Vulnerability of Svalbard coasts to oil spills – climate change consideration

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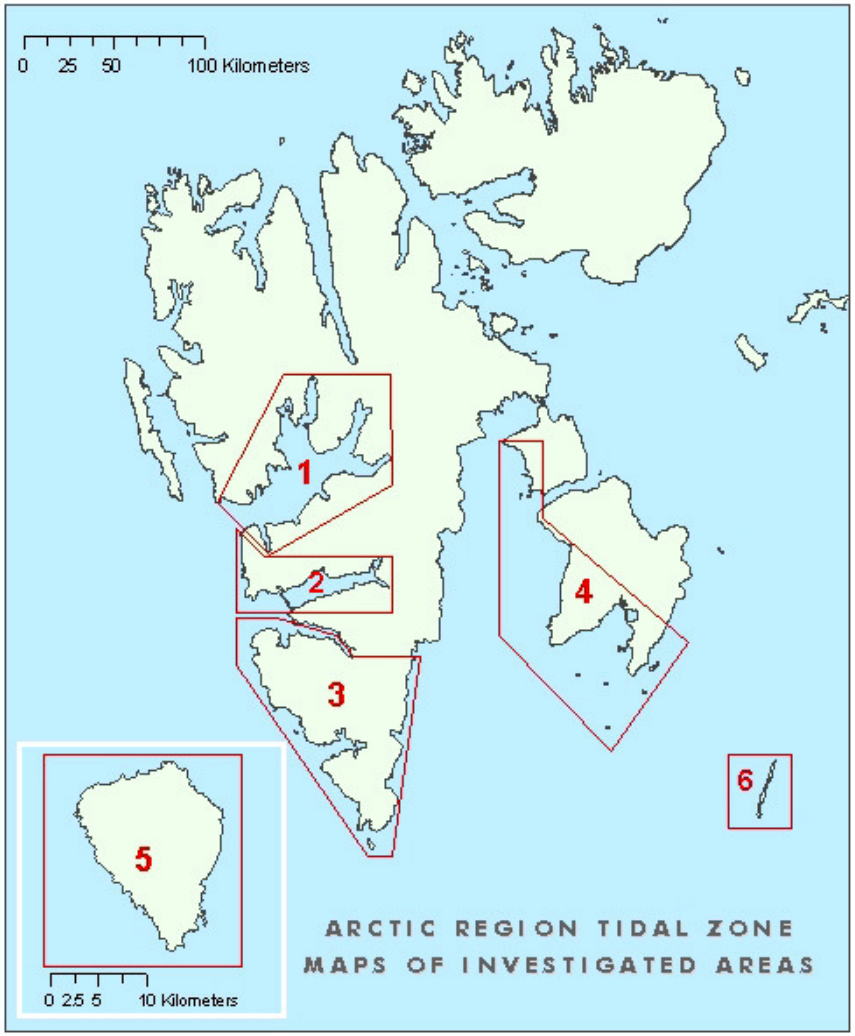
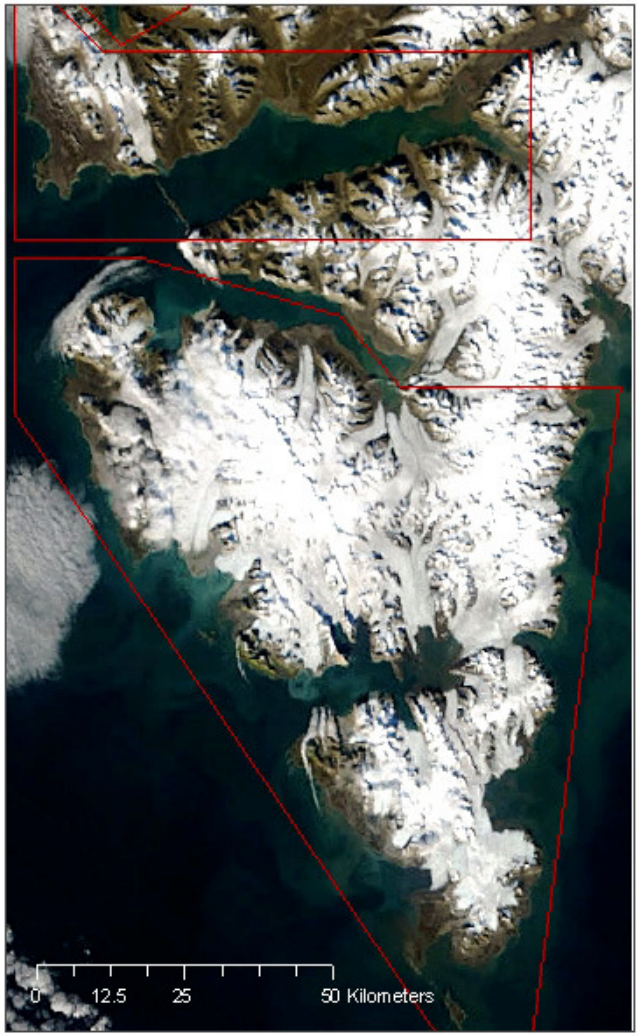
Arctic Frontiers Conference, Tromso, January 2008

