Using the Norwegian Nature Classification System (NiN) for mapping of riparian vegetation and its change over time

Experiences from several projects on behalf of the Norwegian Environmental Agency and the Norwegian Biodiversity Information Centre; 2017-2020



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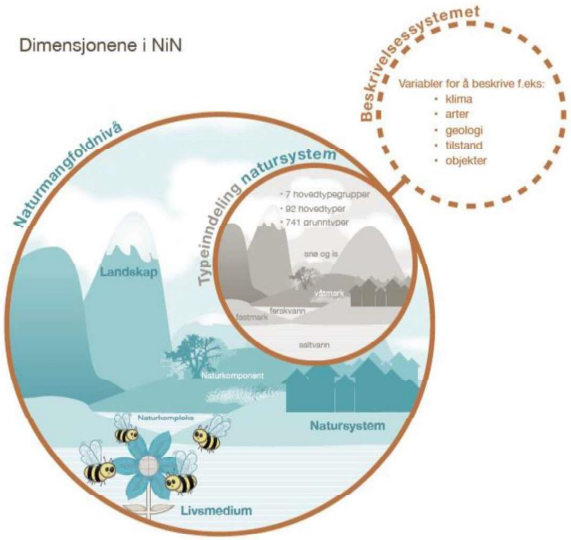
Introduction

- Norway has not adopted the EU Habitat Directive and has developed own classification systems for nature.
- "Nature in Norway" (Natur i Norge, NiN) is the official mapping system. It has been mainly developed by a team of the University of Oslo (Prof. Rune Halvorsen).
- The first version of NiN was released in 2009, the second version is currently under revision. Release of a new, third version is planned in 2022, on behalf of the Norwegian Biodiversity Information Centre.
- My contributions: Test and further development of the NiN system with respect to river morphology, substrate and hydrodynamics; review and workshop for NiN in regulated rivers or rivers with other physical impacts

https://artsdatabanken.no/NiN



Outline

1) Riparian vegetation in Norway – short overview
2) The Norwegian Nature Classification system (NiN)
3) Examples for mapping of floodplain vegetation and its changes
4) Further development of the freshwater part of NiN

