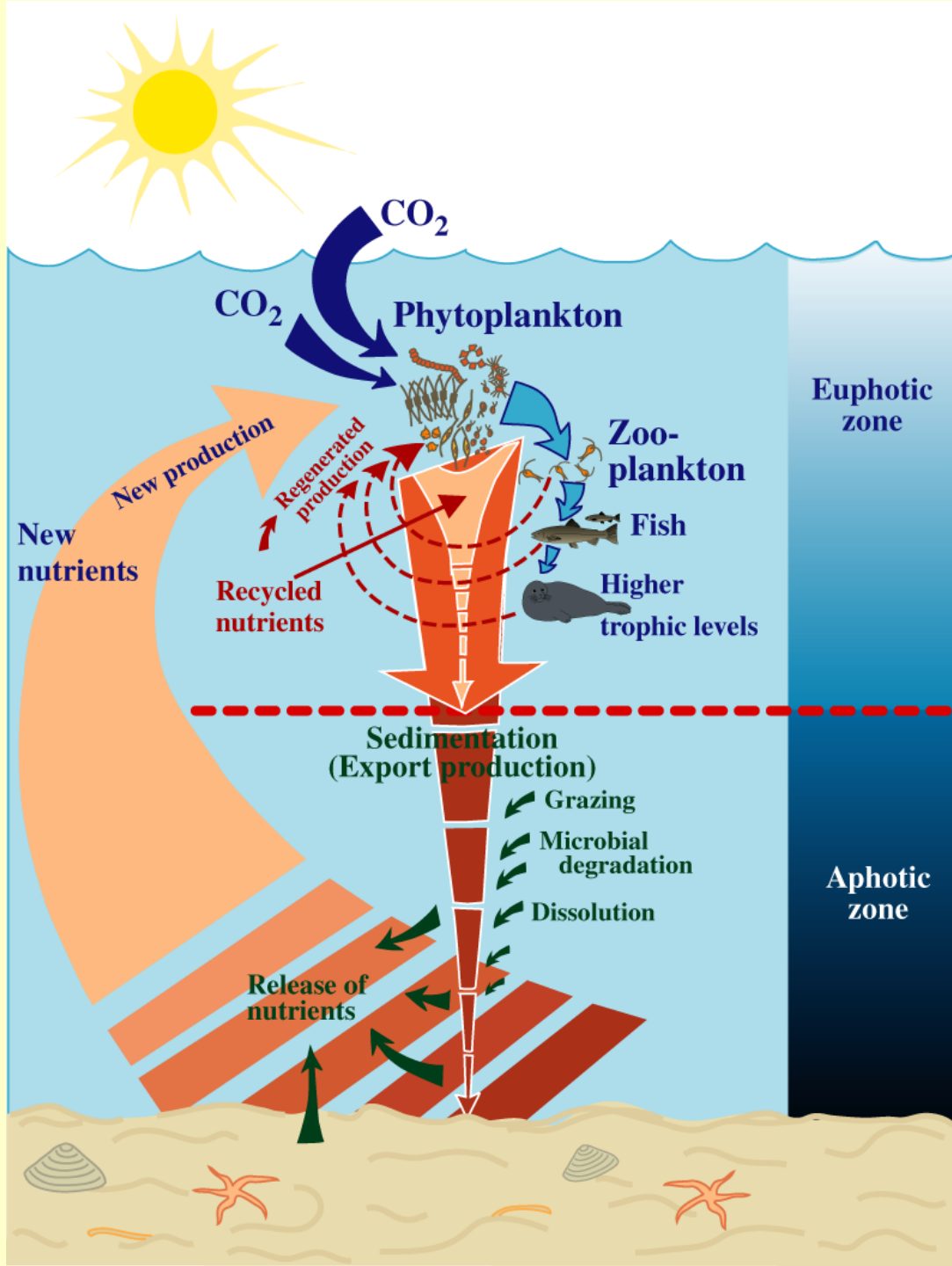
Class Ophiuroidea



Class Crinoidea



Photos: B. Gulliksen & E. Svensen



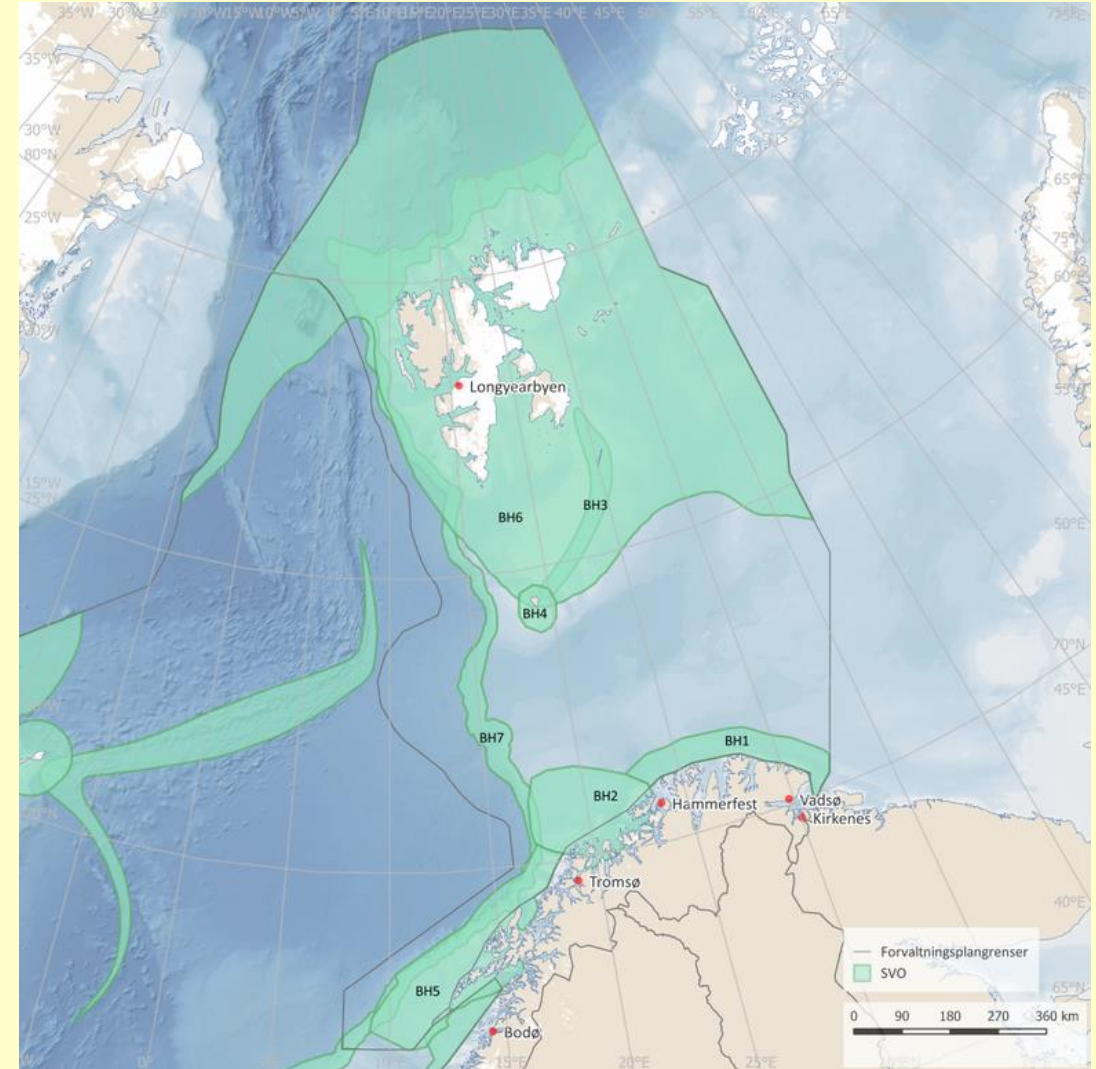
Conceptual view on interactions and processes in Arctic marine ecosystems

(after Keck and Wassmann)

Particularly valuable and vulnerable areas that require special attention

The most important criteria for selecting the areas were:

- whether it supports **high production** and **high concentration** of species
- whether it includes a large proportion of **endangered** or **vulnerable** habitats
- whether it is a **key area** for species for which Norway has a special responsibility or for endangered or vulnerable species
- whether it supports **internationally** or **nationally** important populations of certain species all year round or at specific times of the year



Source: Meld. St. 20 (2019-2020)

Valuable areas - Criteria

- Representativity
- Biodiversity
- Production
- Coupling: marine – terrestrial
- Naturalness
- Uniqueness and/or rarity
- Economic importance
- Social importance
- Scientific importance
- Educational value
- Accessibility
- International or national significance

Tabell 21. Utvalgsriterier for vurdering av marine natur- og kulturverdier brukt i MABA. Omarbeidet etter Theisen (1997), Gabrielsen et al. (1997), DN (1998), Theisen & Brude (1998), Hop et al. (1998), Kelleher (1999). Eksemplene som er nevnt under de ulike delkriteriene er ikke fullstendig. * Er forklart nærmere på neste side.