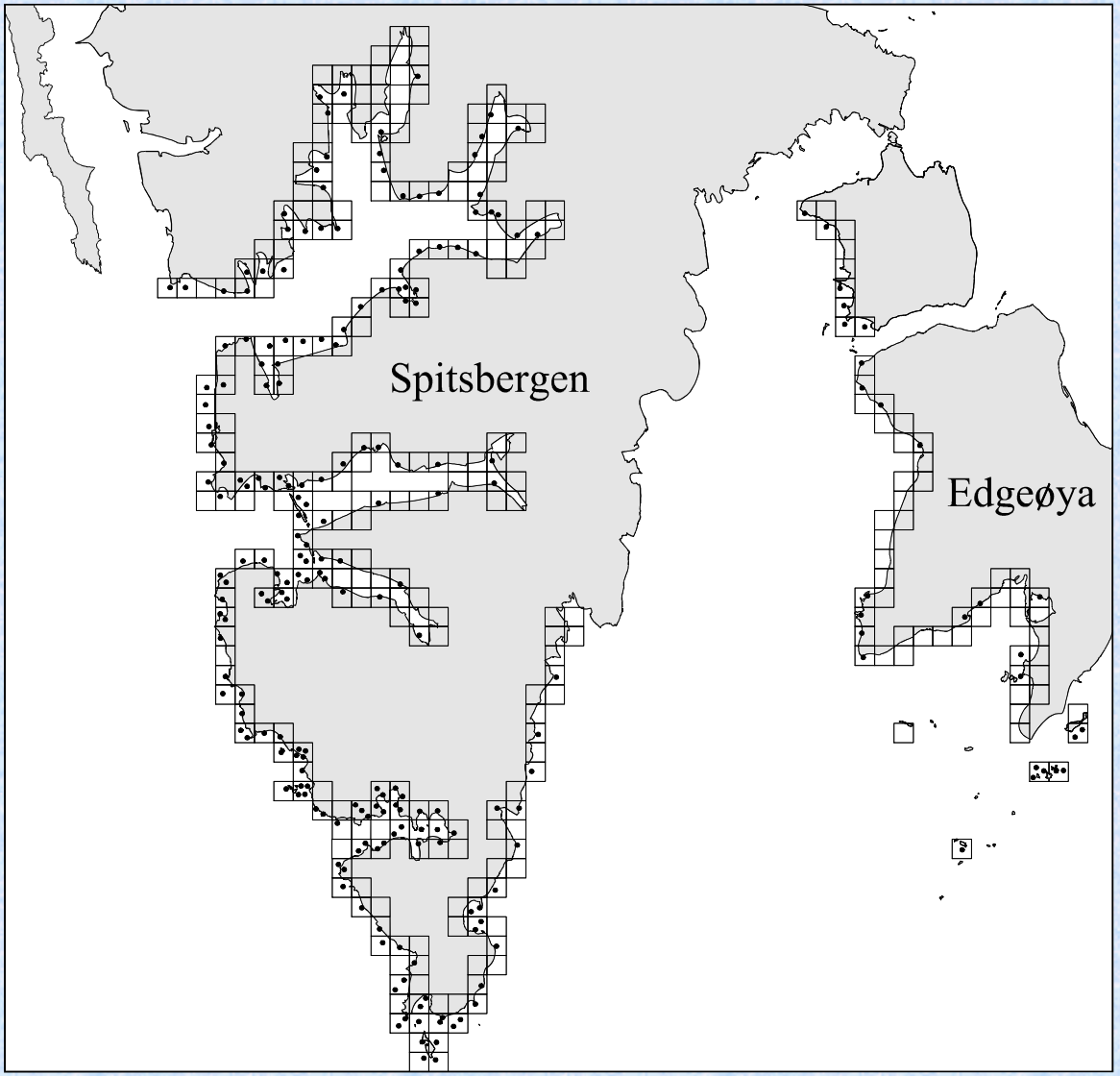
1988 – 1990 Tidal Zone Project
AKUP – Norsk Polarinstitutt – Institute of OCeanology PAS





Deliverables

- Methodology for intertidal zone vulnerability assessment (DNV)
- Data base materials (NPI, IOPAN, MARBEF- OBIS)
- Six scientific papers (Polar Biology, Est. Coastal Shelf Sci, Sarsia, Oil Spill Technology)



Sampling stations & squares 5x5 km grid in Svalbard littoral

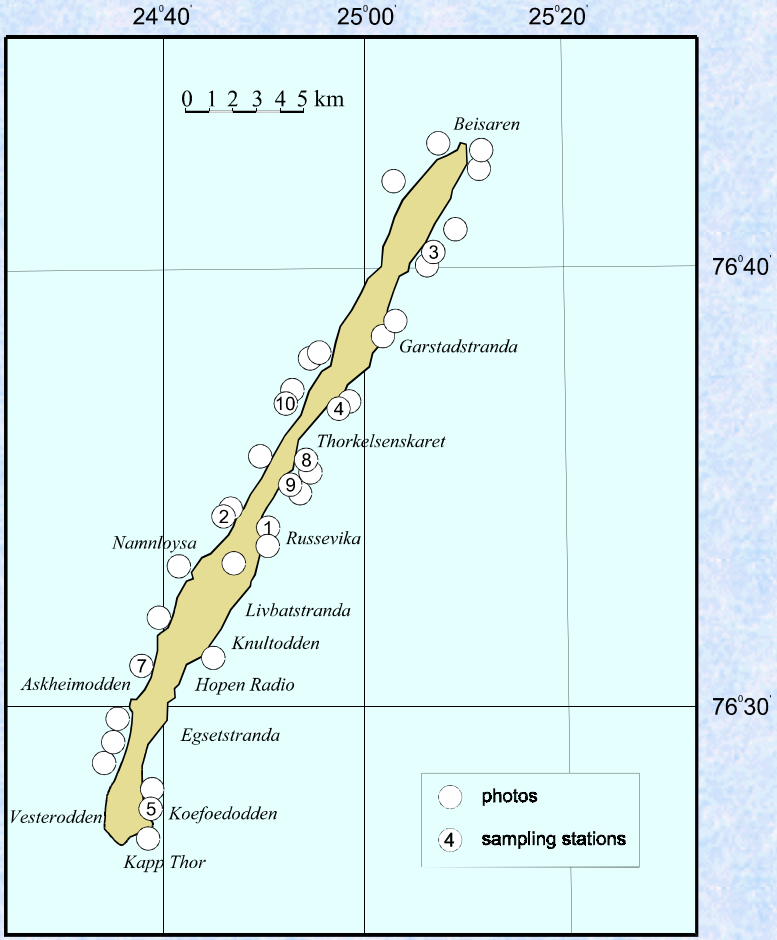


Fig.3 Sampling stations.