Riparian vegetation in Norway: Bioclimatic zones

Fraxinus excelsior

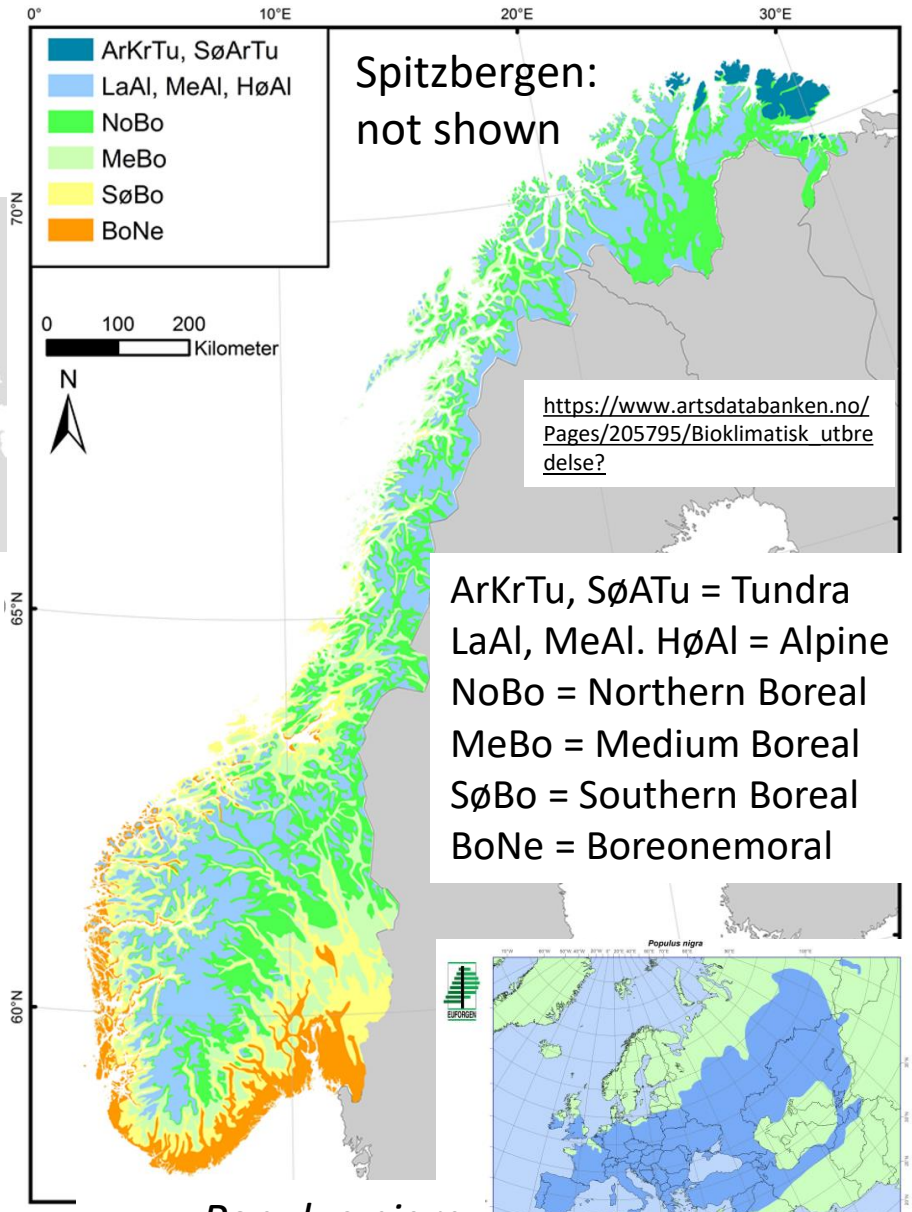
Alnus incana

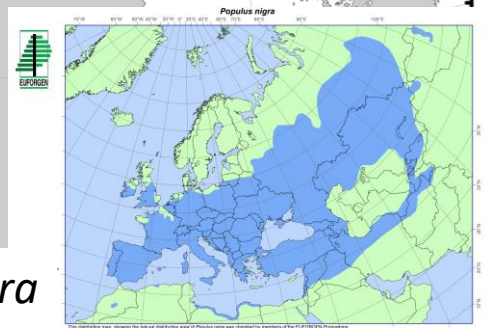
Quercus robur

Alnus glutinosa

Salix alba

Distribution of floodplain tree species

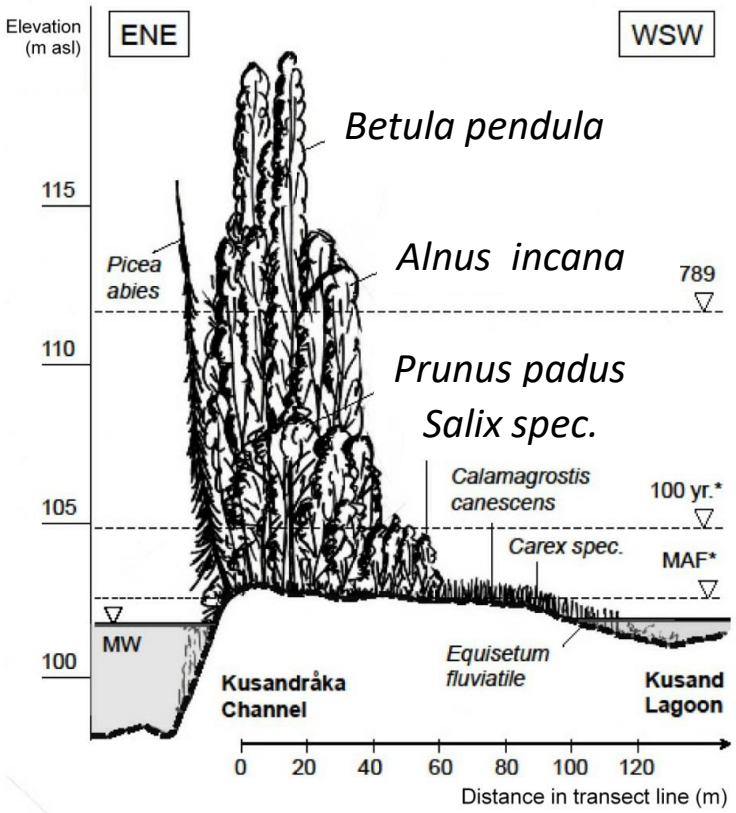


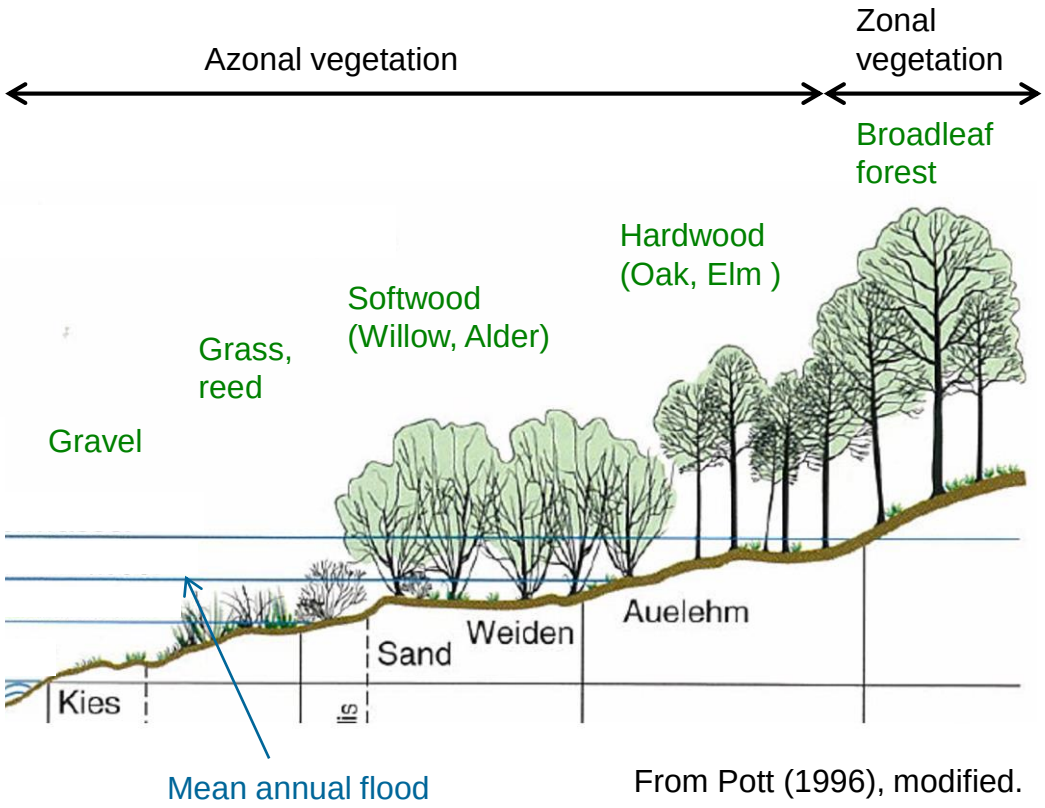


Populus nigra

Riparian vegetation in Norway: Vegetation zonation

Southern Norway

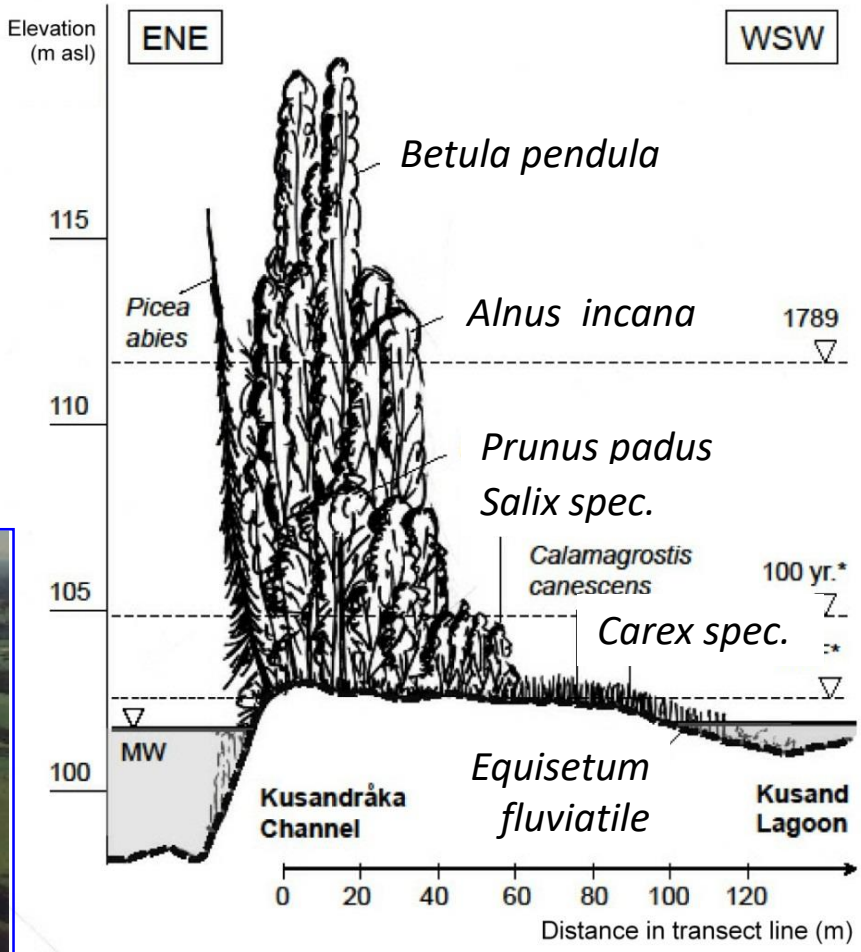


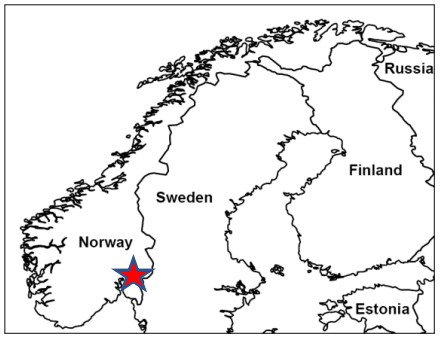


From Pott (1996), modified.

Floodplain in Germany

Riparian vegetation in Norway: Zonation





Transsect at Kusand island,
Lake Øyeren's delta (sand bed river; fine sand and silt on the islands)

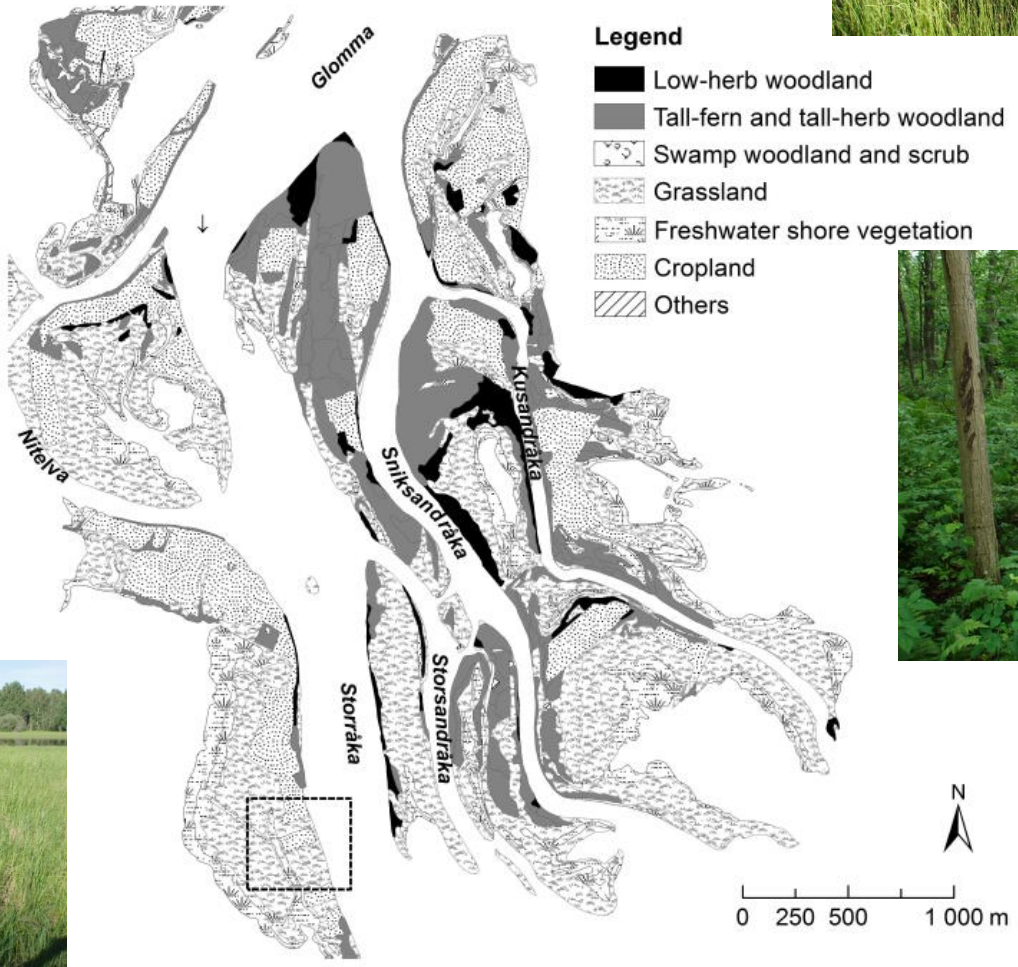
SE Norway

Riparian vegetation in Norway

Grassland with willows (e.g. *Salix cinerea*)

