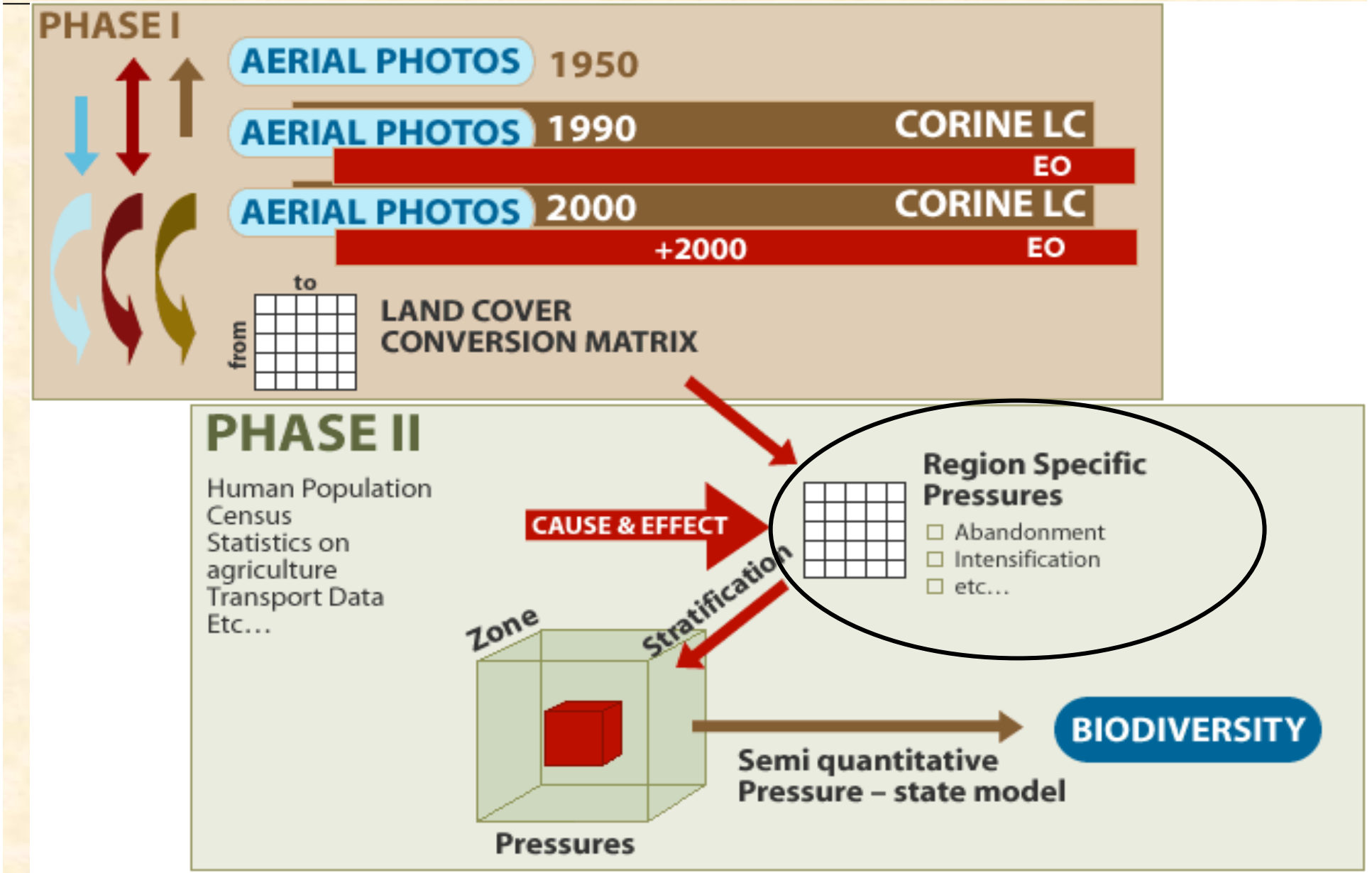
Key Findings: pressures

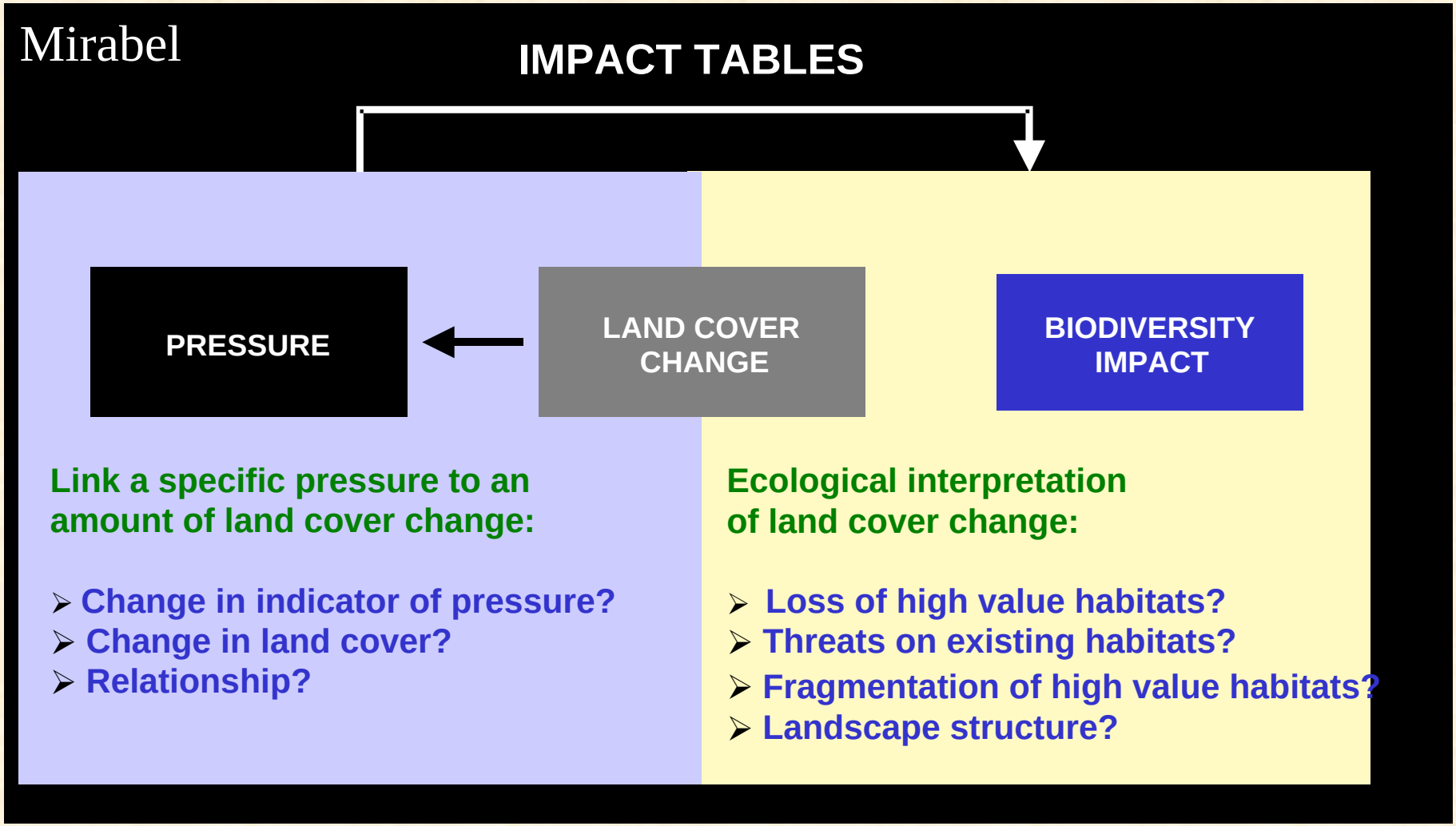
Sandra LUQUE & partners

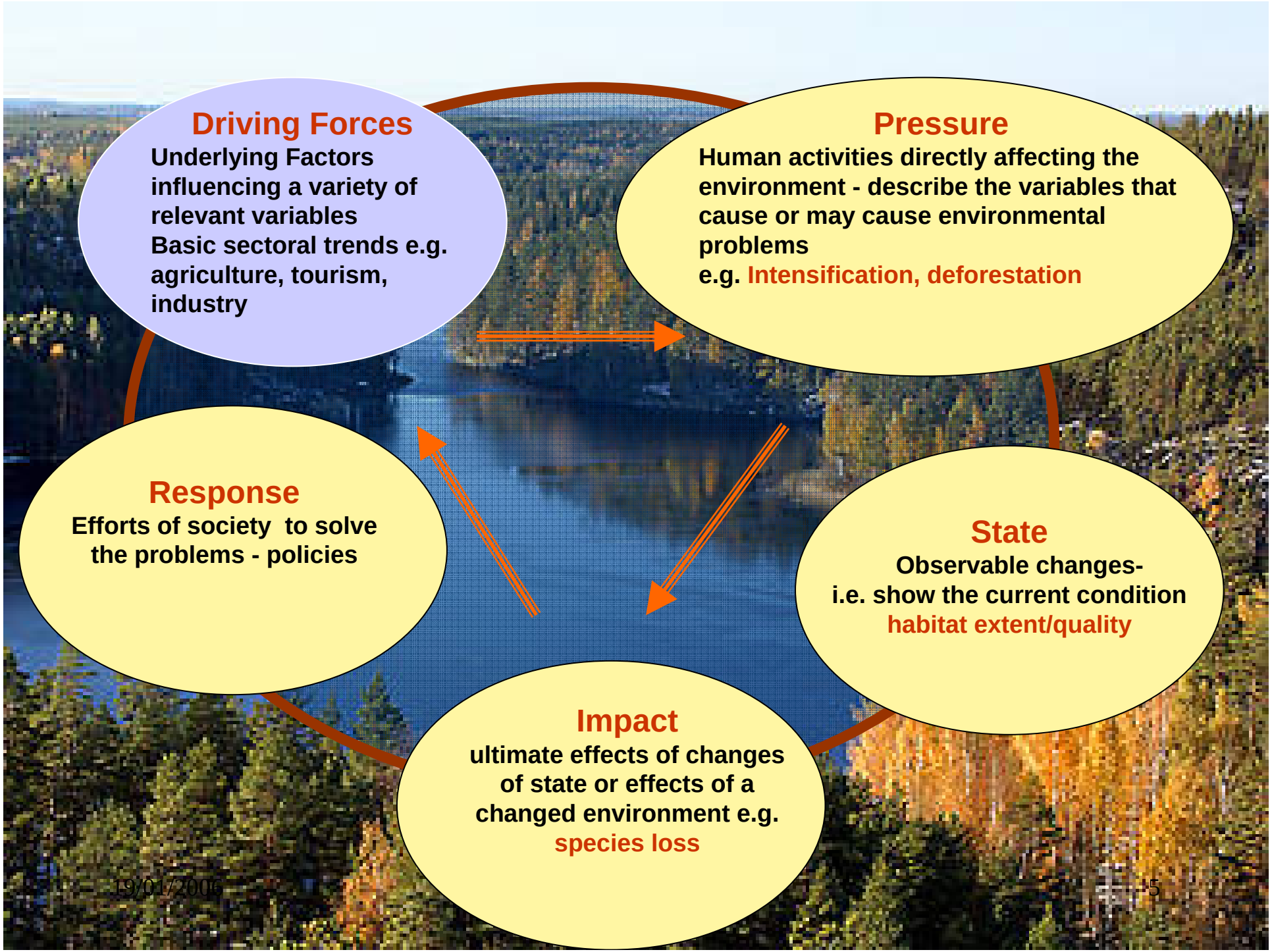
Pressures

BIOPRESS Project aims at providing decision makers with quantitative information on how changing land cover/use has affected the environment and biodiversity in Europe.


biopress
PHASE I
AERIAL PHOTOS 1950
AERIAL PHOTOS 1990
CORINE LC
EO
AERIAL PHOTOS 2000
CORINE LC
+2000
EO
to
from
LAND COVER
CONVERSION MATRIX
PHASE II
Human Population
Census
Statistics on
agriculture
Transport Data
Etc…
CAUSE & EFFECT
Region Specific
Pressures
Abandonment
Intensification
etc…
Stratification
Zone
Pressures
BIODIVERSITY
Semi quantitative
Pressure – state model

Phase II: Pressure –> state -> impact




Driving Forces
Underlying Factors influencing a variety of relevant variables
Basic sectoral trends e.g. agriculture, tourism, industry
Pressure
Human activities directly affecting the environment - describe the variables that cause or may cause environmental problems
e.g. Intensification, deforestation
State
Observable changes-
i.e. show the current condition
habitat extent/quality
Impact
ultimate effects of changes of state or effects of a changed environment e.g.
species loss
Response
Efforts of society to solve the problems - policies

DPSIR : a useful concept ?

- ***Driver > Pressure > State > Impact > Response***
- Launched in the early nineties (e.g. OECD,1994)
- Covers the chains of causes and effects, identifies possible interventions
- Suggests mono-causality and linear processes (unjustified); underestimates Policy as a Driving Force in itself
- Still, a very useful concept !!

Land Cover Change matrix transect

Backdating - result

	AREA [ha]	CODE98																
	CODE53	112	121	122	133	141	142	222	311	312	313	322	324	331	411	511	512	621	SUM
Discontinuous urban fabric	112	**39.2**				0.4													39.6
Industrial or commercial units	121		**11.4**																11.4
Road and rail networks and as	122			**2.7**															2.7
Contruction sites	133																		
Green urban areas	141					**2.3**													2.3
Sport and leisure facilities	142																		
Fruit trees and berry plantation	222	**1.3**						**0.9**											2.2
Broad-leaved forest	311					**4.5**			**46.8**						**2.9**			**4.0**	58.1
Coniferous forest	312	**0.6**		**0.9**	**0.6**		**7.2**		**2.6**	**630.6**		**39.8**	**10.8**					**7.8**	700.9
Mixed forest	313	**0.4**		**1.1**						**0.4**	**50.6**							**6.5**	58.9
Moors and heathland	322	**0.6**	**2.5**	**0.3**				**0.3**	**2.0**	**57.6**	**0.6**	**52.3**		**1.5**				**2.2**	119.9
Transitional woodland/shrub	324						**2.9**		**3.2**	**25.0**	**7.8**		**5.9**					**1.0**	45.8
Beaches, dunes, sands	331									**14.7**		**41.0**		**210.3**					266.0
Inland marshes	411		**2.7**				**4.4**		**80.1**						**15.6**				102.8
Water courses	511			**4.4**												**14.4**			18.8
Water bodies	512																**8.2**		8.2
Agriculture	621	**225.4**	**49.8**	**24.3**	**3.6**	**25.6**	**27.6**	**22.6**	**42.6**	**4.9**	**4.1**		**2.4**		**0.3**			**1434.9**	1868.0
	SUM	267.4	66.5	33.8	4.2	32.7	42.1	23.7	177.4	733.3	63.0	133.1	19.1	211.8	18.7	14.4	8.2	1456.3	3305.8

Process	Ha
urbanisation	391
intensification	26
deforestation	73
afforestation	286
other changes	37

111	Continuous urban fabric	312	Coniferous forest
112	Discontinuous urban fabric	313	Mixed forest
121	Industrial or commercial units	321	Natural grassland
122	Road and rail networks	322	Moors and heathland
133	Construction sites	324	Transitional woodland/shrub
141	Green urban areas	331	Beaches, dunes, sands
142	Sport and leisure facilities	411	Inland marshes
212	Permanently irrigated land	511	Water courses
222	Fruit trees and berry plantations	512	Water bodies
311	Broad-leaved forest	621	Arable or grass land

Pressure model example

TO\T1	1.1.1.	1.1.2.	1.2.1.	1.2.2.	1.2.3.	1.2.4.	1.3.1.	1.3.2.	1.3.3.	1.4.1.	1.4.2.	2.1.1.	2.1.2.	2.1.3.	2.2.1.	2.2.2.	2.2.3.	2.3.1.	2.4.1	2.4.2.	2.4.3.