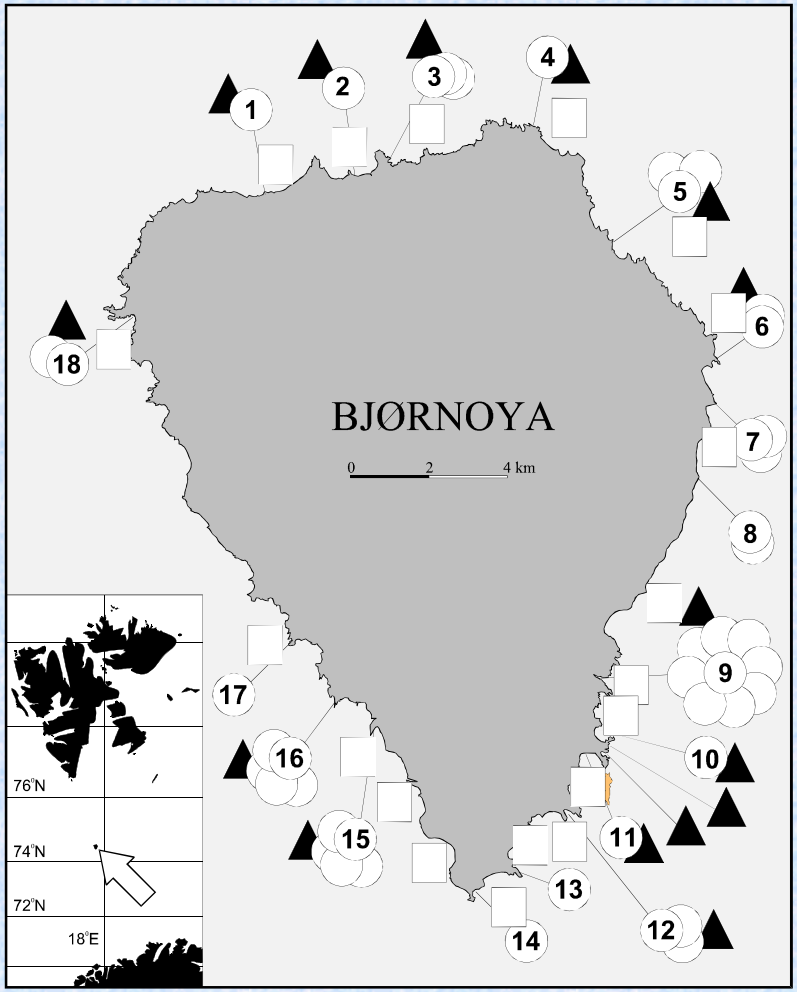
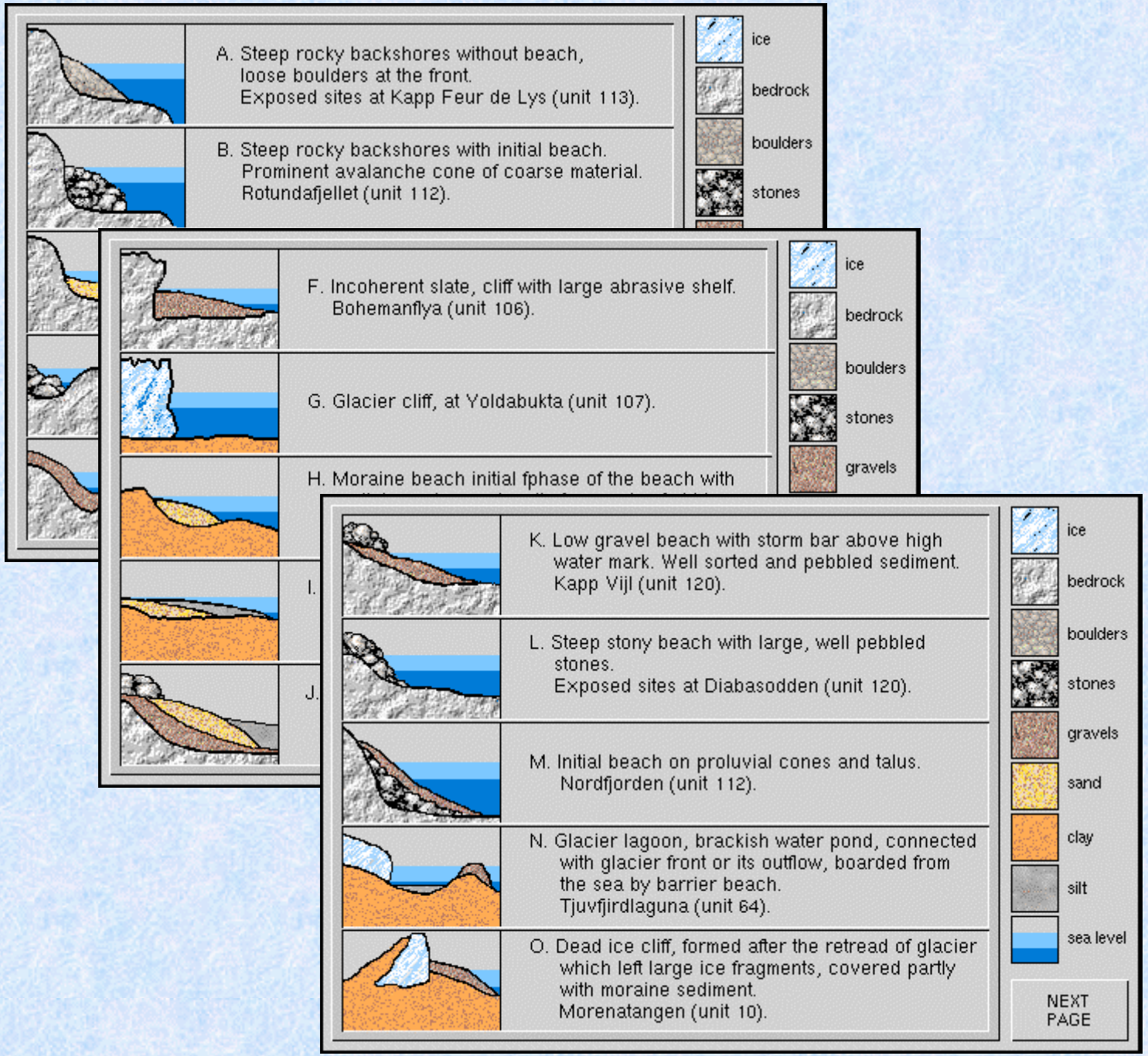
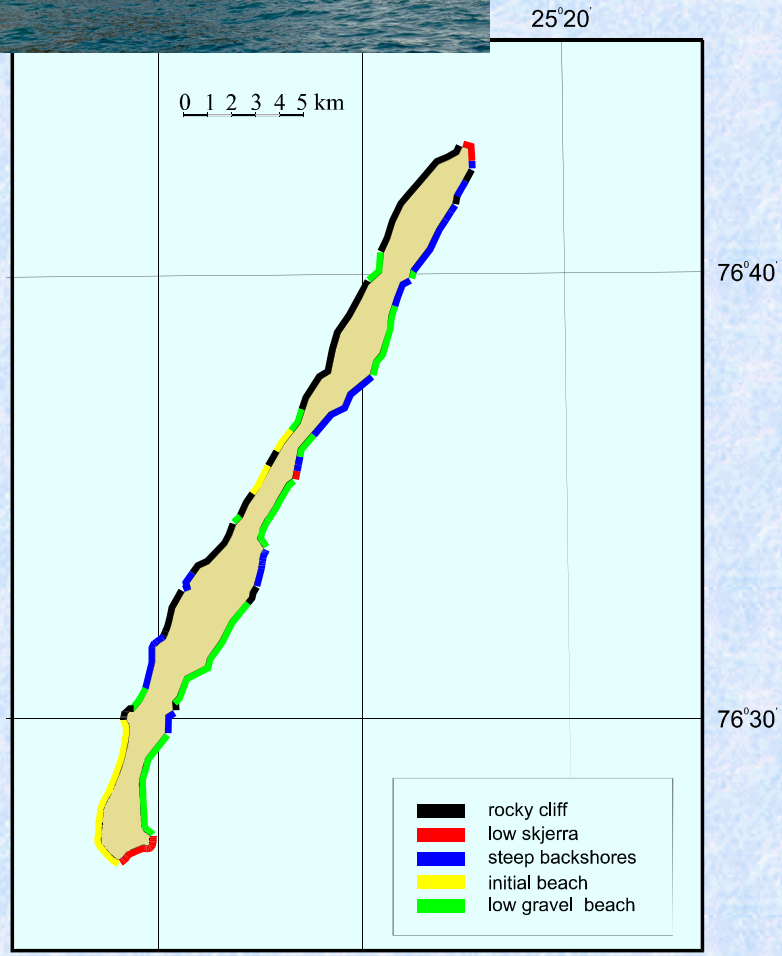


Fig.1 Sampling stations in the littoral of Bjornoya. July 1994
Circles denote macrofauna samples, squares meiofauna samples and triangles dredgings in sublittoral.