Grassland dominated by *Calamagrostis canescens*

Lake Øyeren's delta

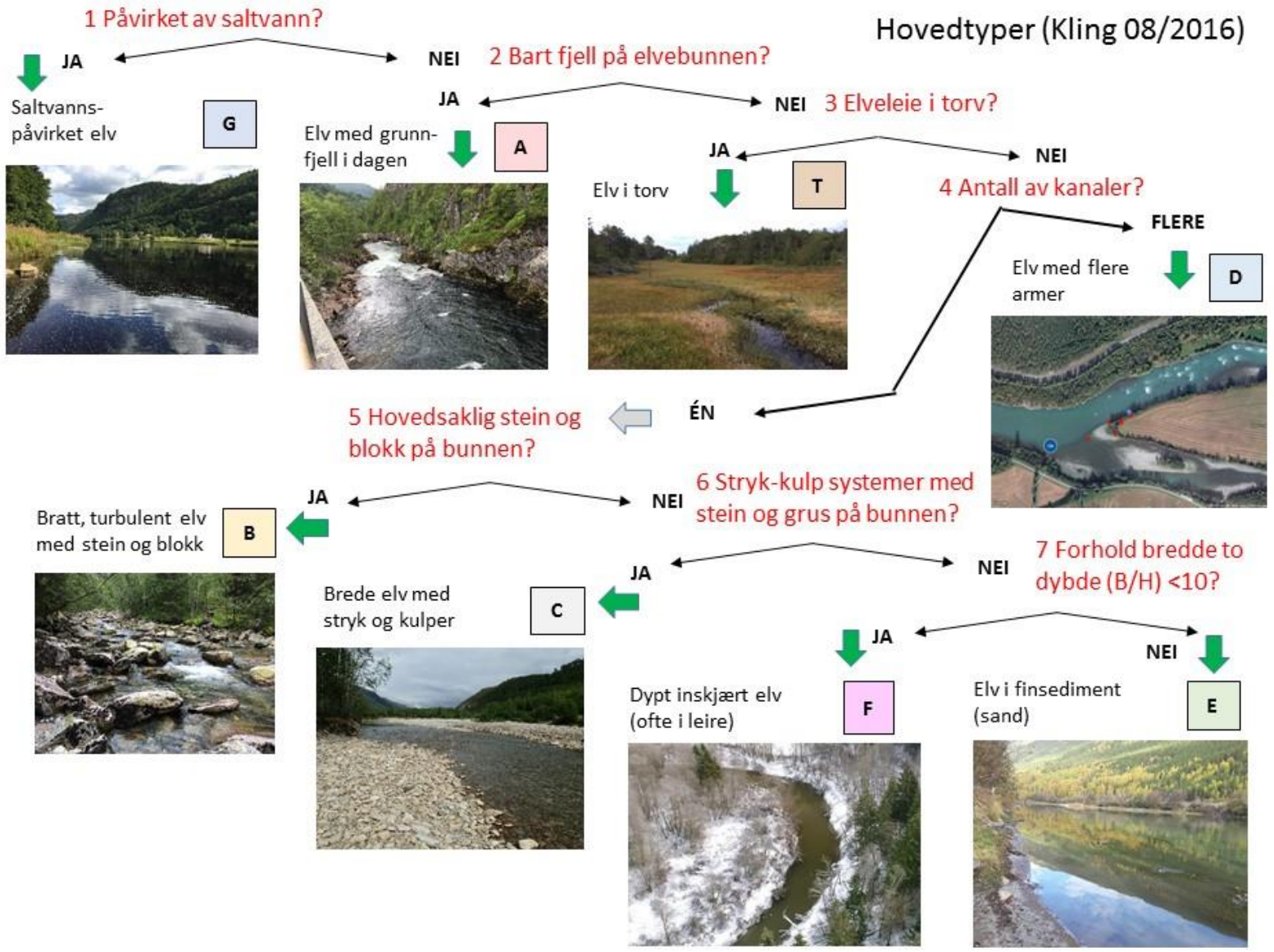


Freshwater shore vegetation including *Equisetum fluviatile*

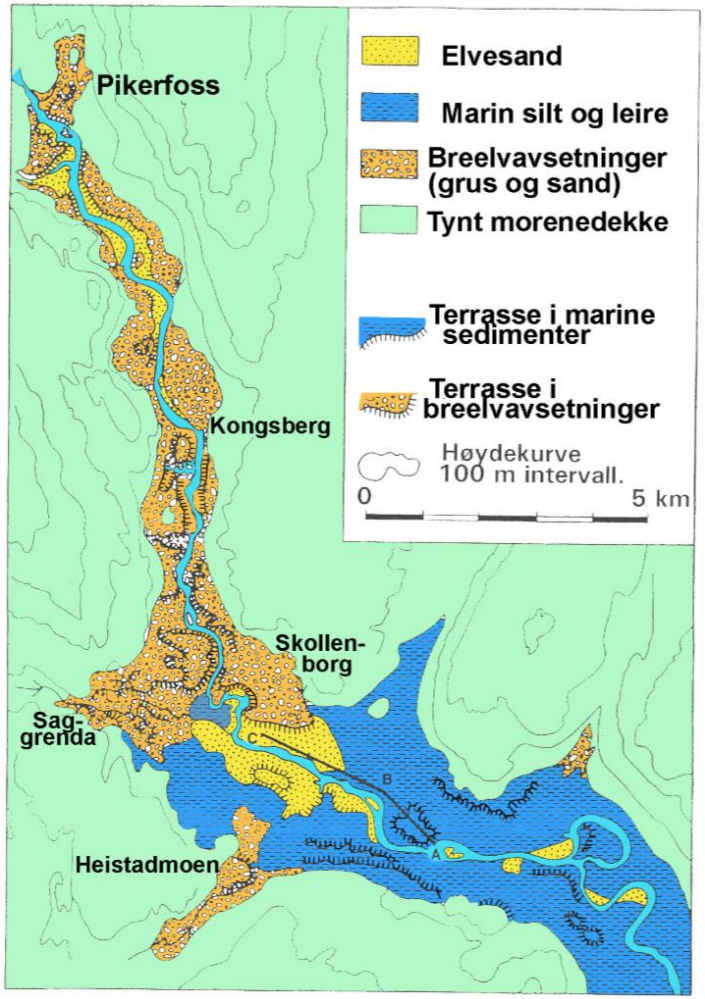
Tall-fern and tall-herb woodland (*Alnus incana*)

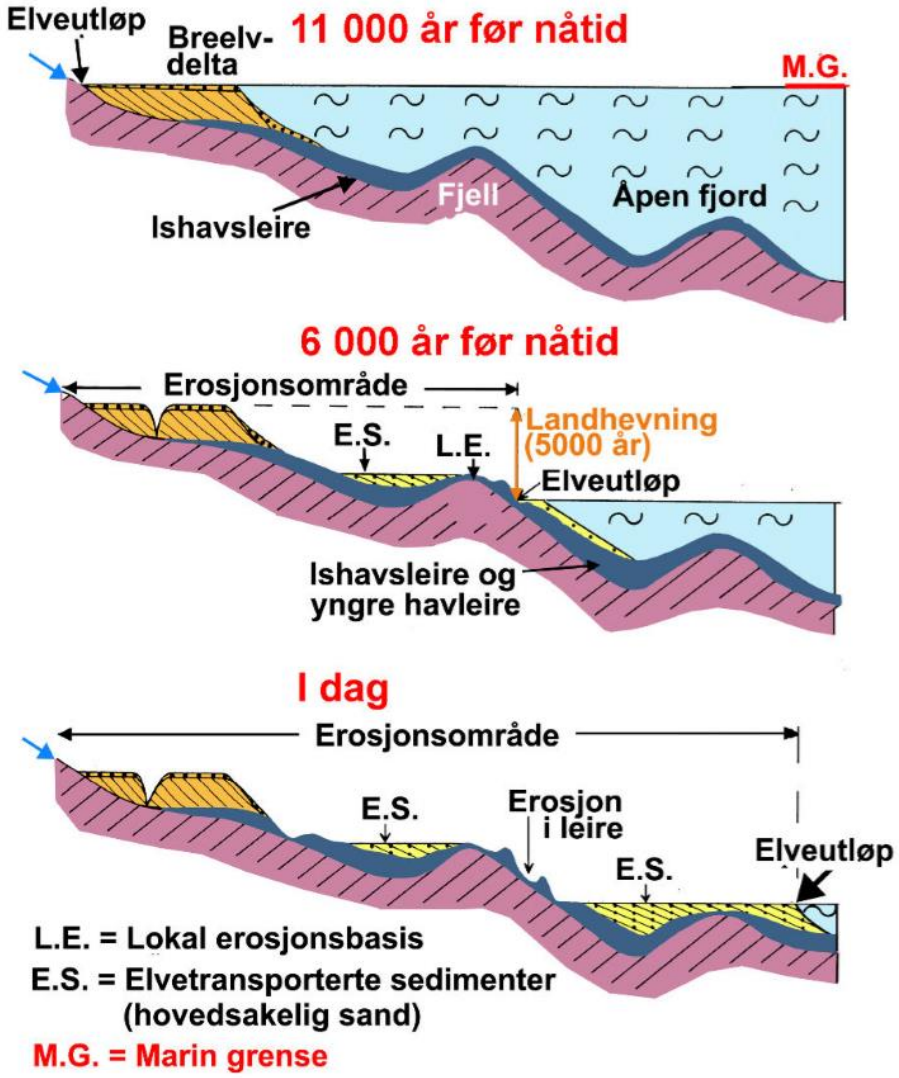
Example for a vegetation map (NIJOS) that was made using an older system

Main river types in Norway (suggested – similar to Sweden)



Development of river valleys and their “erosion base”



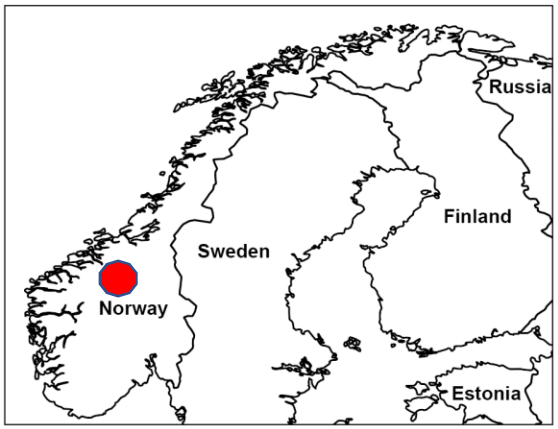


Three phases of development after the last ice age, with land rise, erosion, and sedimentation of fluvial sand, silt and clay. Numedalslågen

Jørgensen et al. (2013)

Riparian vegetation in regulated rivers

Surna River before 2011



What is «Nature in Norway» (Natur i Norge, NiN)?

NiN = a classification system for the ecological variation found in Norway that covers the terrestrial and water areas of the entire country (developed since 2005)

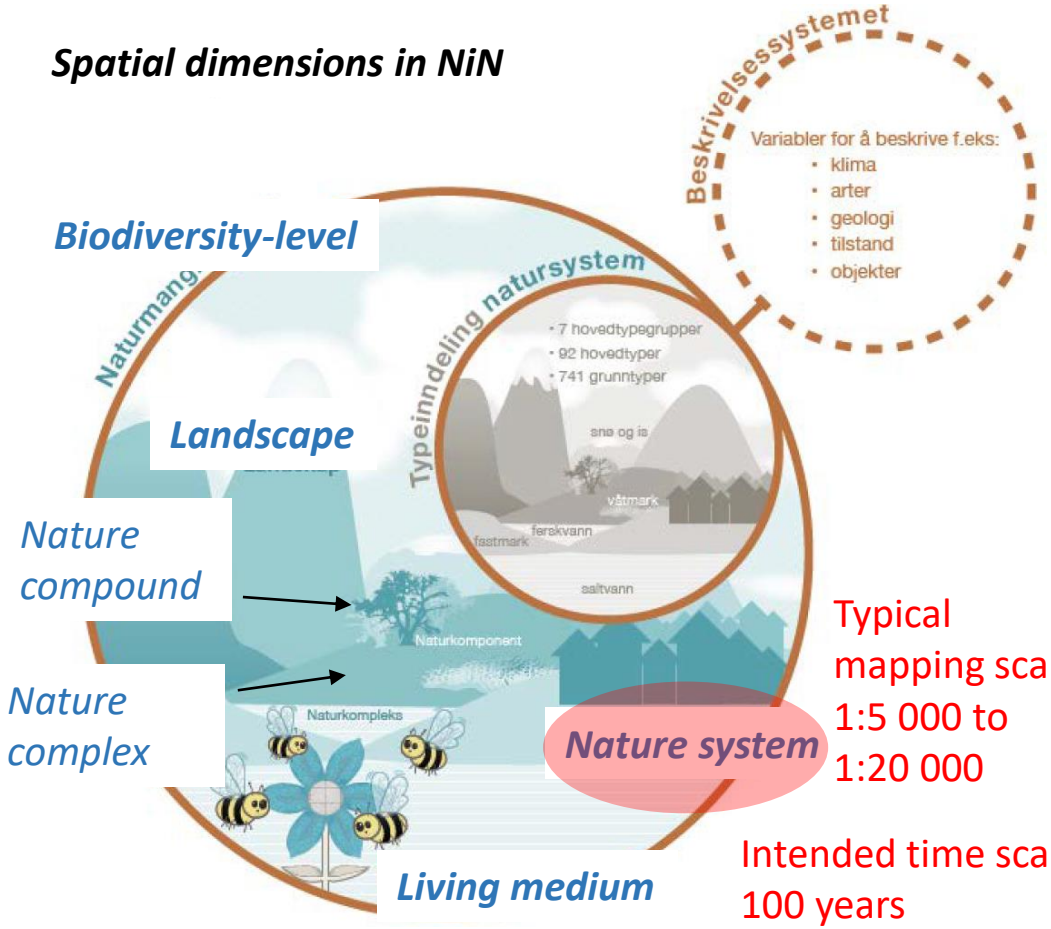
Purpose:

- ❑ To provide a value-independent common terminology for all communities and institutions working with nature
- ❑ To serve as tool for the description of nature variation and for the mapping of nature types in Norway
- ❑ To provide a base for the work with red listed nature types

https://www.artsdatabanken.no/NiN

Description system

Spatial dimensions in NiN

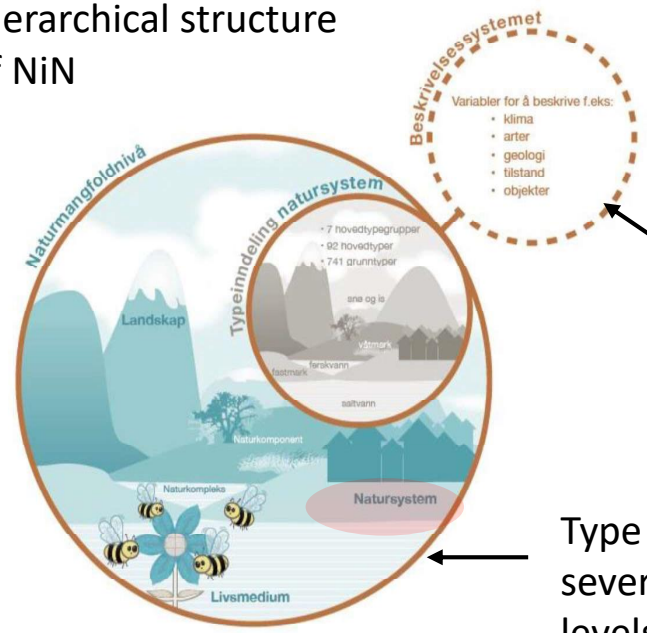


Typical mapping scale: 1:5 000 to 1:20 000

Intended time scale: 100 years

The system “Nature in Norway” (Natur i Norge, NiN)

