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# Prognostic vegetation maps in the evaluation of an impact of hydro engineering ventures in the Vistula River valley

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In the background: Vistula in Wyszogród





Introduction

Study Area

Scenarios of Future Development

Models of Vegetation Changes

The Past versus The Future

Consequences for Natura2000 Habitats

Conclusions



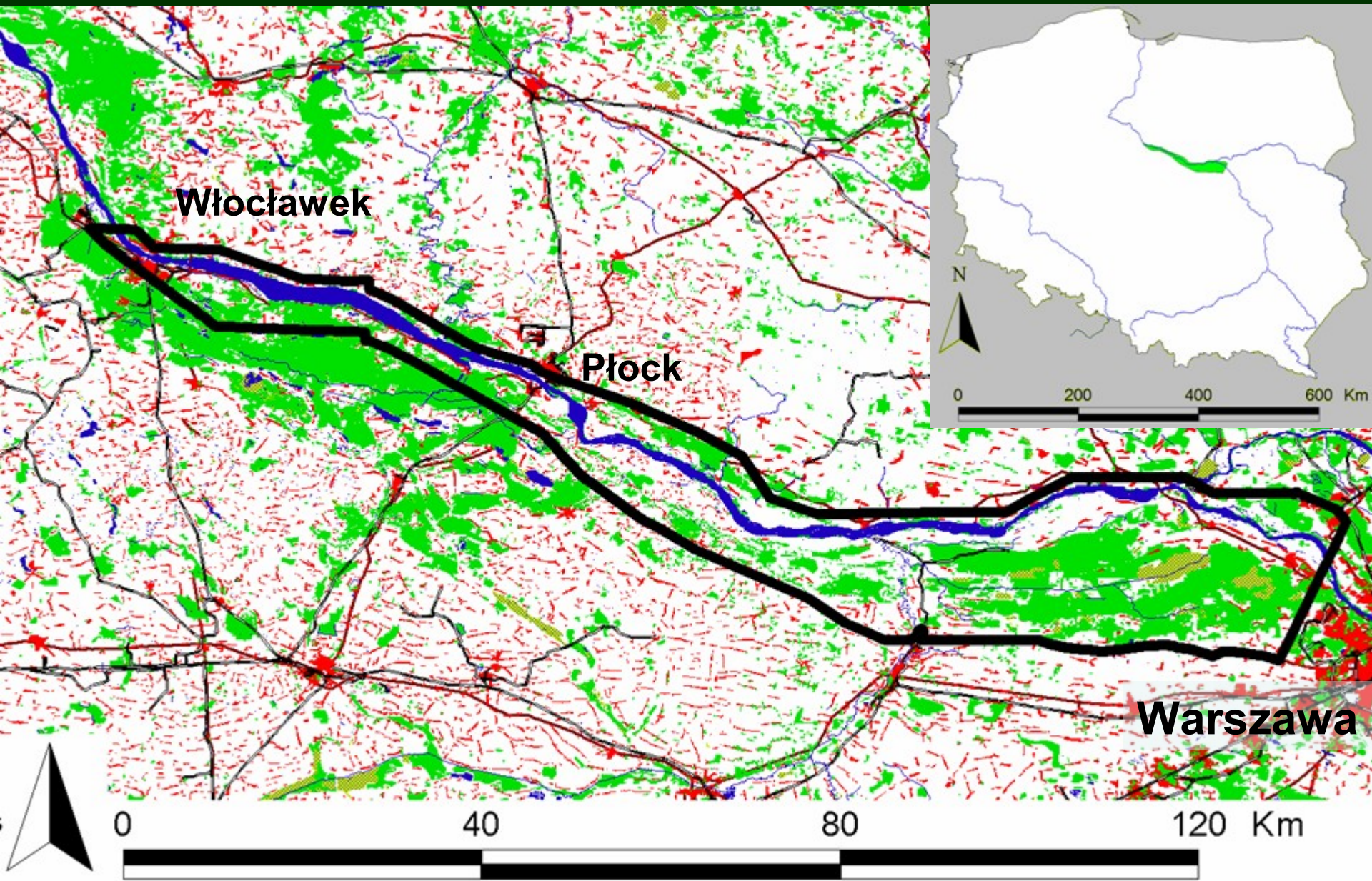
## Introduction - Aim and Scope

- How can we use maps of vegetation to evaluate an impact of hydro-engineering ventures in the river valley and to protect valuable areas (especially habitats listed in Natura2000 directive)?

- How will proposed changes of 2 entirely different scenarios influence the environment in the Vistula valley between Warsaw and Włocławek?

- How will they influence habitats of Natura2000 list - present in the study area?





**Włocławek**

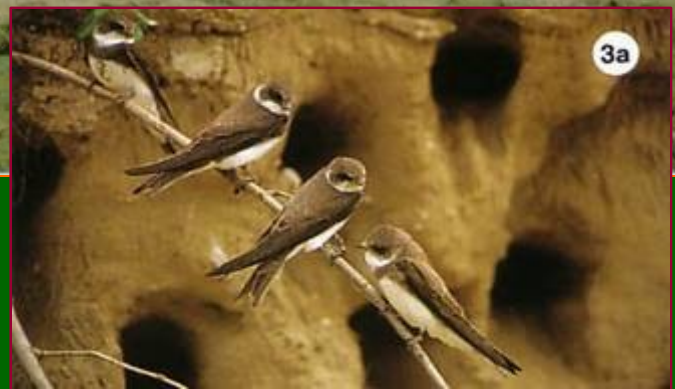
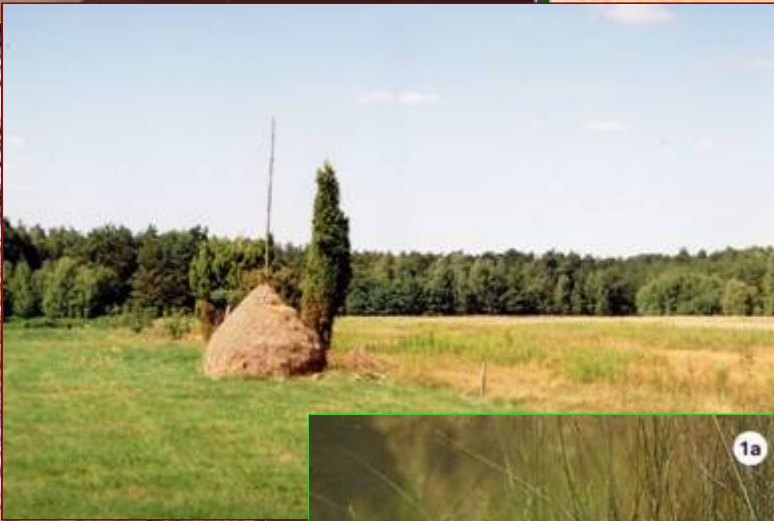
**Płock**

**Warszawa**

Study Area





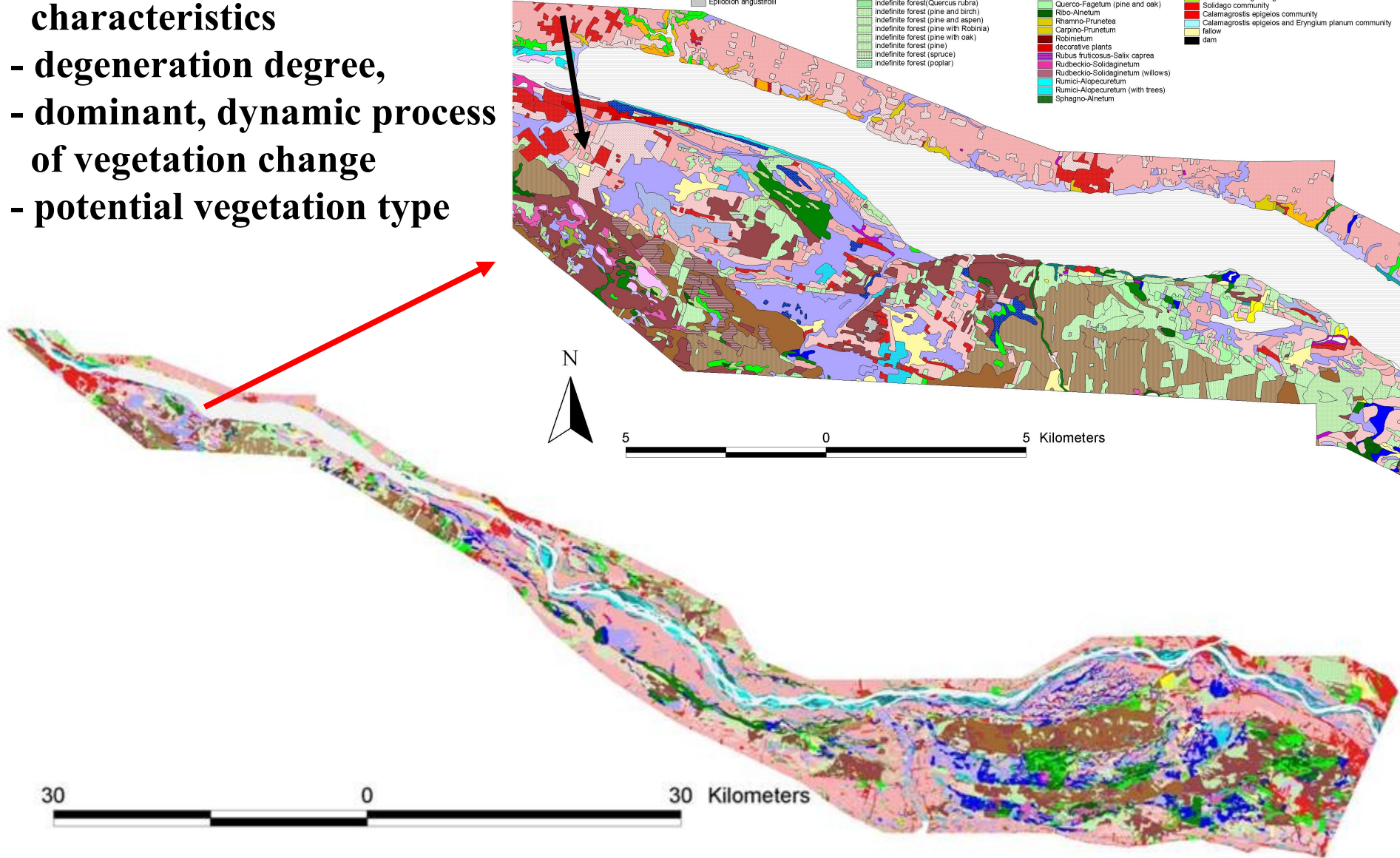




# Data collected with the map:

- syntaxonomic type of actual vegetation or complex characteristics
- degeneration degree,
- dominant, dynamic process of vegetation change
- potential vegetation type

Włocławek



# Models of future state of vegetation according to chosen scenarios (Scenarios elaborated as a part of VEDI Project)

[www.vediproject.org](http://www.vediproject.org)