Utvalgsriterier	Delkriterier	Detaljer	Noen eksempler	
Overordnet kriterium	Viktighet for representasjon av alle biogeografis e soner, naturtyper, habitater, arter og kulturminner i analyseområdet	Sikre representasjon som er typisk	Vanlig forekommende Unikt område, representativt for regionen Områder som har bevart sin opprinnelige karakter	Iskanten Polynyaer Fuglekolonier Iskuringsområde
		Sikre representasjon som er særegen	Sjeldne naturkvaliteter Områder med innhold truet av menneskelig virksomhet Spesielt betydningsfulle arter	Områder nær bosetninger Områder med stor turistaktivitet Områder med fis erikviteter
		Sikre representasjon innenfor et større nettverk	Cirkumpolart i Arktis Nord-sør gradient	
	Viktighet for biologisk mangfold	Spesielt stort biologisk mangfold (diversitet)	Økosystemnivå Artsnivå Genetisk nivå	«Hot-spots»
Leveområder for spesielle arter/bestander		Endemiske arter Sårbare, sjeldne, truede arter * Økologiske indikatorarter * Nøkkelarter * Paraplyarter * Flaggskip * Bestander med nasjonal eller internasjonal verneverdi	Øyer/fuglefjell Strandsonen Drivisen Åpent hav	
Spesielle naturtyper og habitater		Sjeldne Truede Sårbare	Isolerte øyer	
Grenseområder		Yttergrense for en eller flere arters utbredelse	Polarfronten	
Utfyllende kriterier	Viktighet for biologisk produksjon	Stor biologisk produksjon	Høy primærproduksjon Høy sekundærproduksjon	Oppvelling- og frontområder Iskantsonen Permanent isfrie områder i drivisbeltet
		Store konsentrasjoner av arter eller individer	Reproduksjonsområder Oppvekstområder Nærings-, hvile- og myteområder Kaste- og hårfellingsområder Trekk- og vandringsruter	Fuglefjell Grunne områder/banker Iskanten
	Kobling mellom marint og terrestrisk miljø	Grad av påvirkning fra marine organismer på terrestrisk miljø	Vegetasjon ved fuglefjell Næringsressurs	Fuglefjell
	Uberørthet	Graden av menneskeskapt påvirkning	Tekniske inngrep/arealbruk Beskatning (fis e/fangst) Forurensning	Bentiske områder Åpent hav Områder nær bosetninger
	Særegenhet og/eller sjeldenhet	Naturverdier	Særegne/Sjeldne naturtyper	Kystklipper Manglende strandterrasser Enkelte bentiske områder?
		Kulturminneverdier	Særegne og sjeldne kulturminner	Forlis iht. skriftlige kilder
	Økonomisk betydning	Turisme	Områder med opplevelsesverdi	Enkelte strandlokaliteter Fuglefjell
	Fiske/fangst	Reproduksjonsområder Oppvekstområder Nærings-, hvile-, myteområder	Bentiske områder Kystområder Åpent hav	
		Sosial betydning	Verdi for lokale/internasjonale samfunn	Historisk verdi Estetisk verdi Verdi for rekreasjon
	Vitenskapelig verdi	Spesielt vitenskapelig interessante områder/arter/økosystem	Biologiske Geofysiske Geologiske forekomster og fenomener Kulturminner	Et vidt spekter av områder
		Referanseområder Kildeverdi	Forskning Overvåkning	Et vidt spekter av områder
	Pedagogisk verdi	Typelokaliteter	Biologiske Geologiske Økologiske	Et vidt spekter av områder
Illustrering av sammenhenger		Naturfenomener Kulturminner og naturmiljø	Et vidt spekter av områder	
Tilgjengelighet	Vitenskapelig aktivitet Pedagogisk aktivitet Turisme/friluftsliv			
Internasjonal og/eller nasjonal verdi	Eksisterende forpliktelser	Ulike avtaler/forpliktelser Internasjonale konvensjoner	Et vidt spekter av områder	
	Potensiale for å bli innlemmet i et nasjonalt/internasjonalt system	Ulike nettverk verneområder målestasjoner forskningsprogram Internasjonal/nasjonal verneverdi	Et vidt spekter av områder	

Selected valuable areas

- Oceanographically/
topographically special areas

- Fronts
- Strong currents
- Fjords
- Retention areas
- Tidal zone

- Important areas for life history

- Spawning/birth/breeding grounds
- Drifting paths/migrating routs
- Feeding grounds
- Wintering grounds
- Moulting areas

- Other criteria

- Key areas for **endangered** or **vulnerable species**
- or species for which Norway has a **special responsibility**
- or **habitats** for internationally or nationally populations of certain species all year round or at specific times of the year

- Protected areas

- Suggested marine protected areas along the Norwegian coast
- Existing protected areas in Svalbard (e.g. MPA)

- Cultural monuments

Vulnerability

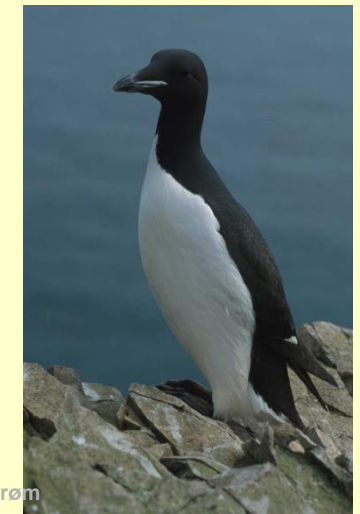
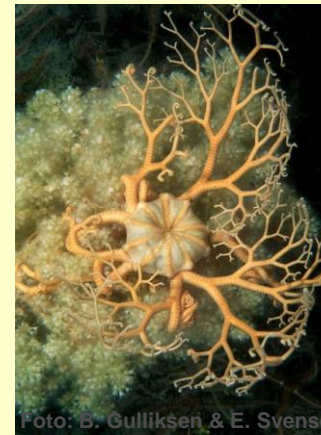
Assessing vulnerability

- Type of impact and duration
- An area is usually not equally vulnerable all year round
- All species in an area will not be equally vulnerably towards a specific environmental pressure
- Differentiating between natural and human-induced pressures on the environment

Vulnerability can be measured at individual, population, community and ecosystem level.

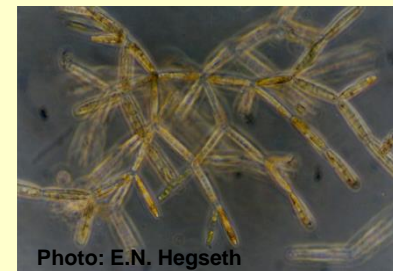
Vulnerability cont.

- **High concentrations of organisms**
 - Number of individuals within an area - influence on the vulnerability
 - High production – grazing areas
 - Breeding colonies
 - Haul out sites
- **Behavior or population dynamics**
 - Species being able to escape unfavorable conditions will be least affected
 - Time spent at sea for feeding or moulting
- **Sessile/motile animals**
 - Sessile animals – particular vulnerable with respect to climate change, pollution, certain types of fishing operations
- **Insulation**
 - Feathers and fur - more vulnerable to oil spills than whales and adult fish – amount of blubber
- **Diet**
 - The diet variability and degree of specialization
- **Key species**
 - Particular important role in the ecosystem
 - Seriously affected – may affect the whole ecosystem



Vulnerability cont.

- **Age**
 - An organism's vulnerability varies in accordance with age
 - Generally, the young stages of an organism's lifecycle will be especially vulnerable - immune, neural, enzyme systems are developed
- **Life history**
 - How long they live
 - When they sexually mature
 - Reproductive rate
- **Migration**
 - Whole life or migrate in and out of the area
- **Border of distribution**
 - Often more vulnerable near its border of distribution
- **Peculiar species composition and/or particularly high species diversity**
- **IUCN Red List species.**
 - Essentially a forecast of the risk of species becoming extinct in Norway.



The Polar Front – important feeding area for seabirds and marine mammals

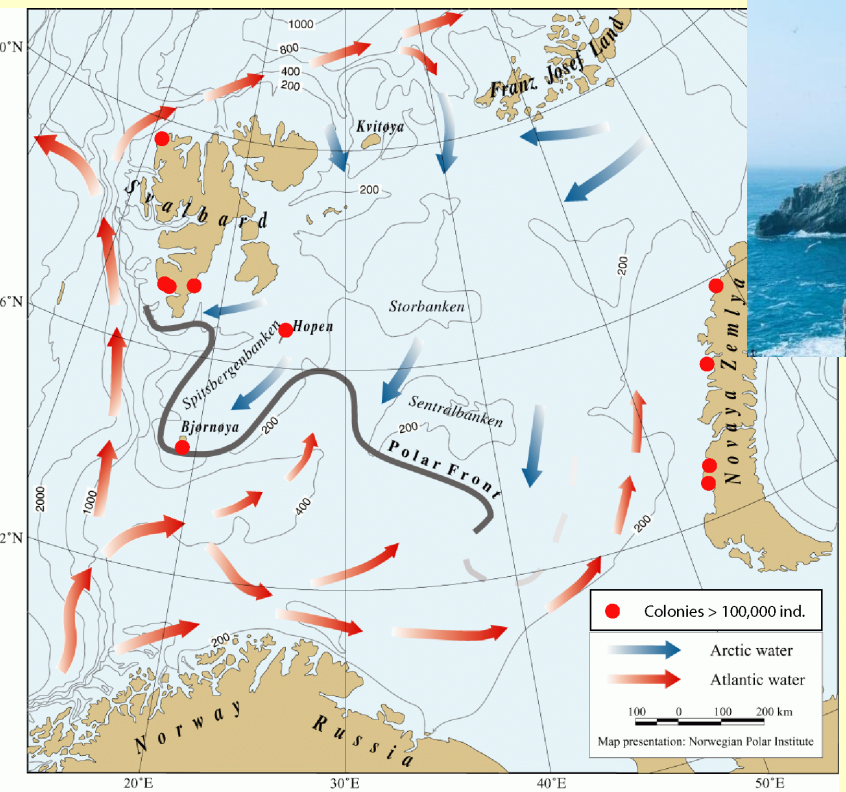
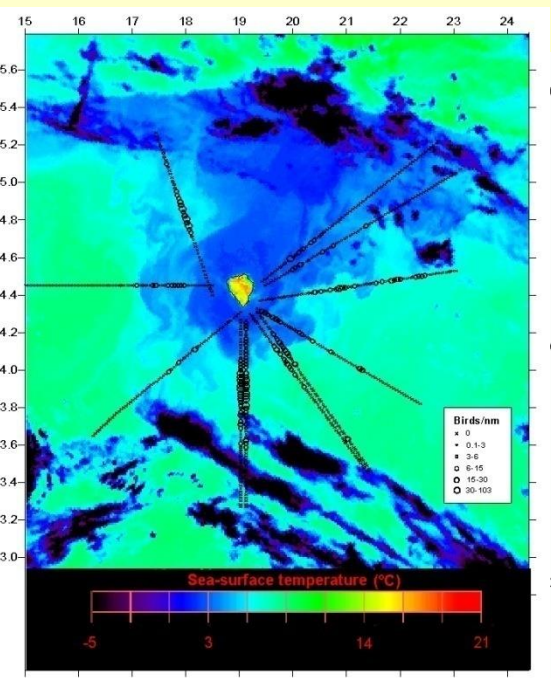


