



A tool for identification and classification of vulnerable visitor sites in Svalbard

Nina E. Eide¹, Dagmar Hagen¹, Anne Cathrine Flyen², Kirstin Fangel¹ and Odd Inge Vistad¹

¹Norwegian Institute for Nature Research (NINA), ²Norwegian Institute for Cultural Heritage Research (NIKU), Norway



Norwegian Institute for Nature Research

Management of Svalbard wilderness – goals and contradictions



Political goals

Economic activity

Protect arctic wilderness

Research & education

Tourism

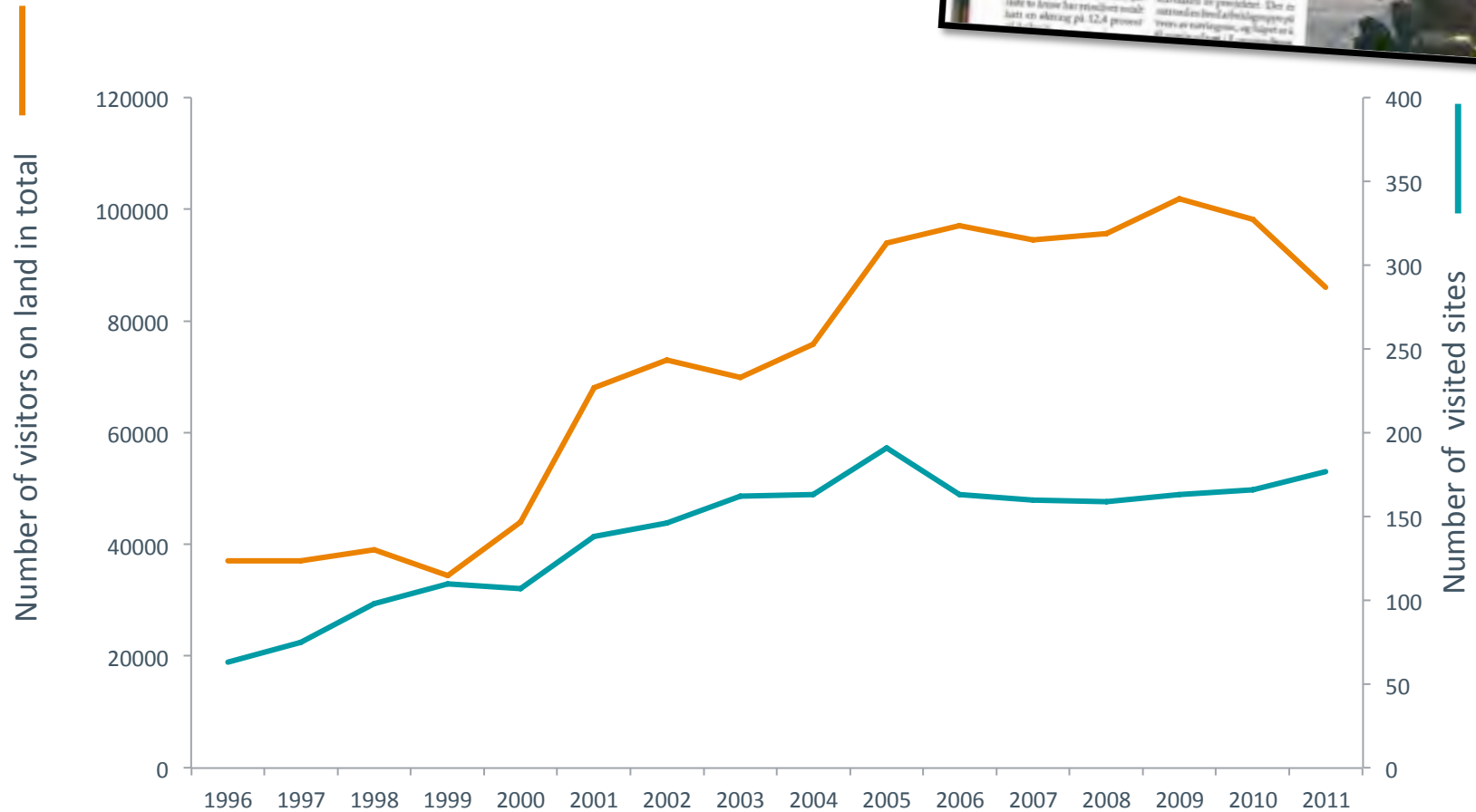
Coal mining



Magdalenefjorden before 1933

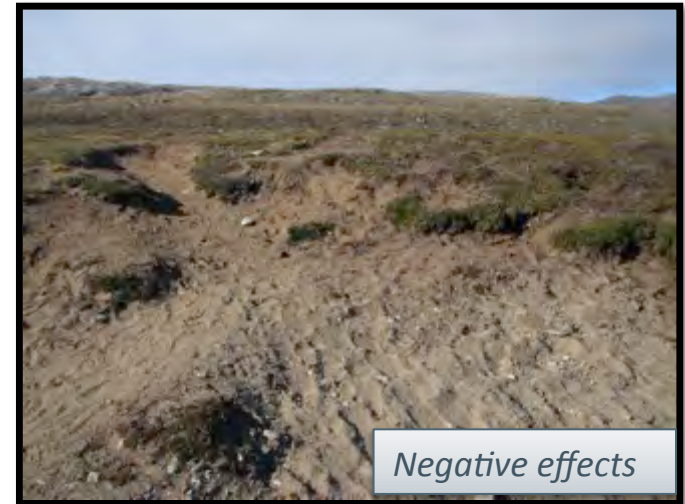
Tourism at Svalbard

(here: coast cruise tourism)