1.1.1. Continuous urban fabric										U	U	U	U	U	U	U	U	U	U	U	U
1.1.2. Discontinuous urban fabric	U		U		U					U	U	U	U	U	U	U	U	U	U	U	U
1.2.1. Industrial or commercial units										U	U	U	U	U	U	U	U	U	U	U	U
1.2.2. Road and rail networks and associated land	U		U		U					U	U	U	U	U	U	U	U	U	U	U	U
1.2.3. Port areas	U									U	U	U	U	U	U	U	U	U	U	U	U
1.2.4. Airports	U	U	U							U	U	U	U	U	U	U	U	U	U	U	U
1.3.1. Mineral extraction sites	U	U	U	U	U	U			U			U	U	U	U	U	U	U	U	U	U
1.3.2. Dump sites	U	U	U	U	U	U			U			U	U	U	U	U	U	U	U	U	U
1.3.3. Construction sites	U	U	U	U	U	U						U	U	U	U	U	U	U	U	U	U
1.4.1. Green urban areas	U	U	U	U	U	U	U	U	U			U	U	U	U	U	U	U	U	U	U
1.4.2. Sport and leisure facilities	U	U	U	U	U	U	U	U	U			U	U	U	U	U	U	U	U	U	U
2.1.1. Non-irrigated arable land	U	U	U	U	U	U	U	U	U	U	U		I		I	I	I	I	I		I
2.1.2. Permanently irrigated land	U	U	U	U	U	U	U	U	U	U	U	I			I	I	I	I	I		I
2.1.3. Rice fields	U	U	U	U	U	U	U	U	U	U	U	Dr	Dr		Dr	Dr	Dr	Dr	Dr		I
2.2.1. Vineyards	U	U	U	U	U	U	U	U	U	U	U	I	I	I				I			I
2.2.2. Fruit trees and berry plantations	U	U	U	U	U	U	U	U	U	U	U	I	I	I				I	I		I
2.2.3. Olive groves	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I		I	I		I
2.3.1. Pastures	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I		I		I
2.4.1 Annual crops associated with permanent crops	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	I			I
2.4.2. Complex cultivation patterns	U	U	U	U	U	U	U	U	U	U	U	I	I	I				I			I
2.4.3. Land principally occupied by agriculture, with significant areas of natural vegetation	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	I	I		
2.4.4. Agro-forestry areas	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	D	I		
3.1.1. Broad-leaved forests	U	U	U	U	U	U	D	D	U	U	U	I	I	I	I	I	I	I	I	I	I
3.1.2. Coniferous forests	U	U	U	U	U	U	D	D	U	U	U	I	I	I	I	I	I	I	I	I	I
3.1.3. Mixed forests	U	U	U	U	U	U	D	D	U	U	U	I	I	I	I	I	I	I	I	I	I
3.2.1. Natural grasslands	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	I	I	I	I
3.2.2. Moors and heathland	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	I	I	I	I
3.2.3. Sclerophyllous vegetation	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	I	I	I	I
3.2.4. Transitional woodland-scrub	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	I	I	I	I
3.3.1. Beaches, dunes, sands	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I		I	I	I
3.3.2. Bare rocks	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I		I	I	I
3.3.3. Sparsely vegetated areas	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	I	I	I	I
3.3.4. Burnt areas	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	I	I	I	I
3.3.5. Glaciers and perpetual snow	U	U	U	U			U	U	U		U										
4.1.1. Inland marshes	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	Dr	I	I	I
4.1.2. Peat bogs	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	Dr	I	I	I
4.2.1. Salt marshes	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	Dr	I	I	I
4.2.2. Salines	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	Dr	I	I	I
4.2.3. Intertidal flats	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	Dr	I	I	I
5.1.1. Water courses	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	Dr	I	I	I
5.1.2. Water bodies	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	Dr	I	I	I
5.2.1. Coastal lagoons	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	Dr	I	I	I
5.2.2. Estuaries	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	Dr	I	I	I
5.2.3. Sea and oceans	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I	Dr	I	I	I
6.2.1. Farmed land	U	U	U	U	U	U	U	U	U	U	U		I		I	I	I		I		I
6.2.2. Plantations (food crops)	U	U	U	U	U	U	U	U	U	U	U	I	I	I				I	I		I
6.3.1. Forests	U	U	U	U	U	U	D	D	D	U	U	I	I	I	I	I	I	I	I	I	I
6.3.2. Grasslands	U	U	U	U	U	U	U	U	U	U	U	I	I	I	I	I	I		I		I

Priority rules

Combination of more than one intensification OR relaxation per case

The less natural the process, the more priority (Urbanisation > Intensification > Drainage > Deforestation > Abandonment > Afforestation) in intensification.