Photo: H. Strøm



Photo: H. Strøm



Photo: Kit og Christian, NP

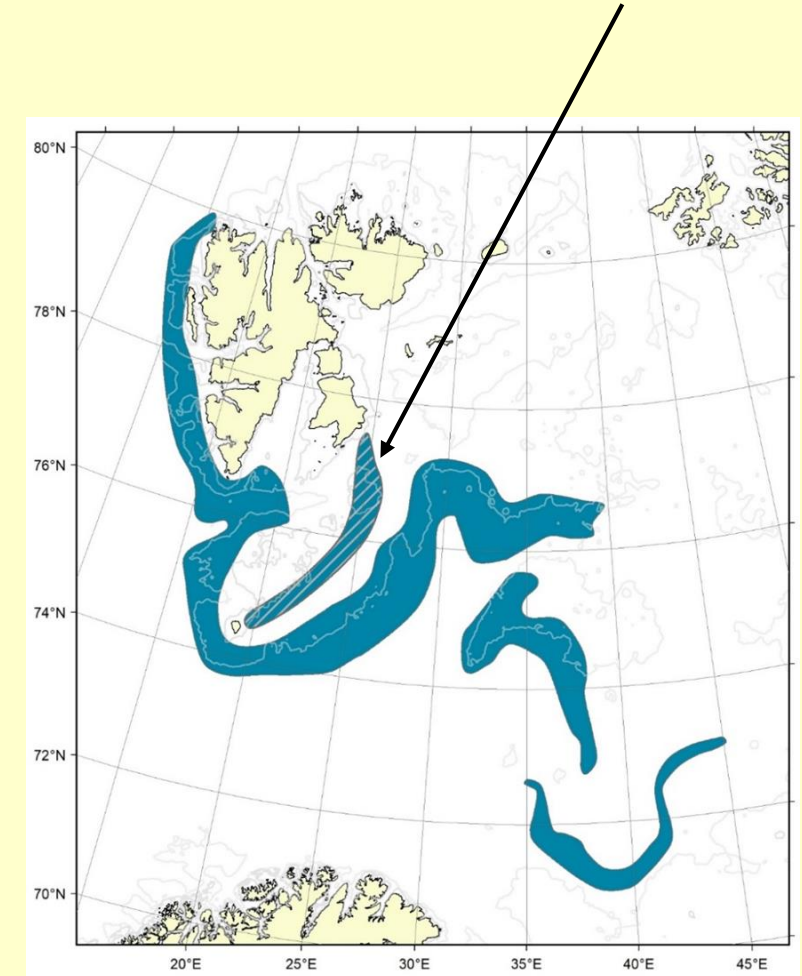
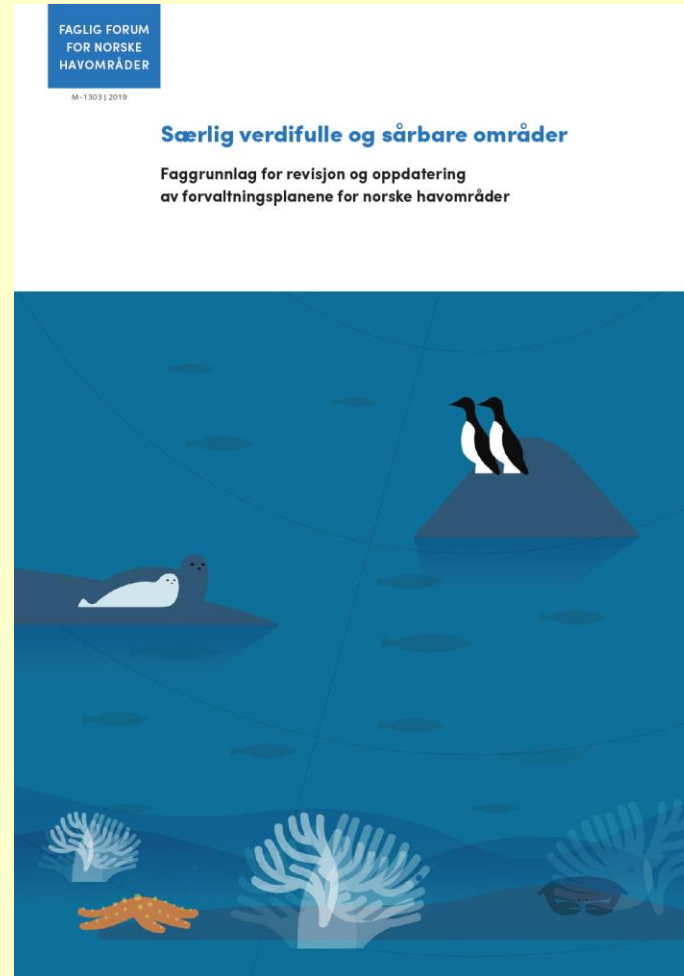
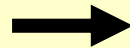
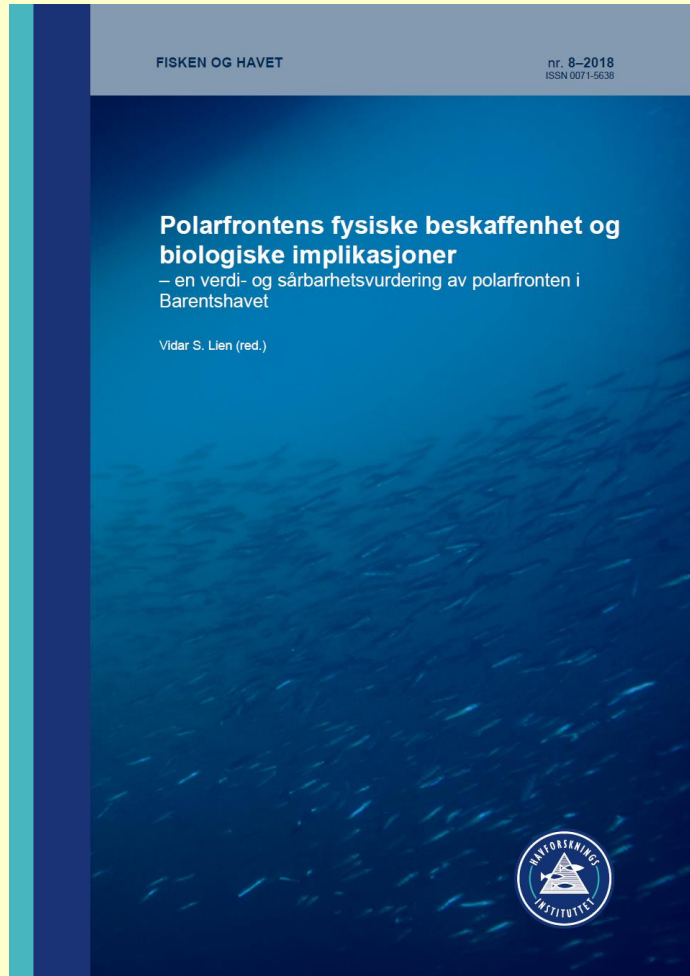


Photo: H. Strøm

Bjørnøya – some of the biggest nesting colonies in the Barents Sea Region and in the North-Atlantic.

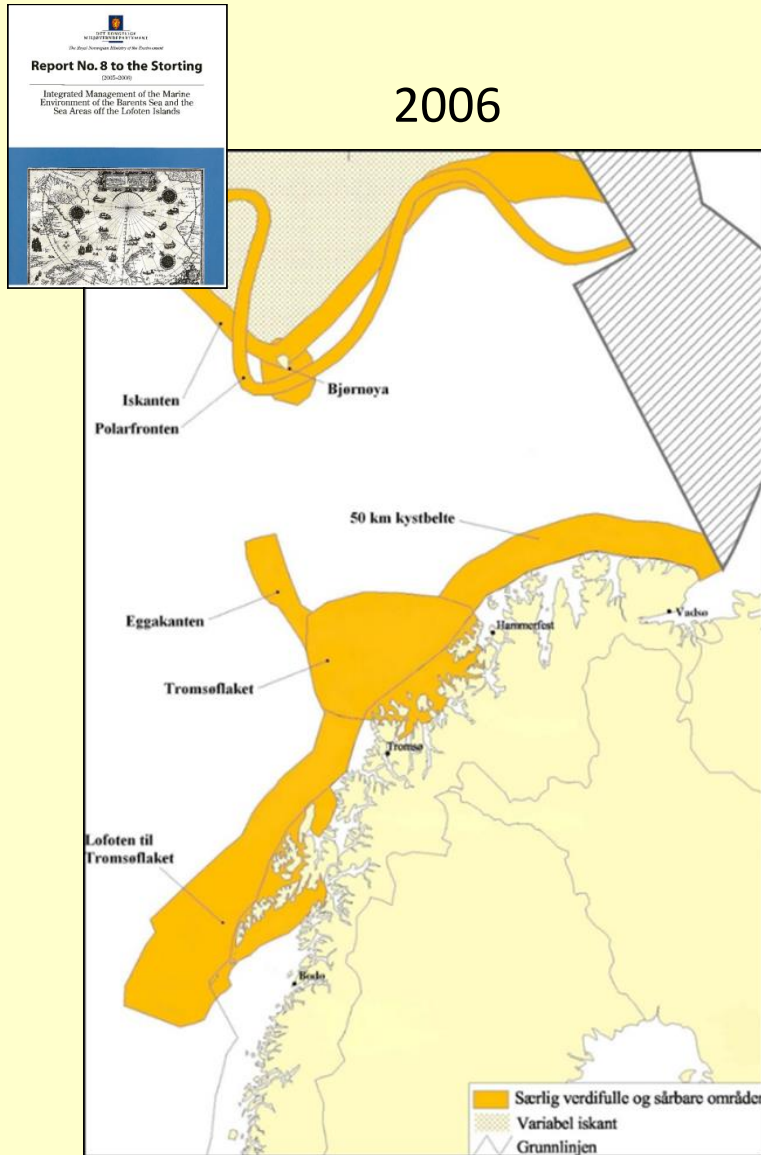
- +
 - Primary production
 - Border for distribution
 - Biodiversity
 - Red list