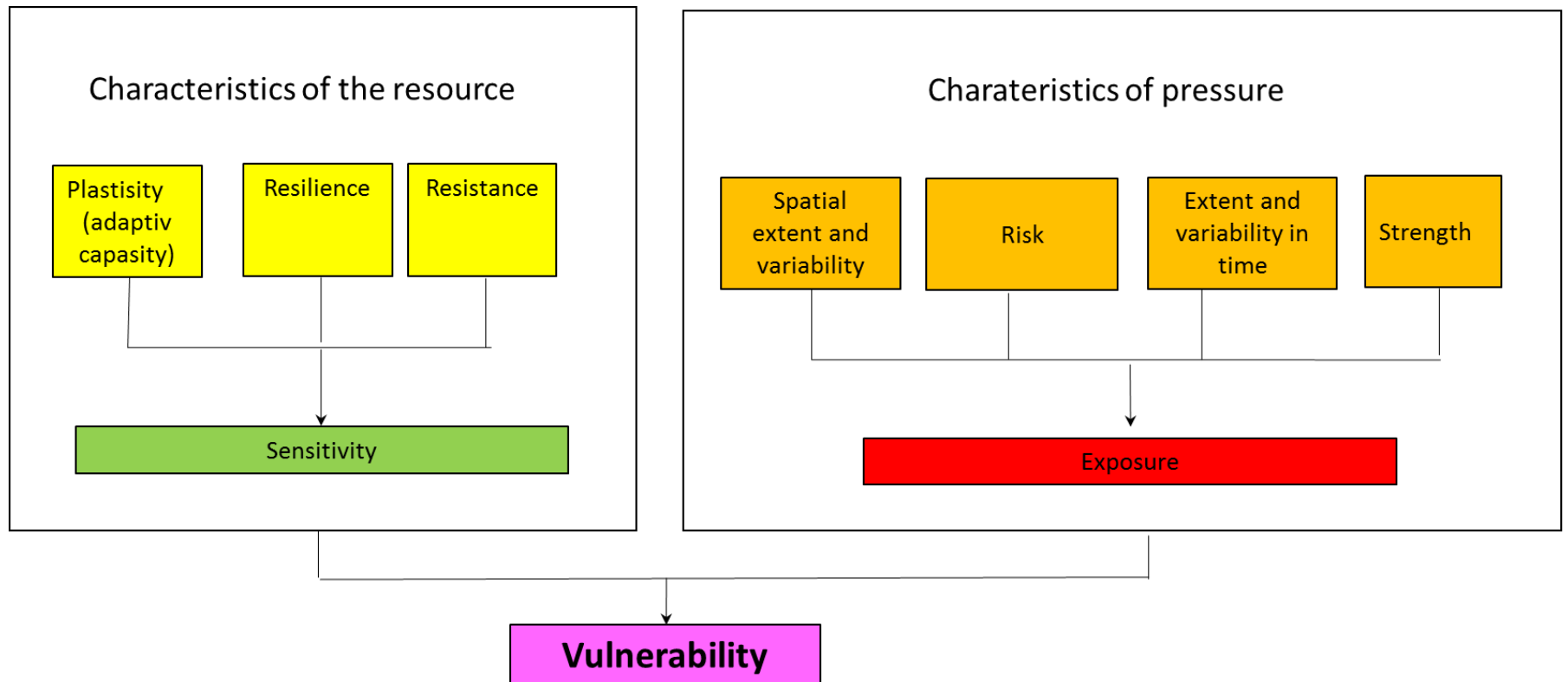




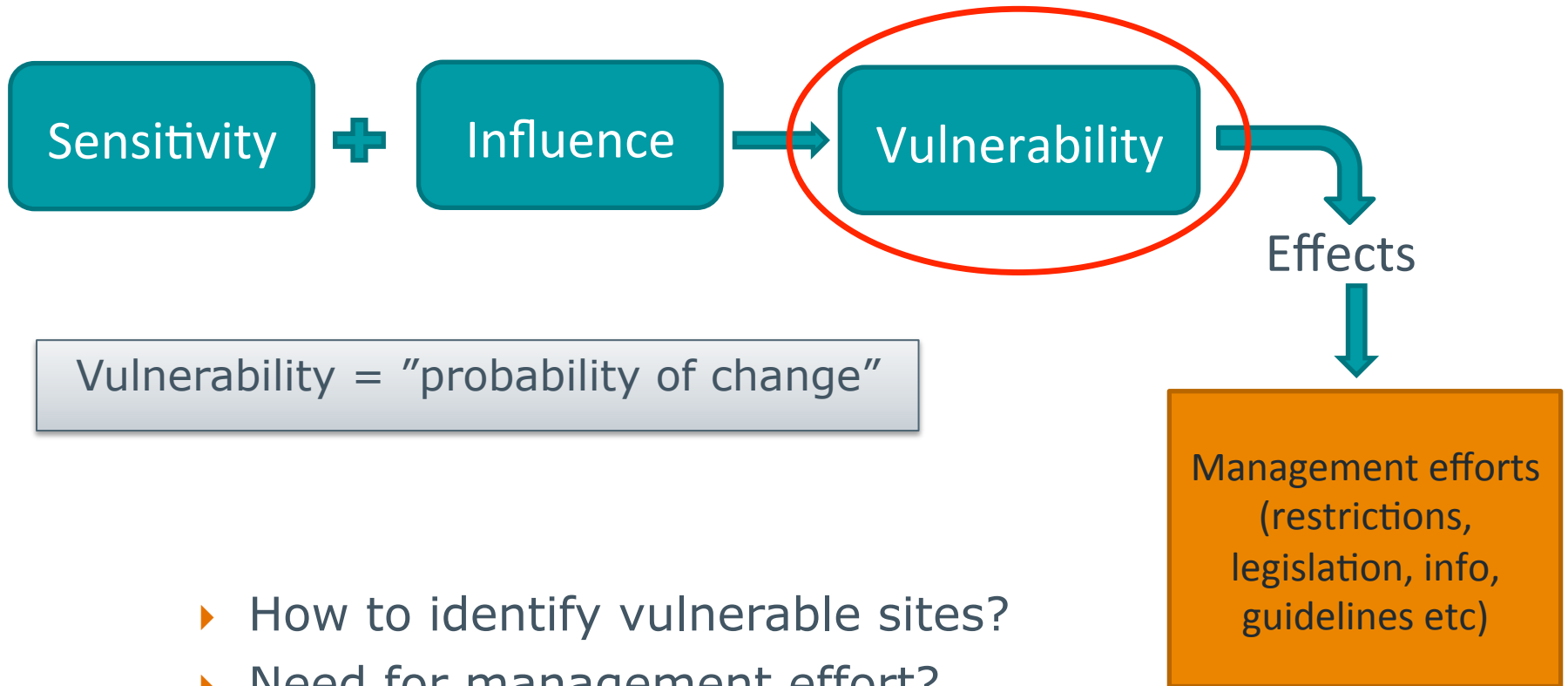
Use, effects and vulnerability assessment – our approach



Vulnerability – definitions



What is a vulnerable site?



Vulnerability = "probability of change"

- ▶ How to identify vulnerable sites?
- ▶ Need for management effort?
- ▶ Find the right and relevant actions
- ▶ Knowledge-based management