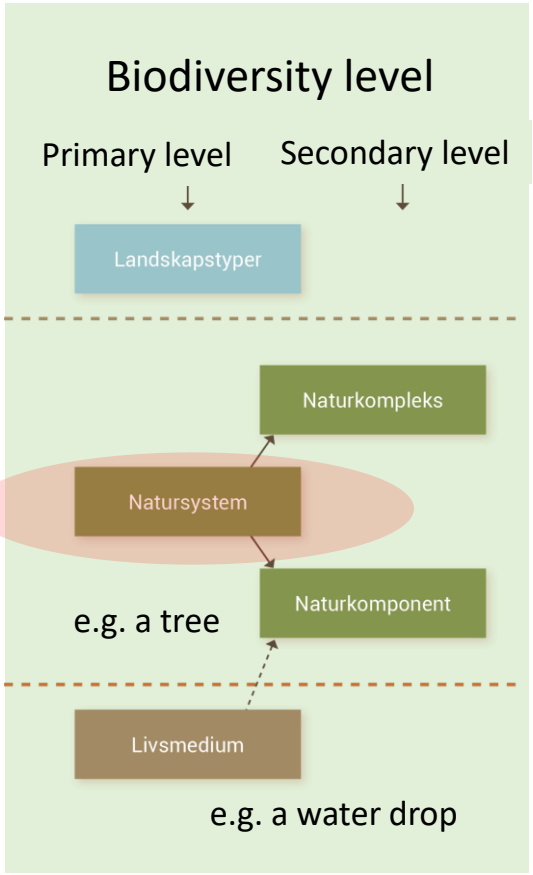
Hierarchical structure of NiN



Description system (allows to integrate info about climate, species, geology, condition, objects)

Type system with several biodiversity levels

- Landscape type
- Nature complex
- Nature system
- Nature compound
- Life medium



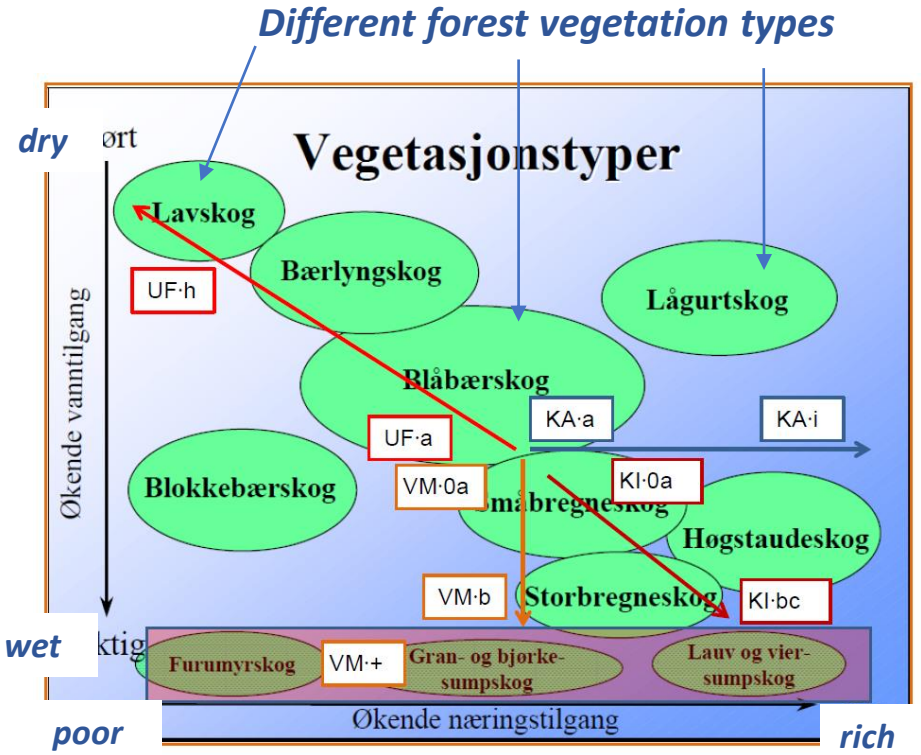
The Nature System is defined as «*all organisms within a more or less uniform, definable area, the total environment they are living in and are adapted to, and the processes that regulate the relations between the organisms themselves and between organisms and their enviroment (including human activity).*»

https://artsdatabanken.no/NiN

Typical mapping scale: 1:5 000 to 1:20 000, Intended time scale: 100 years

NiN: Local complex environmental variables (LCE) and description system

- The different “nature types” within all levels are identified by means of “local complex environmental variables” (LCE).
- LCE are identified as “one among a few local environmental variables that contribute substantially to the variations in species composition” (cp. vegetation science).
- In addition, there is a description system allowing a more detailed characterization of nature variation, for example with respect to human impacts.



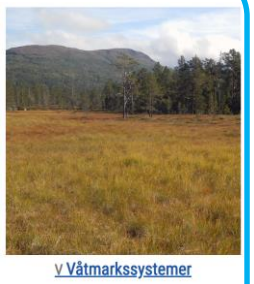
Example - vegetation types for forests and woodlands as function of four LCE:

- KA = Lime content (kalkinnhold)
- KI = Impact from spring water (kildevannspåvirkn.)
- UF = Risk of drying out (uttørkingsfare)
- VM = Water saturation (vannmetning)

Halvorsen, R., Bryn, A. & Erikstad, L. 2016. NiNs systemkjerne – teori, prinsipper og inndelingskriterier. – Natur i Norge, Artikkel 1 (versjon 2.1.0): 1–358. Artsdatabanken, Trondheim; http://www.artsdatabanken.no.

NiN2: Main groups on the “Nature System” level

Systems that are relevant for describing “riparian vegetation”



Wetland systems (V)

13 sub-groups, among them:

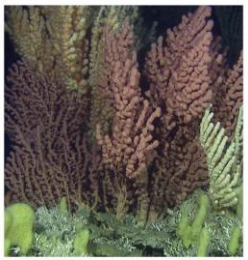
- ❑ V1 – Open fen
- ❑ V2 – Mire and swamp forests
- ❑ V3 – Peat bogs
- ❑ V8 – Shore swamp forests
- ❑ V10 – Semi-natural wet grasslands

Marine water masses

Limnic water masses (F)

5 sub-groups:

- ❑ F1 – River waters
- ❑ F2 – Circulating lake waters
- ❑ F3 – Not circulating lake waters
- ❑ F4 – Heavily modif. river waters
- ❑ F5 – Heavily modif. lake waters



Salt water bed systems

Freshwater bed systems (L)

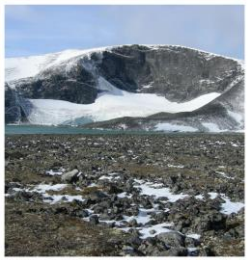
8 sub-groups, among them:

- ❑ L1 –Hard bed
- ❑ L2 – Sediment bed
- ❑ L4 – Helophyte swamp
- ❑ L5 – Freshwater spring bed

Terrestric systems (T)

45 sub-groups, among them:

- ❑ T4 – Terrestric forests
- ❑ T15 – Waterfall meadow
- ❑ T18 – Open hard flood area
- ❑ T30 – Flood forests



Snow- and ice systems

NiN2: Flood forests

2 base types

T Fastmarkssystemer

Terrestric systems (T)

45 sub-groups among them:

- ❑ T4 – Terrestric forests
- ❑ T15 – Waterfall meadow
- ❑ T18 – Open hard flood area
- ❑ T30 – Flood forests

T30-C-1

Flood forests at gravel and stone

2 base types

T30-C-2

Flood forests at fine materials

2 base types

T30-C-3

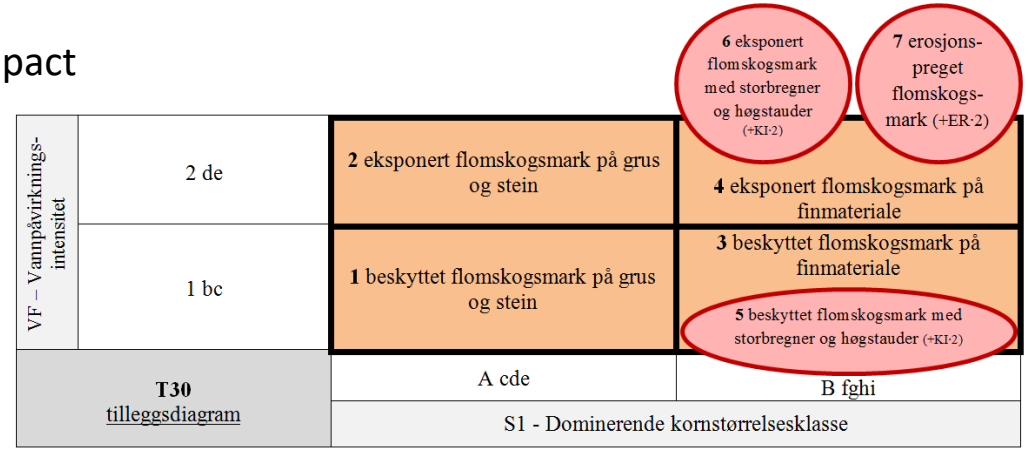
Spring-affected flood forests at fine materials

T30-C-4

Erosion-affected flood forests

1 base type

Water impact intensity



Dominating grain size

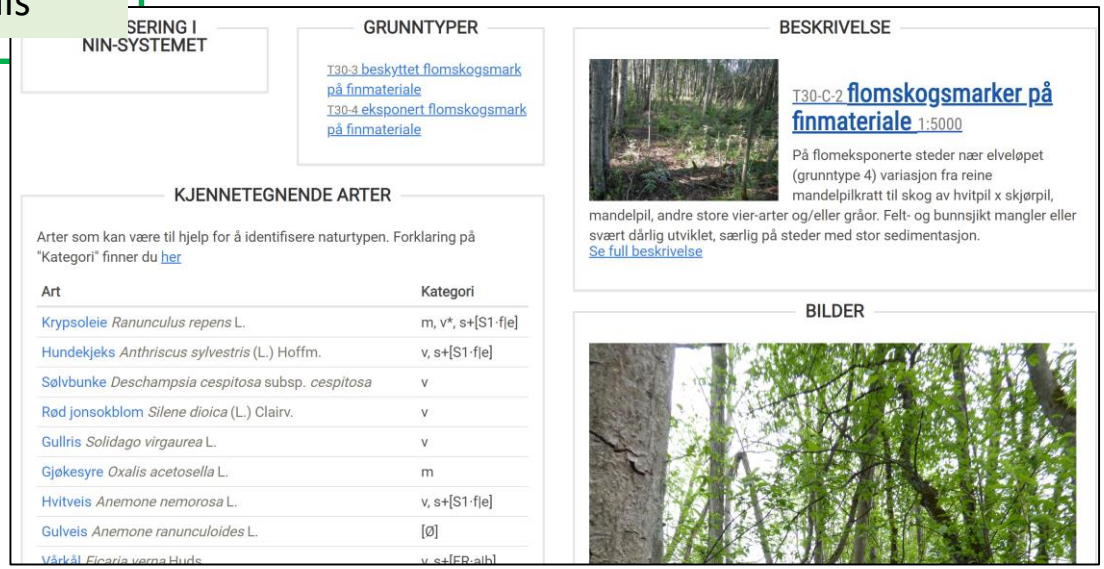
NiN2: Flood forests - example

Flood forests at fine materials

Example for one of the base types: Greyalder-birdcherry-floodplain forest in Lake Øyeren's delta →