Polar front area – polar tidal mixing front as a valuable and vulnerable area



Changes over time

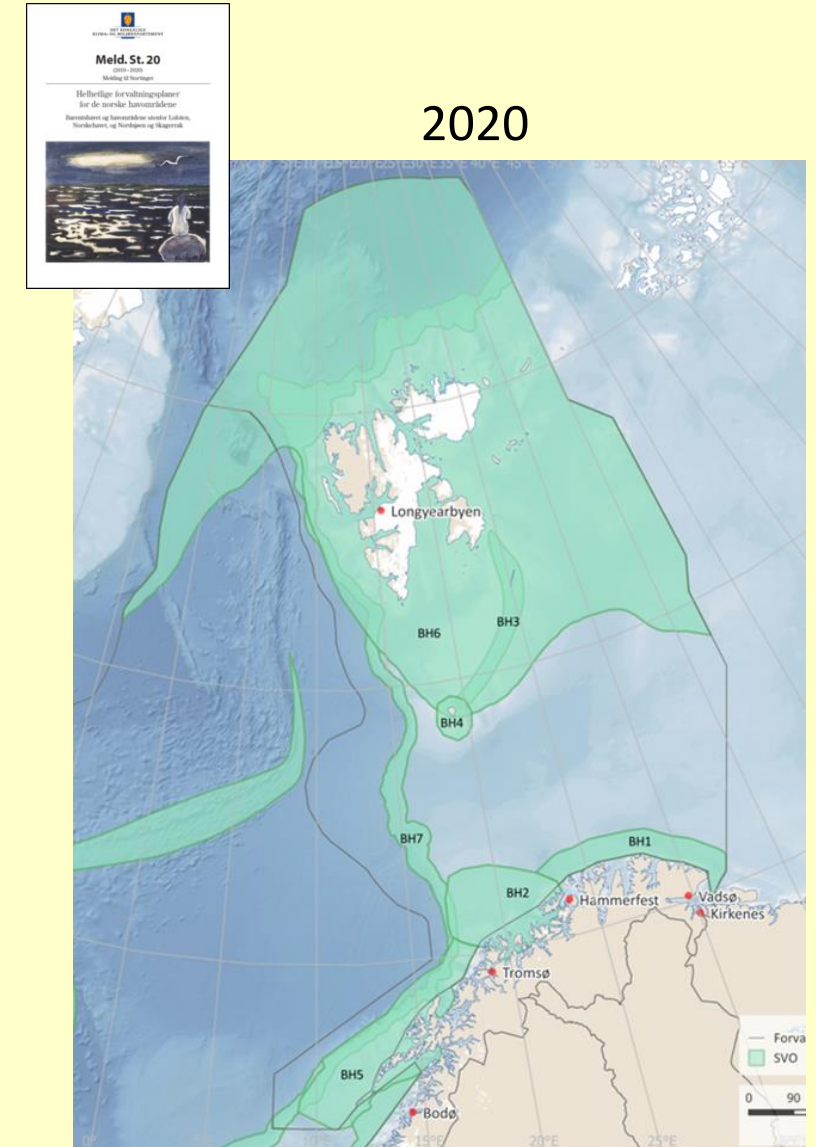
2006



2011



2020



CBD in Norwegian management plans

- Valuable areas
 - Seven criteria
- Vulnerability
- Activity

Value

Vulnerability
Activity

Management
forum - advice

Steering group
- decision

Parlament
- adoption

Spring
2021

Spring
2022

Spring
2023

Spring
2024

Late spring/
early summer 2024



CBD EBSA Criteria

(SCIENTIFIC CRITERIA FOR IDENTIFYING ECOLOGICALLY OR BIOLOGICALLY SIGNIFICANT MARINE AREAS)

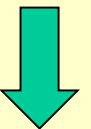
Ice biota, phyo- and zooplankton, benthos, fish, seabirds, marine mammals

CBD EBSA Criteria (Annex I to decision IX/20)	Description (Annex I to decision IX/20)	Ranking of criterion relevance			
		No information	Low	Medium	High
Uniqueness or rarity	Area contains either (i) unique (“the only one of its kind”), rare (occurs only in few locations) or endemic species, populations or communities, and/or (ii) unique, rare or distinct, habitats or ecosystems; and/or (iii) unique or unusual geomorphological or oceanographic features.				
<i>Explanation for ranking.</i>					
Special importance for life-history stages of species	Areas that are required for a population to survive and thrive.				
<i>Explanation for ranking</i>					
Importance for threatened, endangered or declining species and/or habitats	Area containing habitat for the survival and recovery of endangered, threatened, declining species or area with significant assemblages of such species. Three Habitats Directive area within this proposed area has been designated, all with reference to the presence of Harbour Porpoise.				
<i>Explanation for ranking</i>					
Vulnerability, fragility, sensitivity, or slow recovery	Areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery.				
<i>Explanation for ranking</i>					
Biological productivity	Area containing species, populations or communities with comparatively higher natural biological productivity.				
<i>Explanation for ranking</i>					
Biological diversity	Area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.				
<i>Explanation for ranking</i>					
Naturalness	Area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation.				
<i>Explanation for ranking</i>					

Value

Vulnerability

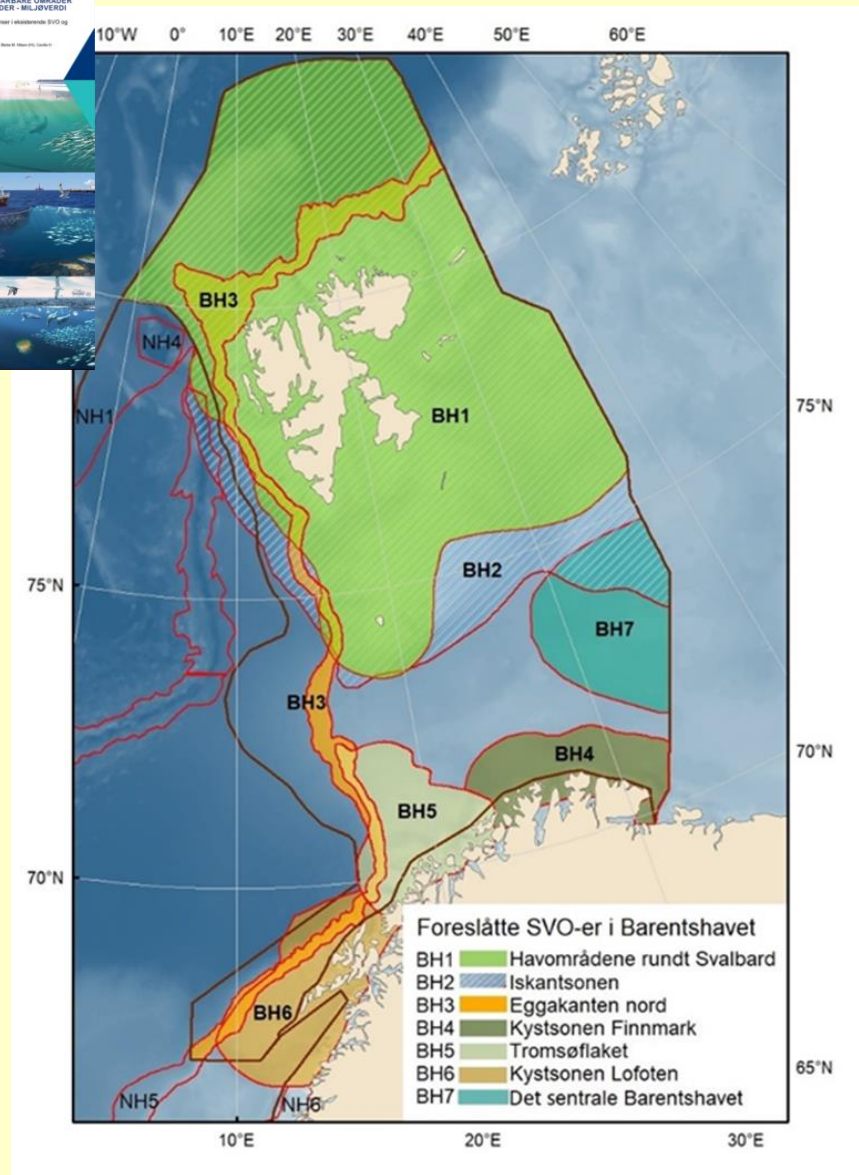
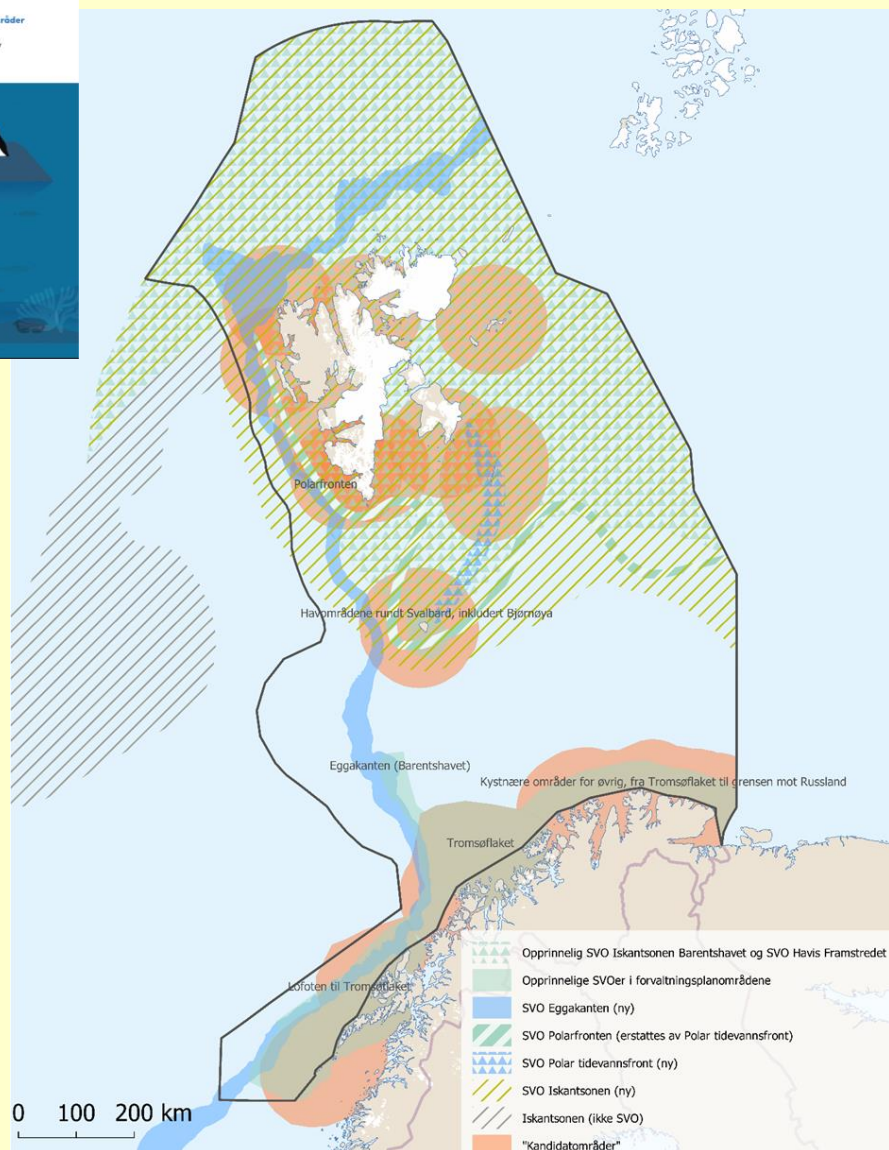
Activity