The less natural the process, the less priority (Urbanisation < Intensification < Drainage < Deforestation < Abandonment < Afforestation) in relaxation

Combination of intensification AND relaxation in the same case:

When intensification is less natural than relaxation, intensification has priority

When intensification is more natural than relaxation, decision should be taken per case

Pressures: How can indicators quantify them ?

Why is it so difficult to select indicators?

PRESSURES

Urbanisation

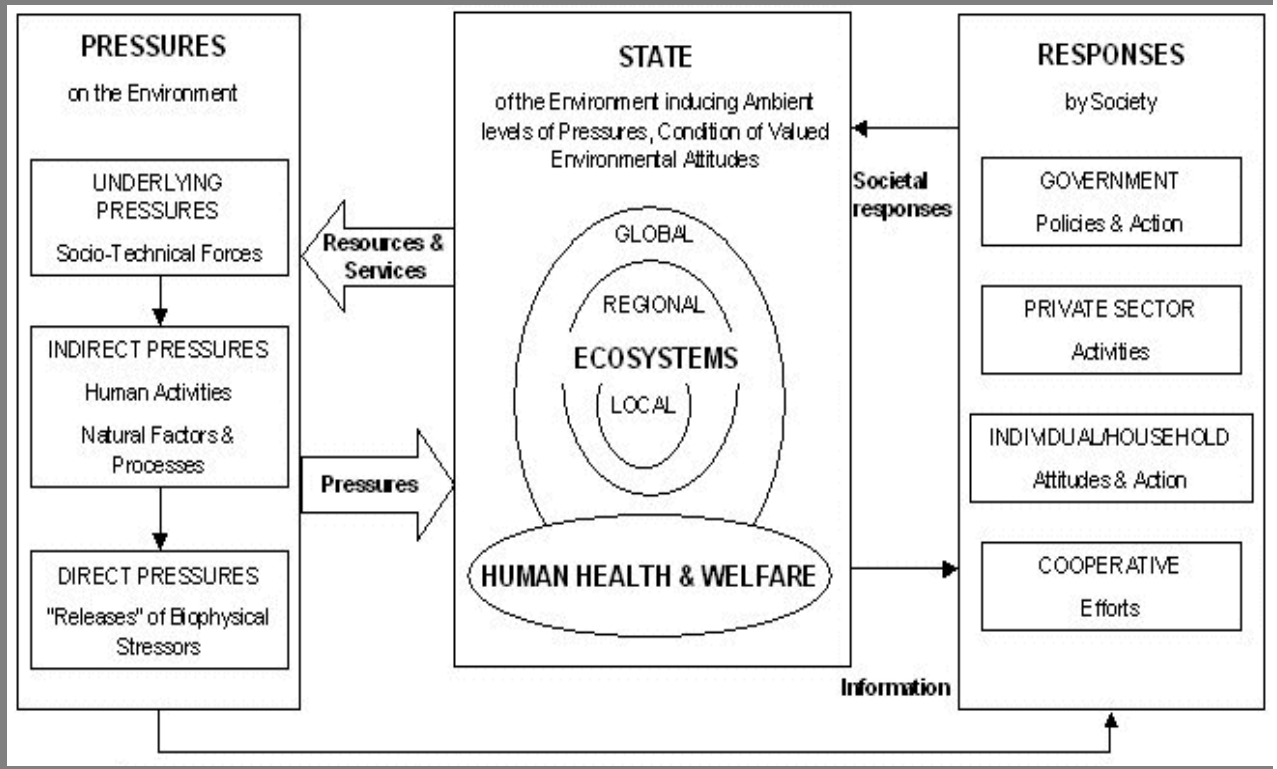
Deforestation

Afforestation

Land Abandonment

Intensification

Drainage



Pressures

Number of Natura 2000 Sites	Biogegraphical Region	Total Area (%)	Main Observed Pressures
46	ALPINE	77%	Afforestation, Deforestation,Urbanisation,
95	ATLANTIC	19%	Afforestation and Urbanisation
16	BOREAL	1%	Deforestation and Urbanisation
60	CONTINENTAL	2%	Afforestation
100	MEDITERRANEAN	1%	Afforestation, Intensification, Urbanisation, Land Abandonment
1	PANONIAN	0%	Intensification

Indicator name and definition	Transferability		Priority
	Space	Time	
URBANISATION			
Population density	L-R-E	S-L	H
Road density	L-R-E	S-L	H
AGRICULTURE INTENSIFICATION			
Average annual fertilizer use	L-R	S	H
Pesticide use	L-R	S	H
Percentage area with intensive cropping of total agricultural land	R	S	H
Used of agricultural pesticides	L-R	S	H
Change in area of agricultural land area (conversion to or from agriculture)	E	L	H
Use of fertilisers	L-R	S	H
Matrix of changes in land cover classified by type and size	E	L	H
LAND ABANDONMENT			
Conversion of agricultural land into semi-natural areas	L	S	H
SOIL DRAINAGE			
Extent of wetland drainage and filling	L-R	S-T	M
AFFORESTATION / DEFORESTATION			
Total forest felling	L-R	S	H
Number and size of forest sizes	L-R-E	S-L	H
Change in land use, conversion of forest land to other land uses (deforestation rate)	L-R-E	L	H

SPACE
L – Local
R – Regional
E – European

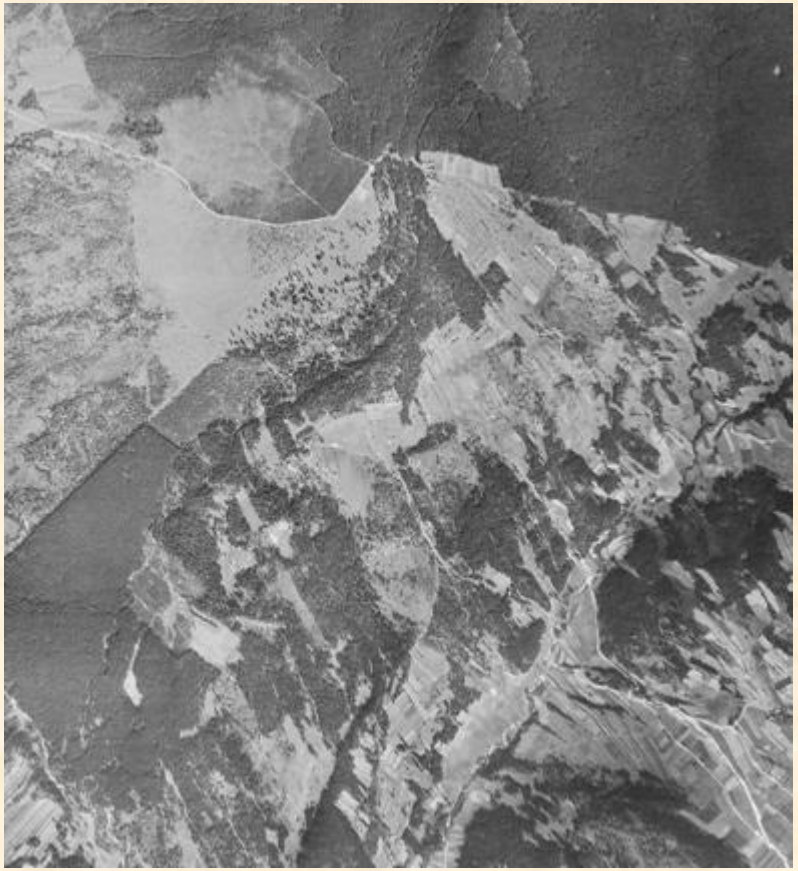
TIME
S – Short-term
L – Long-term

URBANISATION

Urban sprawl –

Milton Keynes (UK) is a new city created in the 1970'ies, 17 years later the city is still growing. The city swallowed up 13 small villages. 20% of the city is open spaces.