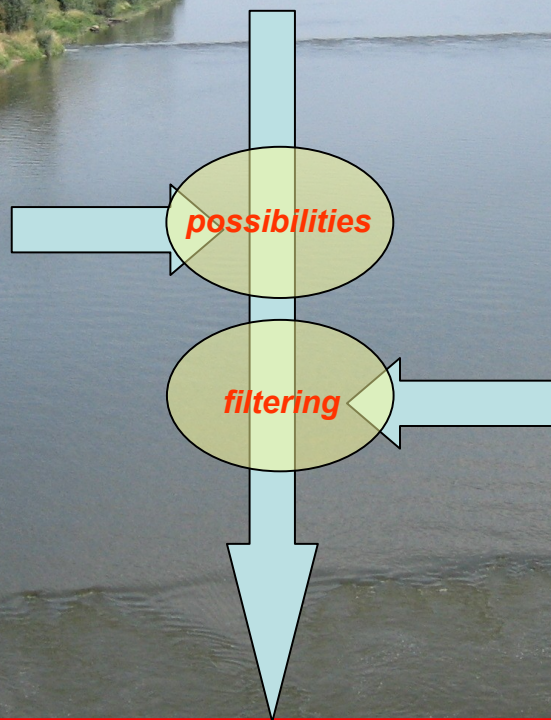




# From the present state to the prognostic model

Documentation of present conditions at the local scale - The map of actual vegetation

Transition possibilities between vegetation types – Dynamic circles of substitute communities



Assumptions on future changes of (natural and anthropogenic) driving forces – Setting scenarios

Elaboration of the most probable future state of environment – Prognostic vegetation maps



# Future state of vegetation according to different scenarios

- Scenario 1. Maximum river regulation and infrastructure development
- Scenario 2. „Brave“ vision of nature protection



# Scenario 1

## Maximum river regulation and infrastructure development

Objective: Greater economic efficiency in transport and energy production

### Elements

- Element 1. Construction of a dam in Wyszogród (584,0 km), at 63m a.s.l., water damming at a maximum height of 70m a.s.l. and a dam reservoir Zakroczym - Wyszogród
- Element 2. Construction of a dam in Płock (618,8 km) at 55m a.s.l., water damming at a maximum height of 63m a.s.l. and a dam reservoir Wyszogród - Płock
- Element 3. Removal of all trees within dikes
- Element 4. Enlargement of built-up areas along main roads

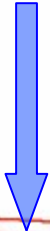


# Scenario 1

## Maximum river regulation and infrastructure development

*according to W3a project of Hydroprojekt Warszawa 1998*

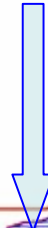
**Włocławek dam (active)**



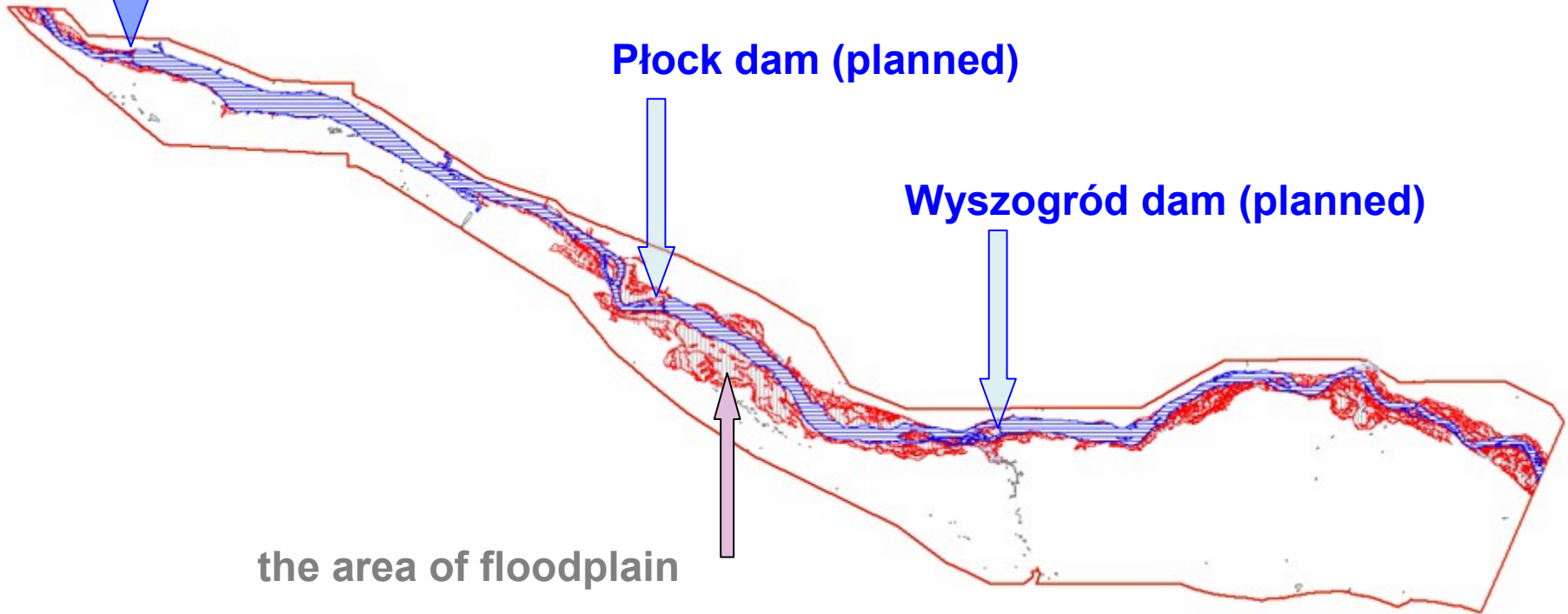
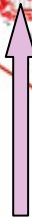
**Płock dam (planned)**



**Wyszogród dam (planned)**



the area of floodplain





# Scenario 2

## „Brave” vision of nature protection

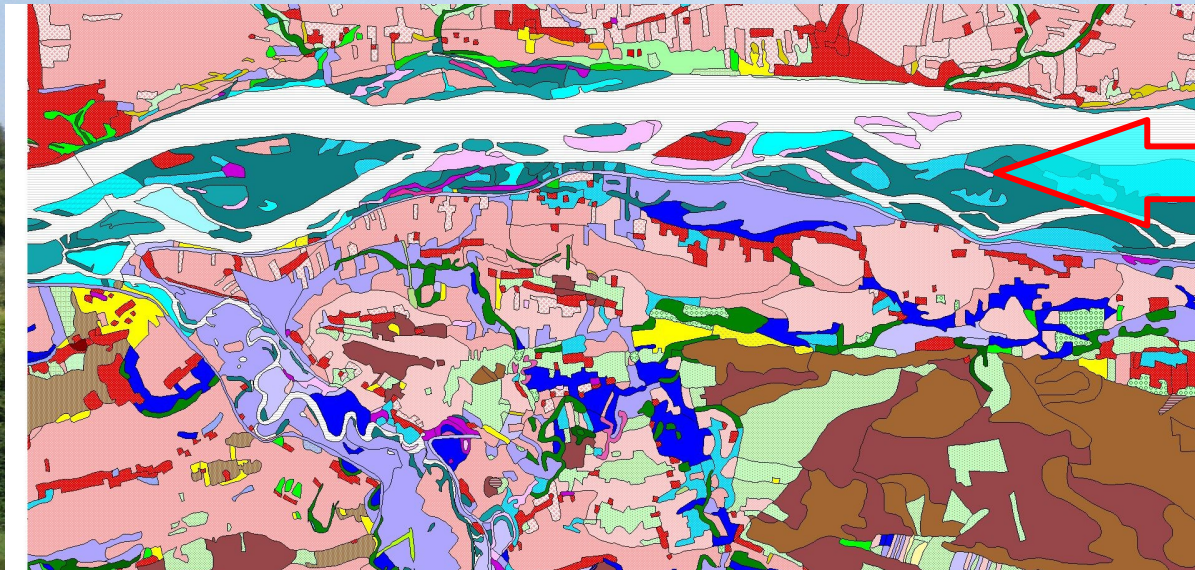
**Objective: Restoration of natural river with minimal anthropogenic impact and regaining water retention in the valley**

### Elements

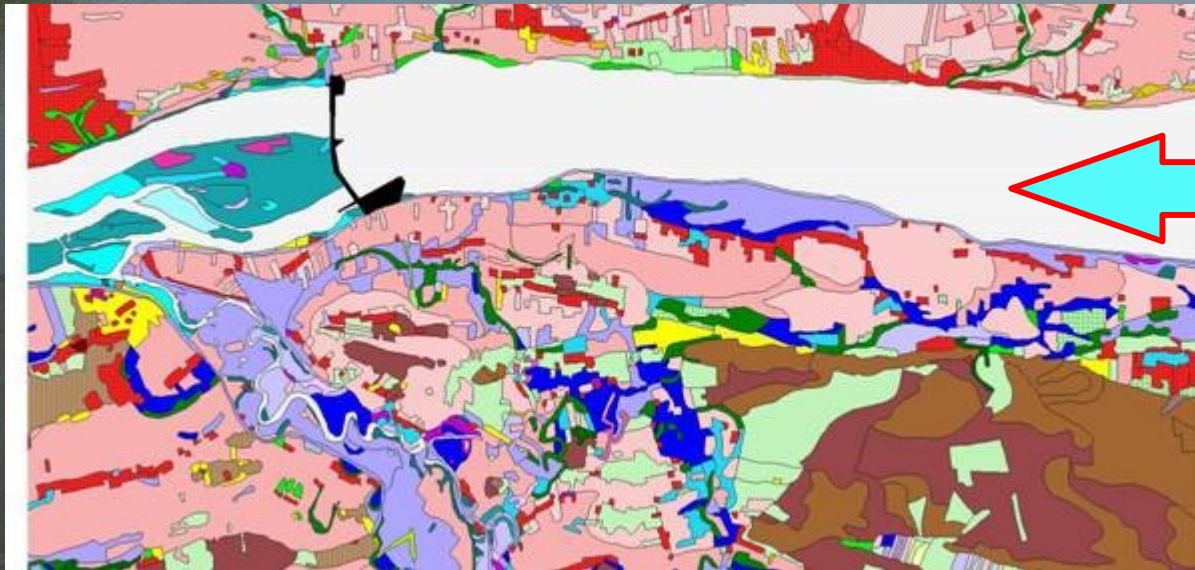
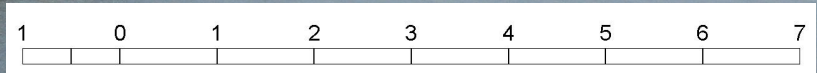
- Element 1. Removal of dikes along the river except some parts
- Element 2. Removal of Włocławek dam till 47.5 m height
- Element 3. Removal of settlements in the flood valley except of Warsaw, Łomianki (partly), Kazuń (partly) and Radziwie
- Element 4. Restoration of water courses in Kampinos National Park
- Element 5. Regeneration of forest communities to the most possible level according to the potential vegetation