2 base types

Description on the web-page



SERING I NIN-SYSTEMET

GRUNNTYPER

T30-3 beskyttet flomskogsmark på finmateriale
T30-4 eksponert flomskogsmark på finmateriale

BESKRIVELSE

T30-C-2 flomskogsmarker på finmateriale 1:5000

På flomeksponerte steder nær elveløpet (grunntype 4) variasjon fra reine mandelpilkratt til skog av hvitpil x skjørpil, mandelpil, andre store vier-arter og/eller gråor. Felt- og bunnsjikt mangler eller svært dårlig utviklet, særlig på steder med stor sedimentasjon.
Se full beskrivelse

KJENNETEGNENDE ARTER

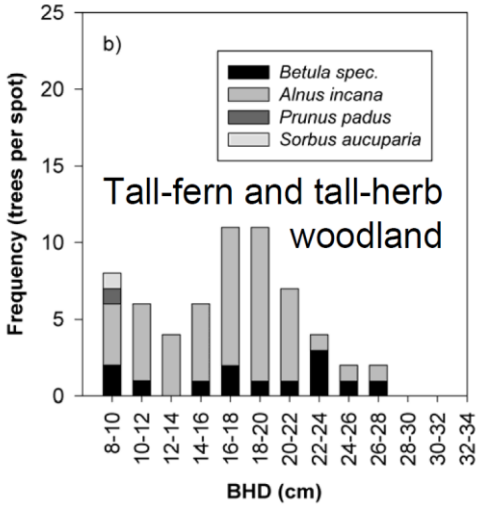
Arter som kan være til hjelp for å identifisere naturtypen. Forklaring på "Kategori" finner du her

Art	Kategori
Krypsoleie *Ranunculus repens* L.	m, v*, s+[S1·f|e]
Hundekjeks *Anthriscus sylvestris* (L.) Hoffm.	v, s+[S1·f|e]
Sølvbunke *Deschampsia cespitosa* subsp. *cespitosa*	v
Rød jonsokblom *Silene dioica* (L.) Clairv.	v
Gullris *Solidago virgaurea* L.	v
Gjøkesyre *Oxalis acetosella* L.	m
Hvitveis *Anemone nemorosa* L.	v, s+[S1·f|e]
Gulveis *Anemone ranunculoides* L.	[Ø]
Vårkål *Ficaria verna* Huds.	v, s+[FR-alb]

BILDER

List of typical species

Photos etc.

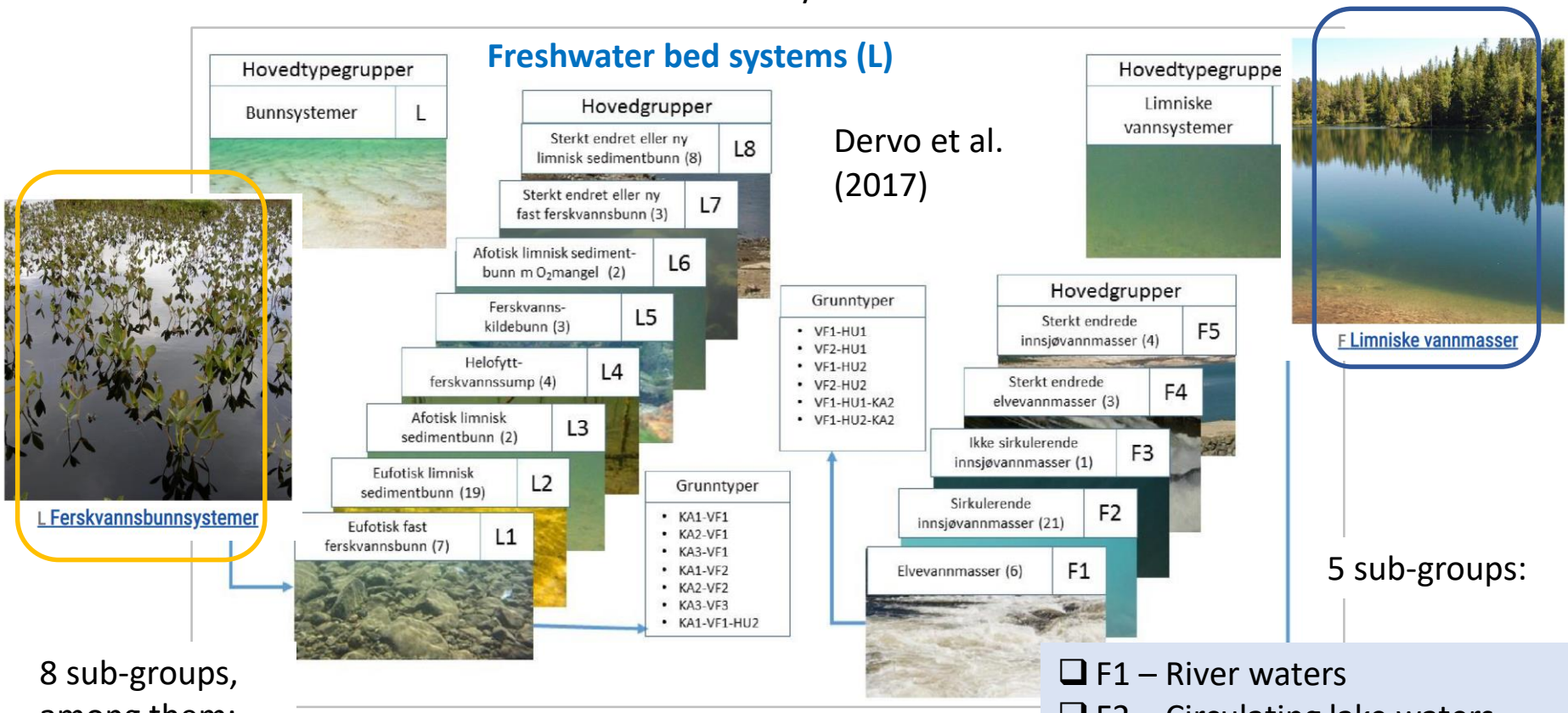


BHD = Breast height diameter

Nature types for freshwater (NiN 2.0)

Limnic water masses (F)

Most relevant for rivers and streams at the «Nature System» level:



8 sub-groups, among them:

- ❑ L1 –Hard bed
- ❑ L2 – Sediment bed
- ❑ L4 – Helophyte swamp
- ❑ L5 – Freshwater spring bed

Most imporant LCEs:

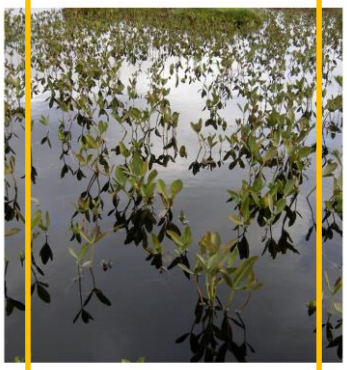
- Lime content (KA)
- Water impact intensity* (VF)
- Humus content (HU)
- Sediment (S3)

5 sub-groups:

- ❑ F1 – River waters
- ❑ F2 – Circulating lake waters
- ❑ F3 – Not circulating lake waters
- ❑ F4 – Heavily modif. river waters
- ❑ F5 – Heavily modif. lake waters

** A complex parameter including a wave exposition index, flow velocity, or moved rain sizes*

NiN2: Freshwater bed systems



Freshwater bed systems (L)

8 sub-groups, among them:

- ❑ L1 –Hard bed
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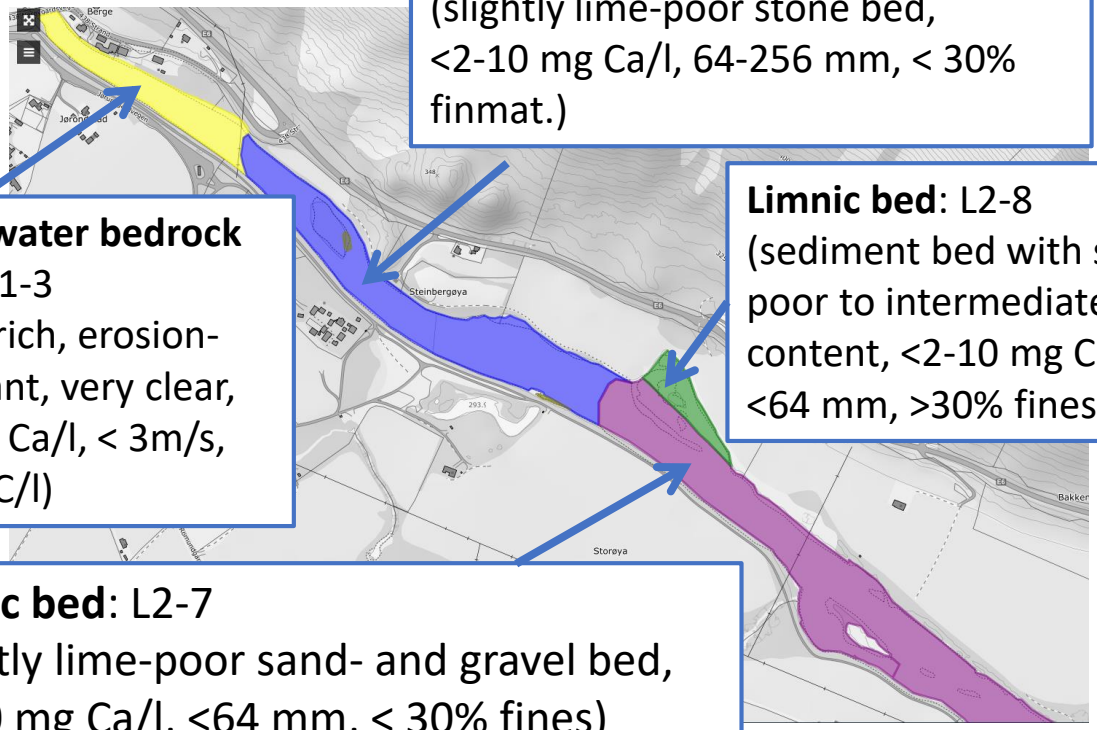
- ❑ L4 – Helophyte swamp
- ❑ L5 – Freshwater spring bed

Mapping results for the «bed system» of Gudbrandsdalslågen river (Dervo et al. 2017)

Limnic bed: L2-10
(slightly lime-poor stone bed, <2-10 mg Ca/l, 64-256 mm, < 30% finmat.)