1993 – Bjornoya & 1994 – Hopen


A. Steep rocky backshores without beach, loose boulders at the front. Exposed sites at Kapp Feur de Lys (unit 113).
B. Steep rocky backshores with initial beach. Prominent avalanche cone of coarse material. Rotundafjellet (unit 112).
ice
bedrock
boulders
stones
F. Incoherent slate, cliff with large abrasive shelf. Bohemanflya (unit 106).
G. Glacier cliff, at Yoldabukta (unit 107).
H. Moraine beach initial fphase of the beach with
I.
J.
ice
bedrock
boulders
stones
gravels
K. Low gravel beach with storm bar above high water mark. Well sorted and pebbled sediment. Kapp Vijl (unit 120).
L. Steep stony beach with large, well pebbled stones. Exposed sites at Diabasodden (unit 120).
M. Initial beach on proluvial cones and talus. Nordfjorden (unit 112).
N. Glacier lagoon, brackish water pond, connected with glacier front or its outflow, boarded from the sea by barrier beach. Tjuvfjirdlaguna (unit 64).
O. Dead ice cliff, formed after the retread of glacier which left large ice fragments, covered partly with moraine sediment. Morenatangen (unit 10).
ice
bedrock
boulders
stones
gravels
sand
clay
silt
sea level
NEXT PAGE

A B C D



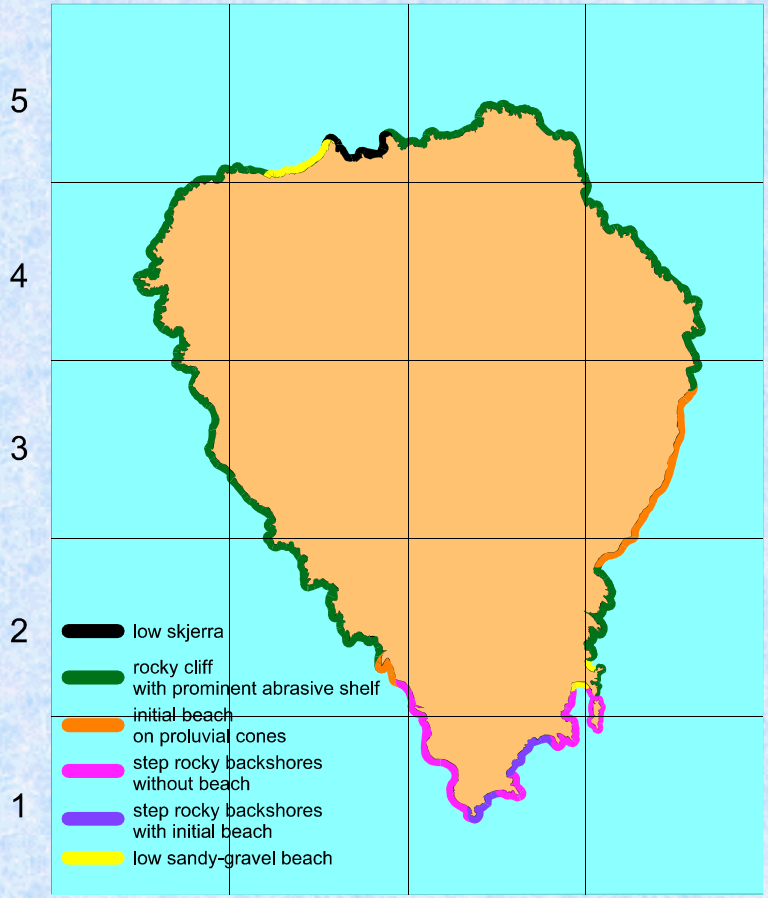
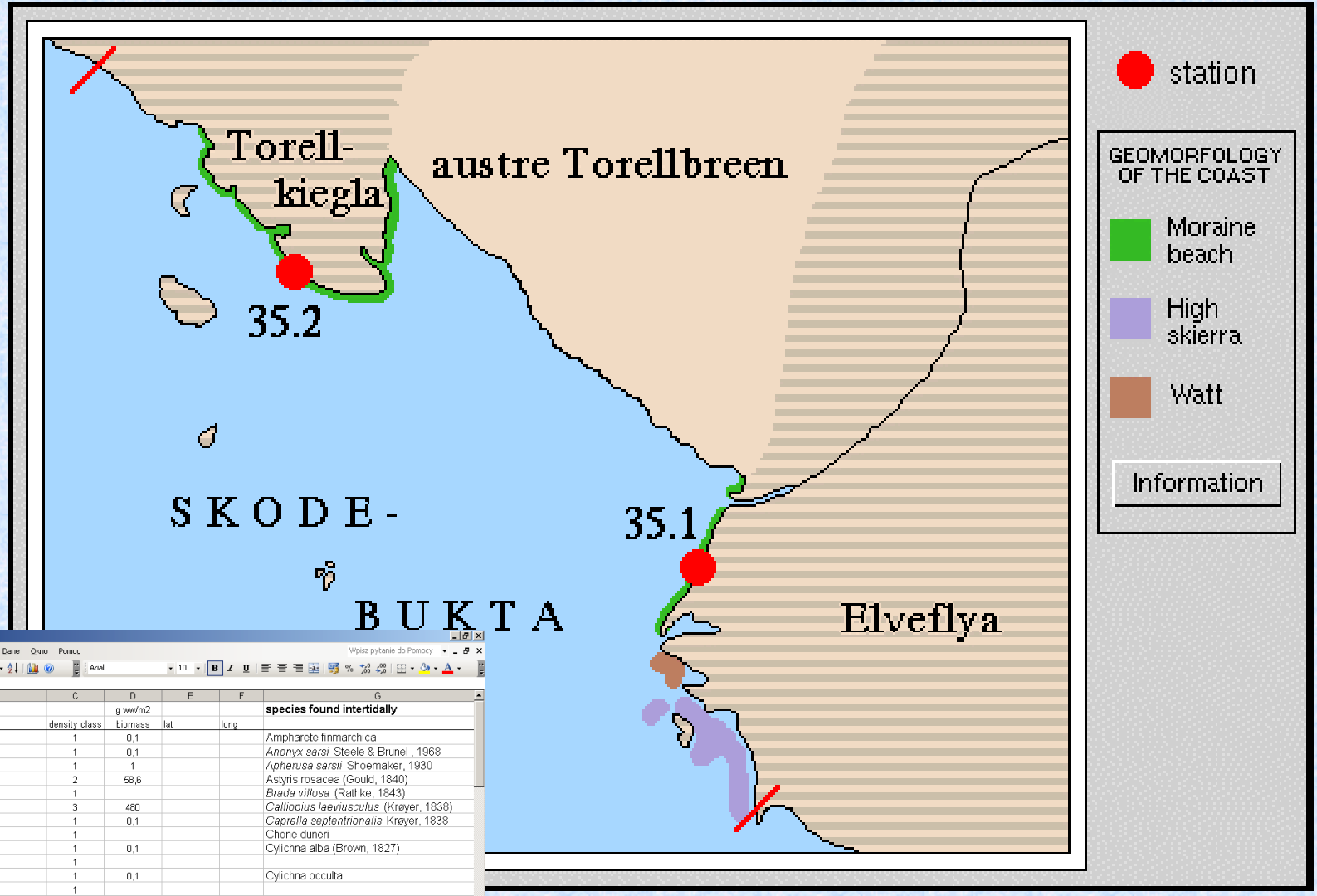


Fig.4 Hopen coast types.