# Proposed location of the „Wyszogród” dam



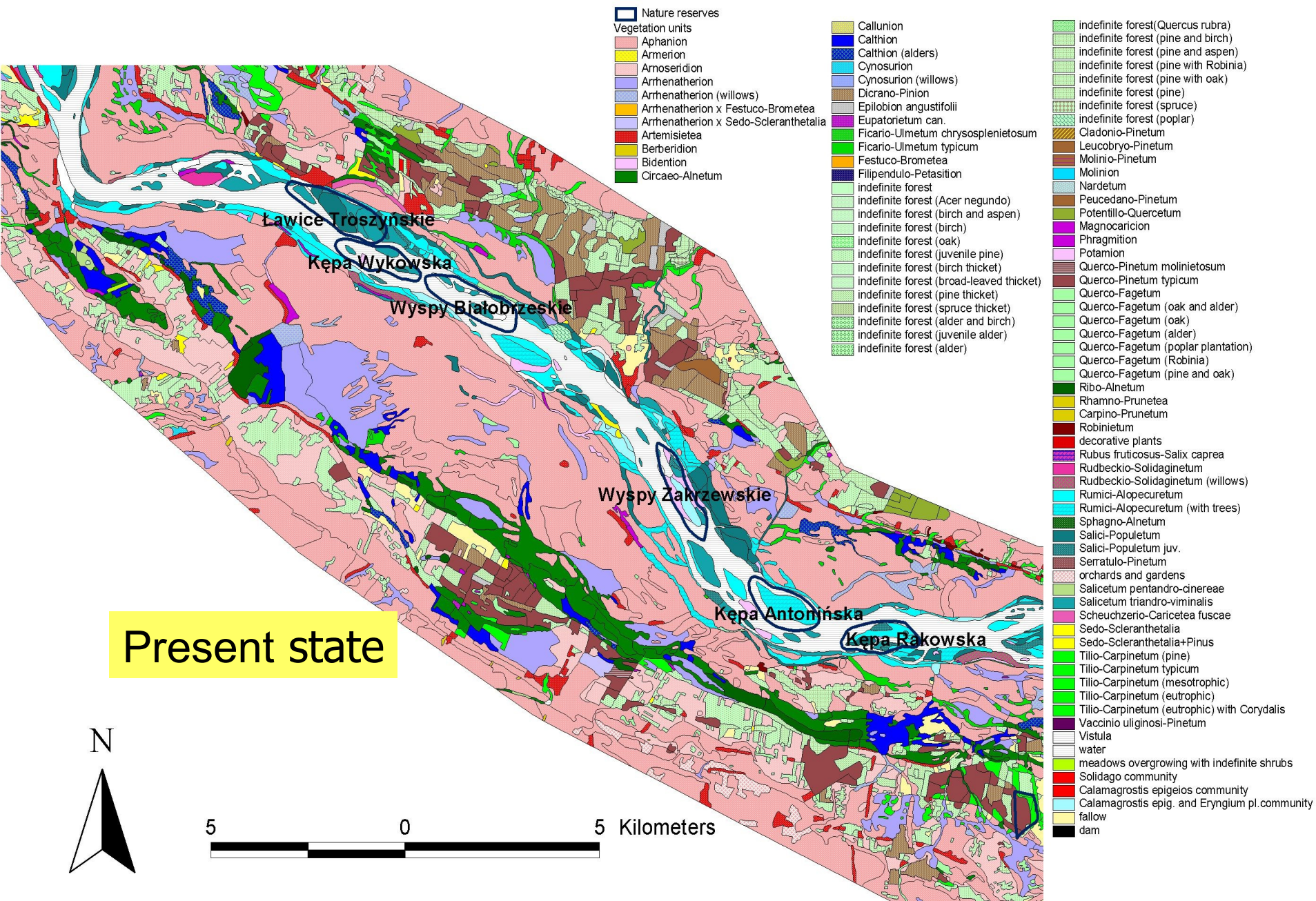
Present state



Disappearance of islands !

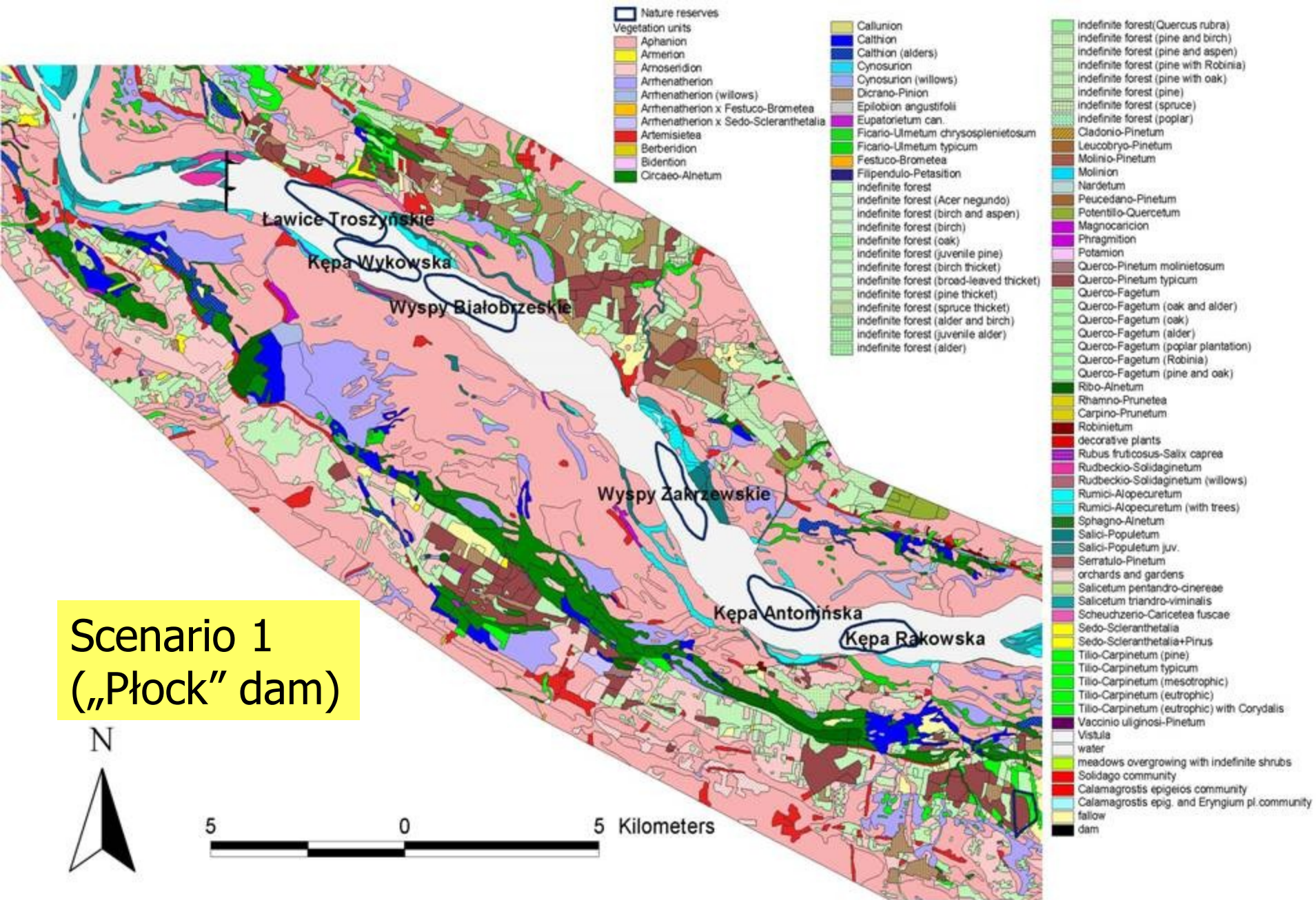
Scenario 1





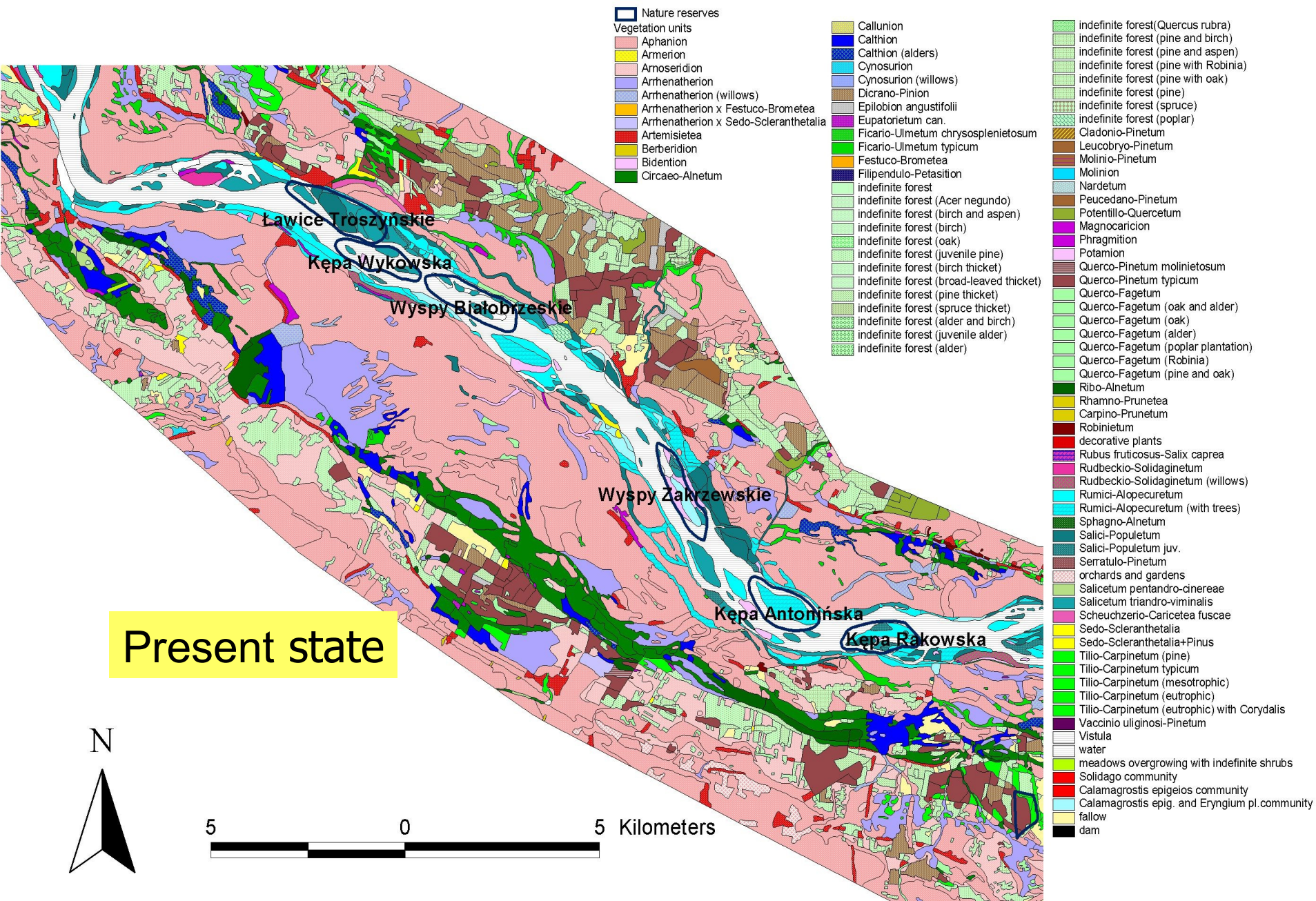
There are 6 nature reserves in the river-bed between Wyszogród and Płock  
 Models of Vegetation Changes





