

WETLAND MONITORING & RESTORATION

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Overview

- Aims & focus of the national environmental monitoring
- Results from the satellite based monitoring program
- Restoration of wetlands

Environmental monitoring - an indispensable part of the environmental work



Current general aims

A systematic approach of collecting, measuring and analysing environmental data in order to:

- **describe the state of the environment;**
- **follow up changes and trends in the physical, chemical and biological environment;**
- identify threats to the environment;
- provide data to be used as a basis for action;
- monitor implementations and effects of action;

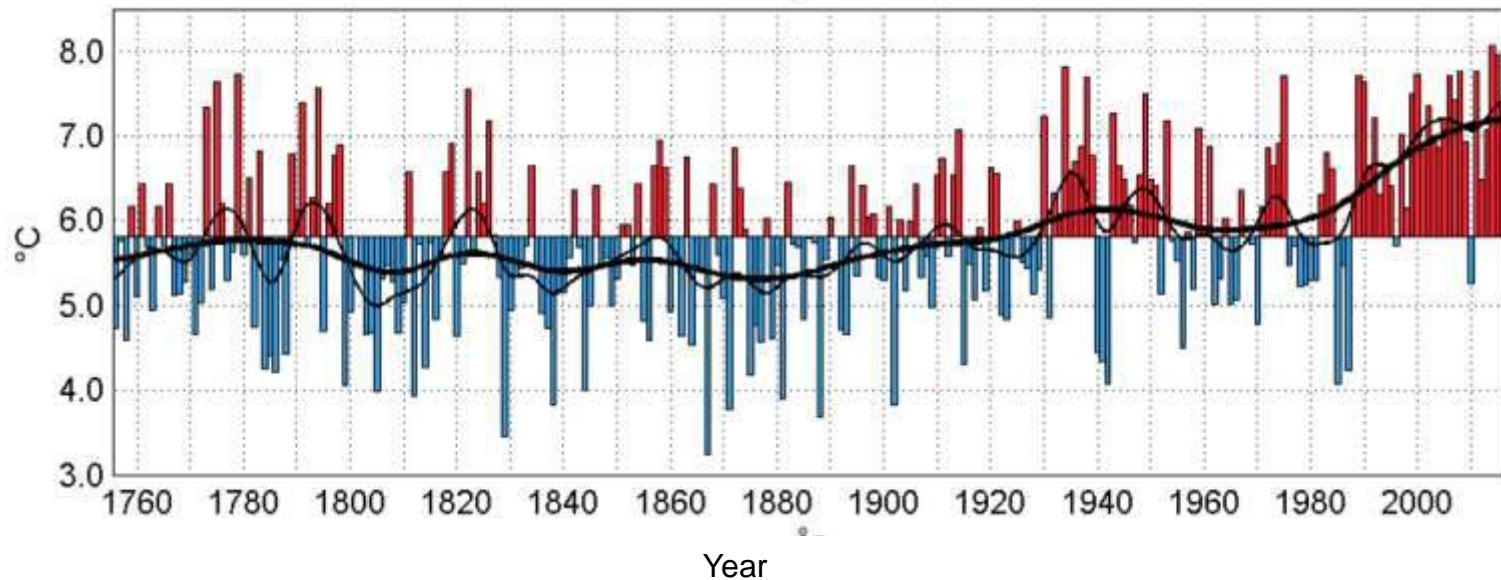
Focus

What environmental monitoring focuses on is regulated by:

- environmental legislation,
- the environmental quality objectives and
- Sweden's duties to report within the framework of international directives and conventions.

Environmental monitoring is a long-term activity

Annual average temperature, Stockholm 1756-2017 (SMHI)



National environmental monitoring

- **Monitoring commissioned by the government**
- **National programs are designed by the Swedish EPA and the Swedish Agency for Marine and Water Management (SwAM)**
- **Regional programs are designed by the County administrative boards (approved by the EPA)**
- **Monitoring is carried out for the Swedish EPA**

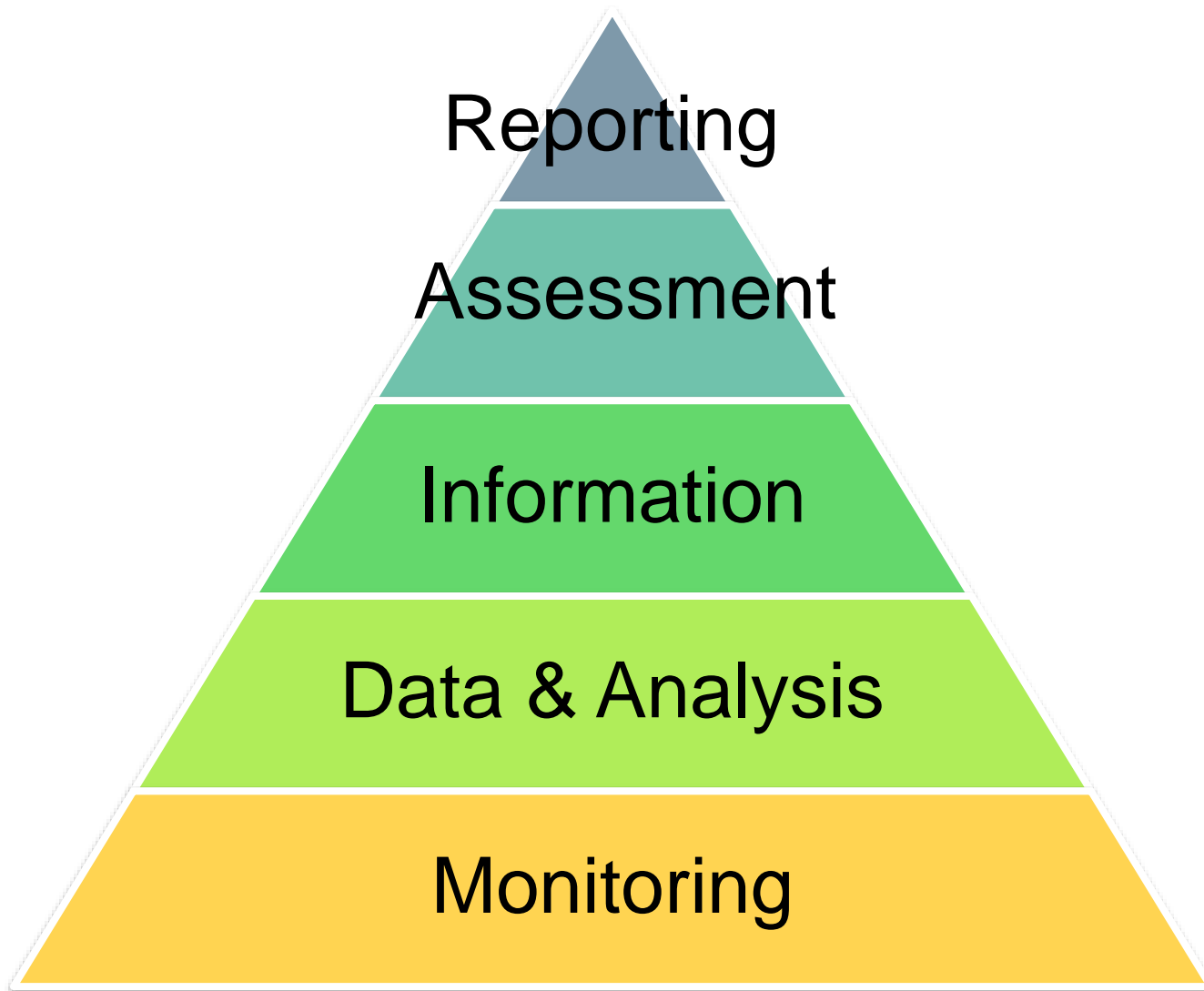


Swedish EPA coordinates the monitoring on a national and regional level



Several agencies, organizations and other groups monitor, or contribute in some way to the environmental monitoring:

- National agencies
- Regional agencies
- Local agencies
- Universities other higher education institutions
- Consulting companies
- Research institutes
- Associations
- Private individuals



Data hosts provide a service on behalf of the Swedish EPA and SwAM

Swedish
Environmental
Research Institute

Swedish
Meteorological and
Hydrological
Institute

The Institute of
Environmental
Medicine (IMM)

Swedish
Geological
Survey

Swedish
University
of
Agricultural
Sciences



Ten national program areas

- Mountains
- Health-related environmental monitoring
- Agricultural land
- Landscape
- Air
- Toxic substances
- Forests
- Wetlands
- Sea and coastal areas
- Freshwater

Wetland program

The aim of the program area Wetland is to monitor the long-term development of wetlands, including hydrological status and biological diversity. The program area is mainly focused on data supply for:

- the environmental quality objective *Thriving Wetlands*
- the Article 17 reporting of the Habitats directive (EU)

Wetland program

Subprograms:

- [Satellite-based monitoring of wetlands](#)
- [Climate-related monitoring](#) (of palsas)

▪



Satellite-based monitoring of wetlands

Brockmann Geomatics
County Administrative Boards
Swedish EPA

Satellite-based monitoring of wetlands

Aim

- Cost-effective method that can monitor large areas and produce comparable results at recurrent occasions.
- Suited for both regional and national levels.
- Monitor open mires (tree cover less than 30 %)
- The monitoring is designed to detect increased biomass/overgrowth related to land use.

The method was tested in a pilot study and the result was evaluated by field control of 212 randomly selected mire areas. It was concluded that the method can produce change information of increased biomass/overgrowth with very high accuracy ($\geq 90\%$ classification accuracy).



Satellite-based monitoring of wetlands

Methodology

The developed method is based on a two-step approach using LANDSAT satellite images from two different points in time. In this program we analyze the change over a 10 year period.

1. A detailed classification of the mires into 20 homogeneous mire units is performed in the oldest image.
2. These mire units are used as masks in the later image for directed change analysis using statistical measures.

1

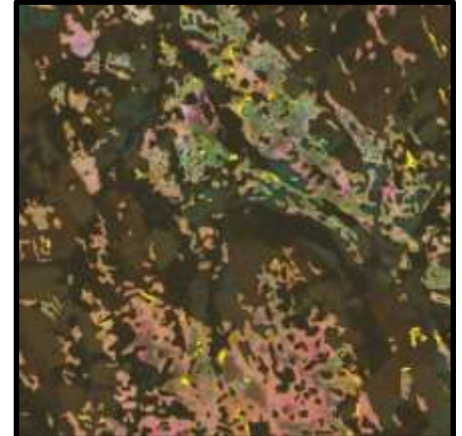
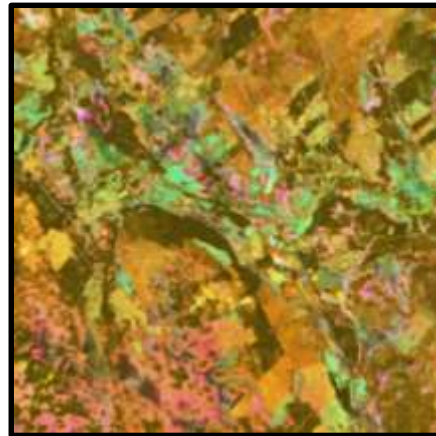
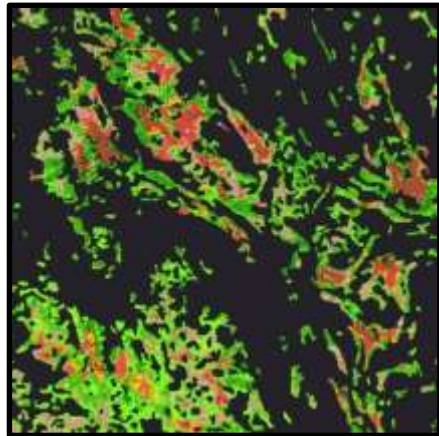
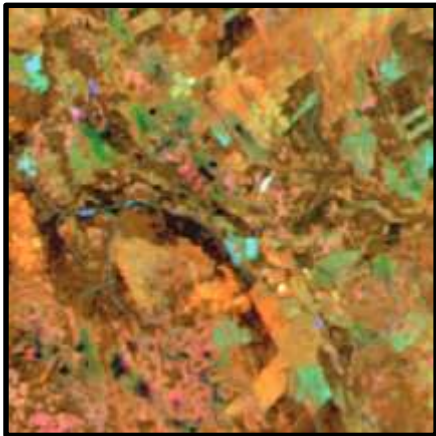
Satellite image –
Old (e.g. 1990)
Classification into
homogenous mire
types

2

Satellite image –
New (e.g. 2000)
Change analysis
with statistical
methods

3

Open mires with
change in the bottom
layer or biomass



Satellite image
(old)

Classification
(old image)

Satellite image
(new)

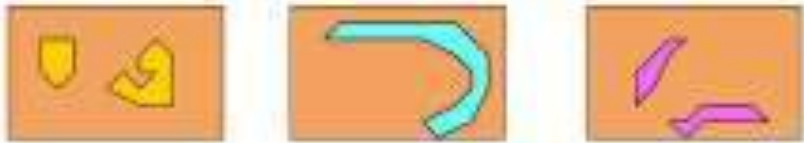
Stratified change
analysis (change
in yellow)

Point in time 1

Satellitedata

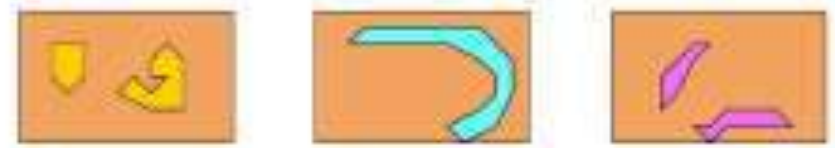


Classification



Homogeneous mire units

Point in time 2



Change analyses



Open mires with change



Satellite-based monitoring of wetlands

Results

The first full rotation of the inventory of Sweden took 10 years.