AFORESTATION - **Slovakia**



1949

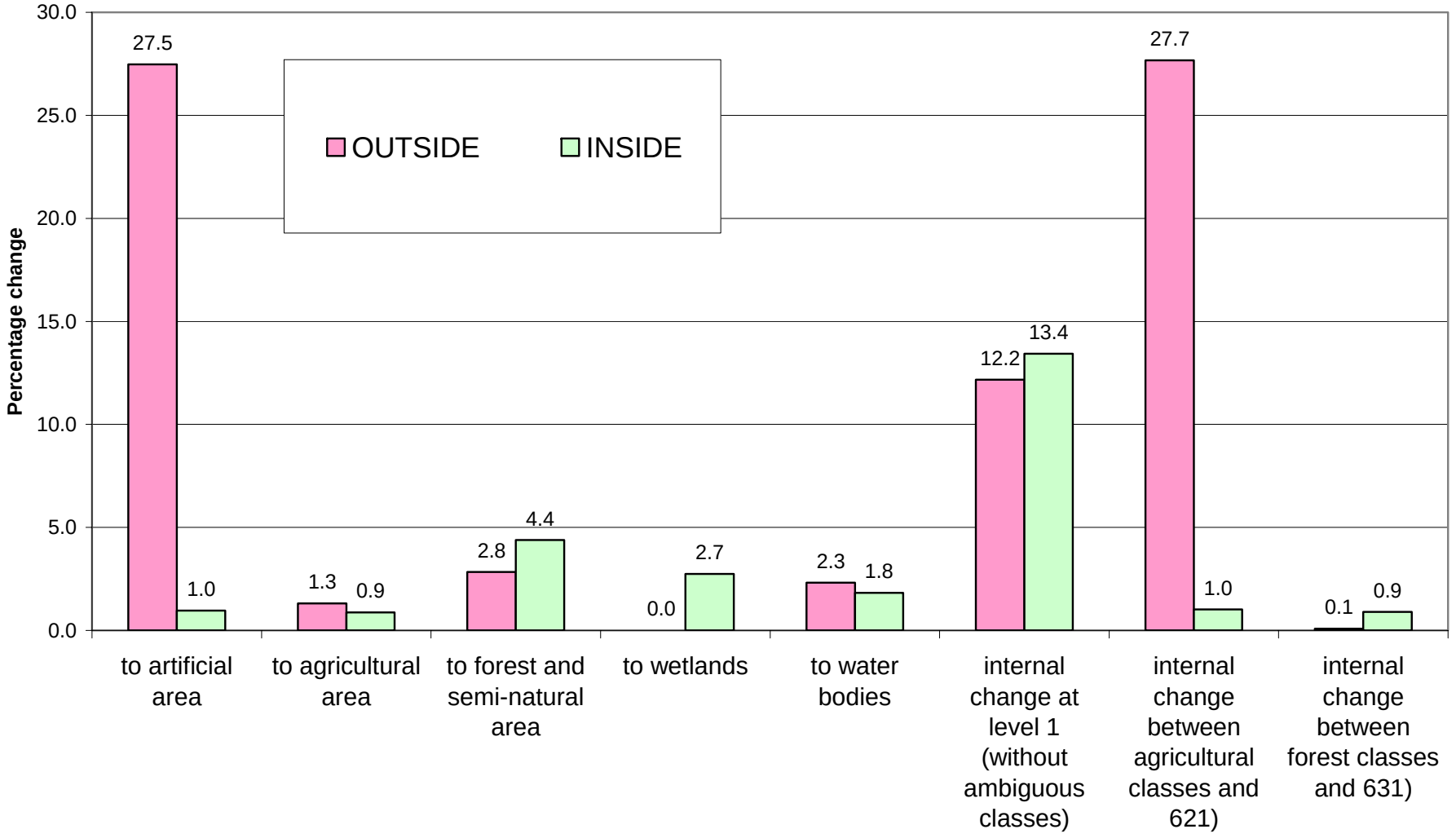
2000

INTENSIFICATION

Intensification is shown in farmland near Hungerford in UK1. This is the best example of imagery in UK1

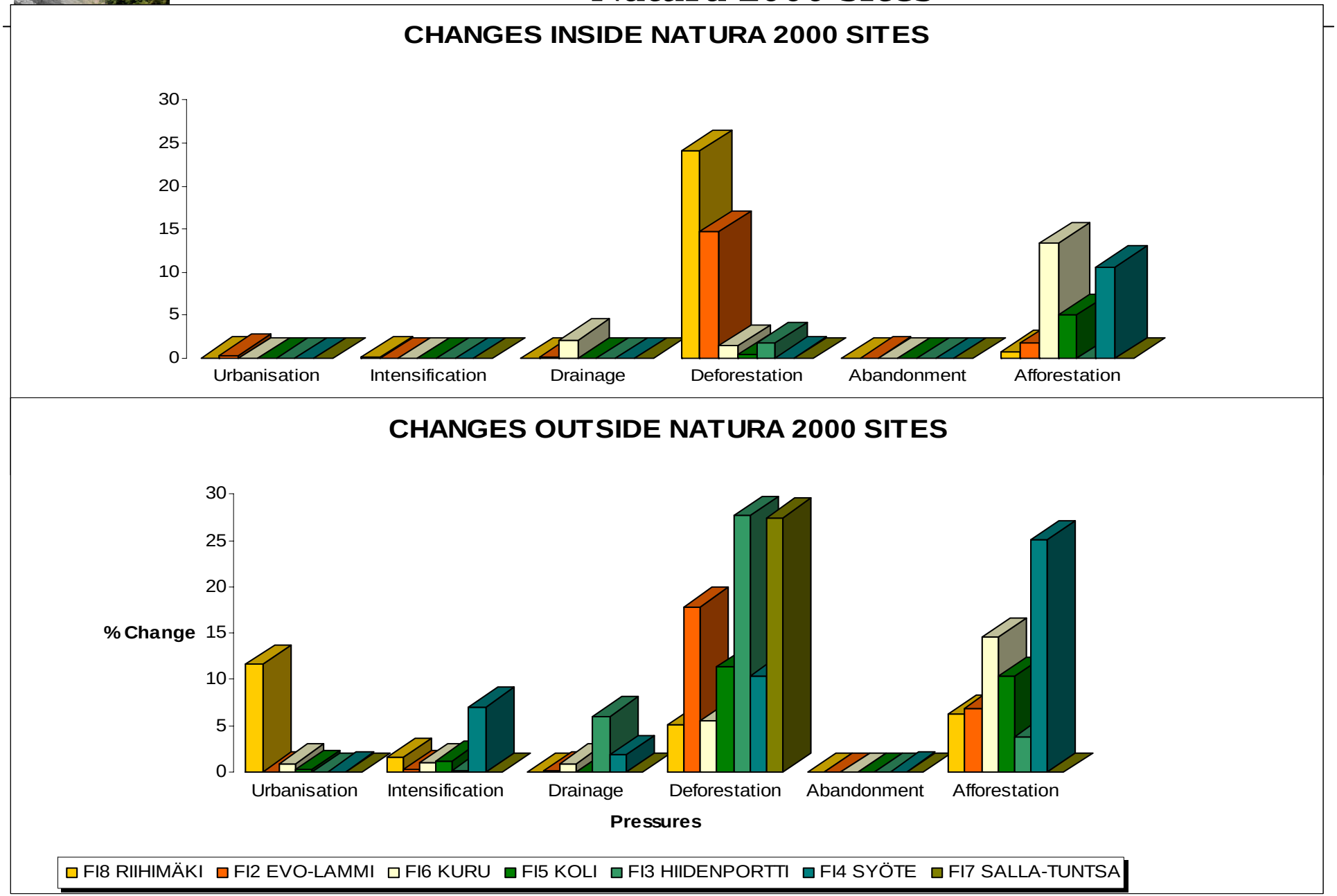
Types of changes occurring inside and outside Natura2000 sites

A 74% of all land cover changes occurred outside the Natura2000 sites.



The changes are expressed in percentages change and are in total 100% (summation of inside and outside changes). A 74% of all land cover changes occurred outside the Natura2000 sites.

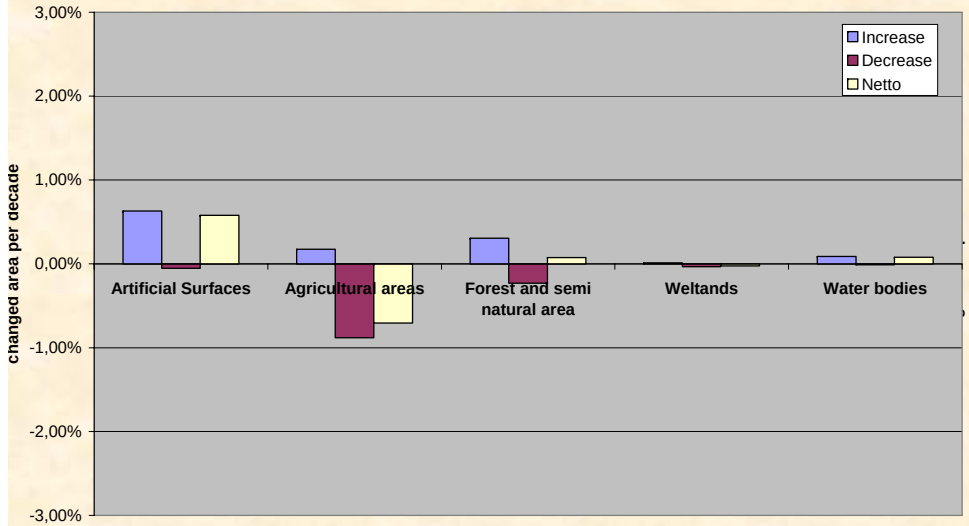
FINLAND: Pressures Inside vs. Outside Natura 2000 sites



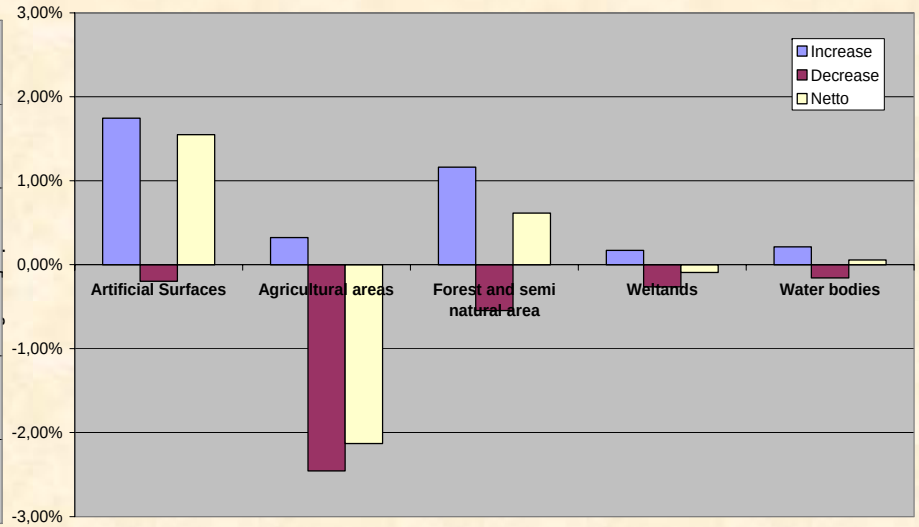
Transect FI8 - Riihimäki - Hyvinkää: NATURA 2000 borders

Lessons learned from historic interpretations

Percentage change of windows 1950-1990



Percentage change of transects 1950-1990



Slovakia 1974 (source ILE SAS)

Slovakia 2000 (source ILE SAS)

From LCC's to processes

Multi-Representation Model

- Finding patterns in land cover change, economic development, technology, and other social indicators which can explain the anthropogenic pressures on Natura 2000 sites
- Reasoning under the effects of regional and local scales

Problems identified: Spatial and temporal integration

- Spatial incompatibility between the borders of administrative units
- Data for the 50's usually do not spatially match with the data after 70's
- Discrepancy of an indicator value at the same time period (e.g Slovakia: differences in statistics at the regional level for the same period)

Problems identified: Spatial and temporal integration (2)

- Data availability for the indicators is very poor; i.e. We have found data sets for only few indicators at the European level
- Missing Data :
  - Tourism (no reliable data for 50's and 60's)
  - Soil/wetland drainage (no data at all) – Joan
  - Fertiliser/Pesticide use (very few countries) - Monica
- Some statistics are available at the municipal level but boundaries changed

Approaches

- Classical Analysis by transforming the socioeconomic data to discrete (ordinal) values and test the significance of these data on LCC via ANOVA tests of ranks, etc.
- Data Mining Analysis by computing a top-down Decision Tree using the information gain theory to find the patterns between LCC and the indicators (Ctree tool).