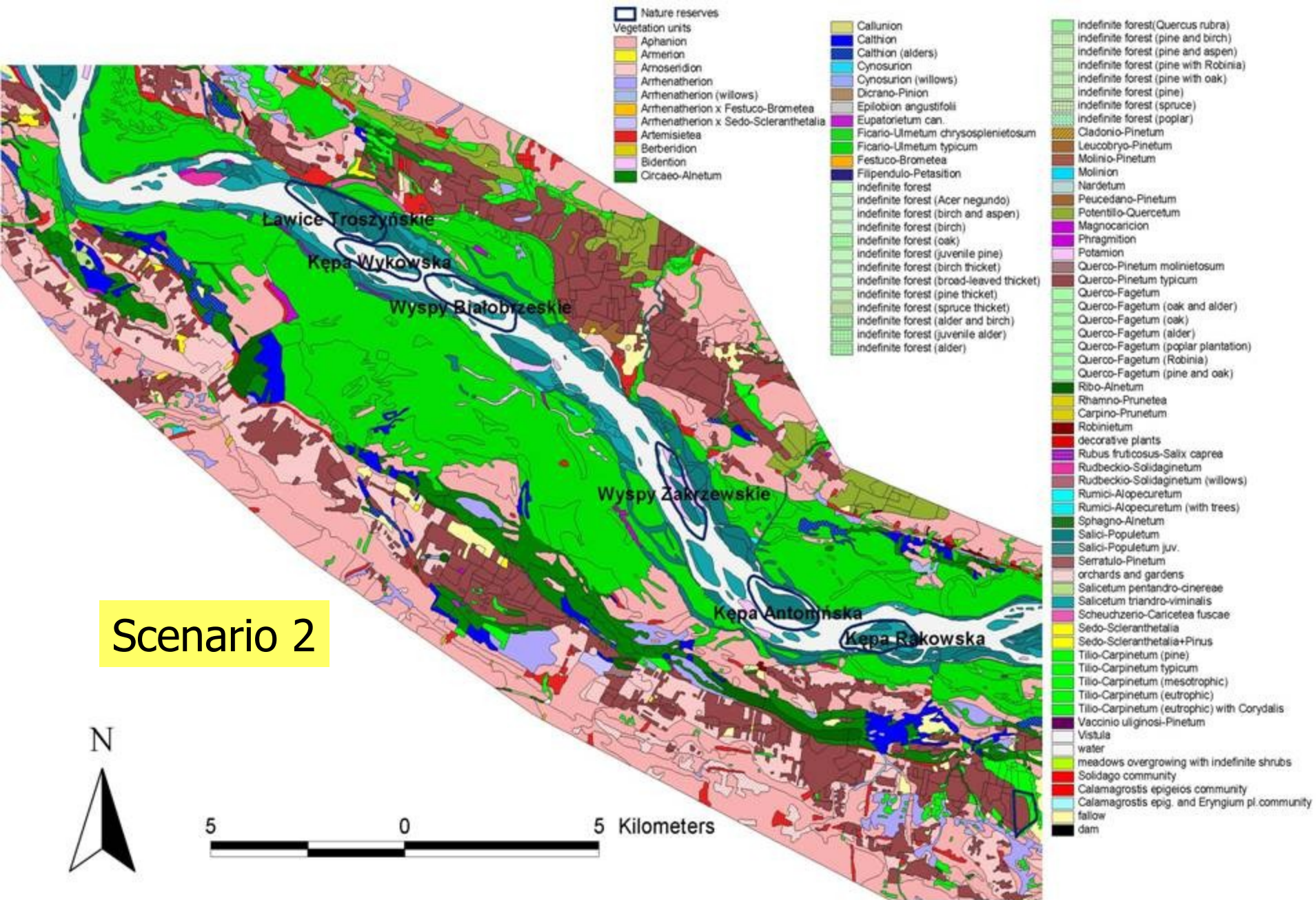
Models of Vegetation Changes





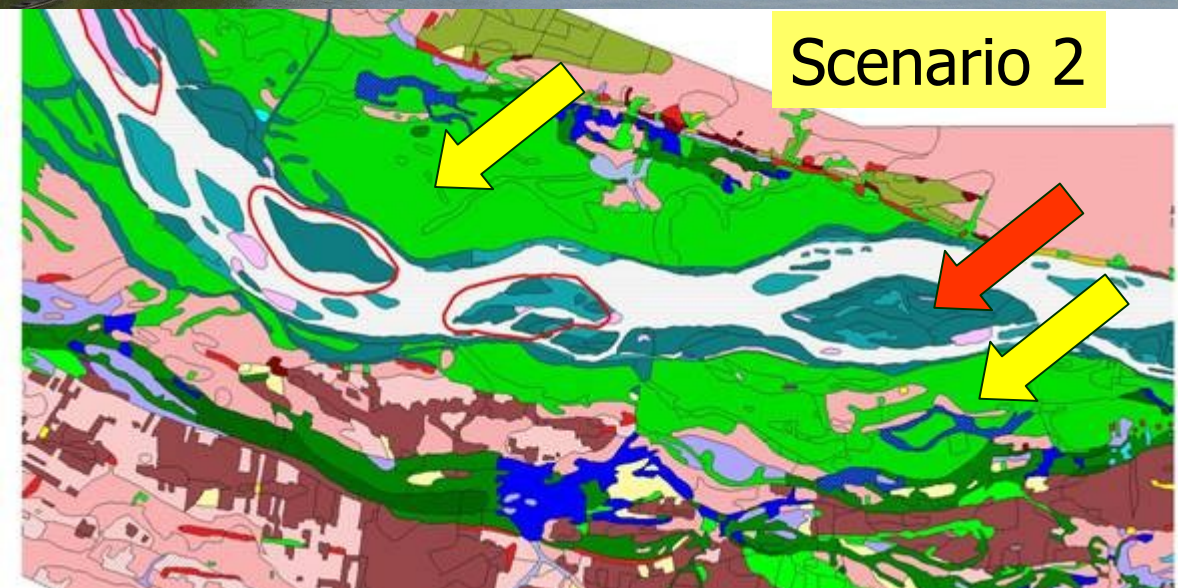
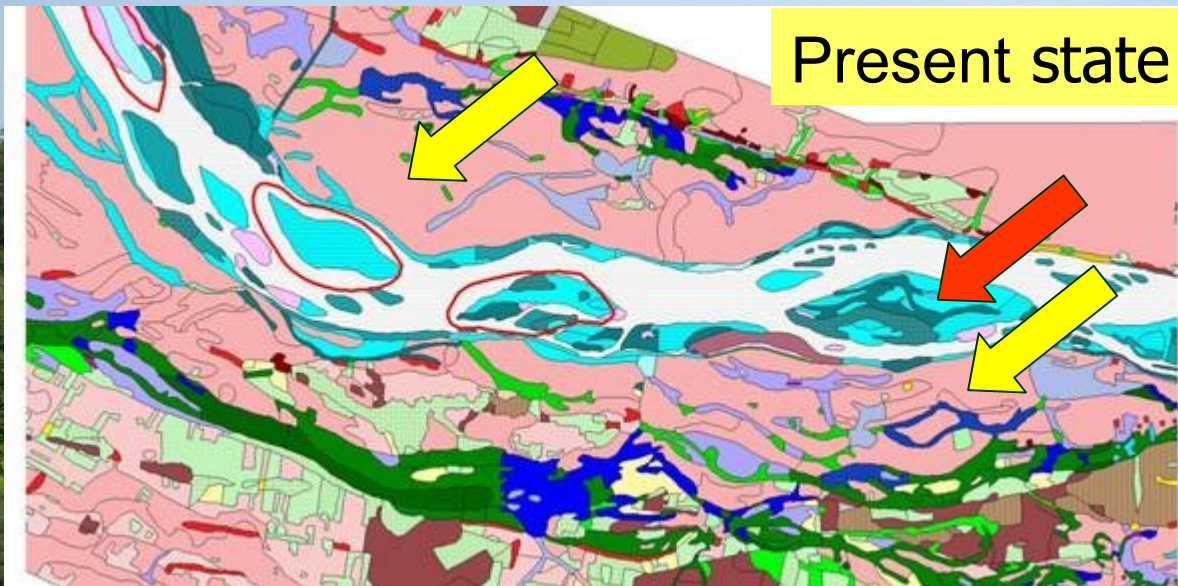
There are 6 nature reserves in the river-bed between Wyszogród and Płock  
 Models of Vegetation Changes