The first inventory started in 2007 and was completed in 2017.

A final report is being produced this year.

A new inventory will start in 2022.

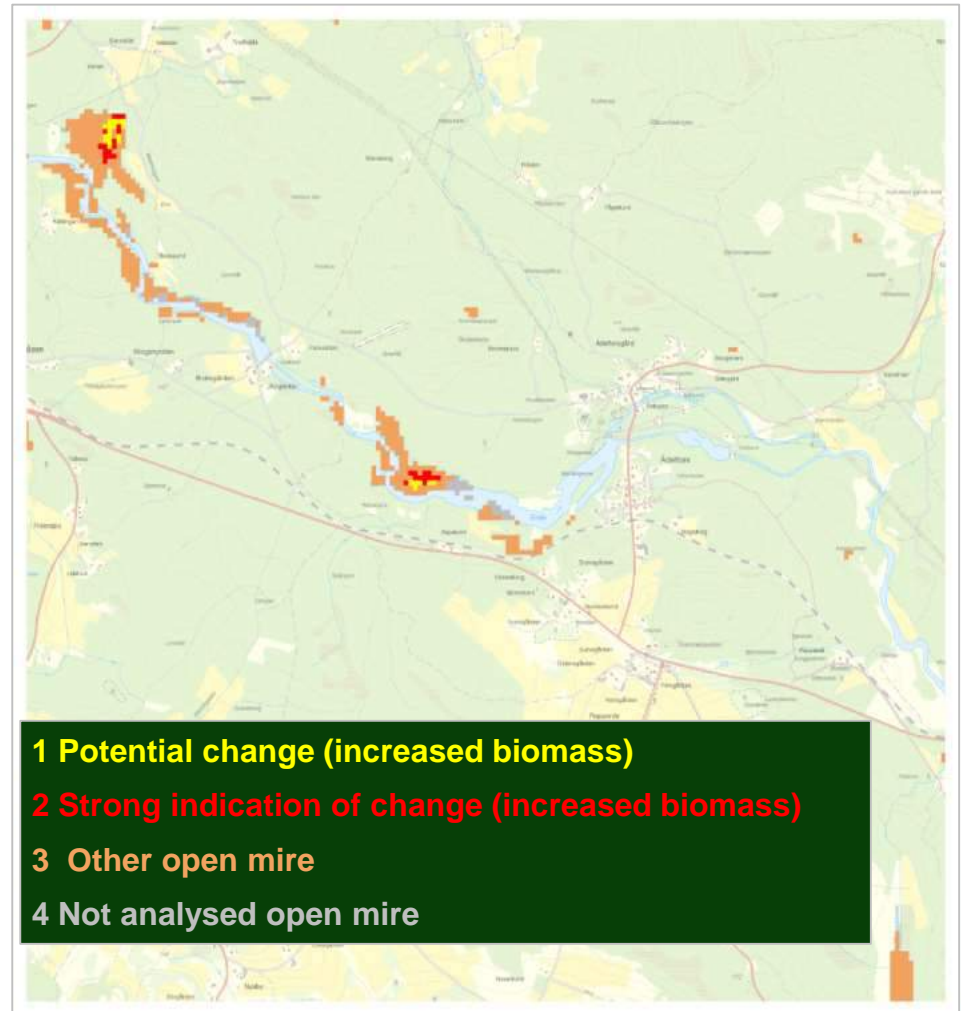


Change indicator

4 classes (resolution 25 m)