Existing areas
New areas

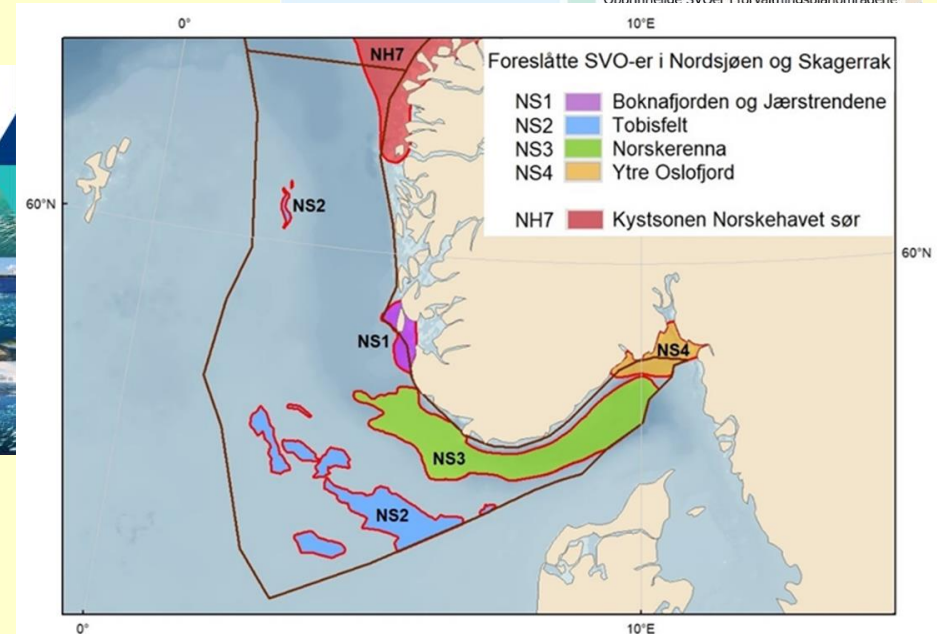
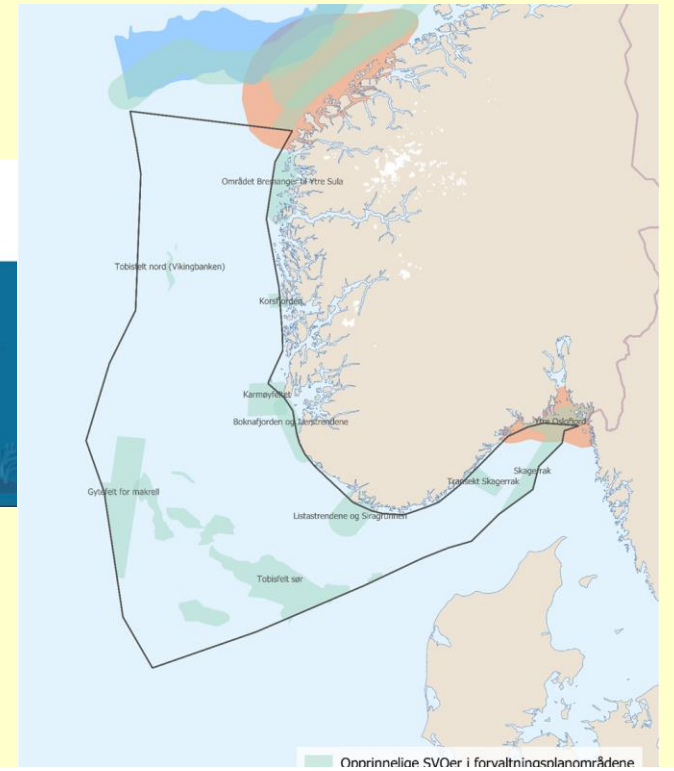
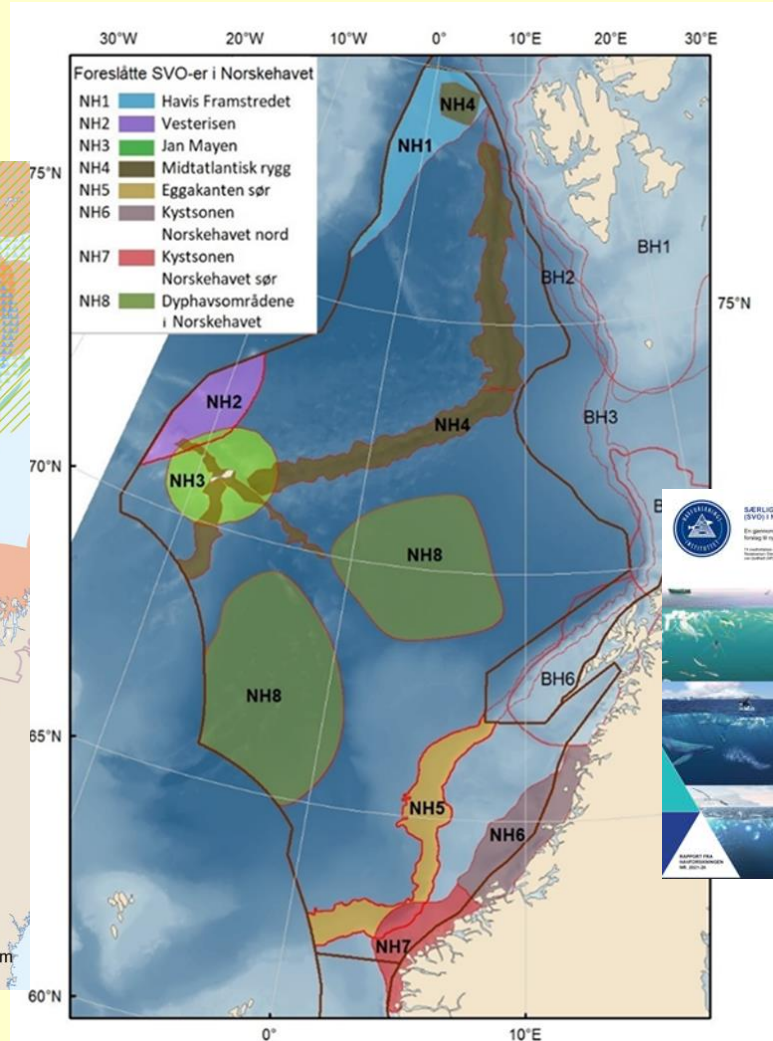
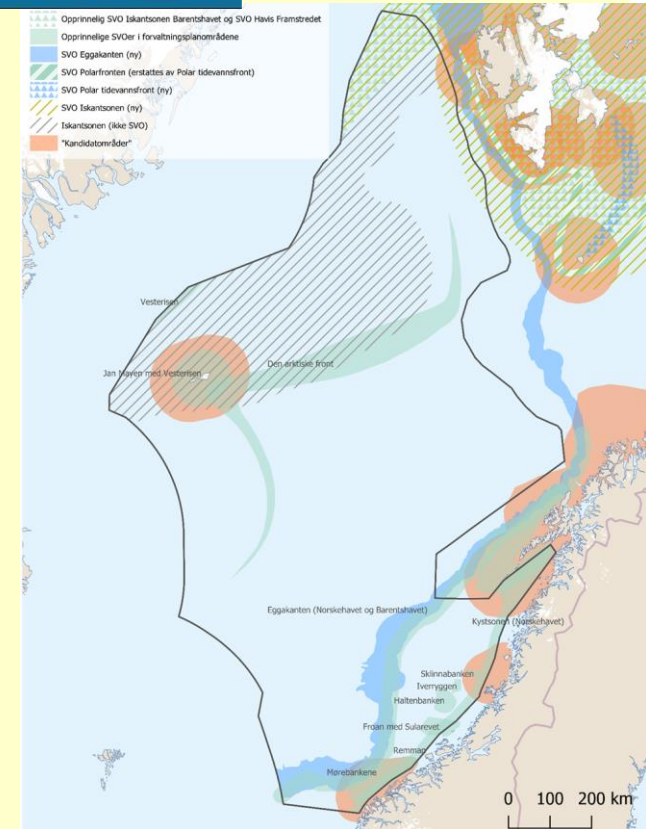
(Spring 2022)

Revision of valuable and vulnerable areas, value

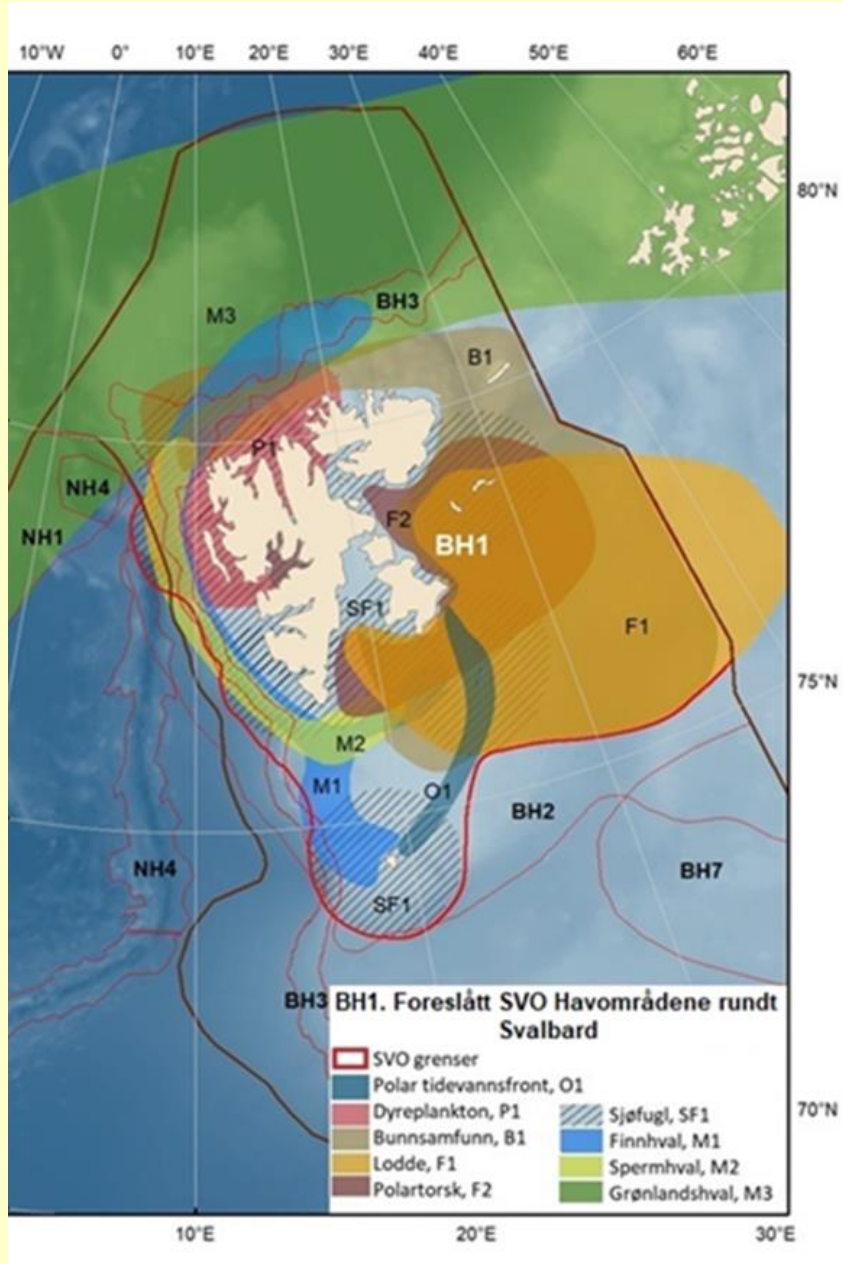


The North Sea-Skagerrak

The Norwegian Sea



Maps



Objectives with different "functions"

Examples

- Strategic/overarching objectives
 - Overriding considerations
- High-level operational objectives/qualitative descriptors
 - Management actions
 - Specific guidelines
 - Environmental status
 - Desired state of the environment

Management of the Barents Sea–Lofoten area will ensure that diversity at ecosystem, habitat, species and genetic levels, and the productivity of ecosystems, are maintained. **Human activity** in the area will not damage the structure, functioning, productivity or dynamics of ecosystems (St. meld. nr. 8 (2005-2006)).