Use and users



Cultural heritage



Wildlife

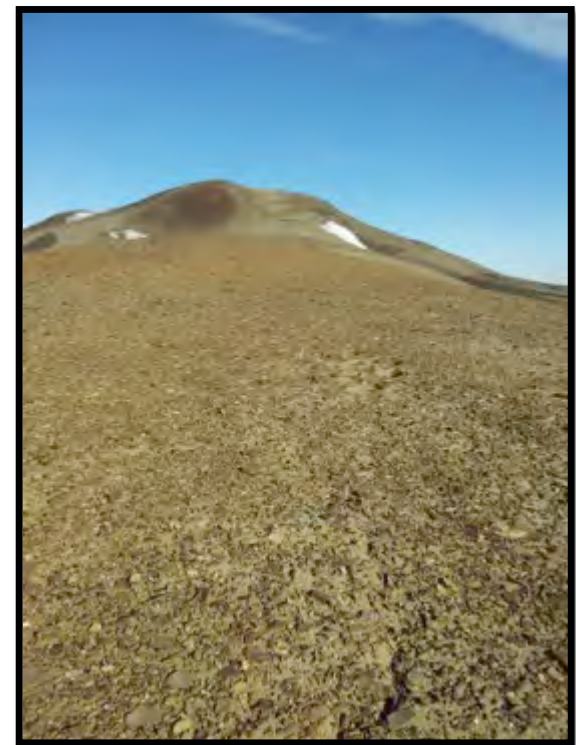


Vegetation



How to identify a vulnerable site?

- Develop relevant sensitivity parameters within each topic
 - ▶ simple, measurable
 - ▶ describes the «probability of change»
- Relate to the use of the sites
 - ▶ Cooperation (including e.g. tourist industry)



Vegetation - sensitivity



Soil

- Texture (fine more sensitive than coarse)
- Organic content (mineral soil has low regeneration)



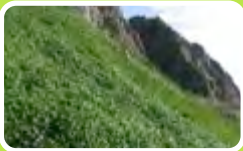
Water

- Availability (wet areas have low tolerance, but better recover)
- Stability (regularity improve the sensitivity)



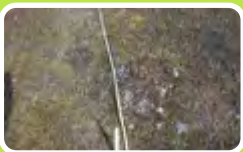
Ground surface

- Slope (steep slope increases risk of erosion, and slow the recovery)
- Variation (hilly and undulating areas are less stable than flat areas)



Species composition

- Graminoid species have higher tolerance and better recovery rate, compared to lichens and lignosa (heath and bush species)



Condition/disturbance

- A moderately disturbed sites might be more sensitive for further disturbance

*Description of gradients based on
Halvorsen et al. (2009);
Nature types of Norway)*

Vegetation – sensitivity



Ecological gradients indicate the level of

- tolerance (resistance to trampling)
- recovery (ability to regenerate / resilience)

Combination of gradients produce a number of **sensitive units**.

Vegetation – sensitive units

Sensitivity unit	Description following the gradients	Tolerance	Recovery
Extreme ridge (often without a continuous vegetation cover)	Dry, mineral soil (fine or coarse grained), exposed, thin and discontinuous vegetation cover	medium	weak
Steep slope with fine soil	Dry, mineral soil (fine-grained), steep, dense or sparse vegetation cover	weak	weak
Brink / steep cliff	Dry, most often mineral soil (but can be organic), steep, dense og sparse vegetation cover	weak	weak
Continuous heath cover	Medium moist/dry, organic soil, flat or moderately steep, continuous vegetation cover	medium	weak
Moist vegetated area	Moist/wet, most typically organic soil (but can be mineral soil), flat, most often continuous vegetatio cover	weak	good
Sparse vegetation on fine-grained soil	Dry/moist, mineral soil, flat (or medrate slope), sparse vegetation cover	weak	weak
Steep slope with dense vegetation	Medium moist, organic soil, dense and continuous cover (frequently below bird cliff)	weak	weak
Not grazed vegetation on shallow soil	Dense vegetation dominated by bryophytes on coarse substrate, established over very long time and determined by absence of reindeer grazing	weak	weak

Vegetation – vulnerability assessment

Site: London	Area	Placing	Area x placing
Extreme ridge (often without a continuous vegetation cover)			
Steep slope with fine soil	3	4	12
Brink / steep cliff			
Continuous heath cover	2	4	8
Moist vegetated area	1	1	1
Sparse vegetation on fine-grained soil			
Steep slope with dense vegetation	1	4	4
Not grazed vegetation on shallow soil			
SUM for the site			25

Wildlife sensitivity

Sensitive species

- Potential for negative effects of disturbance (reduced reproduction)
- Red list status