Framework

- SPACE
  - Level 1 (European Statistics – NUTS 1) for the EU
  - Level 2: (Regional, Municipality Statistics – NUTS 3) for 5 windows located in NL, FI, ES, and SK
- TIME
  - Perform the analysis per decade

The impossible tasks ?!

- Compile a unique database containing all the data sets for the target samples
- Select a unique approach for the integration model
- Define the methodology to be used (one methodology for all or not…)

WP4300 - Tasks

- Task 4310: Identify a final list of indicators and the relevant data sets.
- Task 4320: Develop a generic integration model.
- Task 4330: Integrate the socio-economic data sets.
- Task 4340: Research on defining the methodology.
- Task 4350: Implement the methodology.
- Task 4360: Characterise the different possible indicators.

Two main approaches for the integration model

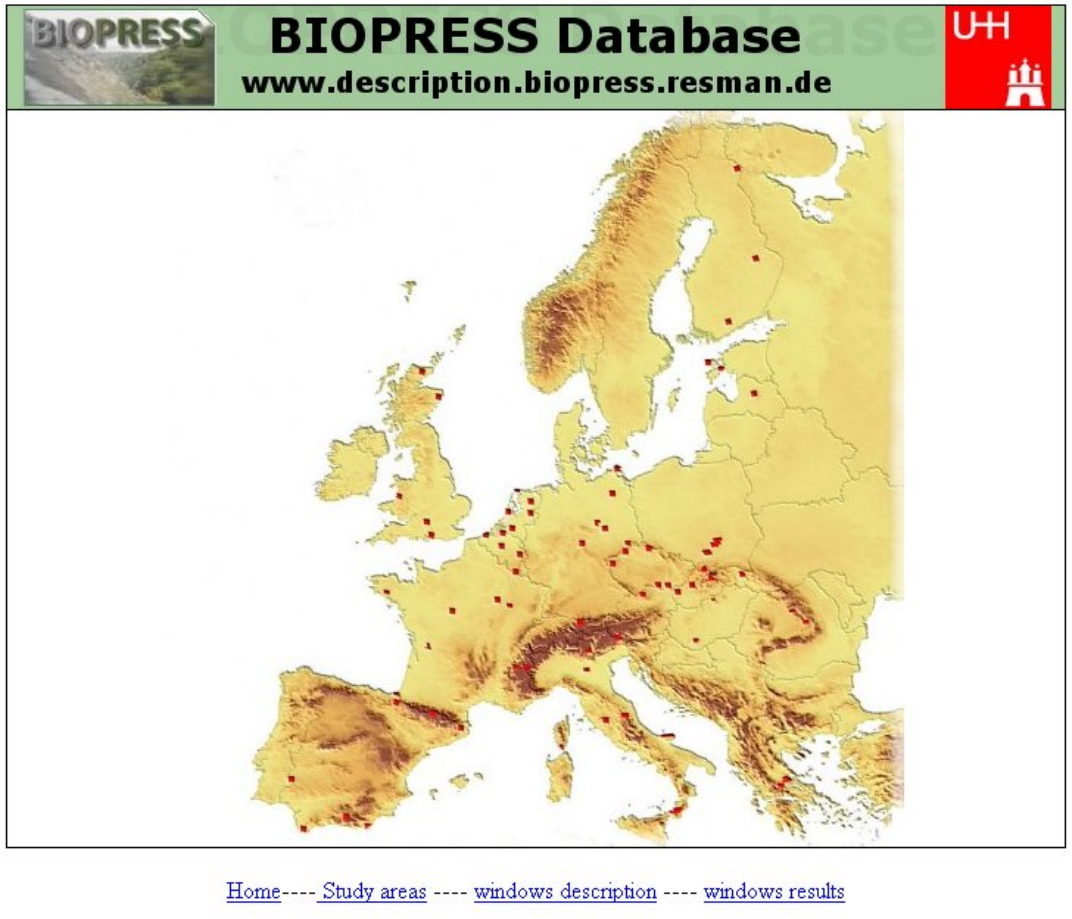
- Spatial Matching: intersection of the boundaries using geo-processing.
- Statistical Approach: quantitative analysis using linear or curvilinear regression or their non-parametric equivalents.

Can we actually identify patterns?

- The main issue is related to the statistics themselves. They present a variety of temporal and spatial scales, as well as accuracy. Because of a lack of long-term monitoring data, it not evident to differentiate between population fluctuations and real trends (patterns).

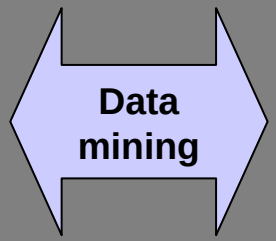
Data mining across spatial scales

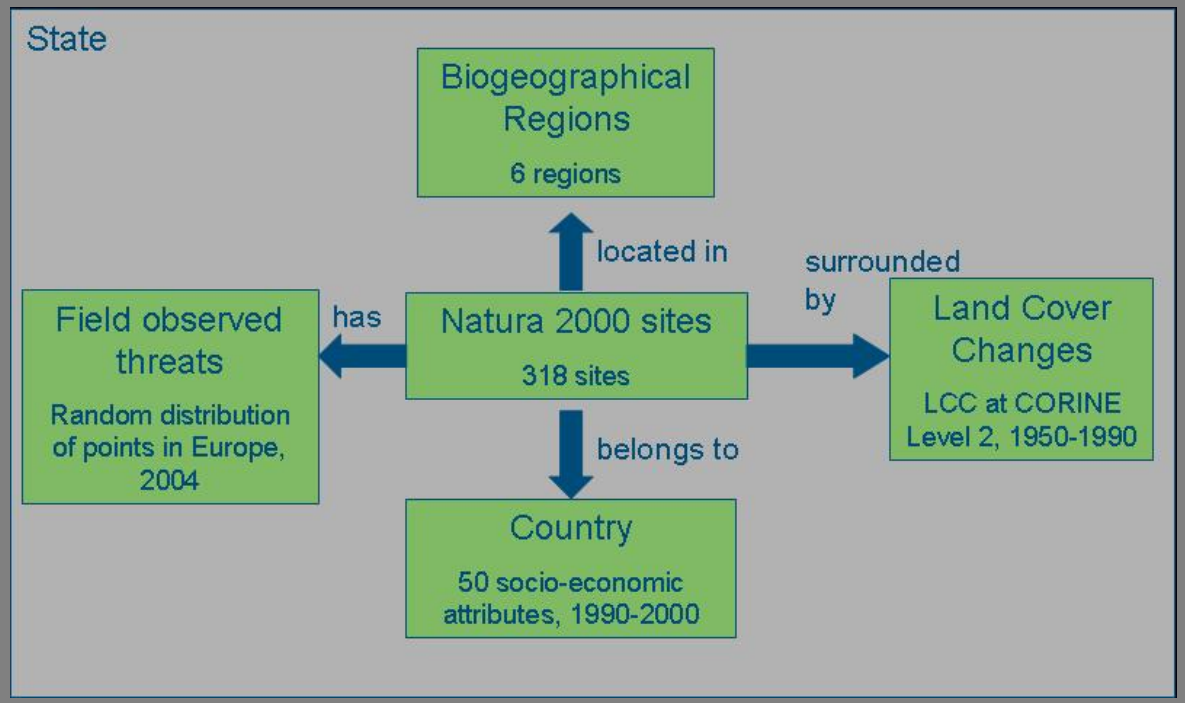
Anthropogenic pressures have been determined by computing the land cover changes, which have been measured around 318 Natura 2000 sites between 1950 and 1990.