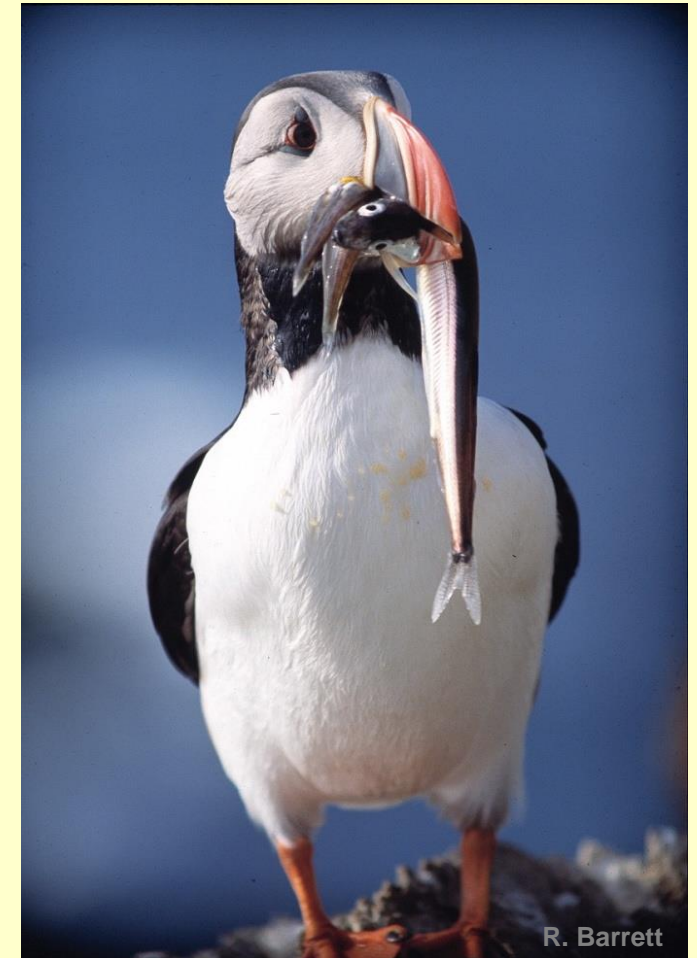
A representative **network of protected marine areas** will be established in Norwegian waters, at the latest by 2012. This will include the southern parts of the Barents Sea–Lofoten area. (St. meld. nr.8 (2005-2006)).

Harvested species will be managed within safe biological limits so that their spawning stocks have **good reproductive capacity**. (St. meld. nr.8 (2005-2006)).

Coordinated and systematic monitoring

The plan opens for an expanded and coordinated monitoring of the environment

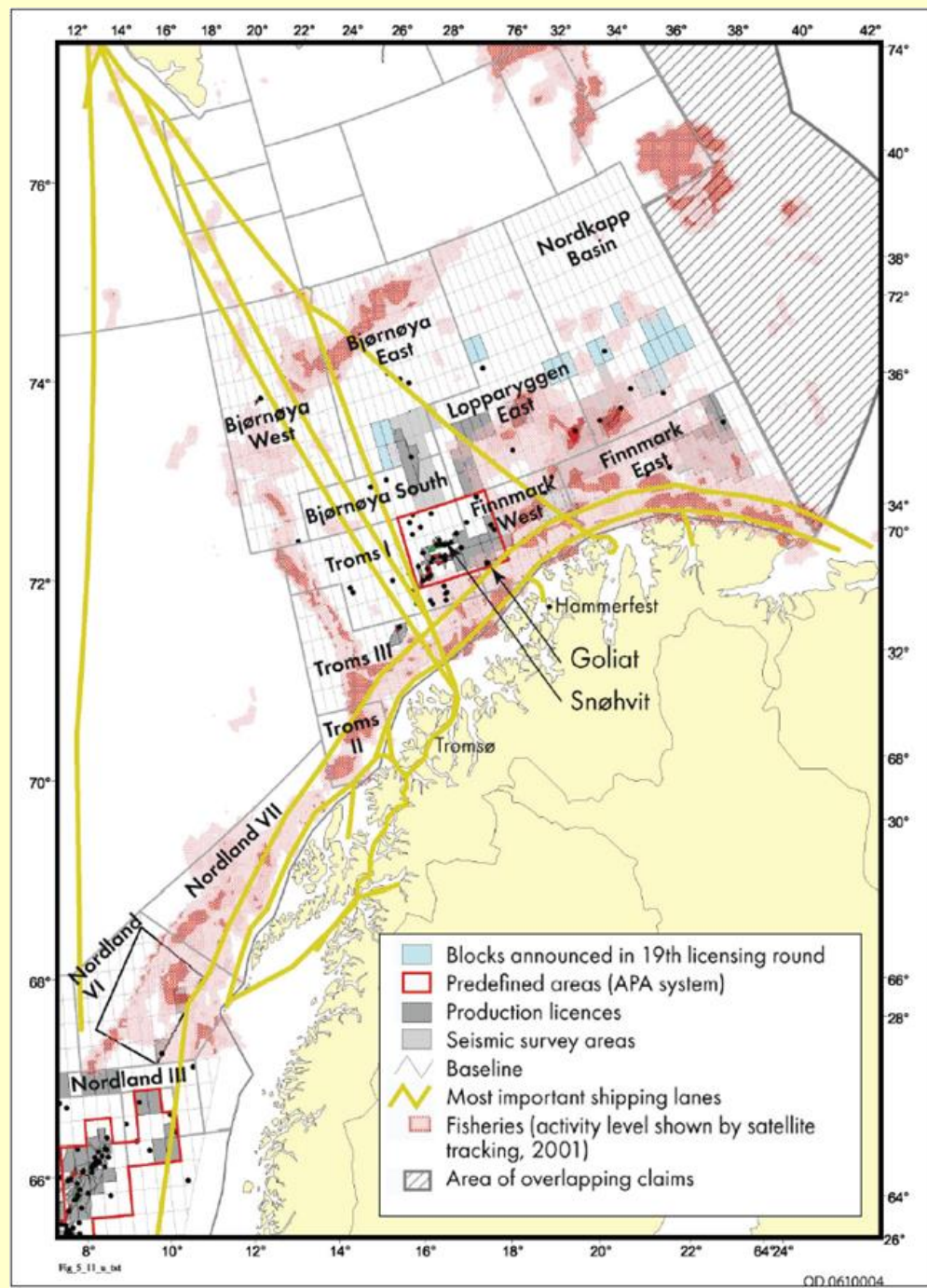
- Monitoring system based on **indicators**, **reference values** and **thresholds for action**
- Updated knowledge about changes in the state of the environment
- Researchers and authorities can make cross-sectoral assessments and implement necessary measures to improve the environment



The Atlantic puffin (*Fratercula arctica*) may be an indicator of the availability of small pelagic fish.

Overall pressures

The state of the environment in the management plan area is ultimately dependent on the overall pressures and impacts of all the different activities that take place both within and outside this area.



Risk evaluation (acute pollution)

- Models and risk analysis are being used as tools to estimate risk.
- Important to be aware of the pros, cons and limitations of these tools.
- Risk will also change over time
 - due to change in traffic volume
 - implantation of measures
 - lessons learned from accidents
 - new technology
 - etc



- Focus on different aspects of risk
 - the probability of accidental discharges
 - the probability of oil contamination
 - the risk of damage
 - the risk of damage-related costs



Integrated Ecosystem Assessments ++

- Description of ecosystems and status of biological diversity and habitats
- Pressures and impacts on the environment
 - Description of activities
 - Climate change, ocean acidification and pollution
 - Environmental effects, incl. cumulative
- Conflicts of interest and coexistence between industries



Photo: N. Øien

Marine ecosystem services

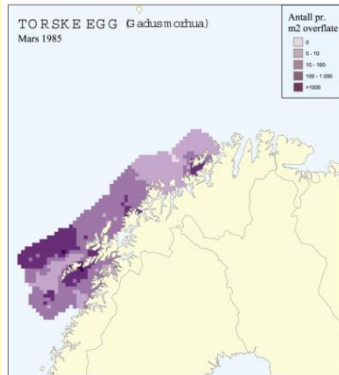
Group	Marine ecosystem services
<i>Production services</i>	Production /supply of food suitable for consumption Production / supply of non-edible products Supply of genetic resources Supply of marine resources for pharmaceutical, chemical and biotechnological industry Supply of decorative resources Supply of energy Supply of space and waterways
<i>Cultural services</i>	Recreational services Aesthetic services Contribution to science and education Maintenance of cultural heritage Inspiration for art and commercials Legacy of the seas (value of existence/heritage)
<i>Regulating services</i>	Climatic and atmospheric regulation Sediment retention Reduction of eutrophication Biologic regulation Regulation of hazardous chemicals
<i>Supporting services</i>	Maintenance of biogeochemical cycles Primary production Maintenance of food web dynamics Maintenance of biodiversity Maintenance of habitats Maintenance of ecologic resistance to change (resilience)

When and where?