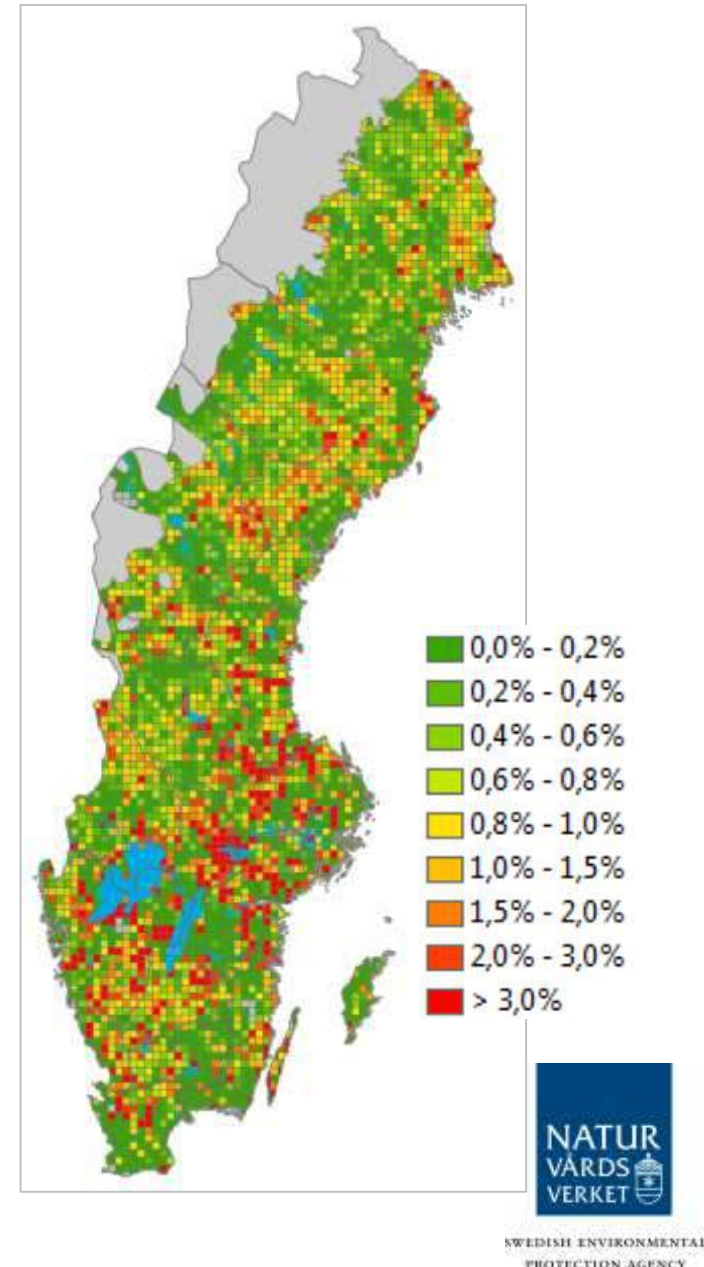


Example area, ca 5x5 km



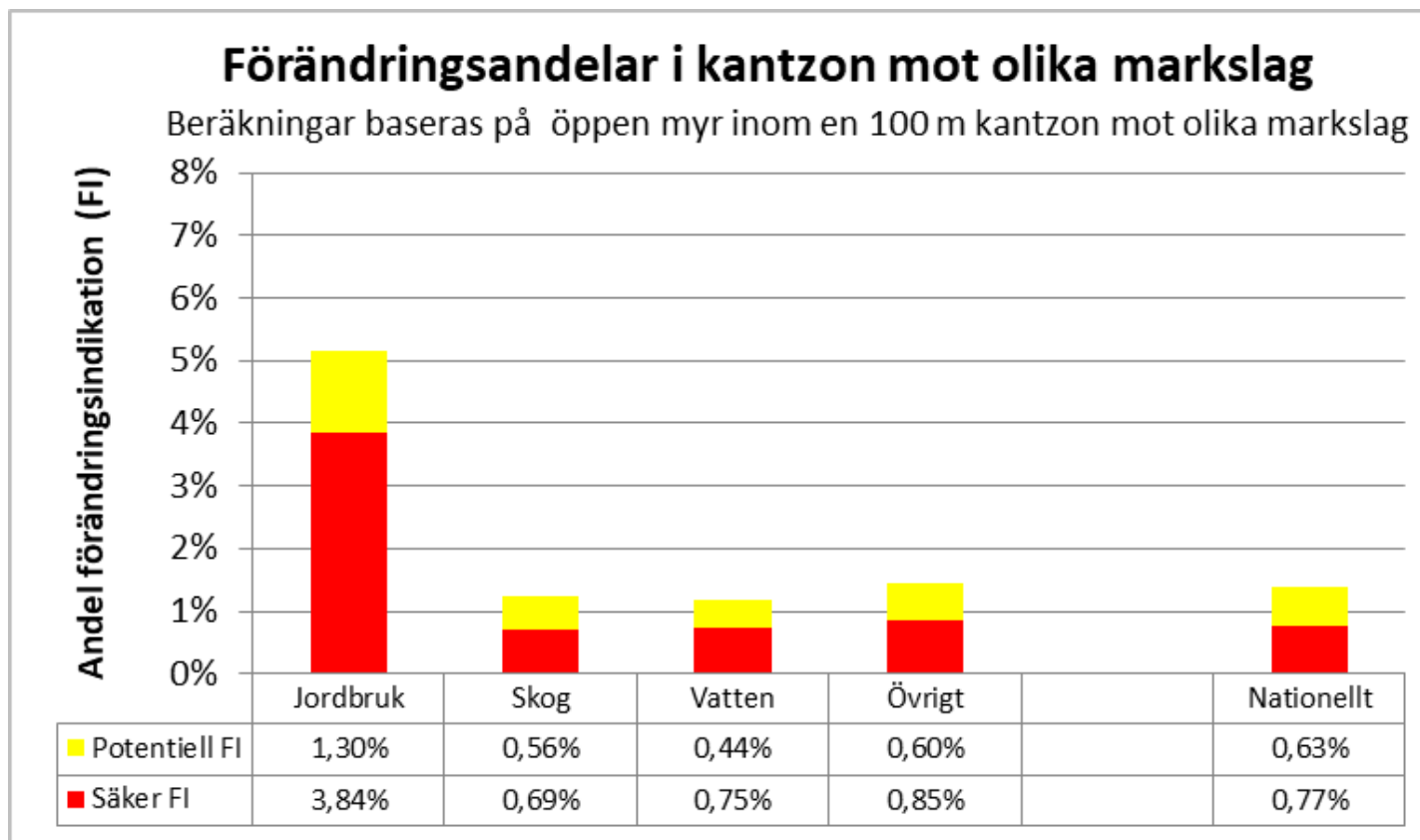
Change in open mires in % of 10x10 km grids

- Strong indication of change 0.77 %
- Potential indication of change 0.63 %



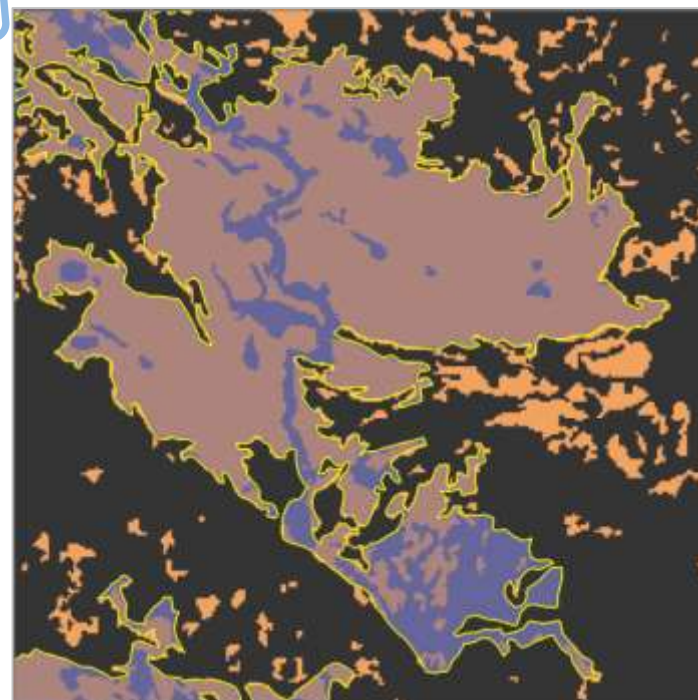
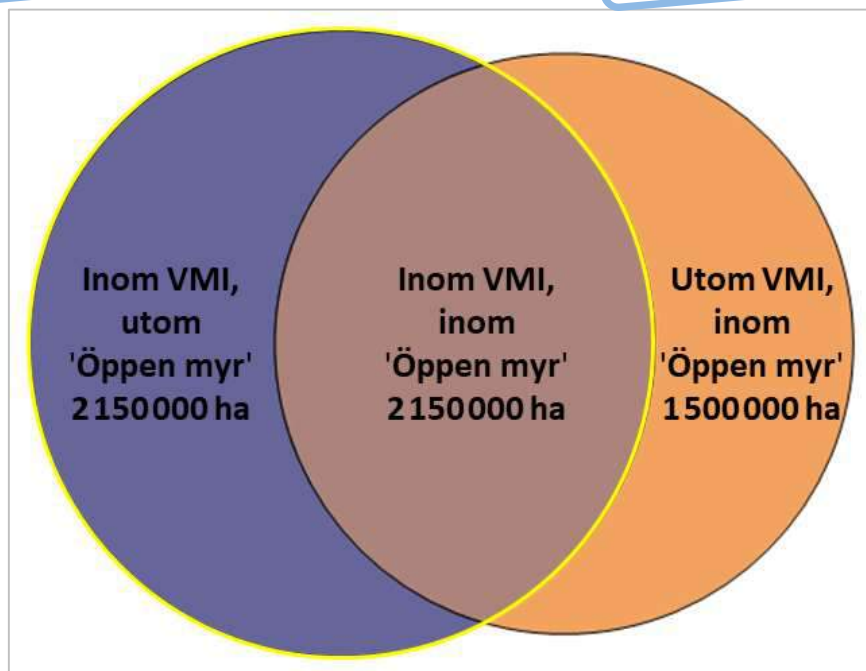