Functional habitats



Wildlife - sensitive species

Red list Svalbard	LC Least concerned 1	NT Near threatened 2	VU Vulnerable 3	EN Endangered 4
Likelihood of reduced reproduction	← Red list status →			
Likely not 2	<i>Ringsel</i> <i>Storkobbe</i> <i>Svalbardrein</i> <i>Svalbardryk</i> <i>Snøspurv</i>		<i>Isbjørn</i> <i>Hvalross*</i> (hanner)	
Likely 4	<i>Fjellrev</i> <i>Svartbak</i> <i>Fjæreplytt</i> <i>Tyvjo</i> <i>Storjo</i> <i>Teist**</i> <i>Alkekonge**</i> <i>Lunde**</i> <i>Havhest**</i>	<i>Polarmåke</i> <i>Myrsnipe*</i> <i>P. svømmesnipe</i> <i>Krykkje**</i> <i>Polarlomvi**</i>	<i>Steinkobbe</i> <i>Ismåke</i> <i>Svømmesnipe*</i> <i>Fjelljo*</i> <i>Lomvi**</i>	<i>Polarsnipe*</i> <i>Heilo*</i> <i>Alke**</i>
Very likely 8	<i>Rødnebbterne</i> <i>Smålom</i> <i>Kortnebbgås</i> <i>Kvitkinngås</i> <i>Havelle</i> <i>Ærfugl</i>	<i>Sandlo*</i> <i>Steinvender*</i> <i>Ringgås</i> <i>Praktærfugl</i>	<i>Sandløper*</i> <i>Hvalross*</i> <i>(hunner m kalv)</i>	<i>Sabin</i>



Wildlife – sensitive habitats

- Sensitivity estimates based expected species occ.
- Function of the habitat (breeding/grazing)

Functional habitat units	Sensitivity
Small island in salt water	27
Wetland with lakes and small dams	26
Lake	13
Small islands in lakes	12
Wetland and bogs	16
Brackish water / shallow water	25
Bird cliffs	5
Geese breeding colony on land	10
Tern colony	22
Spring restingplace for geese	6
Resting place for walruss with calves	24
Arctic fox denning sites	4



Wildlife – registration in the field

1

Identify sensitive habitats

2

Rate for area and location of each unit

FELTSKJEMA side 3

DYRELIV
Vurder tilgjengeligheten av ulike livsmiljø som finnes på lokaliteten og laeng eventuelle turtraseer som gir utløst lokaliteten

Nr. skisse	Livsmiljø	Lokaliteten	Turtrase 1	Turtrase 2	Kommentarer livsmiljø
	Blytteliste i saltvann (27)				
	Frosketrøysystem av Iringsletta/Gamtnes (28)				
	Søkkar livsmiljø (15)				
	Hakkalderne i ferskvann (12)				
	Våtmark/Elvtrøy (16)				
	Stokkmarkslandskapsnaturvernsområde (21)				
	Ungfjell (14)				
	Kalkgrønt (22)				
	Ålmoakker på fastland (10)				
	Varvakkeler (23)				
	Kjellerplassen for gjøen (8)				
	Stegplatta for heisbane i kalk (24)				
	Spillene i stein (9)				

4. Nedtegnede brukere der dagens ferietur på lokaliteten. Spørsmål har negative effekter på en eller flere arter som gjør at ferieturistikk er høyst pålitelig i sær tilstand.
*Arter ut ifra rødlistenummer på kartet (01-02-03 osv)

Fyll inn dato:	BESØK 1	BESØK 2	BESØK 3	BESØK 4	Instruksjoner:
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Tilgjengelighet for ferietur til foto 0 Ikke tilgjengelig 1 < 10% av lokaliteten er tilgjengelig 2 10-50% av lokaliteten er tilgjengelig 3 > 50% av lokaliteten er tilgjengelig
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Forklaring av arter 1 Observed, ikke bekreftingsmelding 2 Observed, bekreftingsmelding ved utvalg 3 Spredt forekomst, lite utvalg (bekreftingsmelding) 4 Spredt forekomst, vanlig (bekreftingsmelding) 5 Fokals (c. 30 individer sett/lokalisert) 6 Fokals (50-100 individer sett/lokalisert) 7 Fokals (> 100 individer sett/lokalisert) 8 Fokals (> 1000 individer sett/lokalisert)
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Livsmiljø registrert <input type="checkbox"/> Arter registrert <input type="checkbox"/> Må kartlegges bedre
					Kommentarer

Area (how large part of the site is covered)	Rating
One /few small areas	1
Many small areas	2
One large area	3
The unit cover most of the site	5

Placing (where is the sensitive unit located in relation to landing site and main attractions)	Rating
Pheriphere part of the site	1
By one of several landing points	2
On the way from landing site and main attraction	3
By the only landing point	5
By the main attraction at the site	5

Wildlife – registration in the field

1

Identify species

2

Rate for abundance and accessibility

FELTSKJEMA side 3

DYRELIV
Vurder tilgjengeligheten av ulike livsmiljø som finnes på lokaliteten og laeng eventuelt turtraseer som gir utsikt på lokaliteten