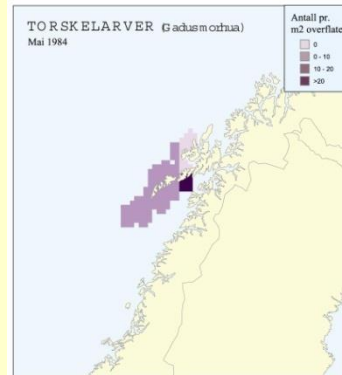
Northeast Arctic cod

(importance of life stage)

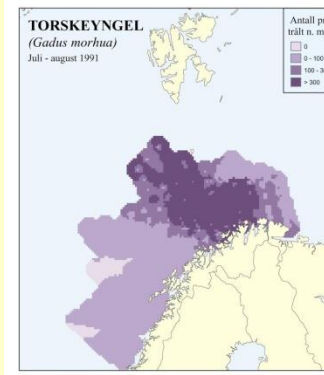
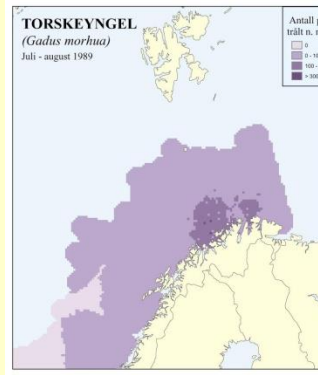
Eggs



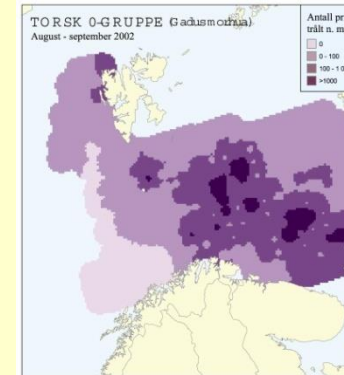
Larvae



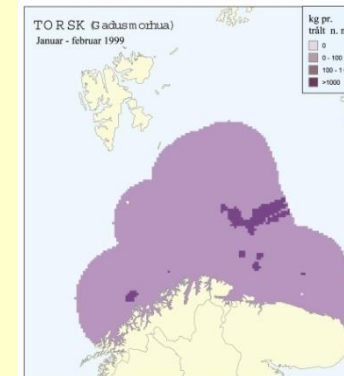
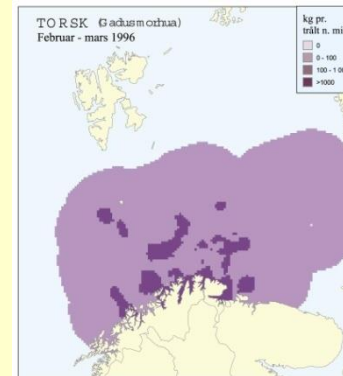
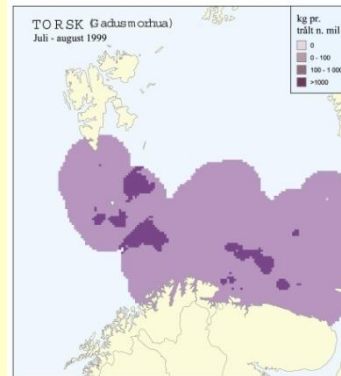
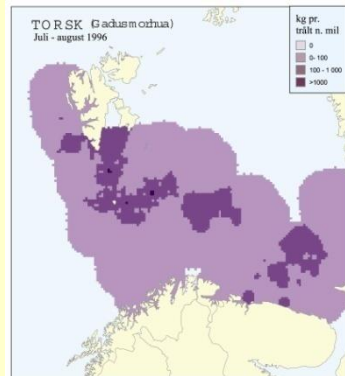
Fry



0-group



Adult

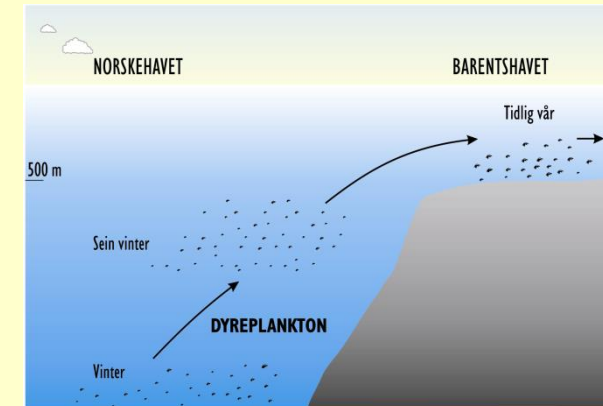


+ different life stage – different prey

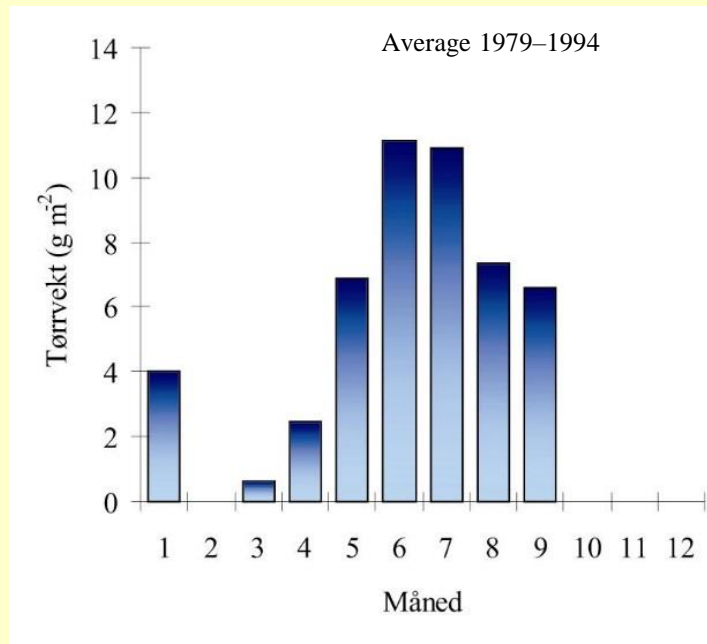
Plankton

(changes throughout a year and between years)

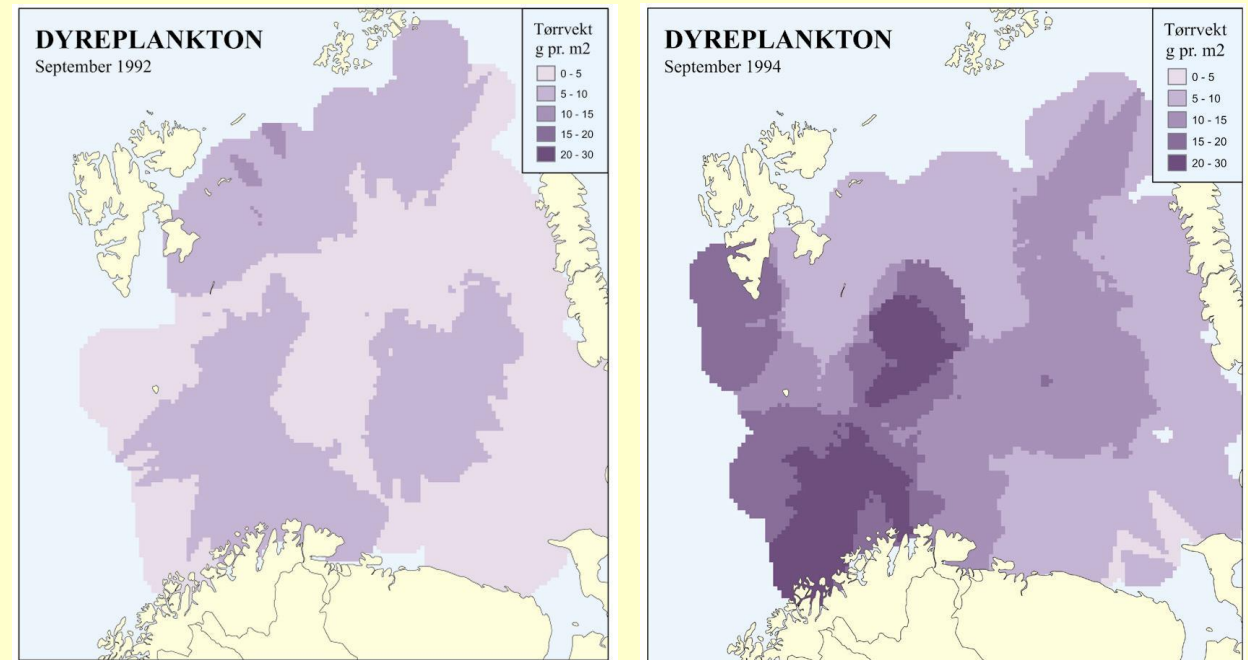
Zooplankton – transport



Zooplankton – biomass

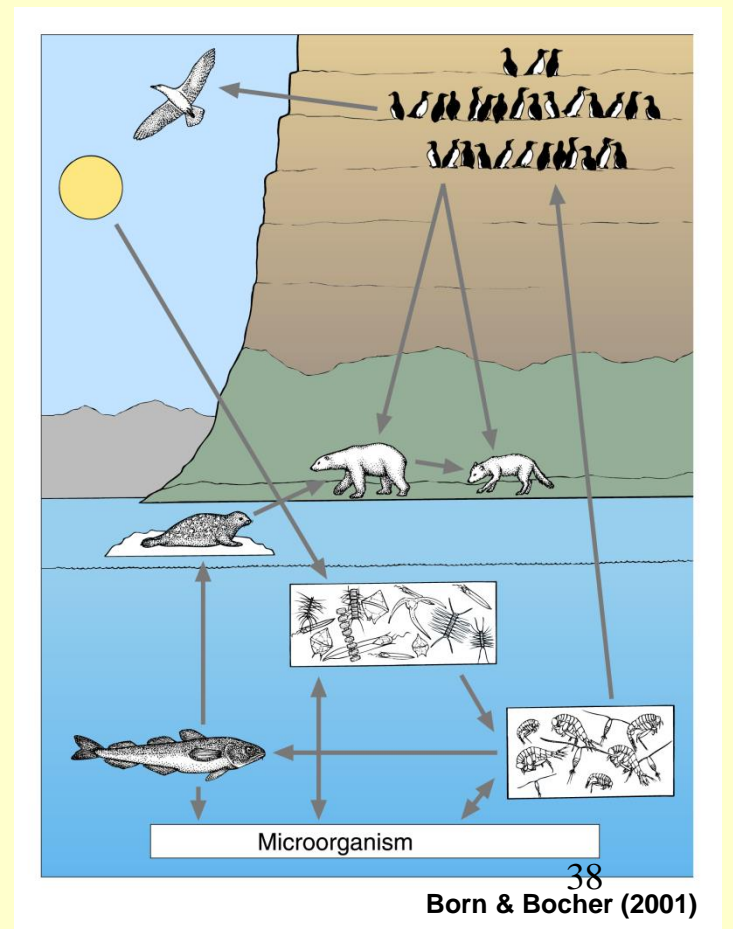


Zooplankton – horizontal distribution



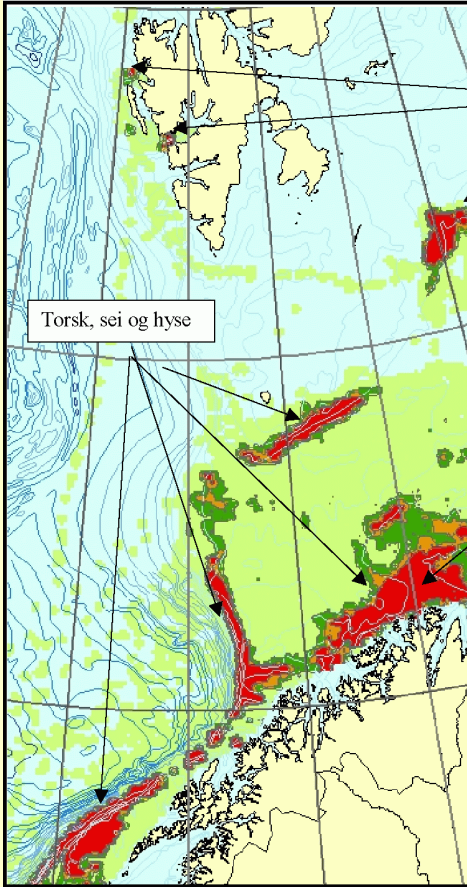
Coupling: sea - land

- Transport of energy from sea to land
- Nesting areas (bird cliffs)
 - Nutrient supply from birds to inland waters
 - Bird cliffs:
 - Areas for arctic fox
 - Plant communities with high demands for nutrients
 - Geese
- Haul out sites
- Den areas