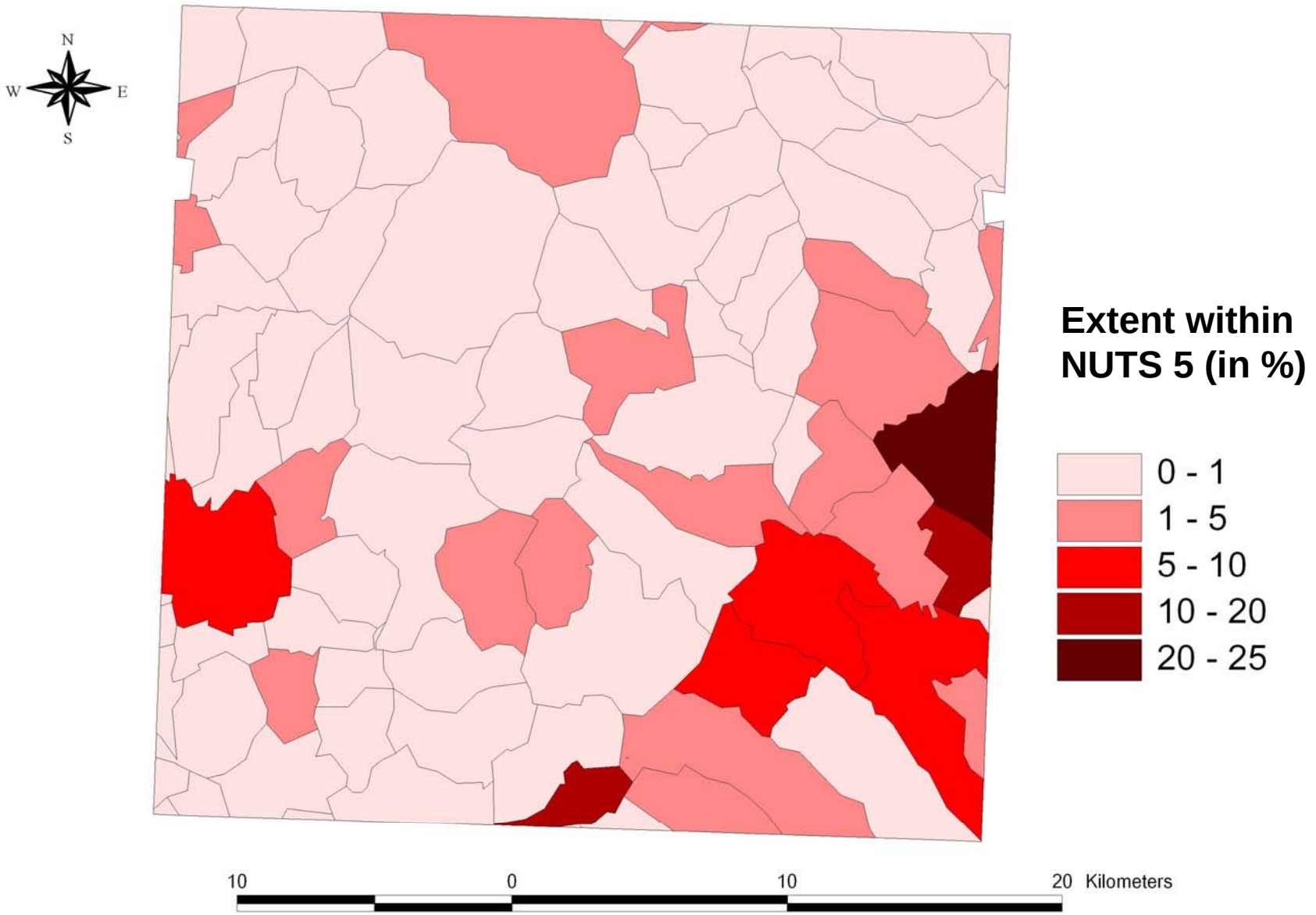
Data Mining

Patterns

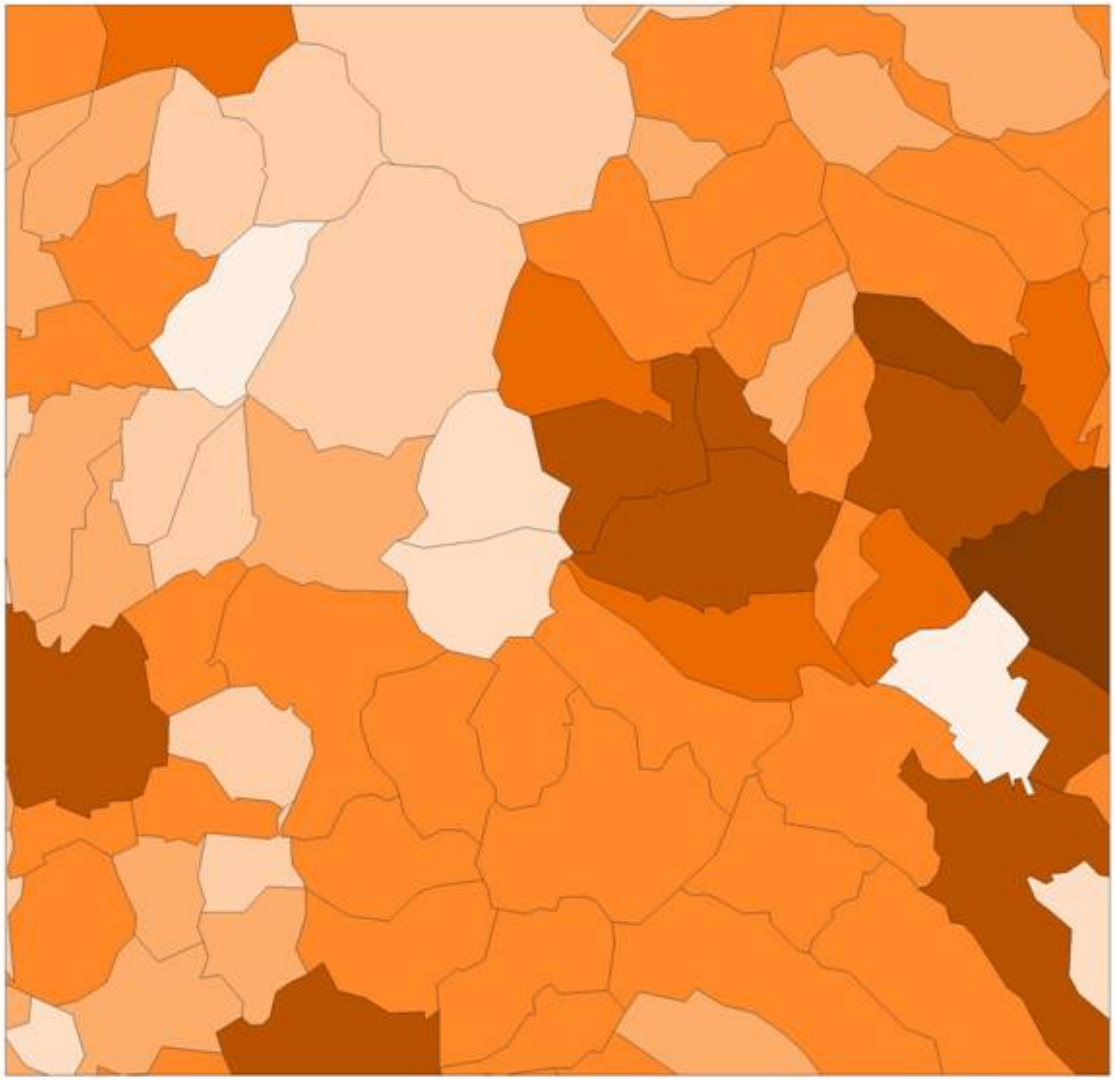




Pressure: Urbanisation



Population density: changes 1950-1990



Increase/decrease of population density within NUTS 5 (in %)

- 0 - 25
- 25 - 50
- 50 - 75
- 75 - 100
- 100 - 150
- 150 - 200
- 200 - 500
- 500 - 750
- 750 - 900

100 % = without changes

10 0 10 20 Kilometers

Population density: selection of the most significant changes within window (increase and decrease)

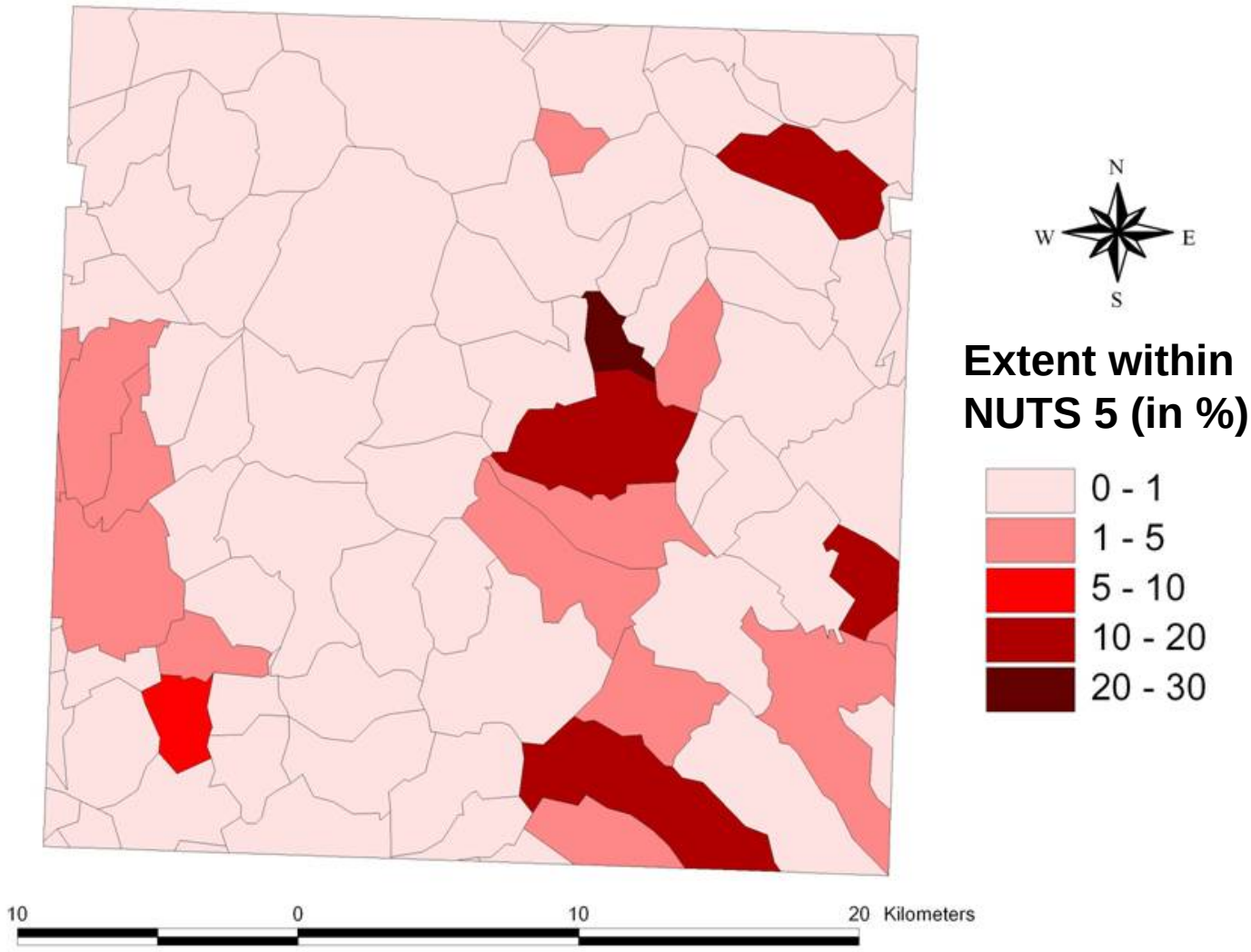
		1950	1960	1970	1980	1990	Difference 1950-1990
	NUTS 5	in inh./m^2					in % of 1950
Increase - top 5	PRIEVIDZA	142	431	640	948	1241	**876**
	KANIANKA	55	68	71	81	400	**734**
	BANOVCE NAD BEBRAVOU	176	251	359	581	753	**427**
	DIVIAKY NAD NITRICOU	24	37	43	88	88	**372**
	PARTIZANSKE	156	171	263	416	569	**366**
Decrease - top 5	LIVINA	61	77	95	46	30	**48**
	UHROVSKE PODHRADIE	14	17	12	8	6	**44**
	OMASTINA	22	27	21	13	8	**36**
	KOS	164	209	234	229	33	**20**
	TREBICHAVA	34	31	23	13	7	**19**