Nr. artene	Livsmiljø	Lokaliteten	Turtrase 1	Turtrase 2	Kommentarer livsmiljø
	Blyttelose i sabbarn (27)				
	Prekalkarensystem av Iringen/Gamten (28)				
	Sollatt livsmiljø (15)				
	Høkkalkarene i Prekalkaren (12)				
	Våttmark/Elvemyr (16)				
	Storvassmark/Elvemyr (21)				
	Engfjell (14)				
	Kalkungen (22)				
	Åfjellskråning på fyllingsjord (10)				
	Forvokst (22)				
	Kjellerplassen for gjen (8)				
	Aggregat for hestenes malk (24)				
	Spillevasskåle (8)				

Å: Nedslagsbrønn der dagens ferdvei på lokaliteten. Kjøperbar har negative effekter på en eller flere arter som gjør at forvokststadiet er høyst på nivået i nær tilstand.
*Arten tilhører spesielle nummer på kartskema (01-02-03 osv)

Tryll (en dato)	BESØK 1	BESØK 2	BESØK 3	BESØK 4	Instruksjoner
					Tilgjengelighet for ferdvei til foto 0 Ikke tilgjengelig 1 < 10% av lokaliteten er tilgjengelig 2 10-50% av lokaliteten er tilgjengelig 3 > 50% av lokaliteten er tilgjengelig
					Forekomst av arter 1 Observert, ikke hekkingsringing 2 Observert, hekkingsringing uendret 3 Spredt forekomst, litt ringing (hekkingsringing) 4 Spredt forekomst, vanlig hekkingsringing 5 Koloni (< 30 individer sett hekkende) 6 Koloni (30-100 individer sett hekkende) 7 Koloni (> 100 individer sett hekkende) 8 Koloni (> 1000 individer sett hekkende)
					<input type="checkbox"/> Livsmiljø registert <input type="checkbox"/> Arter registert <input type="checkbox"/> Må kartlegges bedre
					Kommentarer

Abundance

1	Observed, not breeding
2	Observed, likely breeding
3	Spread breeding, few
4	Spread breeding, common
5	Colony (< 30 individs seen breeding)
6	Colony (30-100 individs seen breeding)
7	Colony (> 100 individs seen breeding)
8	Koloni (> 1000 individs seen breeding)

Access for humans on foot

0	Not accessible
1	< 10 % of the species breeding grounds are accessible
2	10-50 % of the species breeding grounds are accessible
3	> 50 % of the species breeding grounds are accessible

Accumulated knowledge!

Wildlife – vulnerability assessment

Species occurrence list

Steinvender

Polarsvømm

Myrø

Fjæreplytt

Tyvjo

Kortnebbgås

Hvitkinngås

**Vulnerability
(species specific)**



**Abundance
(8 cat.)**



**Accessibility for
humans on foot (4 cat.)**

Functional habitat units

Small island in salt water

Wetland with lakes and small dams

Lake

Small islands in lakes

Wetland and bogs

Brackish water

Bird

Geese breeding

Tern colony

Spring restingplace for geese

Resting place for walrus with calves

Arctic fox denning sites

**Vulnerability
(functional hab)**



Area (4. cat.)



Placement (5.cat)

SUM SPECIES



SUM HABITAT



SUM SITE

Cultural heritage - sensitivity

- Sensitivity units
 - ▶ Accessibility
 - ▶ Readability
 - ▶ State of degradation
 - ▶ Number of objects/ items



Cultural sites – sensitive units



Cultural sites – sensitive units

Sensitive units

Blubber oven

Remnants of houses

Graveyard

Single grave

Russian Orthodox cross/foundations for cross

Single objects/remnants of building materials

Ruin (both building and construction)

Standing building

Standing construction

Boat/wreck

Railway alignment

Track/path (old)

Slaughtering site/ hunting device

Mine

Other kind of sensitive unit

STOP! ▲



Cultural sites – registration in the field

1

Identify sensitive habitats

2

Rate for sensitivity and location of units

FELTSKJEMA side 4

KULTURMINNER Ikke vurdert Ikke aktuelt for lokaliteten

Nr skisse	Sårbar enhet/enkeltretnings	Tilgjengelighet ²			Lesbarhet ³			Fysisk tilstand ⁴			Gjenstander ⁵			Areal av lokalitet ⁶				
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	4	
	Sensitive units																	
	Blubber oven																	
	Remnants of houses																	
	Graveyard																	
	Single grave																	
	Russian Orthodox cross/foundations																	
	Single objects/remnants of building																	
	Ruin (both building and construction)																	
	Standing building																	
	Standing construction																	
	Boat/wreck																	
	Railway alignment																	
	Track/path (old)																	
	Slaughtering site/ hunting device																	
	Mine																	
	Other kind of sensitive unit																	
	STOP!																	