Freshwater bedrock bed: L1-3
(lime-rich, erosion-resistant, very clear, >4 mg Ca/l, < 3m/s, <2 TOC/l)

Limnic bed: L2-8
(sediment bed with slightly poor to intermediate lime content, <2-10 mg Ca/l, <64 mm, >30% fines)

Limnic bed: L2-7
(slightly lime-poor sand- and gravel bed, <2-10 mg Ca/l, <64 mm, < 30% fines)

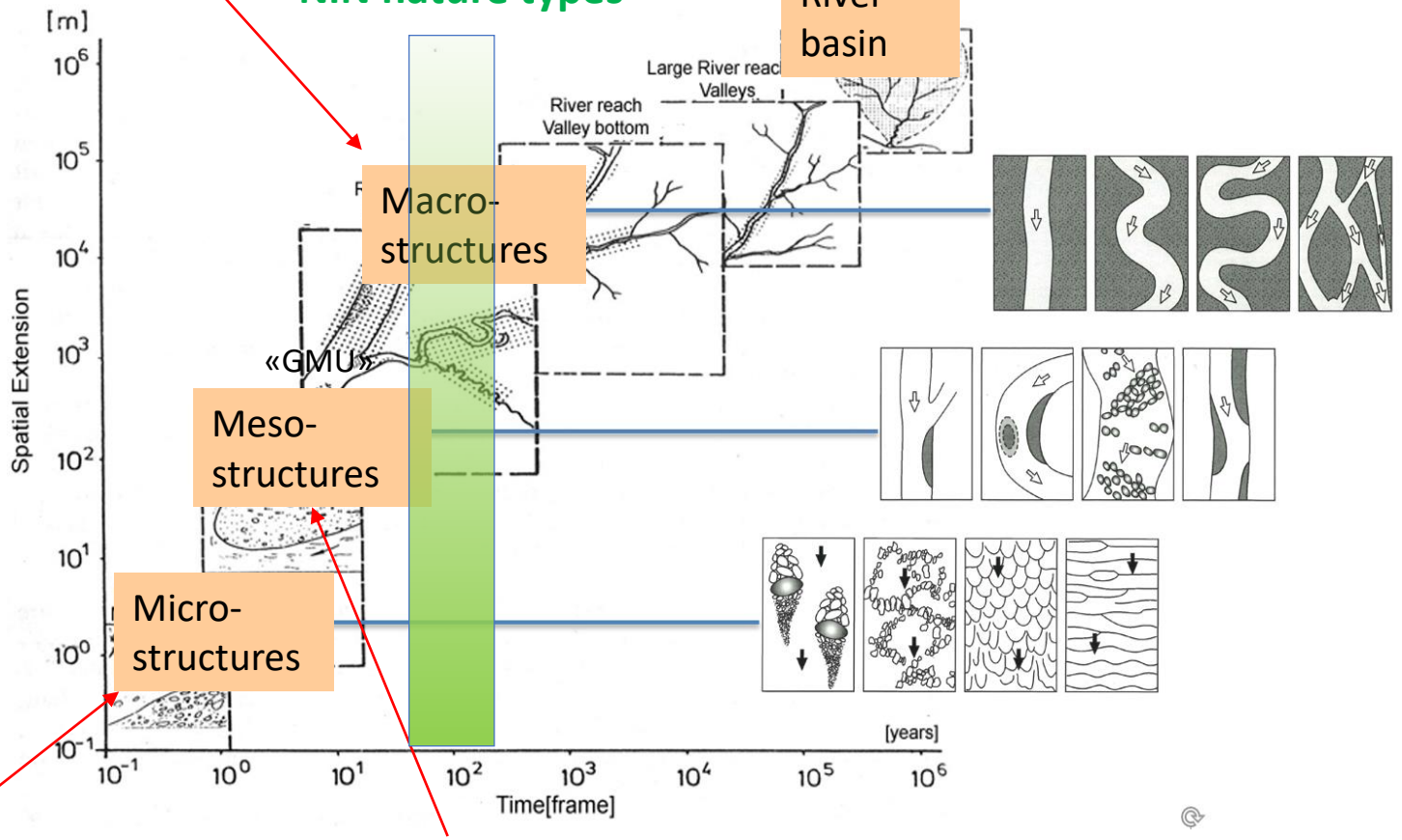
- Lime content (KA)
- Water impact intensity (VF)
- Humus content (HU)
- Sediment (S3)

Time perspective of NiN vs. temporal and spatial scales

Changes during (5)-500 years

NiN nature types

River basin



Changes during < 1 year

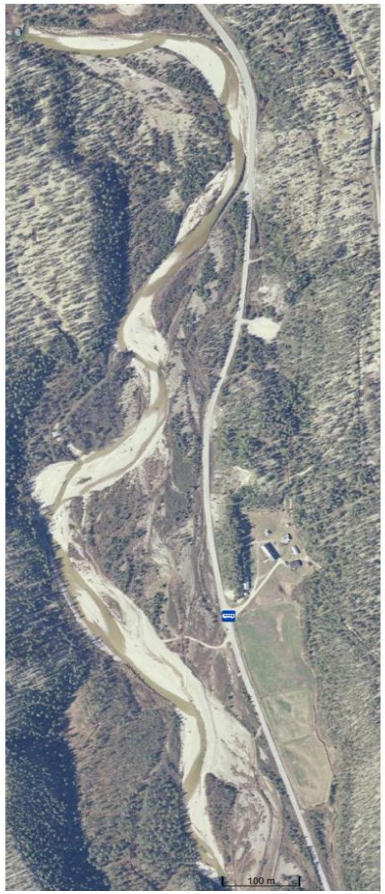
Changes during 1-20 years

Kern (1994), DWA (2015), modif.

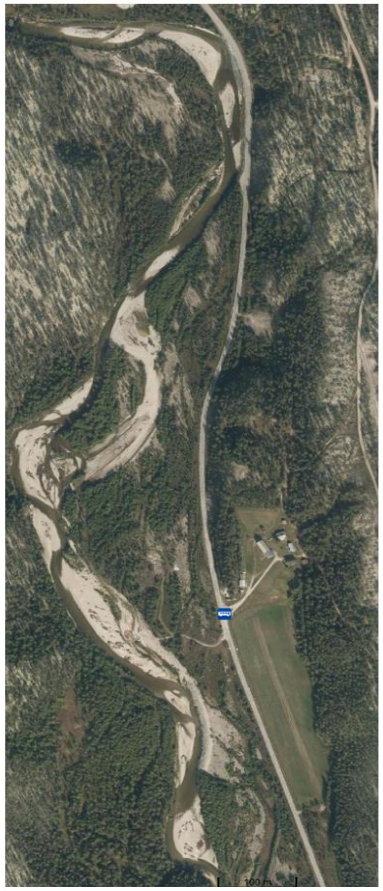
To be included: river dynamics

Typical time scale for GMU-Changes: 1-20 years (see also literature)