Microsoft Excel - isfjordentidalsvalbard

	A	B	C	D	E	F	G
1	Isfjorden			g ww/m2			species found intertidally
2	station	intertidal taxon	density class	biomass	lat	long	
3	101.1	*Oligochaeta*	1	0,1			Ampharete finmarchica
4	101.2	*Oligochaeta*	1	0,1			*Anonyx sarsi* Steele & Brunel , 1968
5	101.3	*Gammarus setosus*	1	1			*Apherusa sarsii* Shoemaker, 1930
6	101.3	*Fucus distychus*	2	58,6			Astyris rosacea (Gould, 1840)
7	101.3	*macrodetritus*	1				*Brada villosa* (Rathke, 1843)
8	102.1	*Gammarus setosus*	3	480			*Calliopius laeviusculus* (Krøyer, 1838)
9	102.2	*Oligochaeta*	1	0,1			*Caprella septentrionalis* Krøyer, 1838
10	102.2	*macrodetritus*	1				Chone duneri
11	103.1	*Oligochaeta*	1	0,1			Cylichna alba (Brown, 1827)
12	103.1	*macrodetritus*	1				
13	103.2	*Oligochaeta*	1	0,1			Cylichna occulta
14	104.1	*Semibalanus balanoides*	1				
15	104.1	*Littorina saxatilis*	1				
16	104.1	*Oligochaeta*	1	0,1			Cylichna scalpta
17	104.2	*Gammarus oceanicus*	3	77			Dendrodoa grossularia Van Beneden, 1846
18	104.2	*Fucus distychus*	3	1613			
19	105.1	*Oligochaeta*	1	0,1			Eteone longa
20	105.2	*Oligochaeta*	1	0,1			Eteone spetsbergensis
21	106.1	*Fucus distychus*	3	1472			Fabricia sabella
22	106.1	*Gammarus setosus*	2				*Flabelligera affinis* M.Sars, 1929
23	106.1	*macrodetritus*	2				*Gammarellus homari* (Fabricius, 1779)
24	106.2	*Semibalanus balanoides*	1				
25	106.2	*Oligochaeta*	1	0,1			*Gammarus oceanicus* Segerstråle, 1947
26	107.1	*Oligochaeta*	1	0,1			*Gammarus setosus* Dementieva, 1931
27	107.2	*Oligochaeta*	1	0,1			*Gammarus wilkitzkii* Birula, 1897
28	107.2	*Littorina saxatilis*	1				
29	107.3	*Oligochaeta*	1	0,1			Halicryptus spinulosus siebold, 1849
30	108.1	*Gammarus setosus*	1	1,2			*Harmothoe imbricata* (Linnaeus, 1767)

Isfjorden intertidal | isfjorden sublittoral

Gotowy

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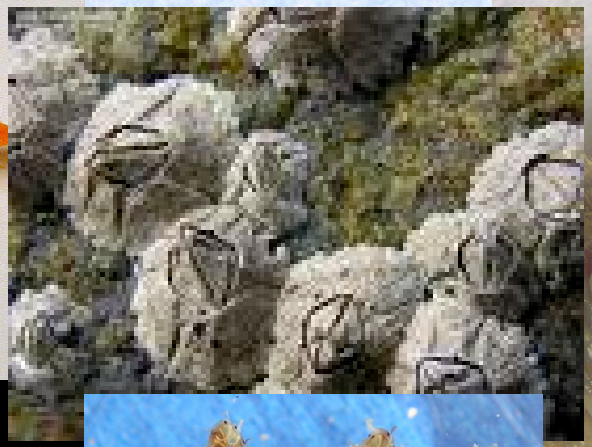


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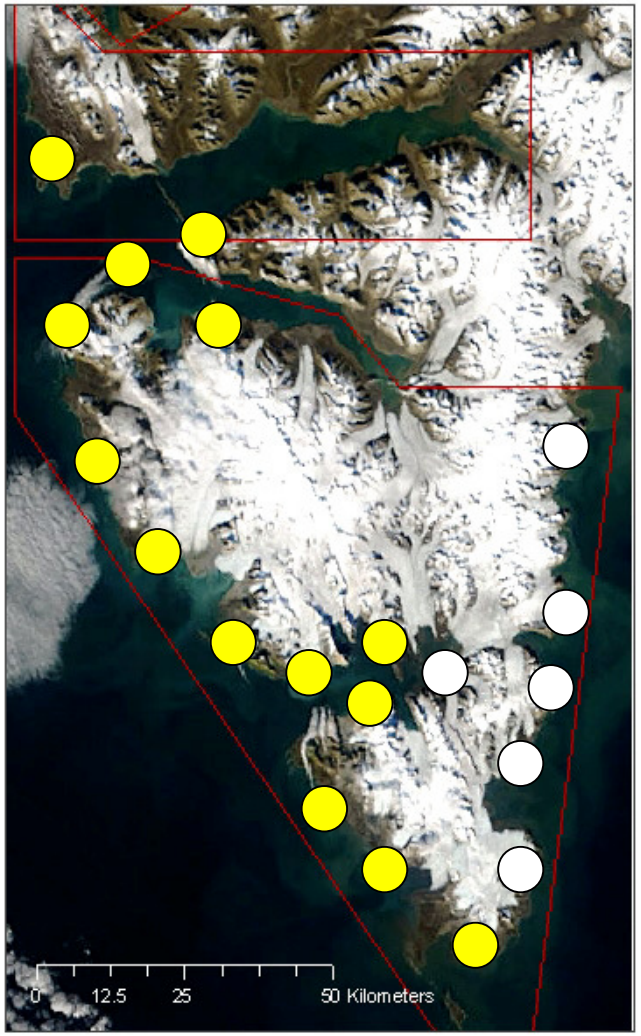
Zoogeographical border in the intertidal - 1988