Models of Vegetation Changes





**Extensive areas of riparian forests on the former arable lands on low terraces**

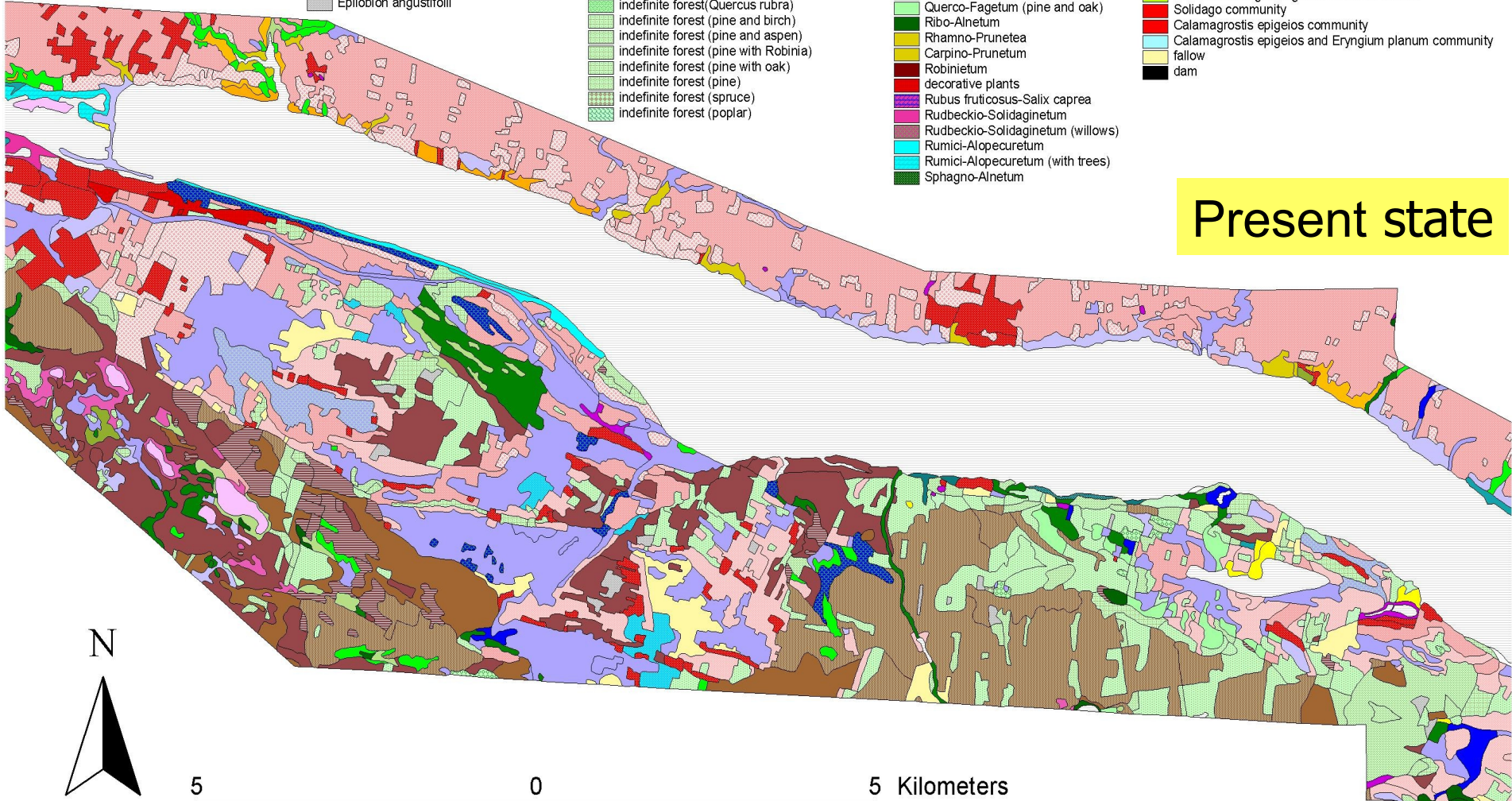
Predominance of natural succession





- |                                       |  |                                     |  |
|---------------------------------------|--|-------------------------------------|--|
| <b>Vegetation units</b>               | <b>Eupatorium can.</b>                   | <b>Cladonio-Pinetum</b>             | <b>Salici-Populetum</b>                              |
| Aphanion                              | Ficario-Ulmetum chrysosplenietosum       | Leucobryo-Pinetum                   | Salici-Populetum juv.                                |
| Armerion                              | Ficario-Ulmetum typicum                  | Molinio-Pinetum                     | Serratulo-Pinetum                                    |
| Amoseridion                           | Festuco-Brometea                         | Molinion                            | orchards and gardens                                 |
| Arrhenatherion                        | Filipendulo-Petasition                   | Nardetum                            | Salicetum pentandro-cinereae                         |
| Arrhenatherion (willows)              | indefinite forest                        | Peucedano-Pinetum                   | Salicetum triandro-viminalis                         |
| Arrhenatherion x Festuco-Brometea     | indefinite forest (Acer negundo)         | Potentillo-Quercetum                | Scheuchzerio-Caricetea fuscae                        |
| Arrhenatherion x Sedo-Scleranthetalia | indefinite forest (birch and aspen)      | Magnocaricion                       | Sedo-Scleranthetalia                                 |
| Artemisieta                           | indefinite forest (birch)                | Phragmition                         | Sedo-Scleranthetalia+Pinus                           |
| Berberidion                           | indefinite forest (oak)                  | Potamion                            | Tilio-Carpinetum (pine)                              |
| Bidention                             | indefinite forest (juvenile pine)        | Quercio-Pinetum molinietosum        | Tilio-Carpinetum typicum                             |
| Circaeo-Alnetum                       | indefinite forest (birch thicket)        | Quercio-Pinetum typicum             | Tilio-Carpinetum (mesotrophic)                       |
| Callunion                             | indefinite forest (broad-leaved thicket) | Quercio-Fagetum                     | Tilio-Carpinetum (eutrophic)                         |
| Calthion                              | indefinite forest (pine thicket)         | Quercio-Fagetum (oak and alder)     | Tilio-Carpinetum (eutrophic) with Corydalis          |
| Calthion (alders)                     | indefinite forest (spruce thicket)       | Quercio-Fagetum (oak)               | Vaccinio uliginosi-Pinetum                           |
| Cynosurion                            | indefinite forest (alder and birch)      | Quercio-Fagetum (alder)             | Vistula  |
| Cynosurion (willows)                  | indefinite forest (juvenile alder)       | Quercio-Fagetum (poplar plantation) | water  |
| Dicrano-Pinion                        | indefinite forest (alder)                | Quercio-Fagetum (Robinia)           | meadows overgrowing with indefinite shrubs           |
| Epilobion angustifolii                | indefinite forest (Quercus rubra)        | Quercio-Fagetum (pine and oak)      | Solidago community                                   |
|                                       | indefinite forest (pine and birch)       | Ribo-Alnetum                        | Calamagrostis epigeios community                     |
|                                       | indefinite forest (pine and aspen)       | Rhamno-Prunetea                     | Calamagrostis epigeios and Eryngium planum community |
|                                       | indefinite forest (pine with Robinia)    | Carpino-Prunetum                    | fallow   |
|                                       | indefinite forest (pine with oak)        | Robinietum                          | dam  |
|                                       | indefinite forest (pine)                 | decorative plants                   |  |
|                                       | indefinite forest (spruce)               | Rubus fruticosus-Salix caprea       |  |
|                                       | indefinite forest (poplar)               | Rudbeckio-Solidaginetum             |  |
|                                       |  | Rudbeckio-Solidaginetum (willows)   |  |
|                                       |  | Rumici-Alopecuretum                 |  |
|                                       |  | Rumici-Alopecuretum (with trees)    |  |
|                                       |  | Sphagno-Alnetum                     |  |

Present state



Models of Vegetation Changes



- Vegetation units
- Aphanion
  - Armerion
  - Amoserion
  - Arrhenatherion
  - Arrhenatherion (willows)
  - Arrhenatherion x Festuco-Brometea
  - Arrhenatherion x Sedo-Scleranthetalia
  - Artemisietea
  - Berberidion
  - Bidention
  - Circaeo-Alnetum
  - Callunion
  - Calthion
  - Calthion (alders)
  - Cynosurion
  - Cynosurion (willows)
  - Dicrano-Pinion
  - Epilobion angustifolii
  - Eupatorium can.
  - Ficario-Ulmetum chrysosplenietosum
  - Ficario-Ulmetum typicum
  - Festuco-Brometea
  - Filipendulo-Petasition
  - indefinite forest
  - indefinite forest (Acer negundo)
  - indefinite forest (birch)
  - indefinite forest (oak)
  - indefinite forest (juvenile pine)
  - indefinite forest (birch thicket)
  - indefinite forest (broad-leaved thicket)
  - indefinite forest (pine thicket)
  - indefinite forest (spruce thicket)
  - indefinite forest (alder and birch)
  - indefinite forest (juvenile alder)
  - indefinite forest (alder)
  - indefinite forest (Quercus rubra)
  - indefinite forest (pine and birch)
  - indefinite forest (pine and aspen)
  - indefinite forest (pine with Robinia)
  - indefinite forest (pine with oak)
  - indefinite forest (pine)
  - indefinite forest (spruce)
  - indefinite forest (poplar)
  - Cladonio-Pinetum
  - Leucobryo-Pinetum
  - Molinio-Pinetum
  - Molinion
  - Nardetum
  - Peucedano-Pinetum
  - Potentillo-Quercetum
  - Magnocaricion
  - Phragmition
  - Potamion
  - Quercio-Pinetum molinietosum
  - Quercio-Pinetum typicum
  - Quercio-Fagetum
  - Quercio-Fagetum (oak and alder)
  - Quercio-Fagetum (oak)
  - Quercio-Fagetum (alder)
  - Quercio-Fagetum (poplar plantation)
  - Quercio-Fagetum (Robinia)
  - Quercio-Fagetum (pine and oak)
  - Ribo-Alnetum
  - Rhamno-Prunetea
  - Carpino-Prunetum
  - Robinietum
  - decorative plants
  - Rubus fruticosus-Salix caprea
  - Rudbeckio-Solidaginetum
  - Rudbeckio-Solidaginetum (willows)
  - Rumici-Alopecuretum
  - Rumici-Alopecuretum (with trees)
  - Sphagno-Alnetum
  - Salici-Populetum
  - Salici-Populetum juv.
  - Serratulo-Pinetum
  - orchards and gardens
  - Salicetum pentandro-cinereae
  - Salicetum triandro-viminalis
  - Scheuchzerio-Caricetea fuscae
  - Sedo-Scleranthetalia
  - Sedo-Scleranthetalia+Pinus
  - Tilio-Carpinetum (pine)
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  - Tilio-Carpinetum (mesotrophic)
  - Tilio-Carpinetum (eutrophic)
  - Tilio-Carpinetum (eutrophic) with Corydalis
  - Vaccinio uliginosi-Pinetum
  - Vistula
  - water
  - meadows overgrowing with indefinite shrubs
  - Solidago community
  - Calamagrostis epigeios community
  - Calamagrostis epigeios and Eryngium planum community
  - fallow
  - dam