Proportion of change adjacent to different types of land

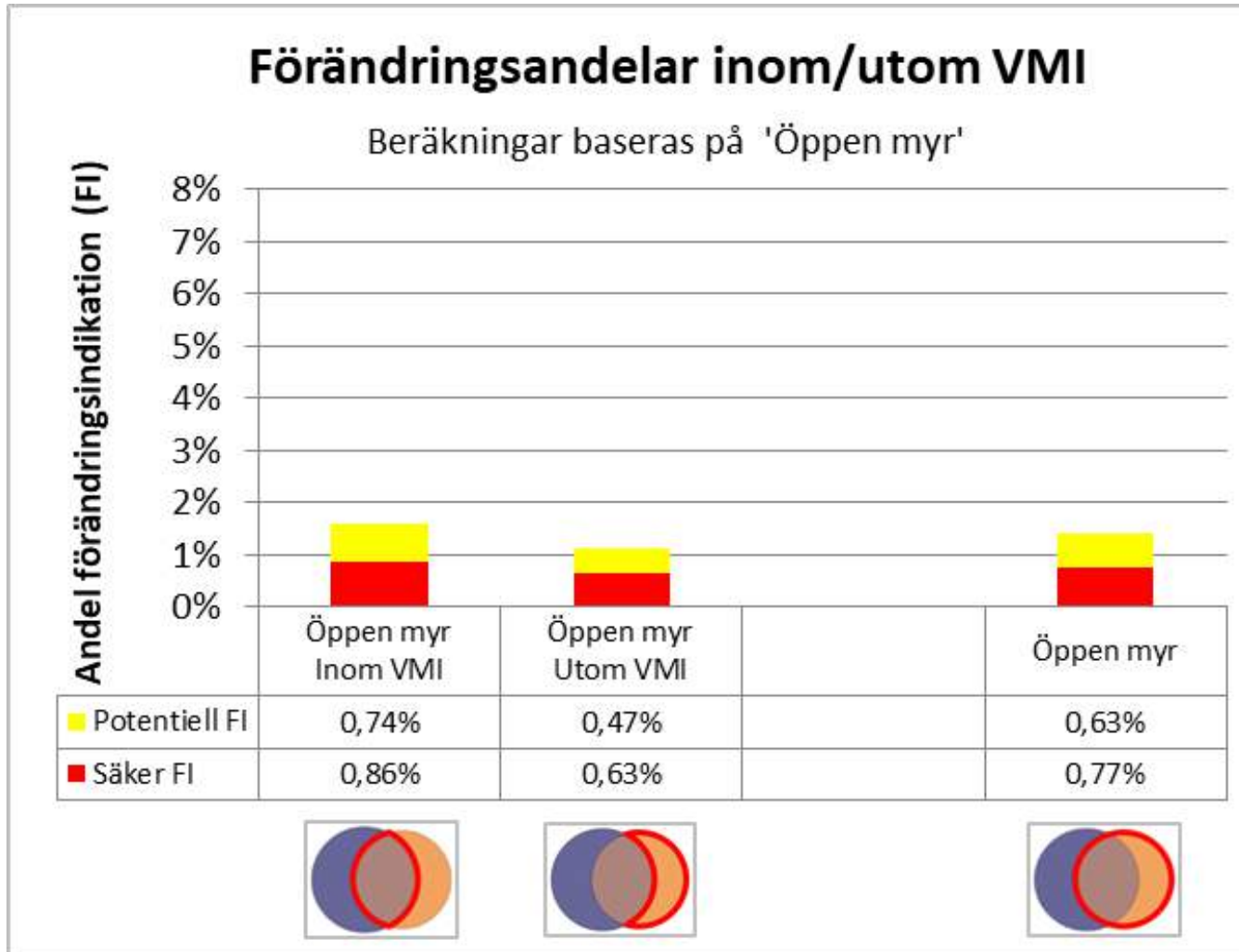


Comparison with VMI

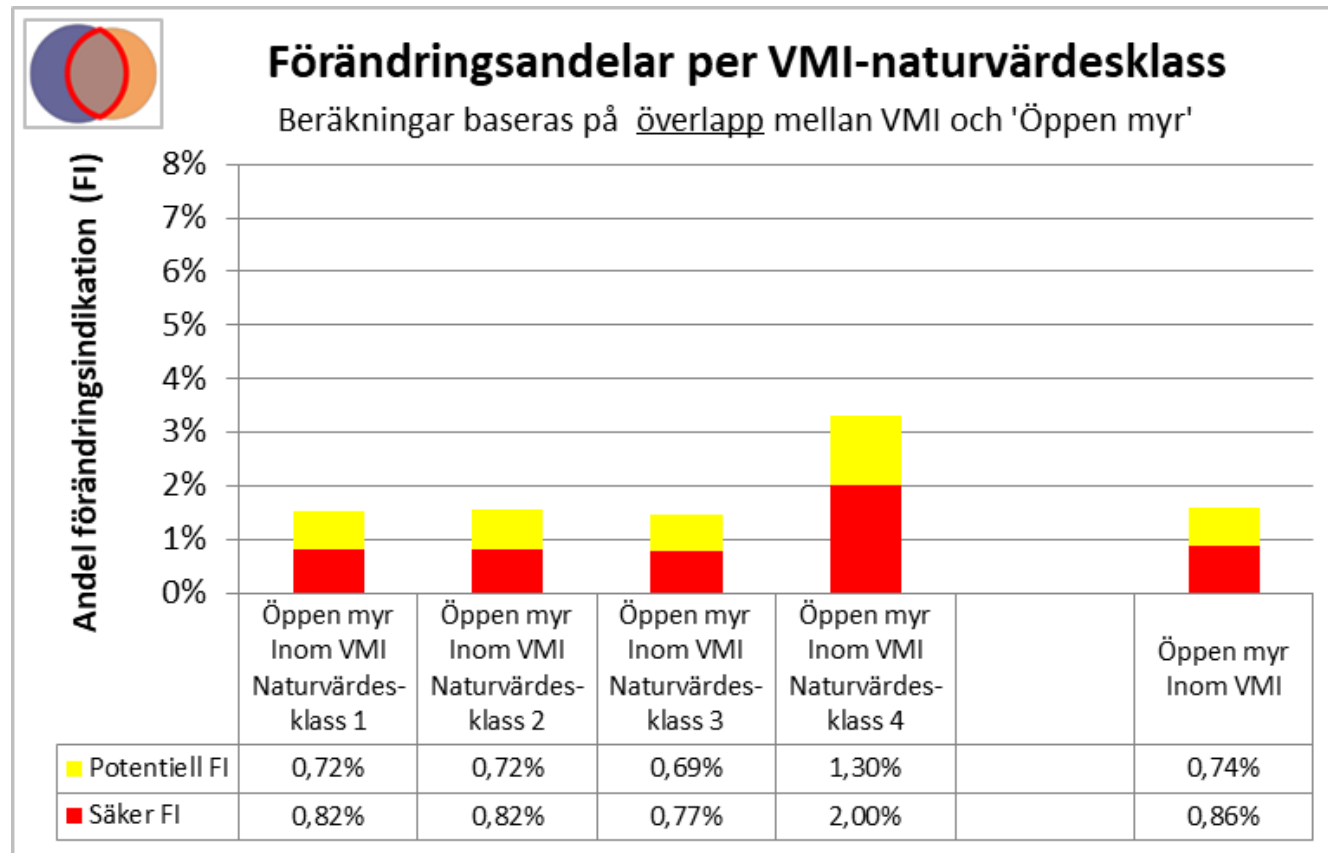
Forests Overlap Small mires



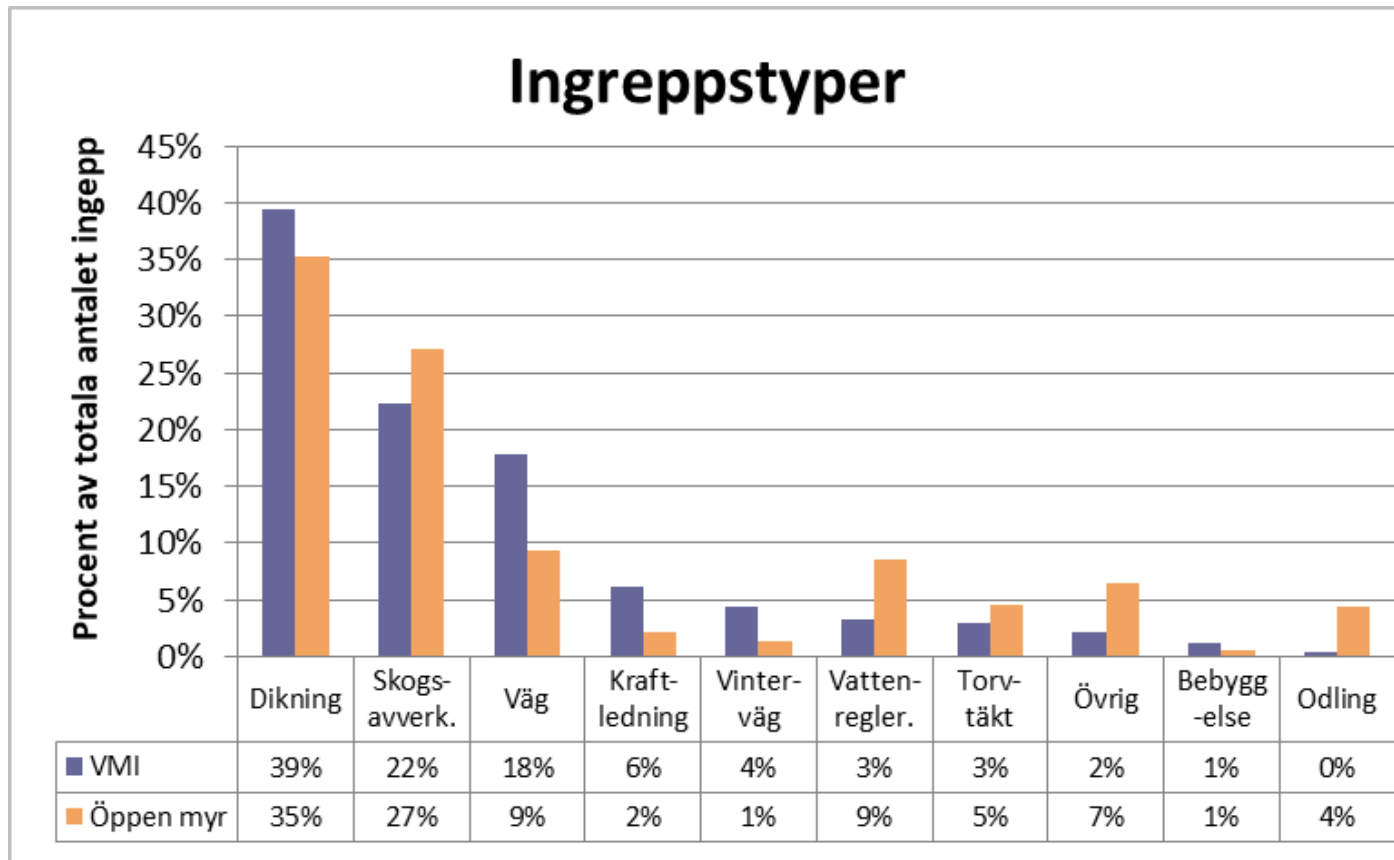
Proportion of change within/outside VMI



Wetlands with low nature conservation value (class 4) has the highest change indicator.



Type of human impact registered in VMI and the Satellite based monitoring show strong similarities.



NILS (National Inventory of the Landscape)

- NILS is a nation-wide programme that monitors the conditions and changes in the Swedish landscape.
- The programme started in 2003 and includes field inventory and aerial photo interpretation.
- Permanent sample plots in all types of terrestrial habitats.
- There are 631 sample plots of 5x5 km, and they are surveyed every 5th year.
- The data is used for environmental reporting, applied research & Land-use policy development.

NILS (National Inventory of the Landscape)

Describes: e.g. habitat, land use, management activities, vegetation cover, field layer, soil, specific plants.

Linear transects

- Linear elements
- Transport routes
- Vegetation strips
- Forest edges
- Fences
- Ditches & water courses
- Shores

Further information:

<http://www.swedishepa.se/>

The screenshot shows the website of the Swedish Environmental Protection Agency (Naturvårdsverket). The header includes the agency's logo, navigation links (About us, Contact, News and press, Svenska), a search bar, and four main menu categories: ENJOYING NATURE, STATE OF THE ENVIRONMENT, COOPERATION, and GUIDANCE. The COOPERATION menu is highlighted in dark blue. Below the navigation, there are three columns of content. The left column lists 'The national environmental quality objectives' with 14 items. The middle column lists 'Environmental work in Sweden' with four items, where 'Environmental monitoring' is highlighted with a red box. The right column features an illustration of a city and the text 'Watch a film about the environmental objectives'.