Fucus & Littorina present

Fucus & Littorina absent



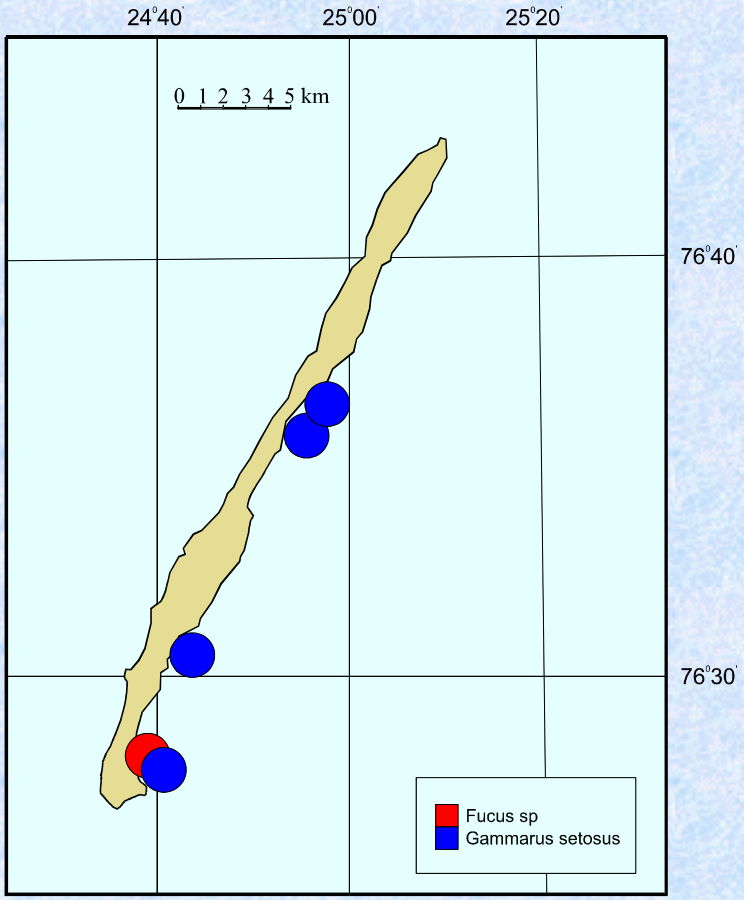
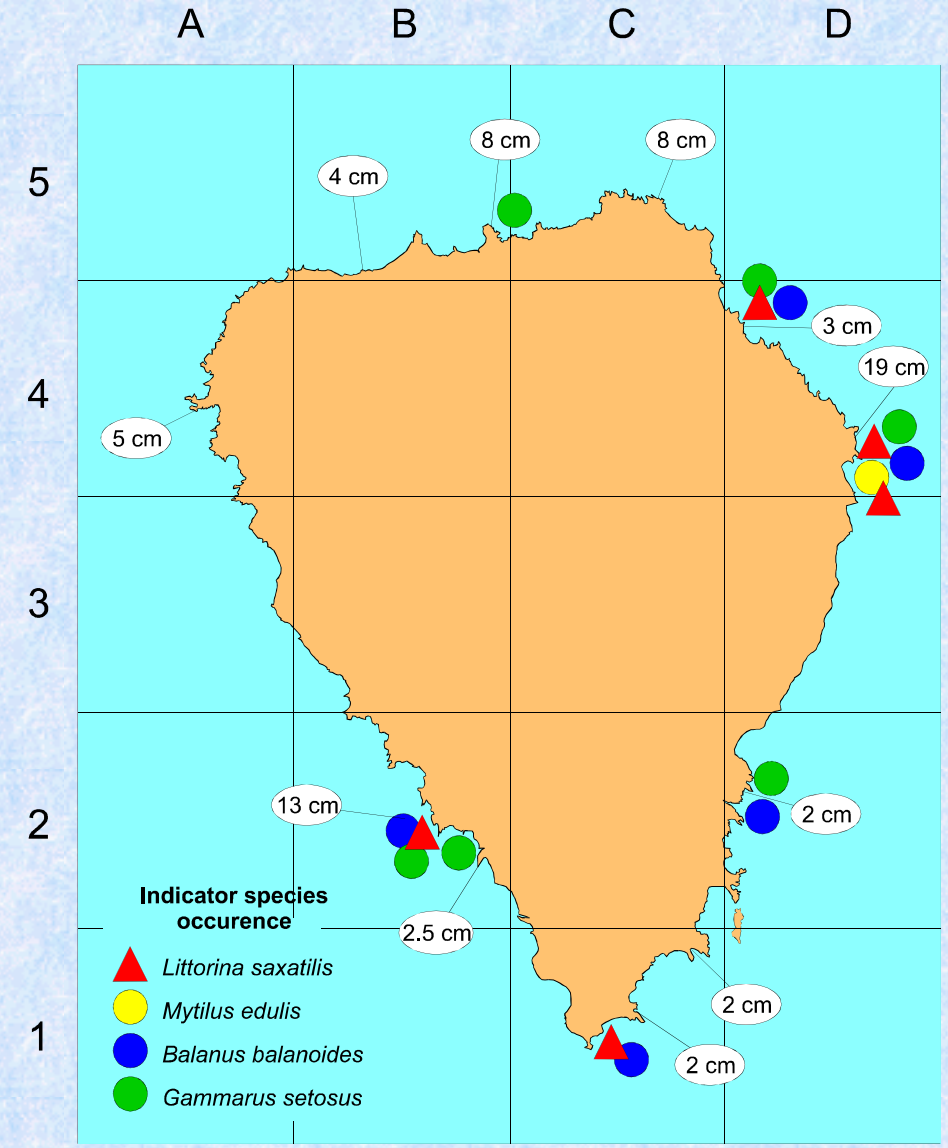
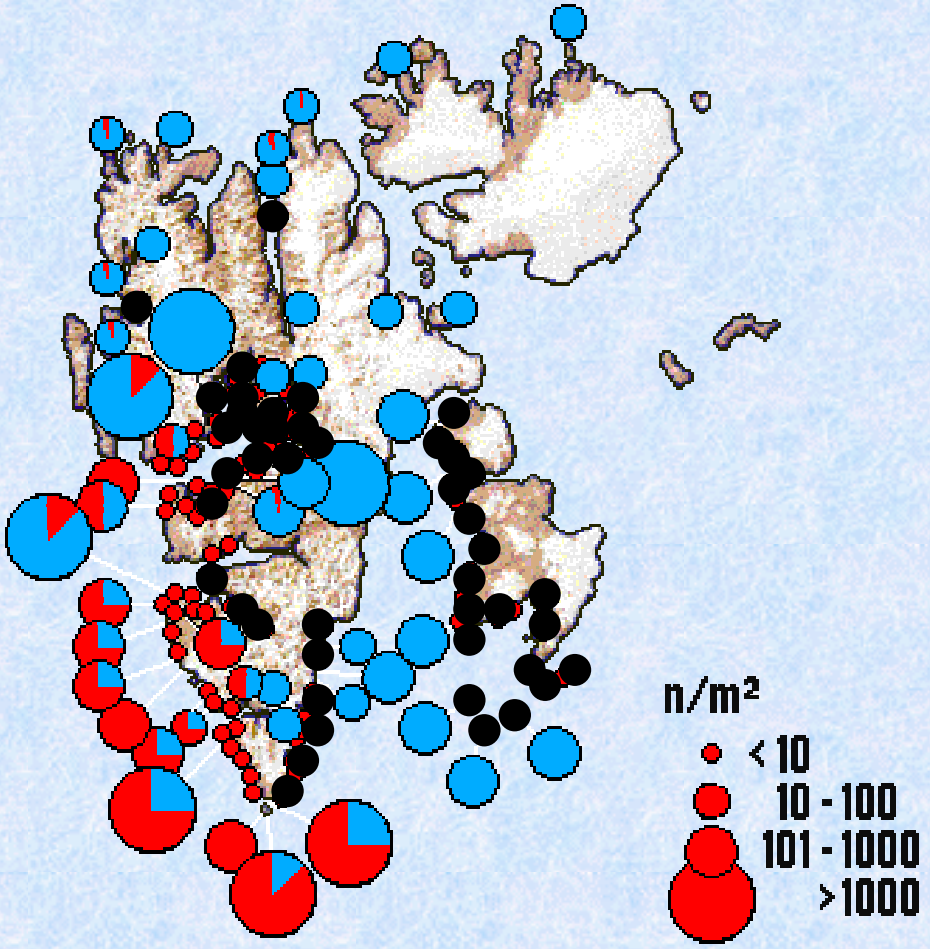