***Integration with land cover*: strong connection of pressure urbanisation with population density change**

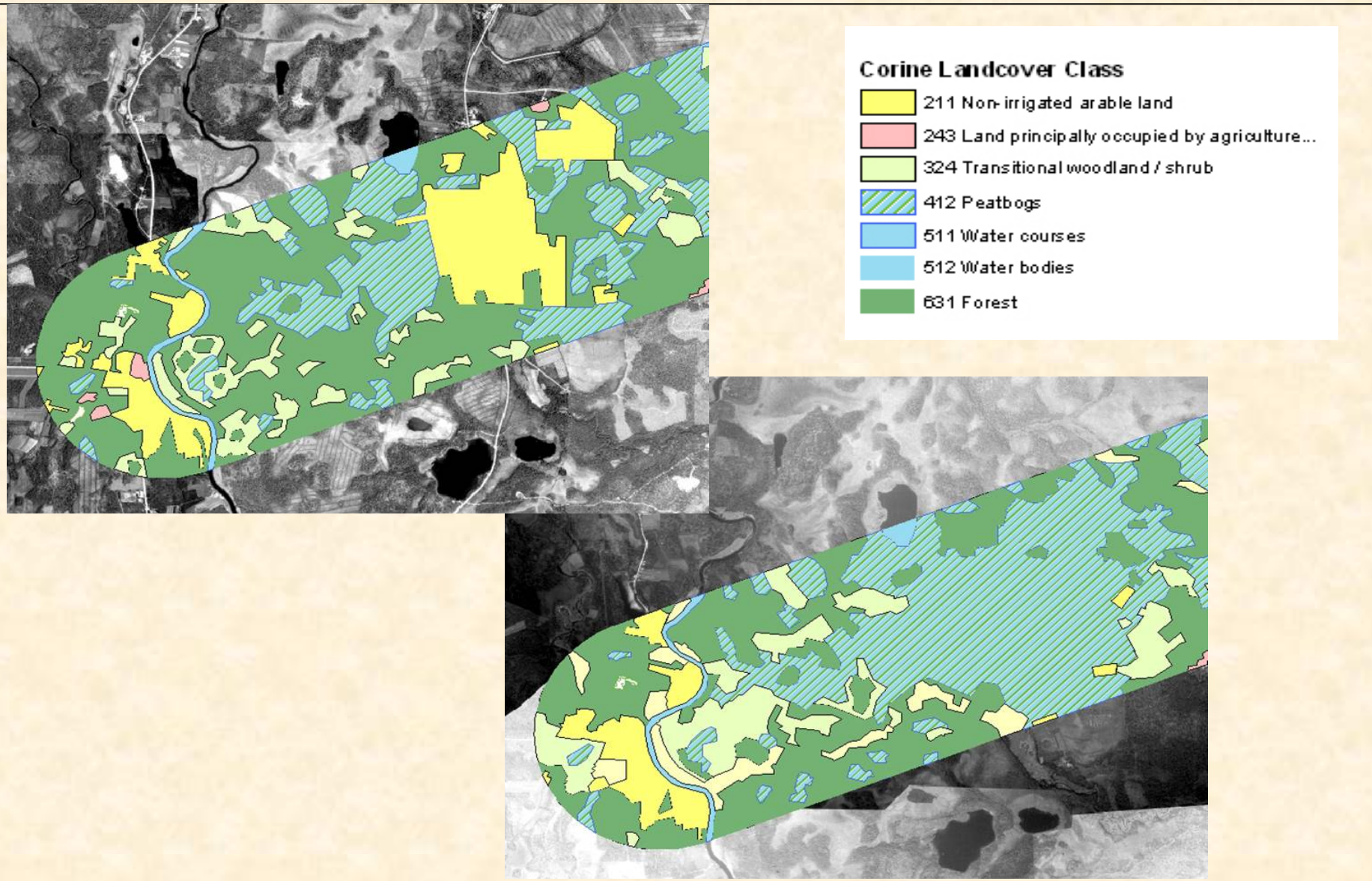
- ***in 4 of 5 municipalities of the greatest density increase there is occurence of this pressure, in 2 of them it is significant (more than 5%)***

- ***in all 7 municipalities of the greatest extent of pressure (more than 5%) there is increase of population density, in 4 of them significant (more than 200%***

Pressure: Intensification

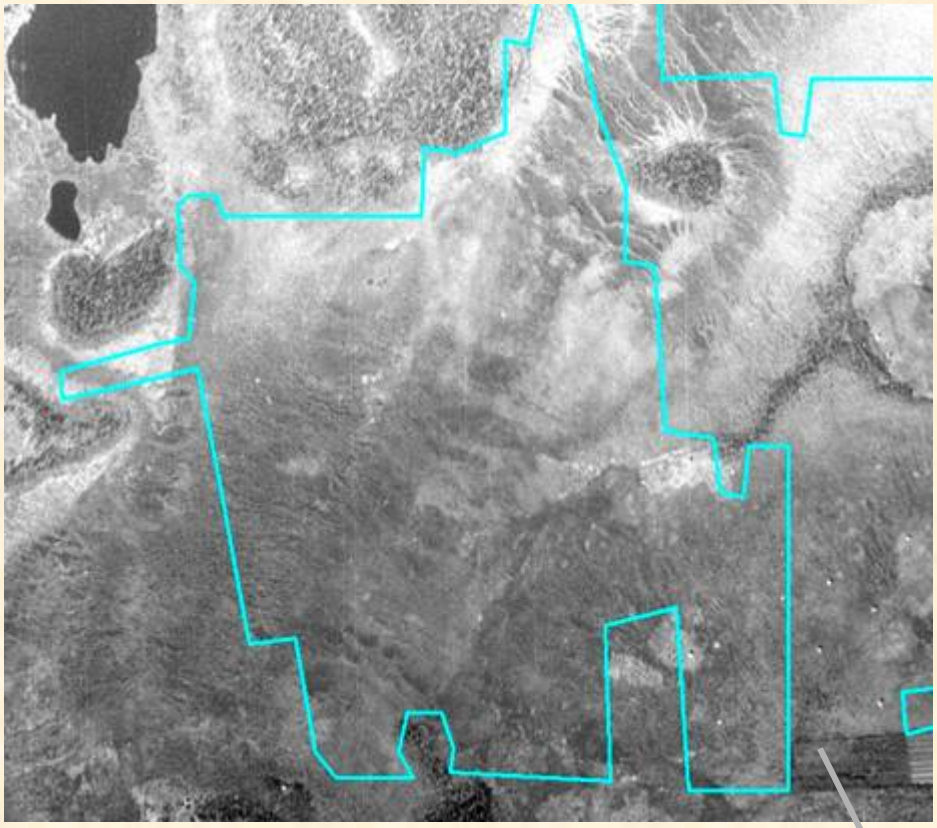


Peatbogs into arable land - INTENSIFICATION



412 to 211 - Peatlands to Arable land

Peatlands in natural state

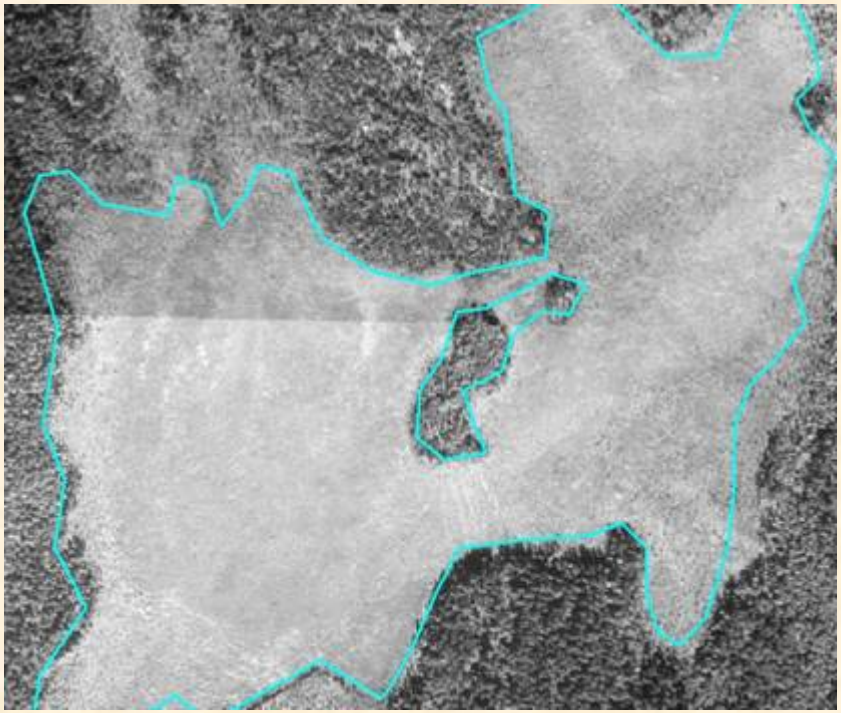


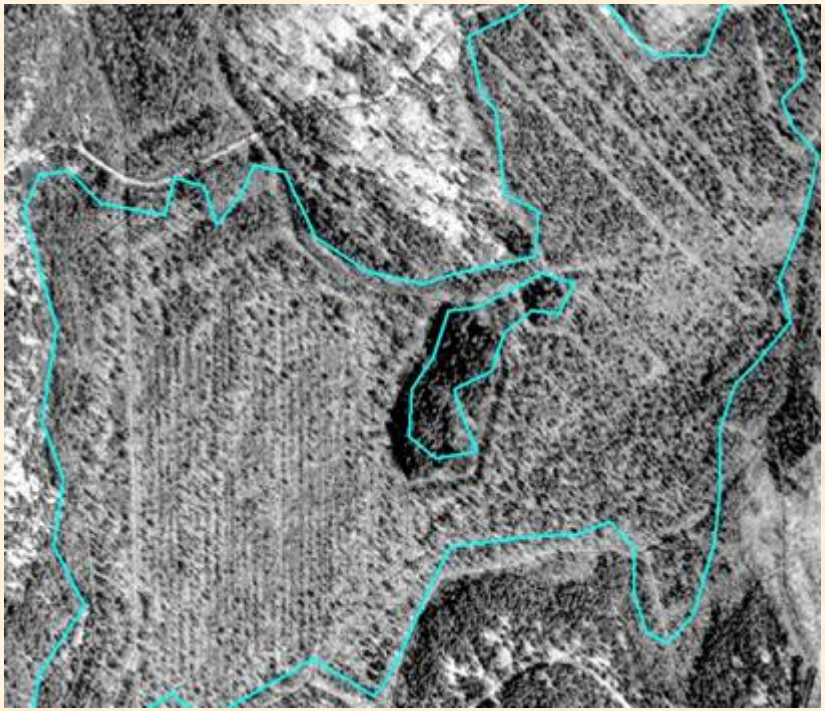
Hay production (hay was harvested and dried in place)