Vulnerability criteria	Level of vulnerability	Rating
Accessibility	Not accessible	1
	Medium accessible	2
	Easy accessible	3

Area (how large part of the site)	Rating
One small area with clear and evident demarcation	1
One large area, or several small areas with clear and evident demarcation	2
One large area, or several small areas, with diffuse demarcation	4
Most of the site	5

Number of objects/remnants	Bad physical condition	6
	Few objects	1
	Medium amount of objects	2
	Many objects	3

Cultural sites – vulnerability assessment

Site: London						
	Accessibility	Readability	Physical condition	Objects	Area	Σ Vulnerability criteria X Area
Sensitive unit						
Remnants of house	3	4	4	2	2	26
Objects/remn. of materials	3	4	4	2	4	52
Ruin	3	1	6	2	2	24
Standing building	3	1	1	1	2	12
Standing construction	3	4	4	2	1	13
Railway alignment	3	1	1	1	2	12
Track/path (old)	3	1	4 Δ	1	1	9
Stop Δ						
SUM for the site						148

Use and users

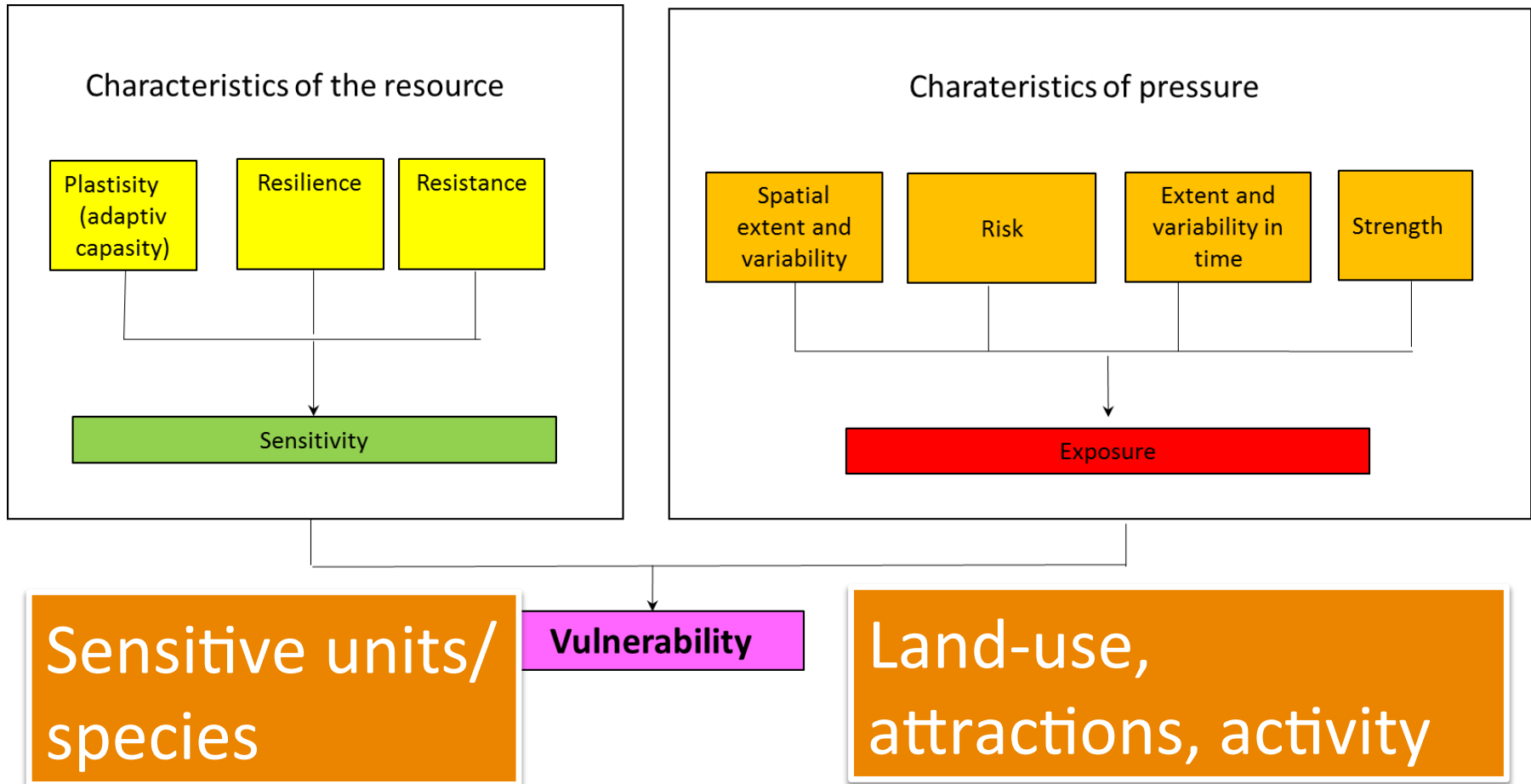
– *“probability of change”*

- What is relevant?

- ▶ Behavioural studies WHERE
- ▶ Type of activities WHAT
- ▶ Group characteristics
- ▶ Visitor numbers
- ▶ With or without guide
- ▶ Environmental knowledge
- ▶ Attitudes
- ▶ Preferences



Sensitivity and land-use



Levels of vulnerability

Calculate within each topic  three levels

Low vulnerability (high tolerance and resilience)	Tolerant to the present level of use and to human influence in general. No need for management efforts at the present level of human use.
Vulnerable (medium tolerance and resilience)	Some vulnerable units in part of the site. A closer inventory is suggested to evaluate the need for management efforts.
High vulnerability (low tolerance and resilience)	Management efforts are needed to reduce or prevent negative effects of human use.

Nr	Landing site	Wildlife	Vegetation	Cultural site	Visitors
1	Gravnesodden/Gravneset	64	180	38	7004
2	Alkehornet/Trygghamna	59	320	118	2538
3	Kapp Lee	113	120	34	1651
4	Ny-London (Blomstrandøya)	176	250	135	1571
5	Virgohamn	4	0	174	1279
6	Purchasneset, Lågøya	212	0	112 Δ	1262
7	Eolusneset	20	0	30	1244
8	Gnålodden	107	120	34	1228
9	Smeerenburg (sletta-/odden)	98	200	125	1123
10	Fuglesongen/Alkeura	111 Δ	120		1053
11	Isflakbukta, Phippsøya	106	50	9	735
12	Sallvhamn	74	30	108	540

- The vulnerability score is not the answer, but should initiate:
 - ▶ Go to the field data, what are the critical units
 - ▶ Supplementary data needed?
 - ▶ What can be relevant efforts in each specific site?
 - ▶ Structured way of giving priority between sites

Perhaps a
guideline??

Using the vulnerability assessment approach

- ▶ Governor of Svalbard: management plans (east; 2012 and west; 2013)
- ▶ AECO 20 guidelines Svalbard (west; 2011 and east; 2012)
- ▶ Governor: Vulnerability assessment handbook; 2014
- ▶ Scientific publication (ongoing)
- ▶ Norwegian Environmental Agency: mainland National Parks (2014-2015)

- ▶ Greenland?
- ▶ Canada?
- ▶ Antarctica?

Guideline example 1

Vulnerable vegetation (250)



Guidelines

- Please use the existing paths up to the cabin. Do not use the brink as a crosscut. The fine-grained soil is easily eroded and very vulnerable to trampling.
- Use existing tracks whenever possible.
- Please keep distance to the breeding long-tailed skua. They will warn you by flying very close, possibly dive bombing you and make anxious noises. Return in the direction you came from until the birds have calmed down.
- Observe the house ruins and construction sites from a perimeter. Avoid trampling as the cultural remains are fragile.
- Small pieces of marble are also protected cultural remains as part of the heritage site. They are not to be removed.
- Please respect privacy if the cabins are occupied.

The background and argument for these recommendations are found in the vulnerability assessment forms and can be verified.

Guideline example 2

Robust vegetation (0)



Guidelines

This site is an important haul out for walrus, also females with calves, and visits must be conducted in accordance with general guidelines for walrus. Pay special attention to the section regarding females and calves.

Try to walk in a line to avoid disturbing incubating common eiders.

When approaching the camp, walk up the cliff to the monument on the south-western side. Do not walk in the area underneath the monument.

Do not pick up or in any way rearrange possible artifacts at the site.

No specific guideline specific related to vegetation.
But for cultural heritage and fauna this site is vulnerable, and the guidelines point at this.



Contributors:

Svalbard Environmental Protection Fund
The Governor of Svalbard
Association of Arctic Expedition Cruise Operators (AECO)
Svalbard Tourism AS