Fig.10 Important littoral species.





intertidal
Atlantic – red – Gammarus oceanicus
Arctic – blue – Gammarus setosus
Black – absent

Physical parameters

- Principal (X6)
- - Type of the shore
- - wave exposure
- Important (x 3)
- - type of the substrate
- - sediment flux
- - ice cover duration
- - ice cover type
- -weathering potential
- - stranded kelp on shore
- - water transport

- Vulnerability

E.g. shore type

1 (low) – cliffs with deep shelf

2 (medium) - cliffs with shallow shelf, low beaches

3 (high) – tidal flats, sheltered rock pools

Biological parameters

- Principal (X6)
- - key species presence
- Important (x 3)
- - recovery potential
- - macrophytes cover
- - amphipod density
- - resettelment potential

Secondary (x 1)

- - supply from sublittoral
- - export to sublittoral
- - bird moulting, haul out, feeding ground

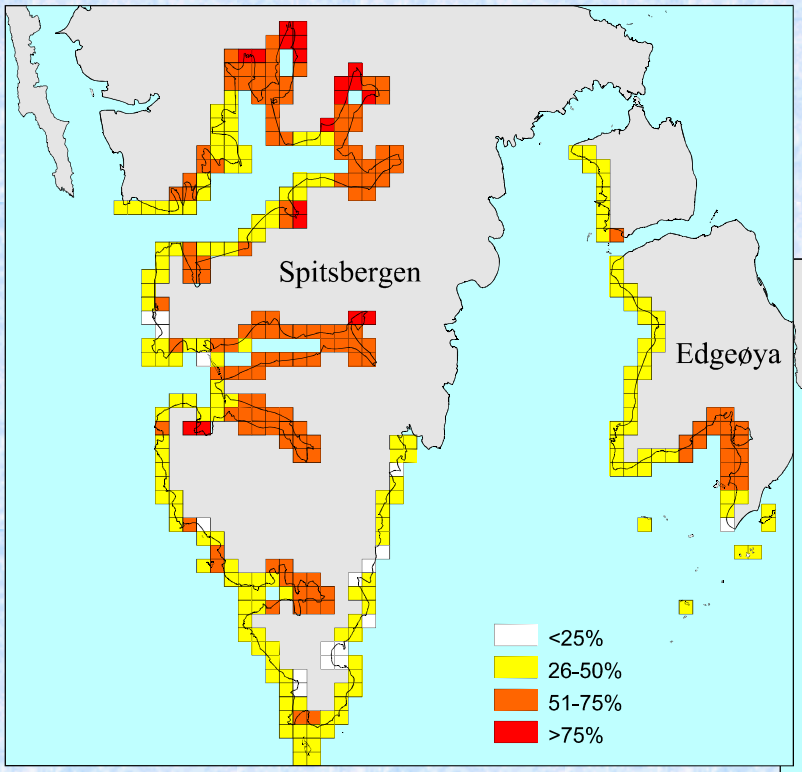
- Vulnerability

E.g. recovery potential

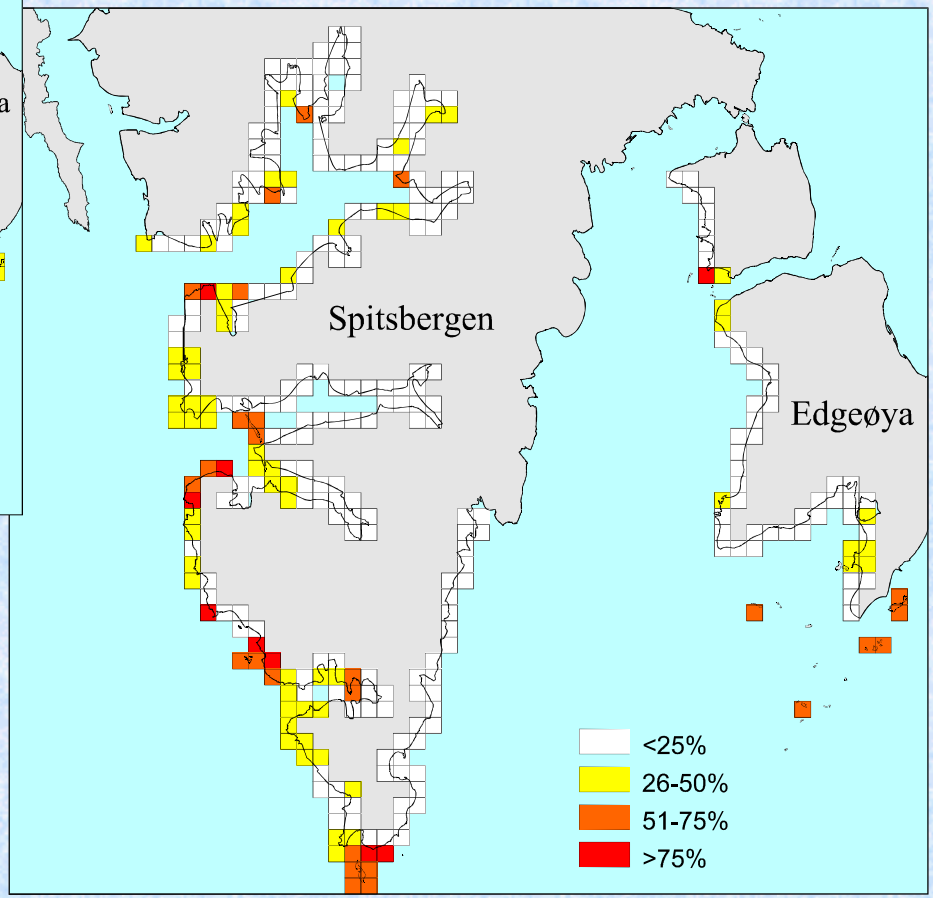
1 (low) – area of fast growing organisms

2 (medium) – mixture of r and K strategists

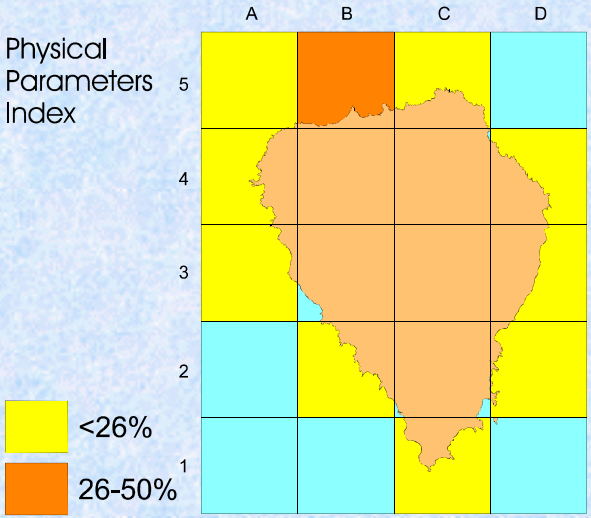
3 (high) – area dominated by slow growing K - strategists