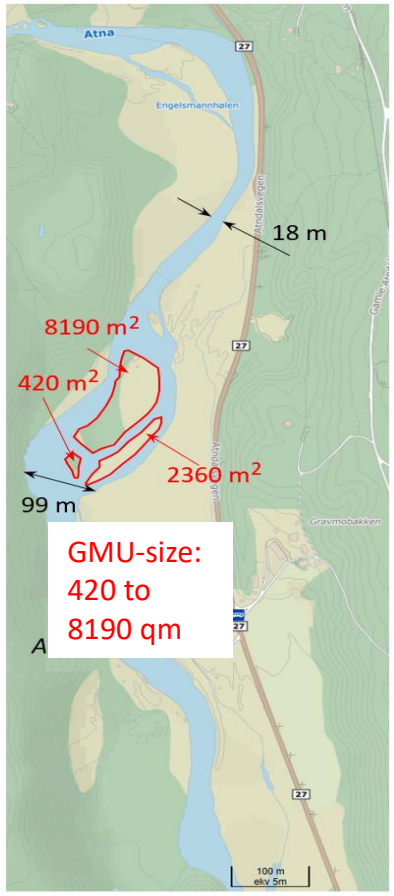
Atna river 1969



2004

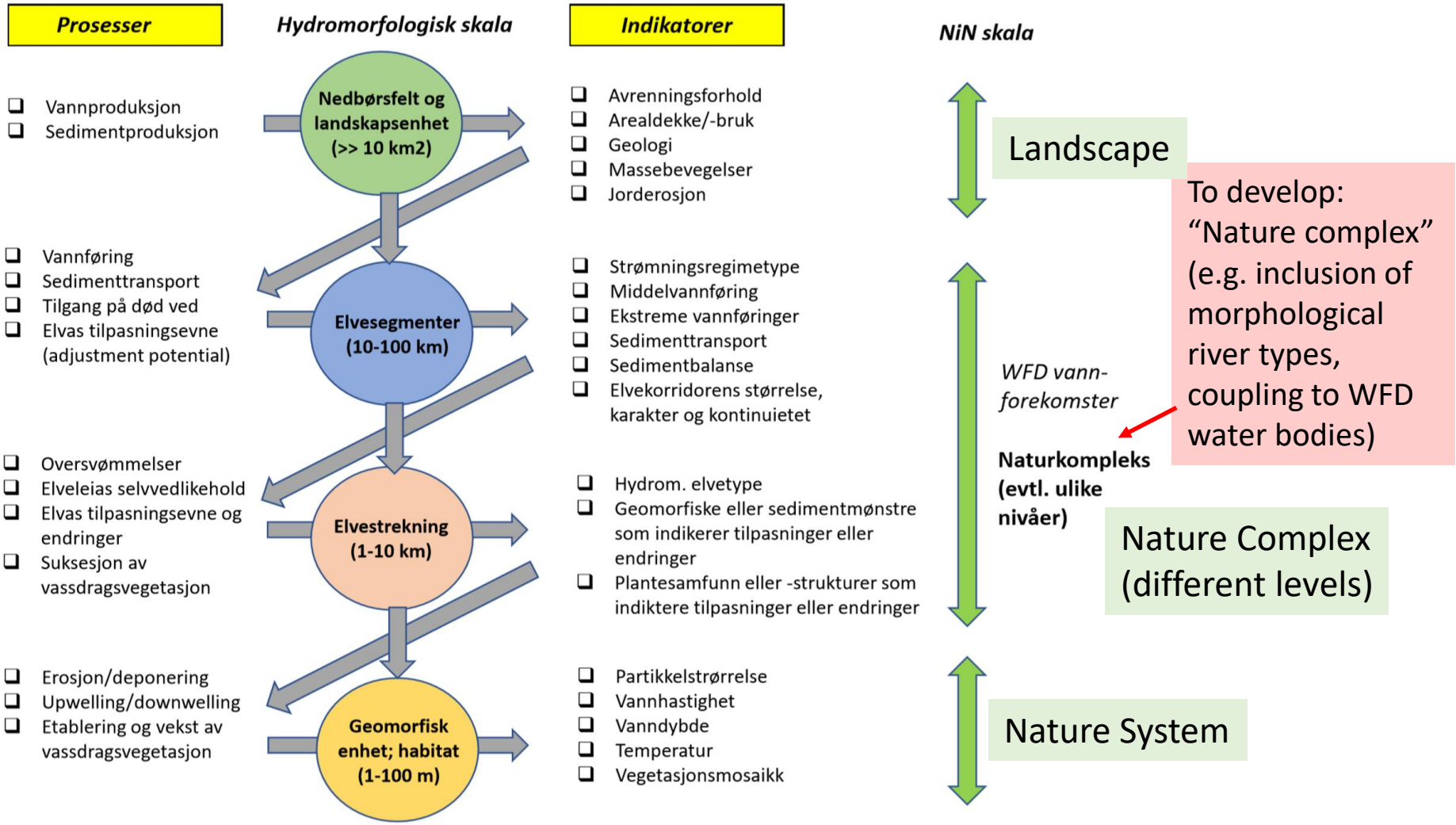


2015



Topogr. map

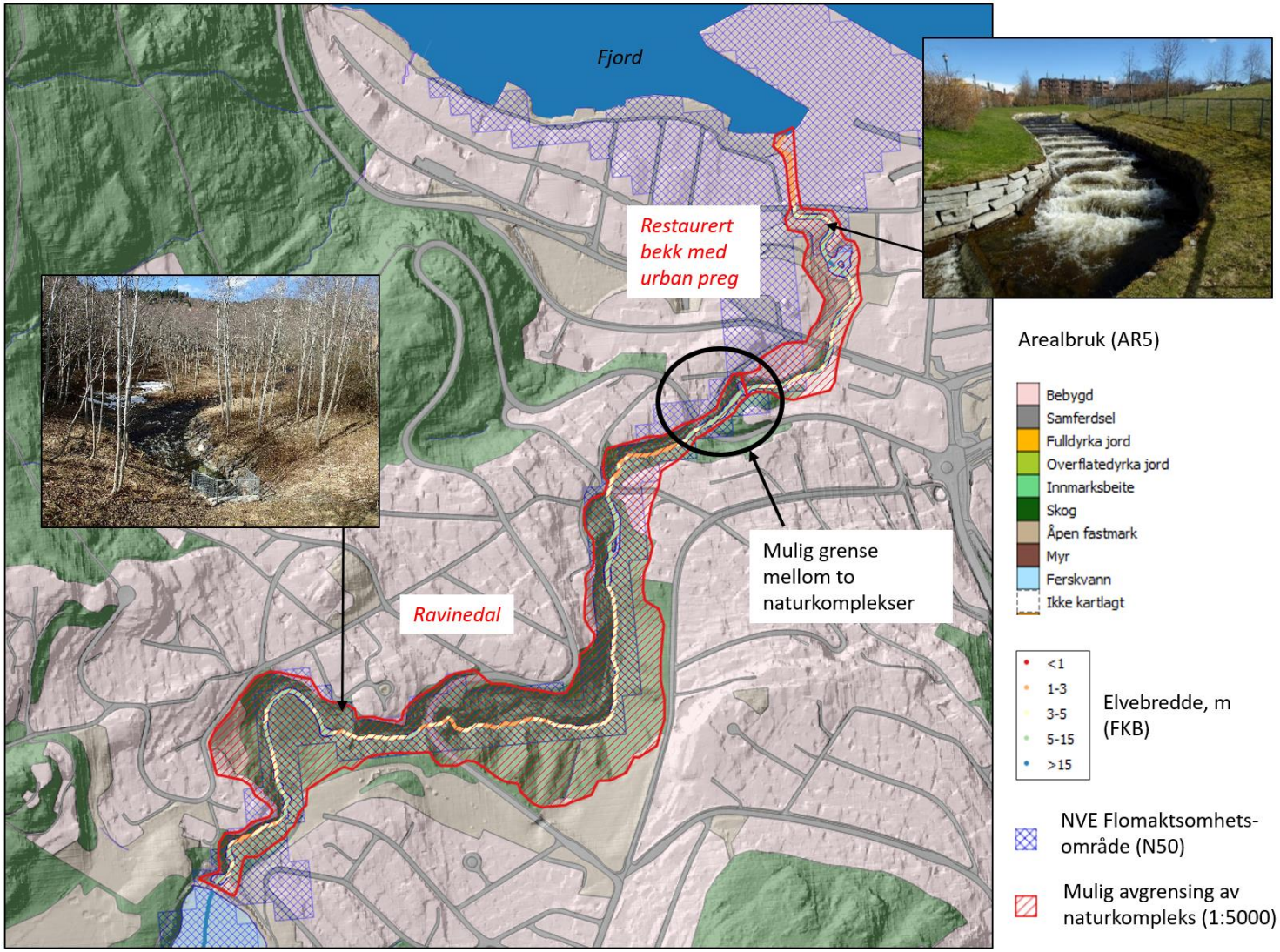
Further development of NiN's freshwater part



Scales of the EU REFORM Project (Gurnell et al. 2015) and respective levels of the NiN system

Further development of the «nature complex» units

WFD «Water bodies» should correspond to «nature complex» units.



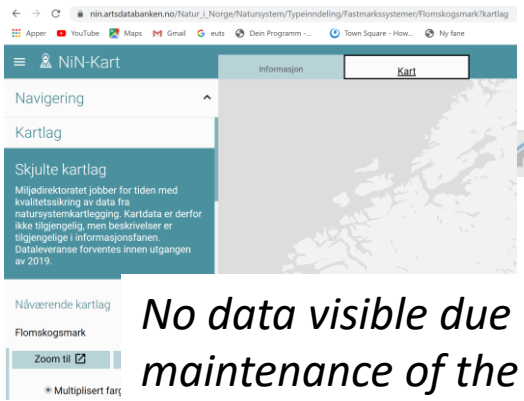
Example: Ilabekken stream near Trondheim

Actual status of nature type mapping and publicly available data

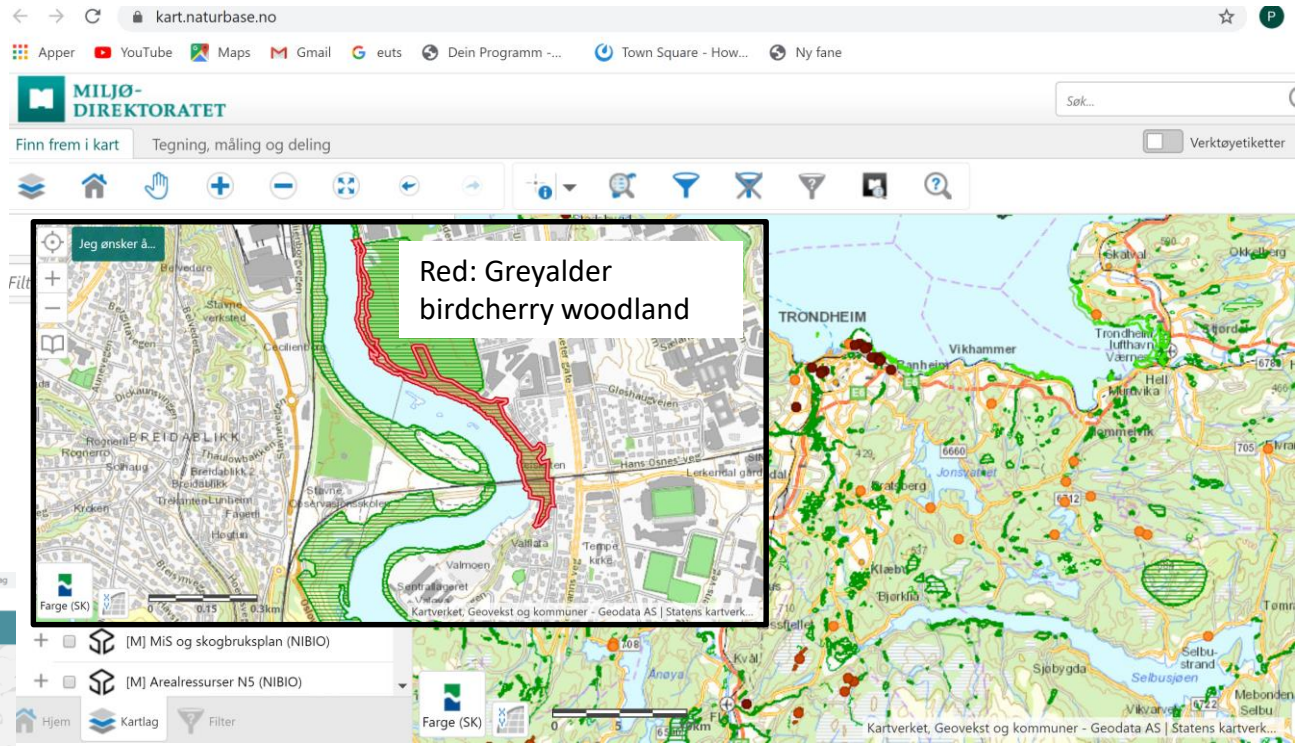
Info NiN-webpage (Artsdatabanken):

January 2020:

- ❑ 2761 km² NiN "nature system" are mapped*
- ❑ 18766 different species mapped



No data visible due to maintenance of the system (2020-01-24)



"Naturbase" – nature mapping system of the Environmental Agency: many mapping units according to older systems (DN Manual 13)

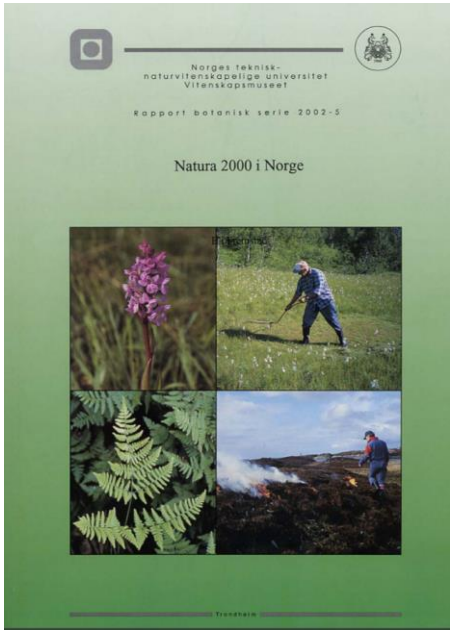
* This equals 0,7 % of Norway's area (385 207 km2)

NATURA 2000 and Norwegian classifications

Tabell 1. Natura 2000-enheter som er representert i Norge, jevnført med 1) naturtyper som kartlegges for kommunenes oversikt over biologisk mangfold (DN 1999, tabell 3.4), 2) truete vegetasjonstyper (Fremstad & Moen 2001), 3) vegetasjonstyper i Norge (Fremstad 1997).
Enheter som ikke har paralleller i 1, 2 eller 3 angis med ---. Mange enheter kommenteres i siste del av kapittel 2.