NATUR VÅRDS VERKET SWEDISH ENVIRONMENTAL PROTECTION AGENCY

About us Contact News and press Svenska Search

ENJOYING NATURE
Protected areas & Hunting

STATE OF THE ENVIRONMENT
Statistics & Facts

COOPERATION
Objectives & Responsibilities

GUIDANCE
Laws & Regulations

- > Agenda 2030 and The Global Goals
- > Environmental objectives
- > The national environmental quality objectives
 - > Reduced Climate Impact
 - > Clean Air
 - > A Non-Toxic Environment
 - > A Protective Ozone Layer
 - > A Safe Radiation Environment
 - > Zero Eutrophication
 - > Flourishing Lakes and Streams
 - > Good-Quality Groundwater
 - > A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos
 - > Thriving Wetlands
 - > Sustainable Forests
 - > A Varied Agricultural Landscape
 - > A Magnificent Mountain Landscape
 - > A Good Built Environment
 - > A Rich Diversity of Plant and Animal Life

- > Environmental work in Sweden
 - > Work areas
 - > Government commissions
 - > Environmental monitoring
 - > Research
- > International cooperation
 - > Bilateral cooperation
 - > Multilateral cooperation
 - > International environmental conventions
- > The Swedish EPA in the EU

> Watch a film about the environmental objectives

Environmental quality objectives



**“The overall goal of environmental policy
is to hand over to the next generation a society in
which the major environmental problems have been solved,
without increasing environmental and health problems
outside Sweden’s borders.”**

THE GENERATIONAL GOAL

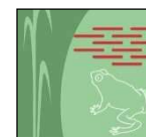
ENVIRONMENTAL QUALITY OBJECTIVES



Reduced Climate Impact



A Safe Radiation Environment



Thriving Wetlands



Clean Air



Zero Euthropication



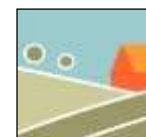
Sustainable Forests



Natural Acidification Only



Flourishing Lakes & Streams



A Varied Agricultural Landscape



A Non-Toxic Environment



Good-Quality Groundwater



A Magnificent Mountain Landscape



A Protective Ozone Layer



A Balanced Marine Environment...



A Good Built Environment

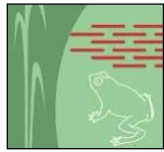


A Rich Diversity of Plant and Animal Life





”The ecological and water-conserving function of wetlands in the landscape must be maintained and valuable wetlands preserved for the future.”



The environmental quality objective

Thriving Wetlands aims to ensure that:

- wetlands of all types are represented throughout the country within their natural range,
- important ecosystem services of wetlands, such as biological production, carbon storage, water conservation, water purification, and buffering of water flows, are preserved,
- wetlands are re-established, particularly where activities such as drainage and peat production have resulted in losses and fragmentation of wetlands, and species associated with wetlands have the opportunity to spread to new sites within their natural range,
- habitats and naturally occurring species associated with wetlands have a favourable conservation status and sufficient genetic variation within and between populations,
- threatened wetland species have recovered and habitats have been restored,
- alien species and genotypes do not threaten biodiversity,
- genetically modified organisms that can threaten biodiversity are not introduced,
- the natural and cultural heritage values of wetlands in a landscape perspective are preserved and the conditions for continued preservation and development of these values are in place, and
- the value of wetlands for outdoor recreation is safeguarded and maintained, and the impact of noise is minimized.



WETLAND RESTORATION



Some facts....

- Sweden has lost about 25 % of its wetlands since early 1800s
- Since early 1800s agriculture land has increased with 2,3 millions hectare through drainage
- 2500 lakes has been lowered or completely drained



The Environmental Code



Land – and the water on, and under it – is mostly privately owned.

Regulation of water activities:

- Wetlands bigger than 5 hectares need a judicial decision.
- Wetlands smaller than 5 hectares need ok from the inspection agency.

Special regulation for ditches



- All new/altered/removed ditches need a judicial decision.
- Wetlands impacting drainage system and ditches need a judicial decision.

Wetland restoration project 2018



Two-step ditch

Aim of the project :

Promoting construction of new and restored wetlands all over Sweden in order to strengthen the landscape's own ability to maintain and balance water flows, and to contribute to ground water formation.

Ecosystem services

Nature based solutions



Northern lapwing (*Vanellus vanellus*)

- Reduce consequences of floods
- Reduce consequences of drought
- Enhance groundwater formation
- Reduce use of groundwater for watering crops
- Reduce eutrophication
- Enhance biodiversity
- Climate adaptation
- Reduce climate impact
- Reduce toxins in water
- Refuge for animals in case of forest fire
- Reduce the spread of forest fires
- Stormwater management
- Attractive areas for recreation
- Areas for nature schooling
- ...

Wetland restoration project 2018



Filling of a ditch in a moor
Photo: Länsstyrelsen Västerbotten

Budget 200 million SEK

- Grants to local projects (LONA).
- Grants to restoration activities in protected areas.

Results:

- 160 local projects.
- 281 restoration measures in protected areas.



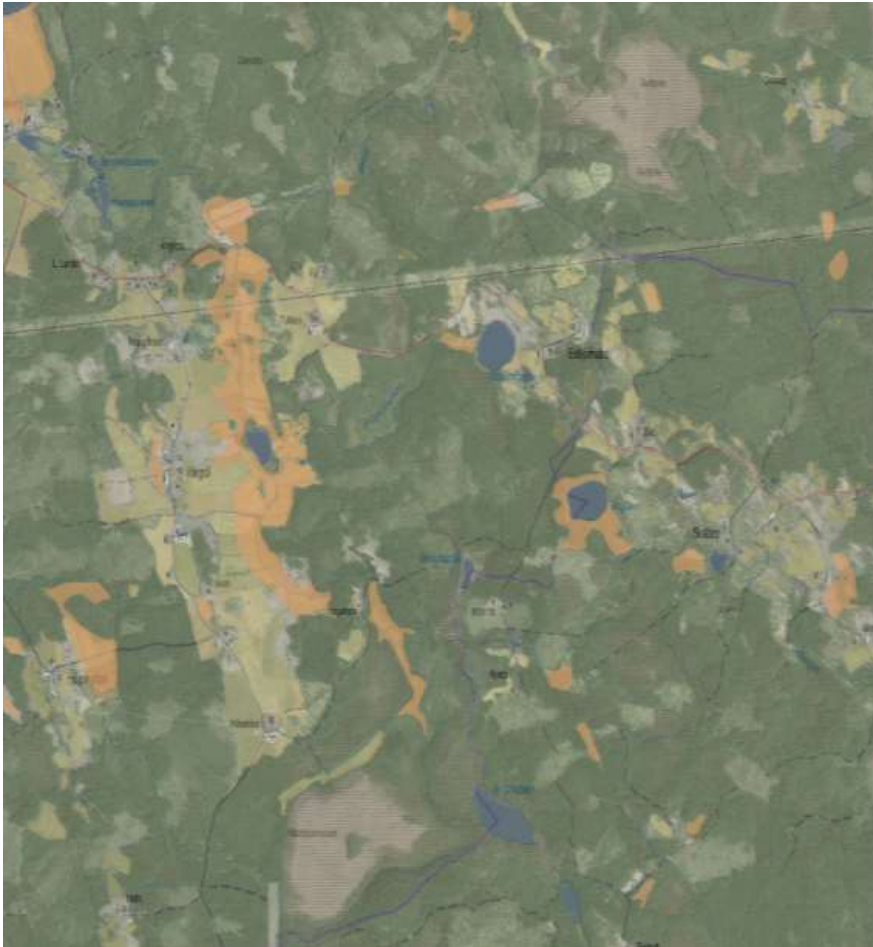
SWEDISH ENVIRONMENTAL
PROTECTION AGENCY

Wetlands restoration project 2018



- Cooperation with the Geological Survey of Sweden, and other agencies.
- Capacity building: fact sheets, webinars, excursion.
- Call for research projects

Potential sites for wetlands



A geospatial analysis comparing

- Soil map (peat)
- Topographic Wetness Index (TWI)
- ***Topographic low points***



Källa: *Potentiella våtmarkslägen. GRIP on LIFE (2019)*



The need for wetlands



A compilation and analysis of geographical data from different authorities, showing

- High eutrophication levels
- Flood prone areas
- Drought prone areas
- Climate gas contributing areas (i.e. ditched peat)
- Biodiversity loss
- Groundwater shortage risk assessment

Källa: Återrapportering av Våtmarkssatsningen.