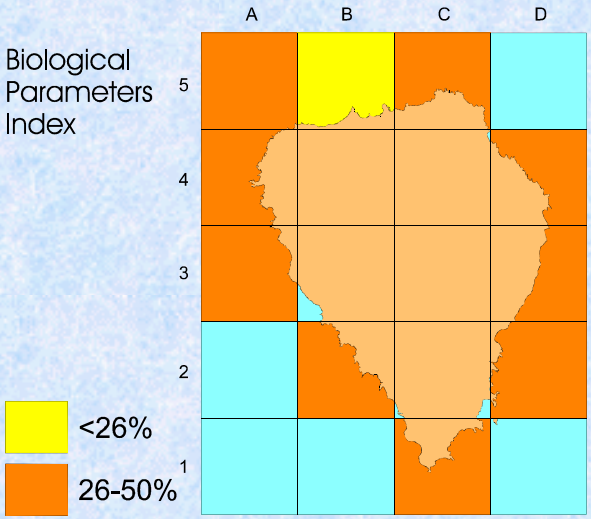


Physical Parameters Index



Biological Parameters Index





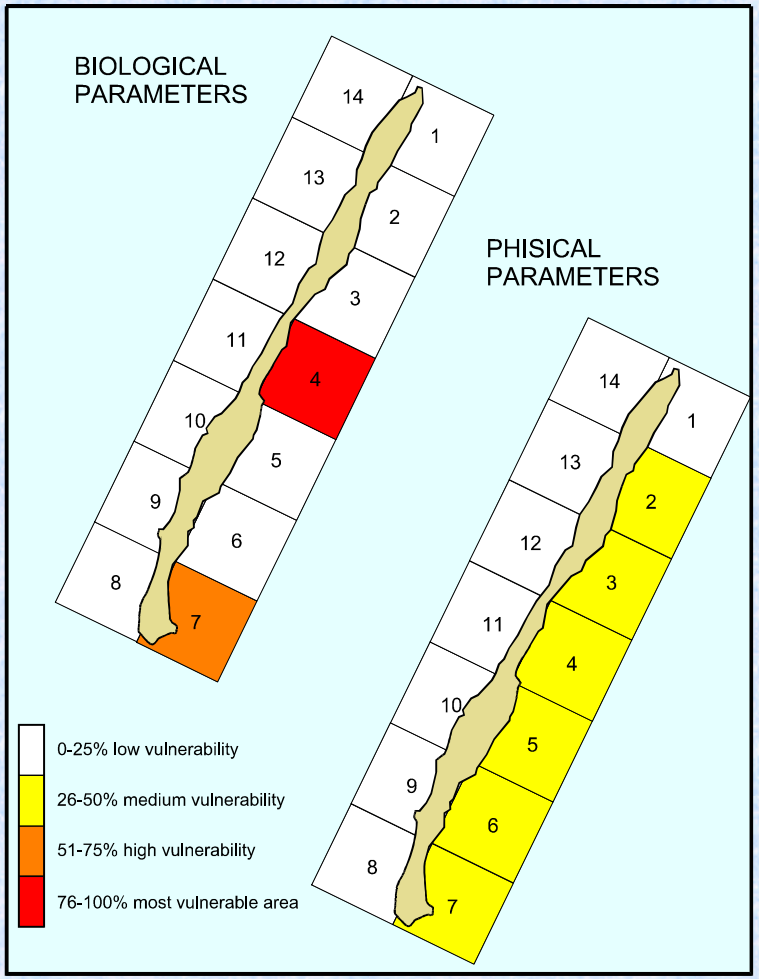


Fig.11 Hopen coasts vulnerability to oil spill.

tidal flats are not equal !

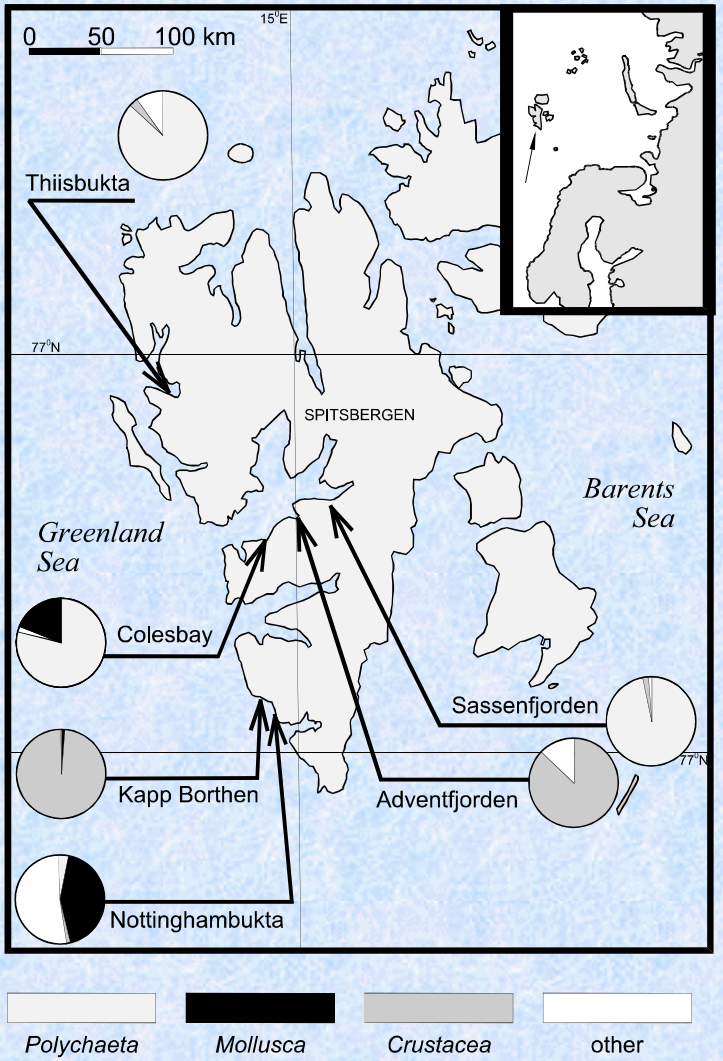


Fig.1 Percent share of major taxonomic groups in macrobenthos biomass in the investigated localities

Climate related changes in intertidal

- Less ice foot & fast ice ★★★
- Storminess (effective waves exposure) ★
- Increased sediment transport ★
- More organic substrate on the shore ★
- New intertidal species ★
- Higher macrophyte biomass ★★
- Expansion of Atlantic community ★
- Coastal change on the expense of glaciers ★★
- More shore birds ?
- More meiofauna biomass ?