Natura 2000	1) Naturtyper	2) Truete vegetasjonstyper	3) Vegetasjonstyper i Norge
3210 Elver i Fennoskandia	--- Se merknad		O, P, Q (se 3220-3260) Q4 Fosseeng C3 Gråor-heggeskog Se merknad
3220 Urterik kantvegetasjon ved elver i fjellet	Større elveører	Pionér-ør	Q2 Urte- og grasør
3230 Elver med klåvedkratt	Større elveører	Klåvedkratt	Q3a Elveørkratt, klåved-utforming
3240 Elver med pil/vier-kratt Se merknad	Se merknad	Mandelpilkratt Duggpilkratt Grønnvierkratt i Nord-Norge	Q3b Elveørkratt, tindved-utforming Q3c, d Elveørkratt, gråor-bjørk-vier-utforming Q3e Elveørkratt, duggpil-utforming Q3f Elveørkratt, mandelpil-utforming
3260 Elver med langskuddvegetasjon eller vannmoser	Meandrerende elveparti Ikke-forsurede restområder	---	P1a Langskudd-vegetasjon, tusenblad-tjønnaks-utforming P6 Mose-sjøbunn

NiN2:
Flood forests at fine materials



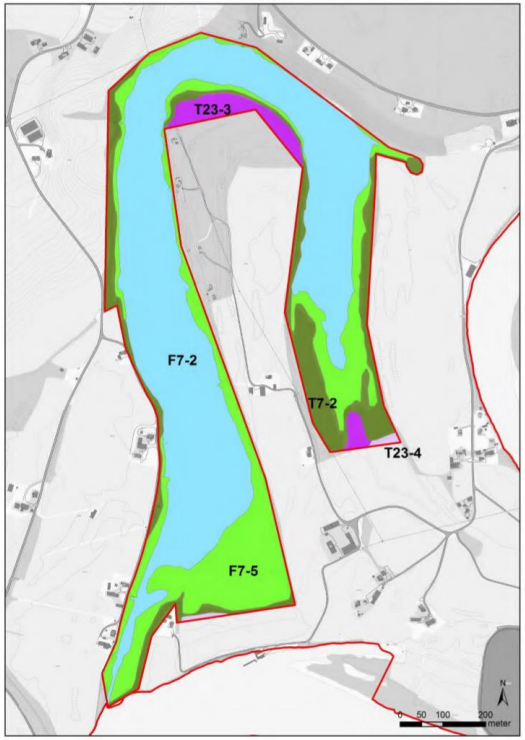
Fremstad (2002)

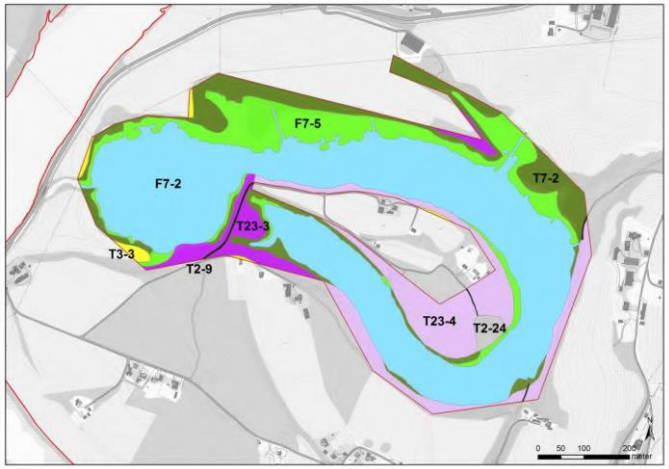
Translation table from 2002 allows to relate some NATURA 2000 types to Norwegian systems (fully translated into NiN?)

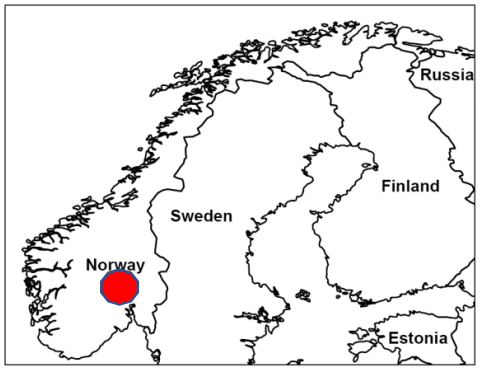
Further development of NiN's description system

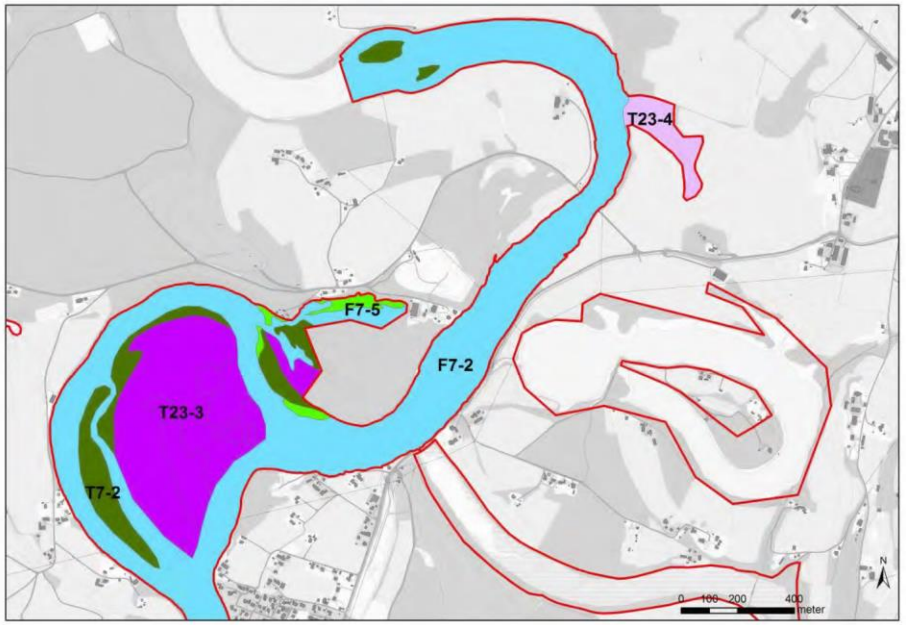
- Include and adapt lists of hydromorphological structures that were recently suggested by fluvial geomorfologists, for Norwegian conditions
- Add typical impacts and measures, such as mitigation measures, and elements of hydropower and urban drainage systems
- Couple to existing mapping systems, e.g. of embankment structures (Norwegian Water and Energy Directorate)

Examples for NiN mapping: Storelva River and oxbow lakes





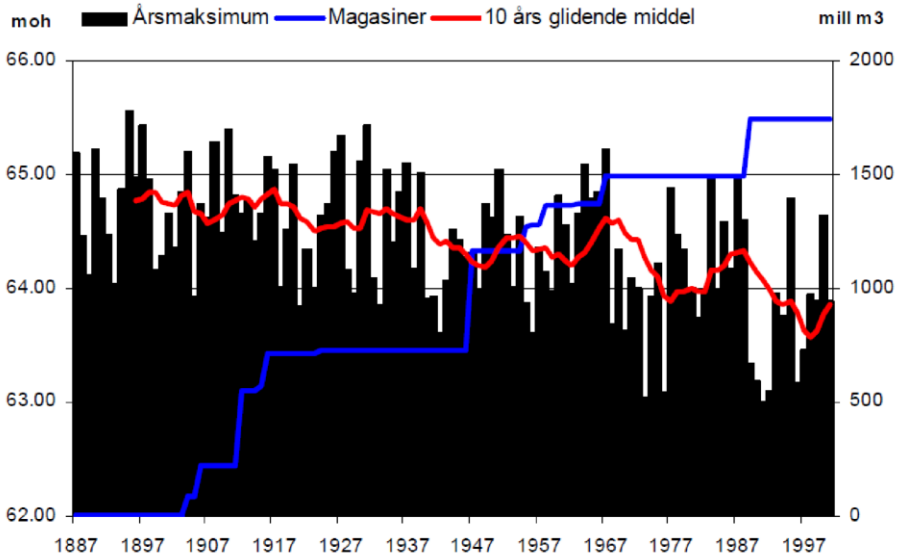




FMBU (2016): Forvaltningsplan for Nordre Tyrifjorden og Storelva naturreservat. Utkast 2016

F7-2=eufotisk ferskvannsbløtbunn, F7-5=helofyttsump, T7-2=nedre leirflomskog, T23-3=svak lågurtskog, T23-4=lågurtskog

Riparian vegetation in Norway



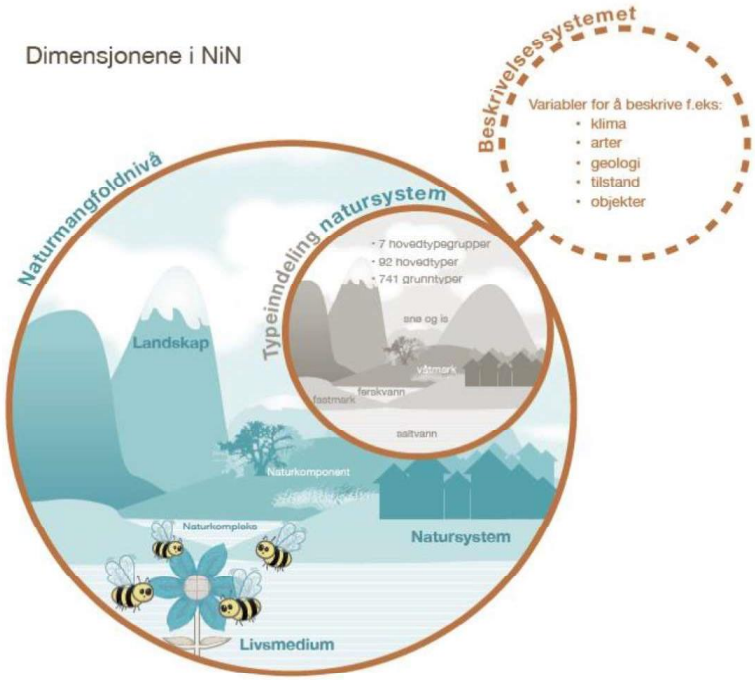
Storelva River
near Tyrifjord

https://www.norgeibilder.no/

Decrease of flood water levels due to regulation (NVE-data)

Conclusions and outlook

- Riparian vegetation in Norway and the respective species reflect the bioclimatic conditions.
- The system “Nature in Norway” (NiN) is a classification system for the ecological variation found in Norway, with the intention to provide a value-independent common terminology.
- NiN is based on ecology science and quite well developed and tested for “terrestric areas”.
- We have tested the system for several rivers and streams in Norway and found a number of issues for the freshwater part that need to be improved. In particular the dynamic of river systems and the process-based inter-dependencies between substrate, slope, valley shape and river morphology are not sufficiently reflected.
- Our ongoing work contributes with the improvement of the system, having in mind the quality of publicly available data sources and on-going developments in remote sensing.
- NiN could be a suitable tool to map changes of riparian vegetation over time. At the current state of mapping, however, there is little data readily available.



Thank you!
¡Muchas gracias!

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I would like to thank my project partners from the Norwegian Institute for Nature Research for a good cooperation and the Norwegian Environmental Agency and the Norwegian Biodiversity Information Centre for the possibility to contribute to the further development of NiN for freshwater.

CONVERGES
European Riparian Ecosystems