## Scenario 2



Models of Vegetation Changes

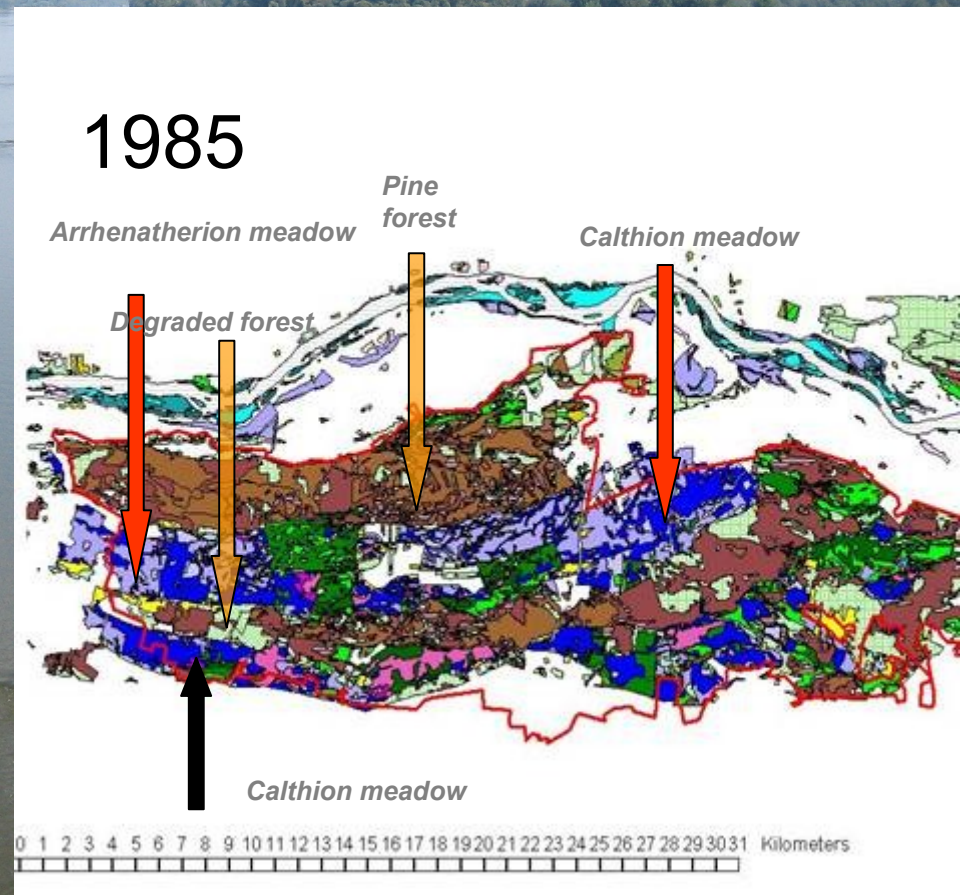
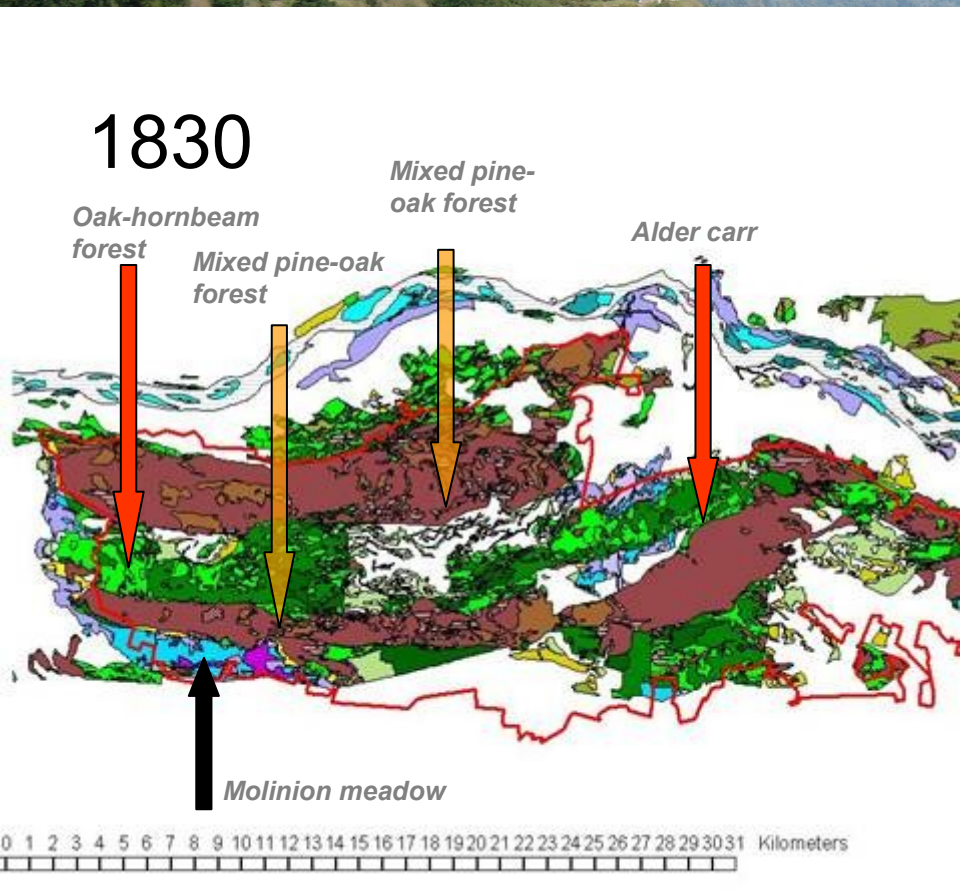


# Historical background of present state and future possible states

The comparison of vegetation in 1830  
and 1985 based on interpretation of  
topographic maps and the map of  
potential vegetation



# Comparison of two vegetation maps (based on interpretation of topographic maps)

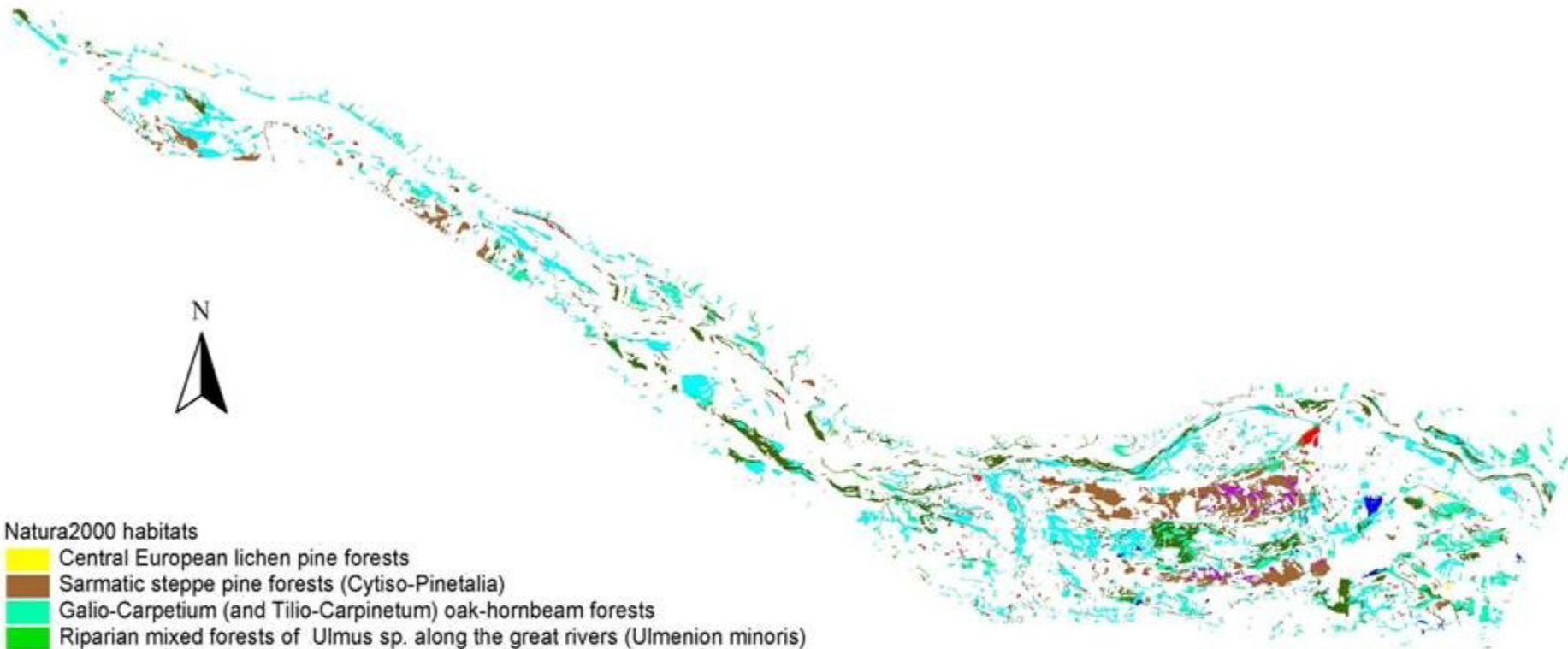


Kampinos National Park

The Past versus The Future

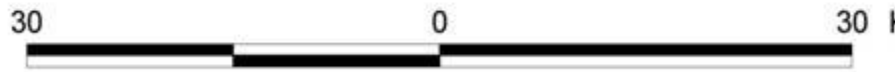






Natura2000 habitats

- Central European lichen pine forests
- Sarmatic steppe pine forests (*Cytiso-Pinetalia*)
- Galio-Carpetium (and Tilio-Carpinetum) oak-hornbeam forests
- Riparian mixed forests of *Ulmus* sp. along the great rivers (*Ulmenion minoris*)
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Pandion*, *Alnion incanae*, *Salicion albae*)
- Bog woodland
- European dry heaths
- Semi-natural dry grasslands and shrubland facies on calcareous substrates
- Xeric sand calcareous grasslands
- Lowland hay meadows
- Molinia meadows on calcareous, peaty, clayey-silt-laden soils
- other