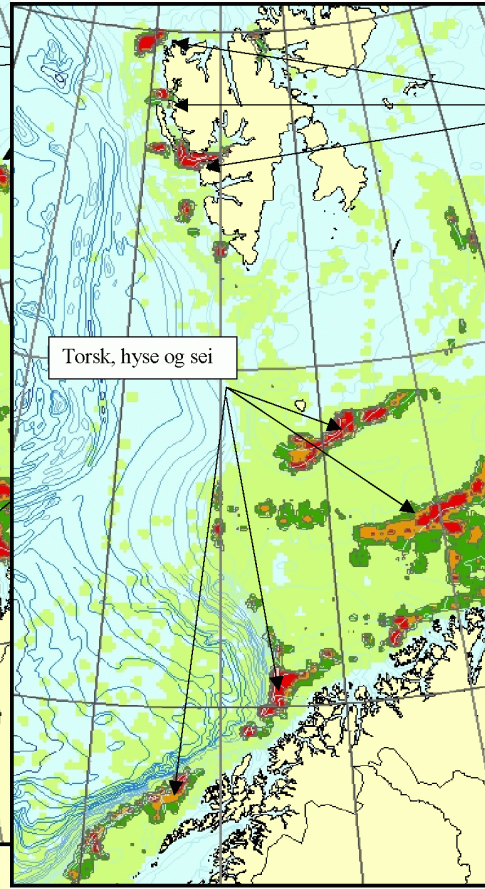


The fishery activity

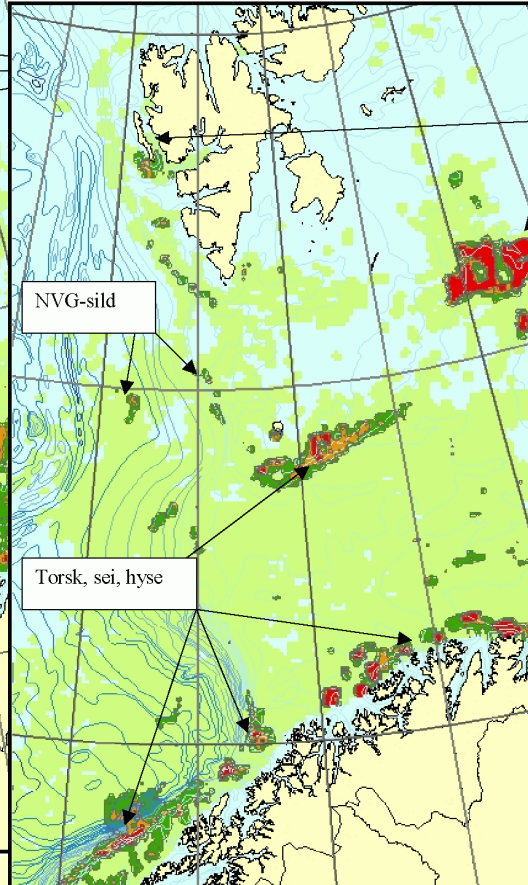
1. quarter 2001



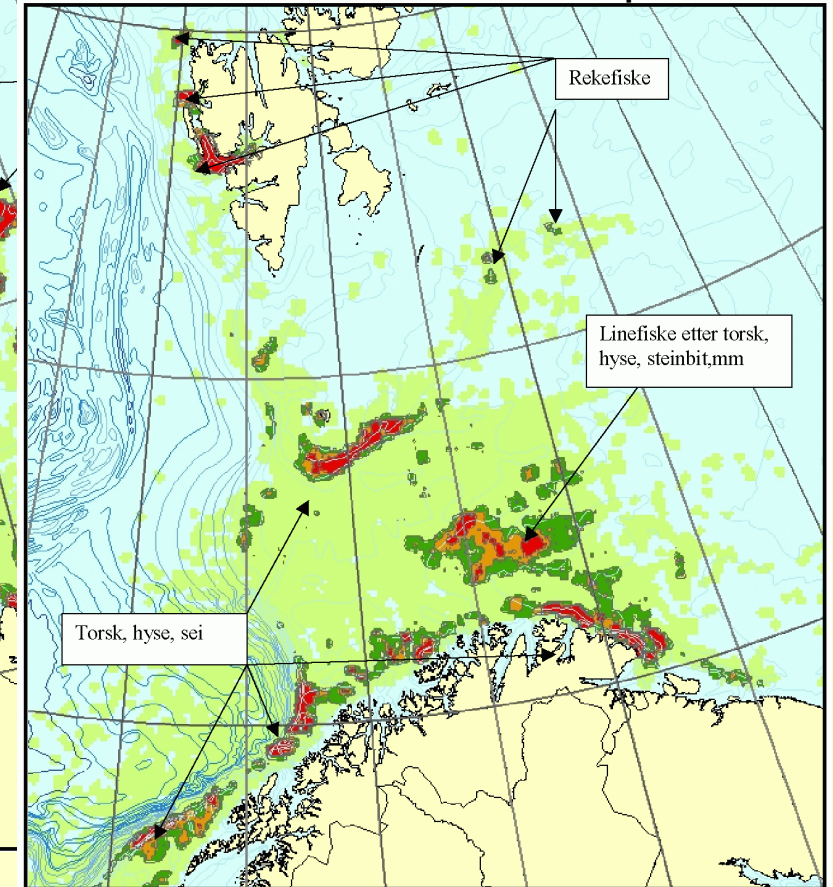
2. quarter 2001



3. quarter 2001



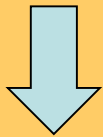
4. quarter 2001



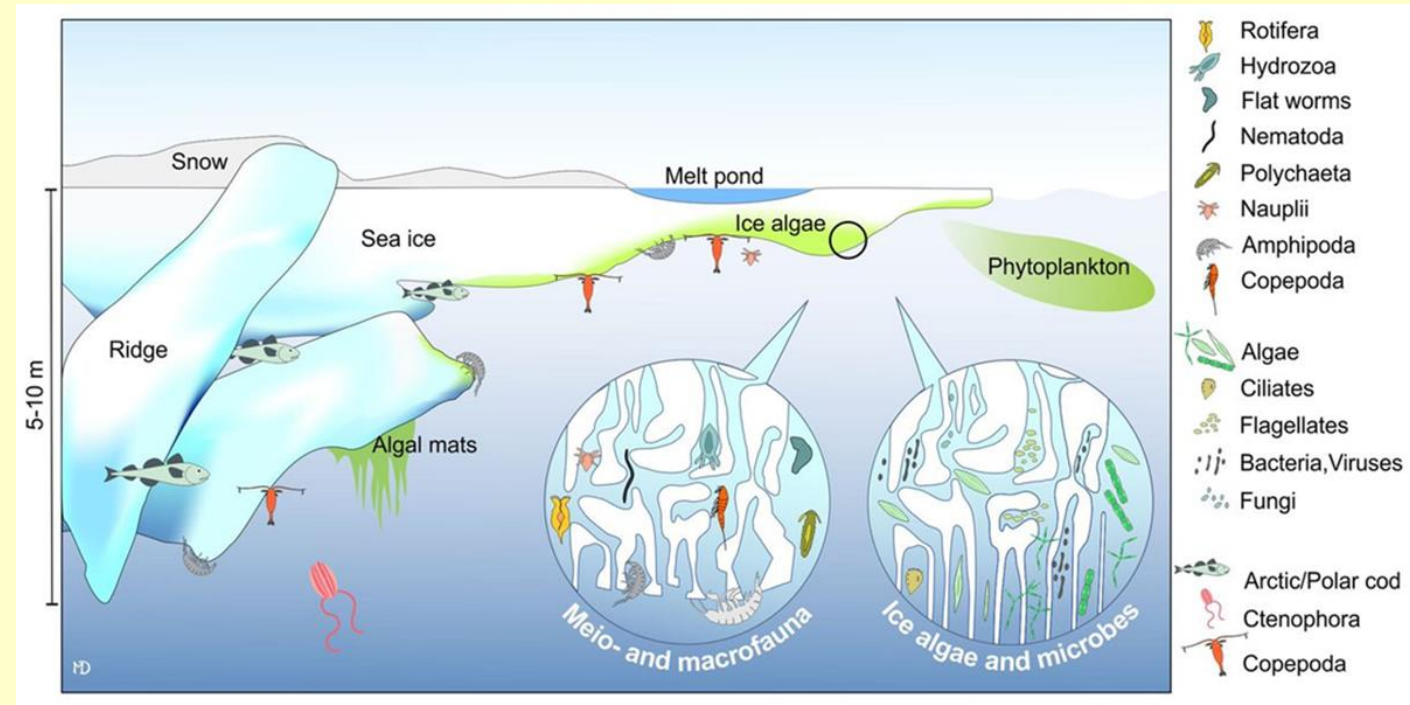
Conclusion

Conclusion

- Physical, chemical information
- Ecosystem structure and functions
- Red list
- Sea floor – water column – (sea ice)
- Seasonal and annual variations
- Do observations relate to the Marginal ice zone and/or Polar front??



- Polar front as a valuable (CBD) and vulnerable area?



Source: von Quillfeldt et al. (2018), modified from Bluhm et al. 2017

Thank you for your attention!