Länsstyrelsen Gotland (2018)

Other restoration projects:

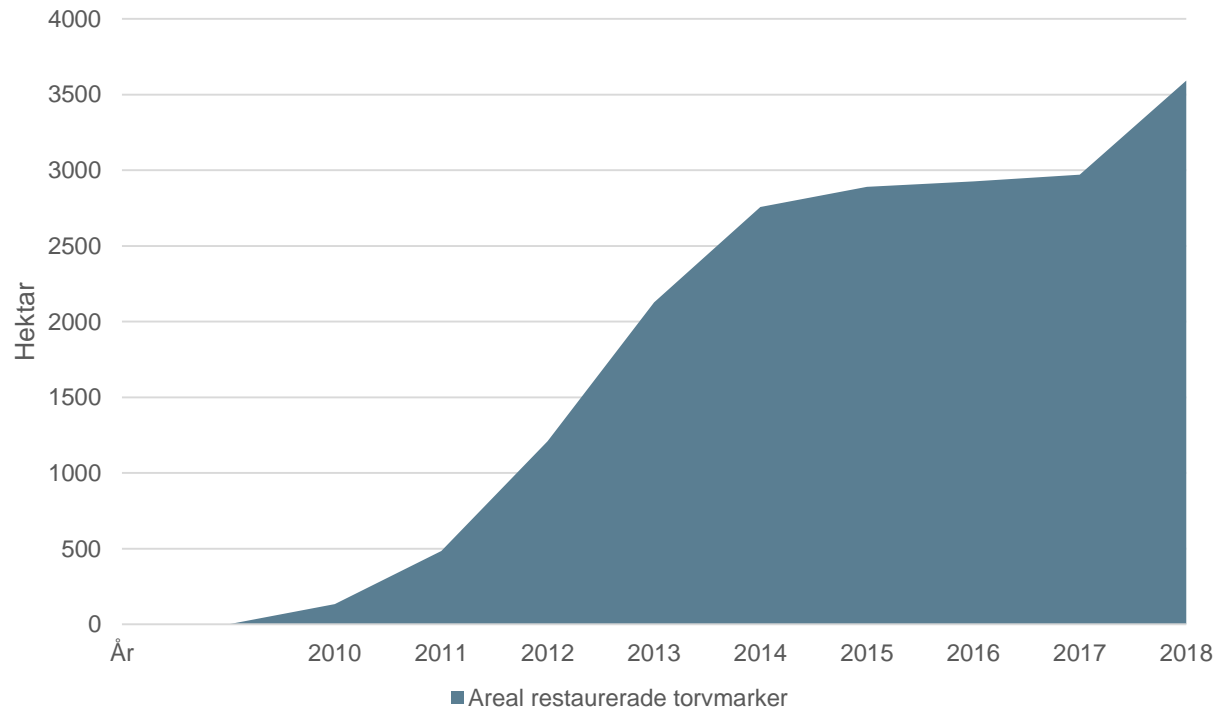
- Grants from the Swedish board of Agriculture (CAP)
- Life-projects (Life to (ad)mire)



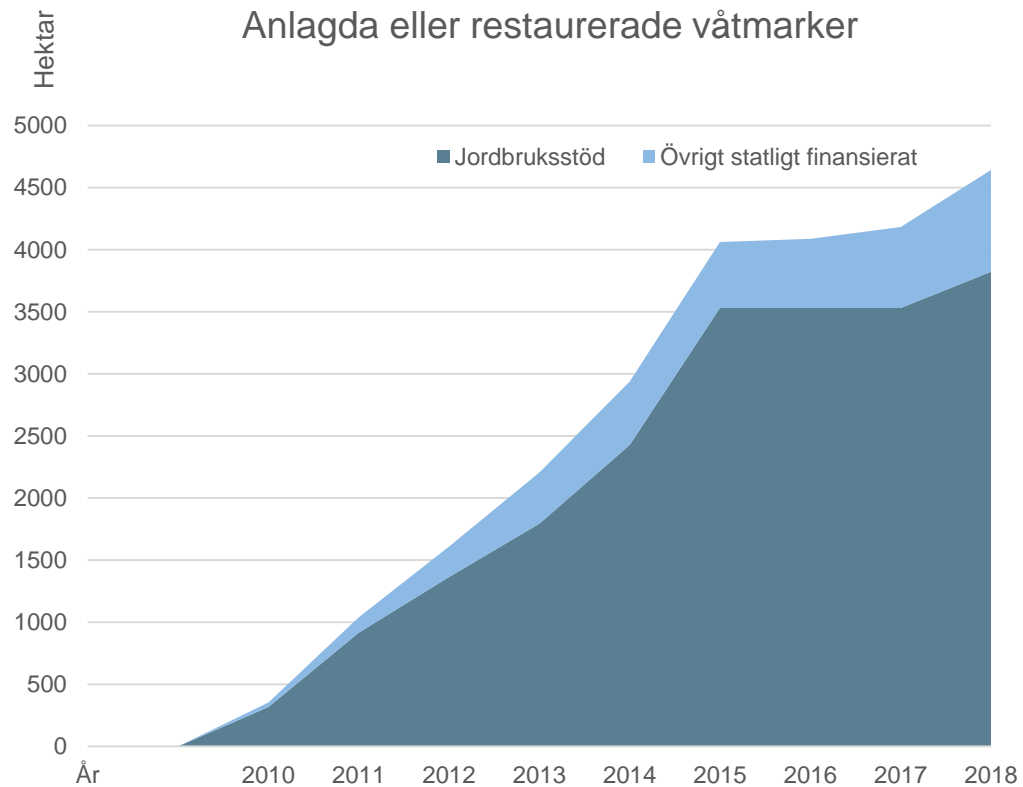
Filling of a ditch on a Northern pasture

Photo: Länsstyrelsen Västerbotten

Restored peatland



Constructed or restored wetlands (except peatlands)





QUESTIONS?

Thank You!

Contact:

helena.oberg
@naturvardsverket.se

Eurasian curlew (*Numenius arquata*)