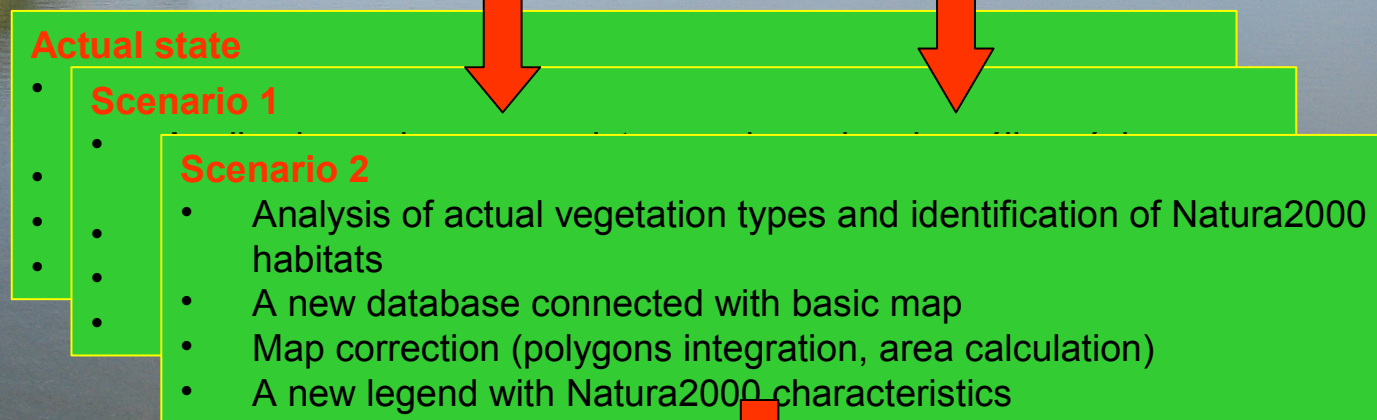


# Transformation of the basic vegetation map into the derived thematic map

Input Data



Retrieving

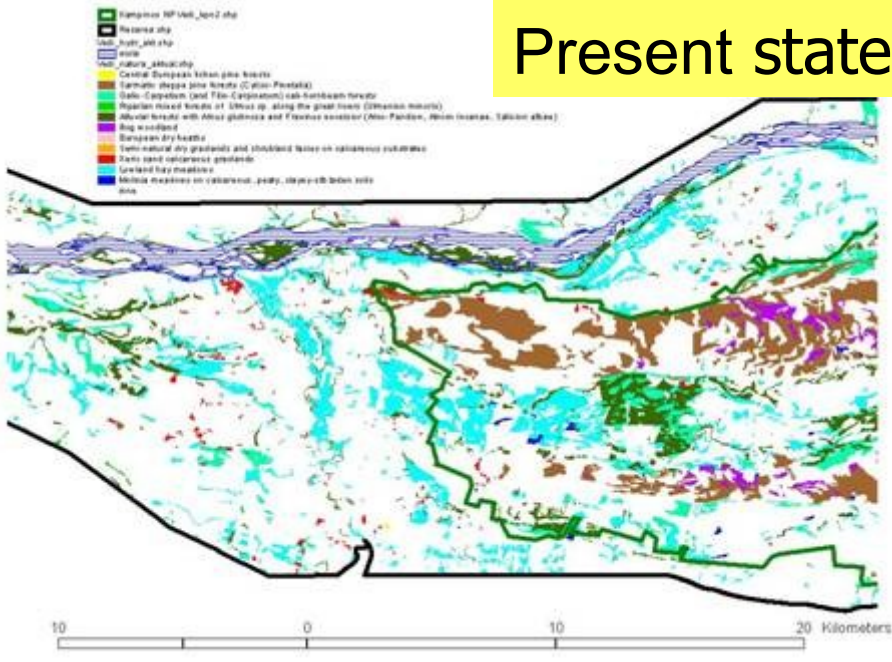


Output

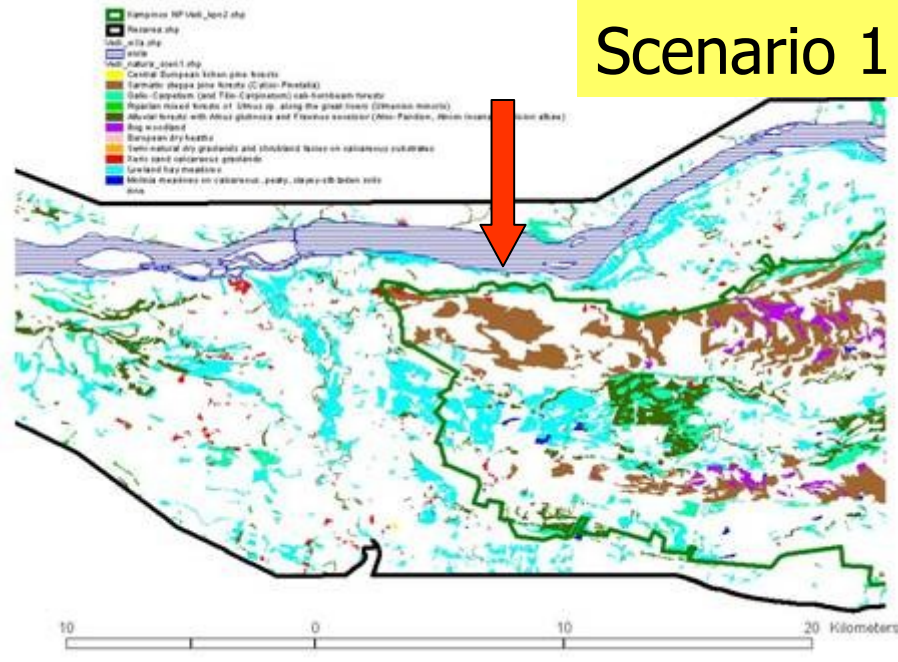




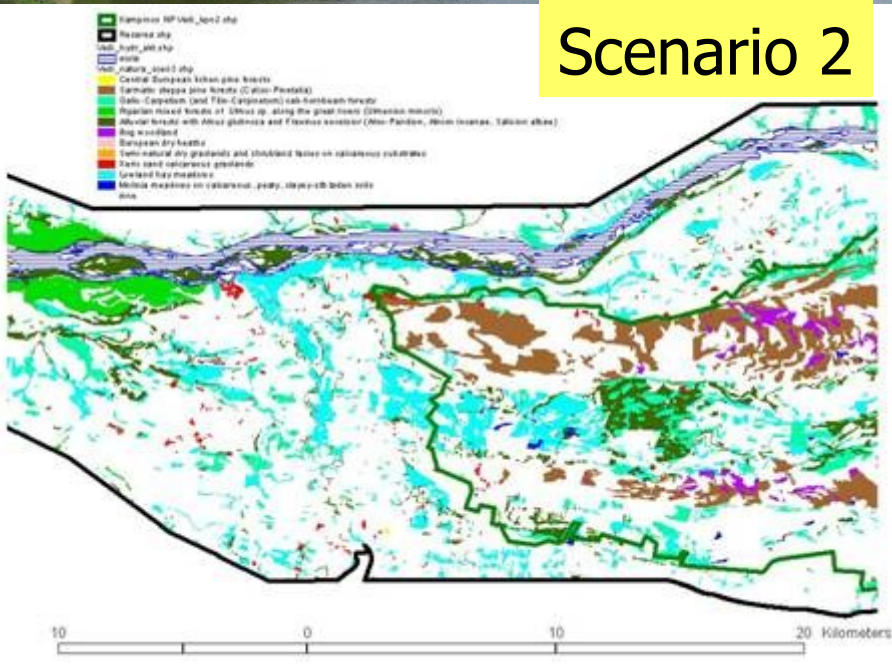
# Present state



# Scenario 1

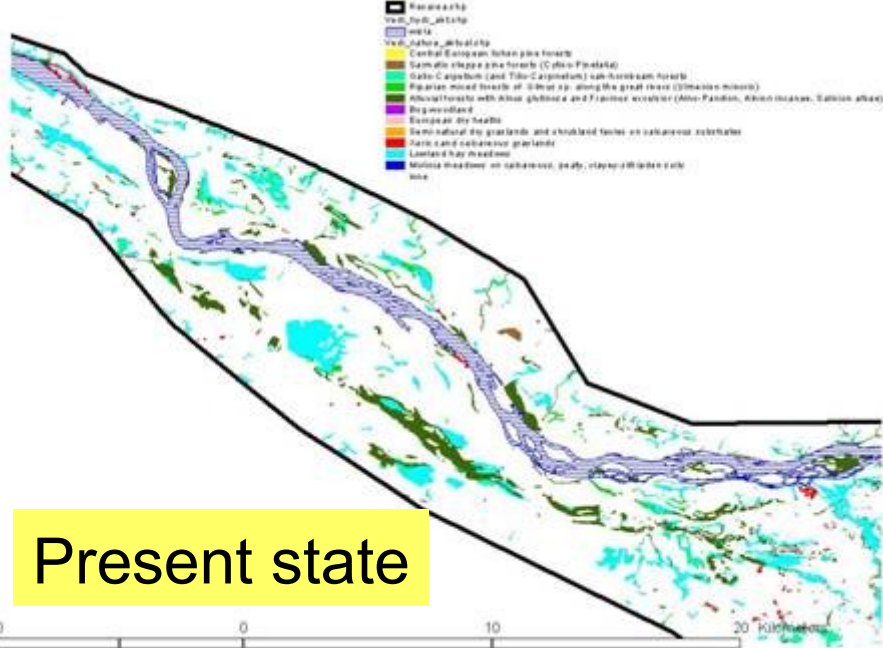


# Scenario 2

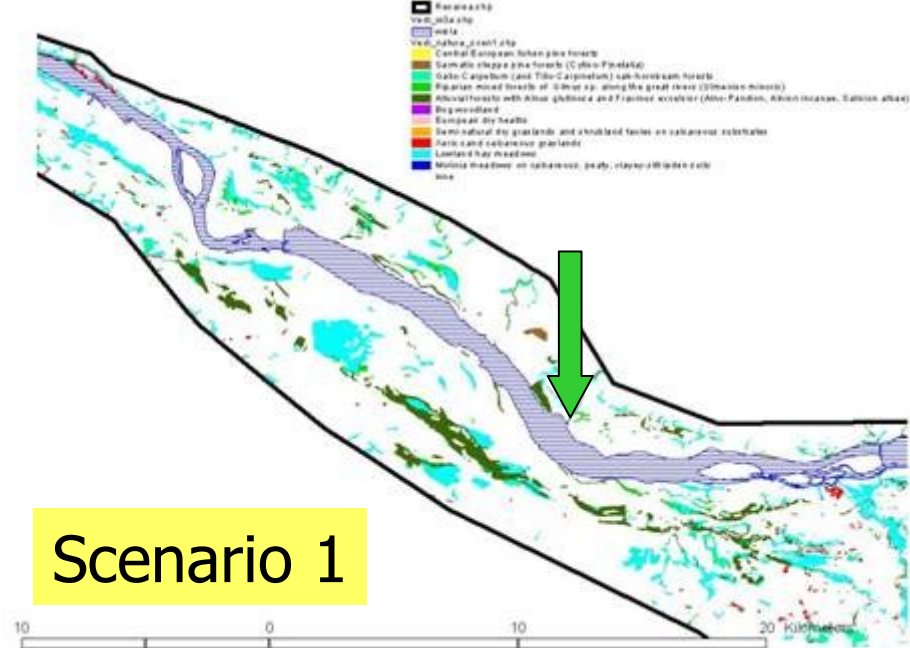


Changes:  
Scenario 1 - significant -  
removal of riparian forests

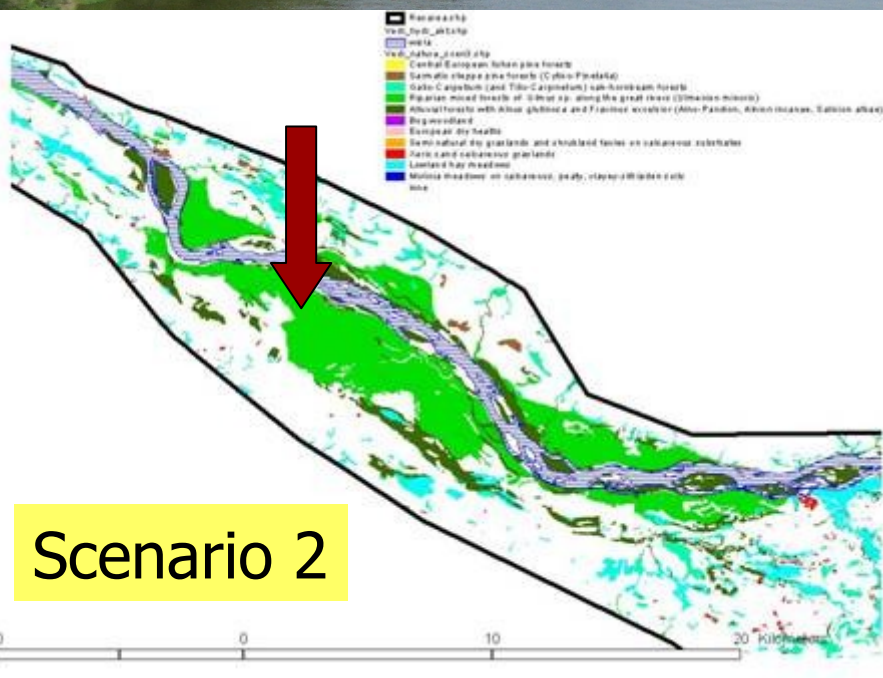




Present state



Scenario 1



Scenario 2

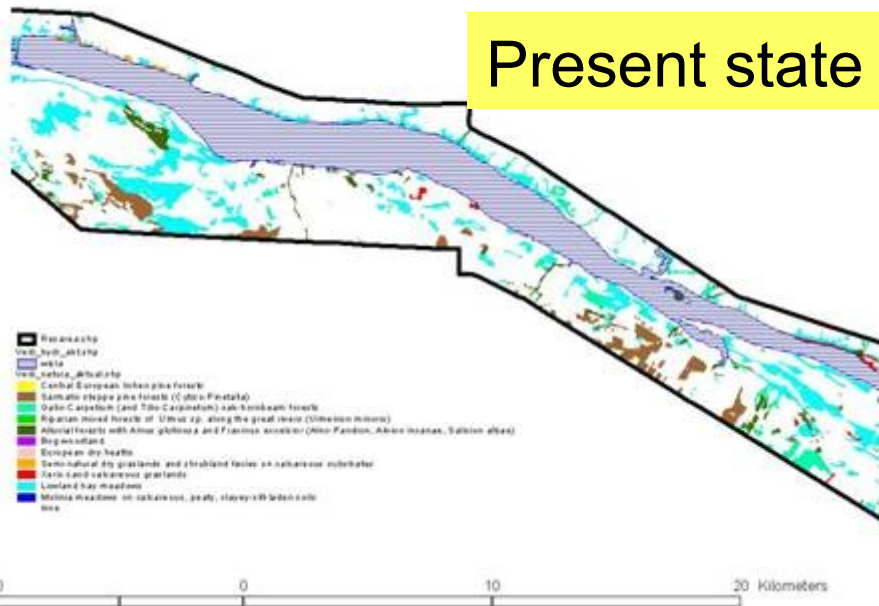
Changes:

Scenario 1 - small - mainly shrinking of riparian forests

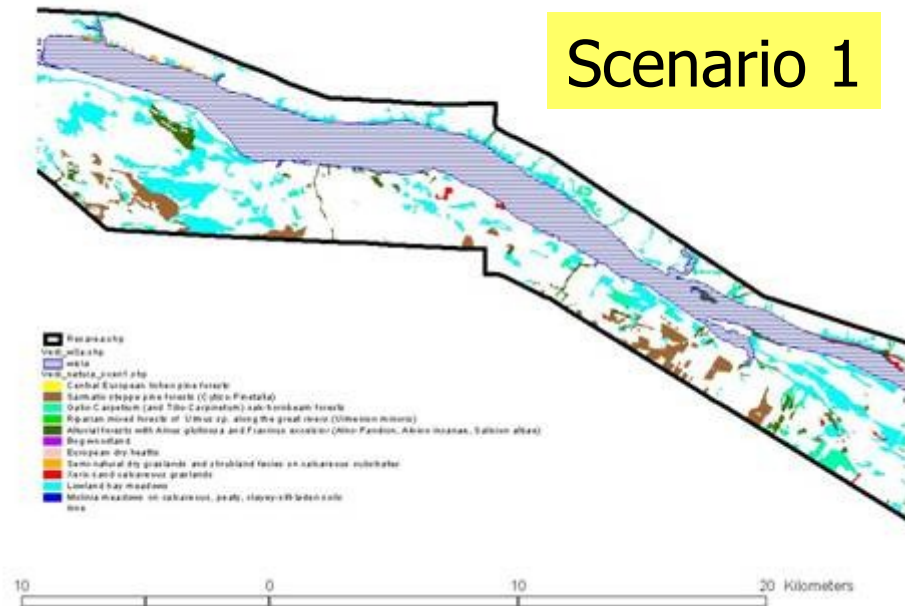
Scenario 2 - large - due to removal of dikes and restarting of succession on flooding terraces



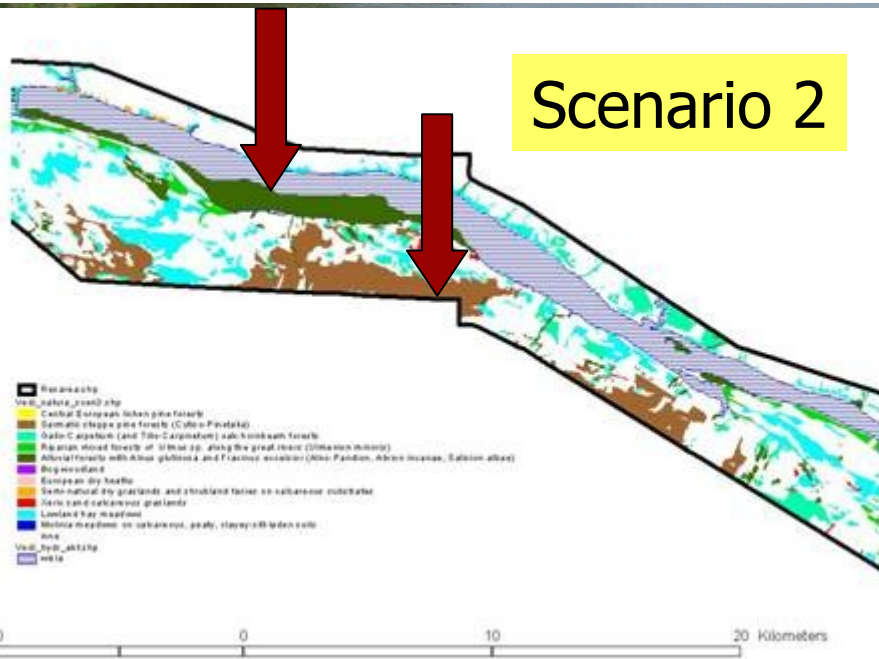
## Present state



## Scenario 1



## Scenario 2



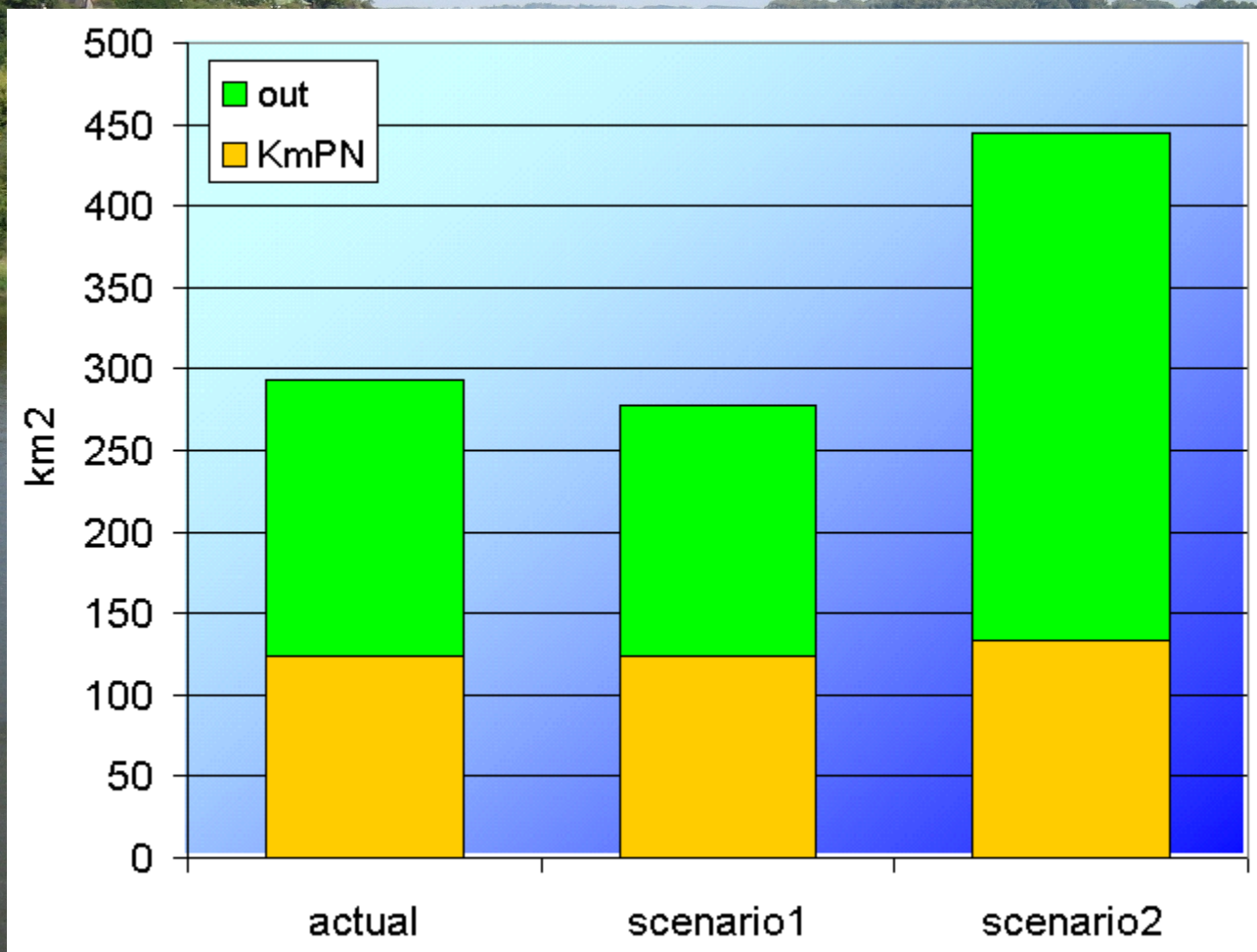
Changes:

Scenario 1 - no changes

Scenario 2 - significant changes due to a partial removal of the Włocławek dam, and due to forest regeneration



# „Losses and gains” for habitats listed in „Habitat Directive”





# Conclusions

- Digital, multidimensional vegetation maps allow to make derived thematic maps and to add new characteristics to original data.
- Scenarios 1 and 2 represent two opposite approaches for Vistula river valley management: Scenario 1 proposes further synanthropisation, while scenario 2 is focused on restoration.
- Scenario 2 results in considerably bigger changes of the Natura2000 habitats. Their area increases significantly. Scenario 1 leads to the reduction in these habitats (especially in the floodplain).
- Changes which would take place according to scenario 2 (restoration) can be compared with changes which took place during the last 150-200 years. They would affect more or less the same territory but in the reverse direction. It, of course, does not mean the reestablishment of the previous status of the area.
- Spatial planning process should include the identification of actual state and possible changes of habitats listed in Natura2000 directive (especially those which have not been yet under protection).





**Thank You  
For Your Attention**

**Jan Matuszkiewicz, Anna Kowalska &  
Jerzy Solon**