In Finland 1 mill. hectares of peatland turned into fields – at the present half of them are used as fields

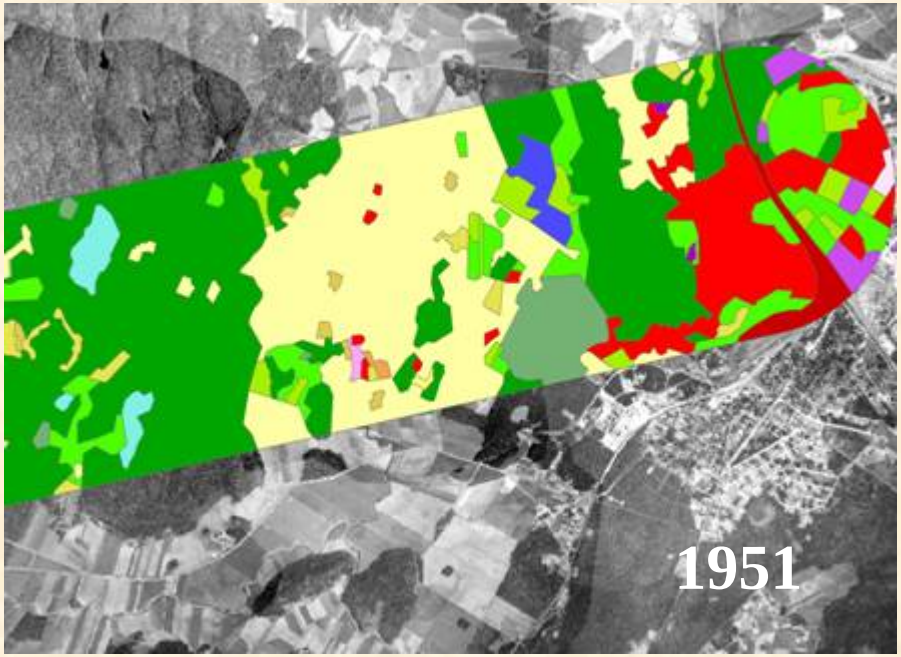
Drainage – Afforestation 412 TO 324 & 631

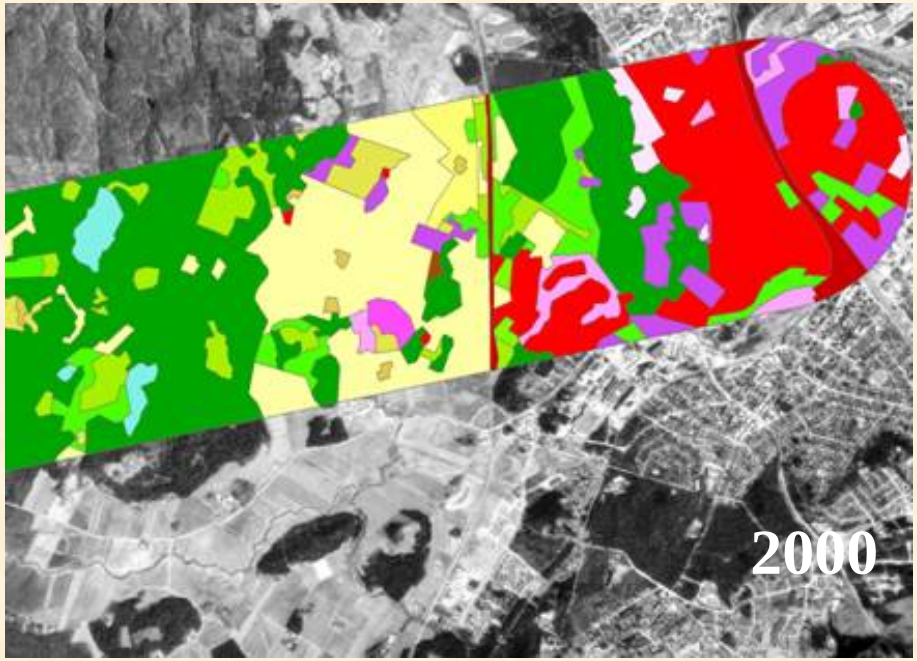
Peat bogs are ditched and turned into transitional woodland and forest





URBANISATION - FINLAND - Riihimäki-Kytäjä





FI8 Riihimäki

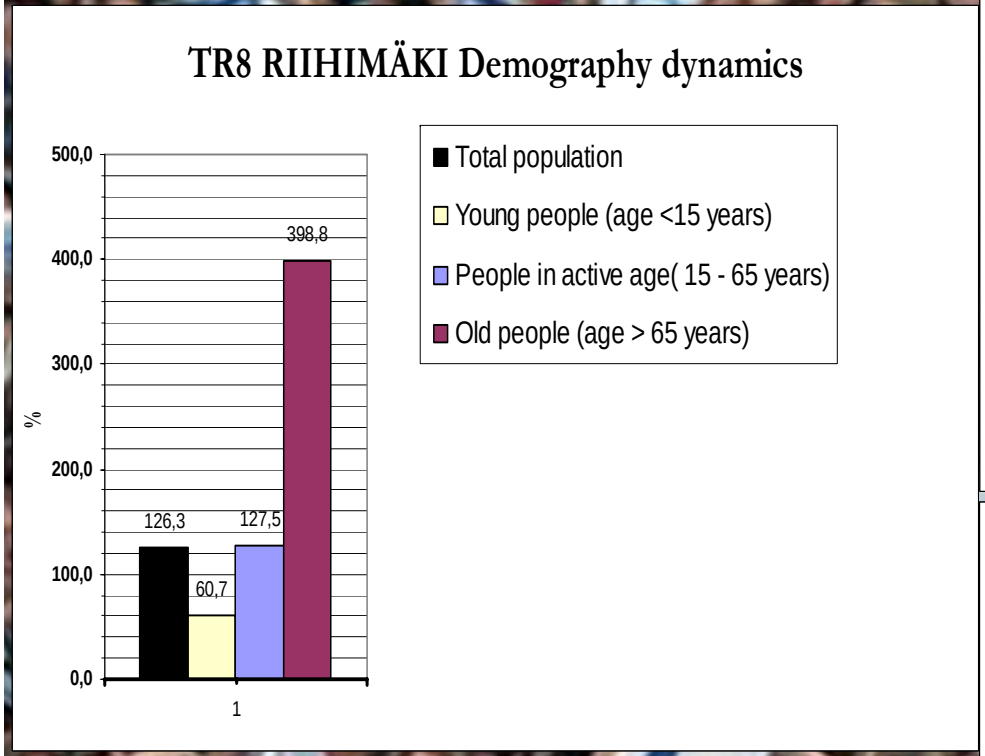
	1. Artificial surfaces (ha)	2. Agricultural areas (ha)	3. Forests and semi-natural areas (ha)	4. Wetlands (ha)	5. Water bodies (ha)
1951	6,33%	25,66%	55,97%	0,76%	11,29%
1986/1987	14,28%	21,69%	52,49%	0,83%	10,72%
2000	15,15%	20,39%	52,92%	0,83%	10,72%

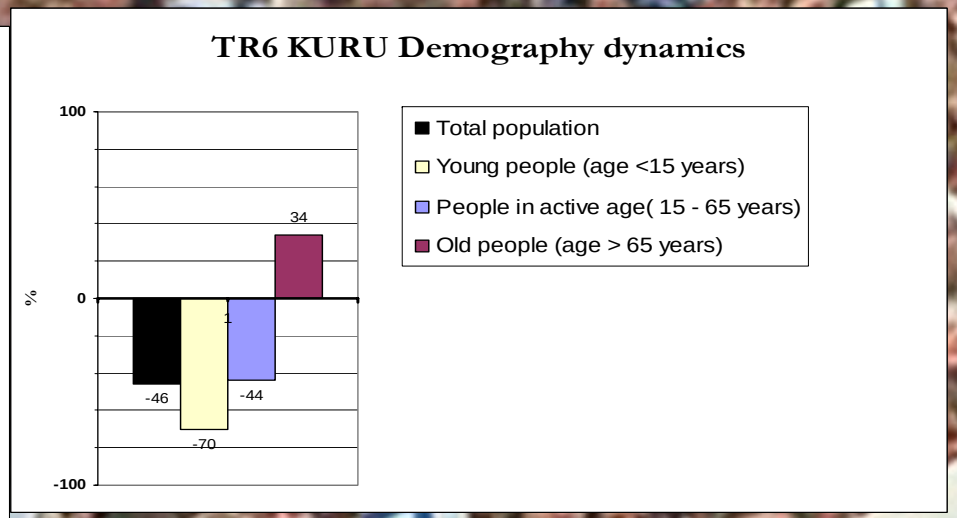
1950 - 1990 (% of area)	WINDOW	TRANSECT
Urbanisation	2,9 %	9,3 %
Intensification	0,4 %	1,3 %
Drainage	0,1 %	0,0 %
Deforestation	0,1 %	8,9 %
Abandonment	0,0 %	0,0 %
Afforestation	0,4 %	5,1 %
No relevant changes	0,1 %	2,3 %
No change	96,0 %	73,2 %
Grand Total	100,0 %	100,0 %

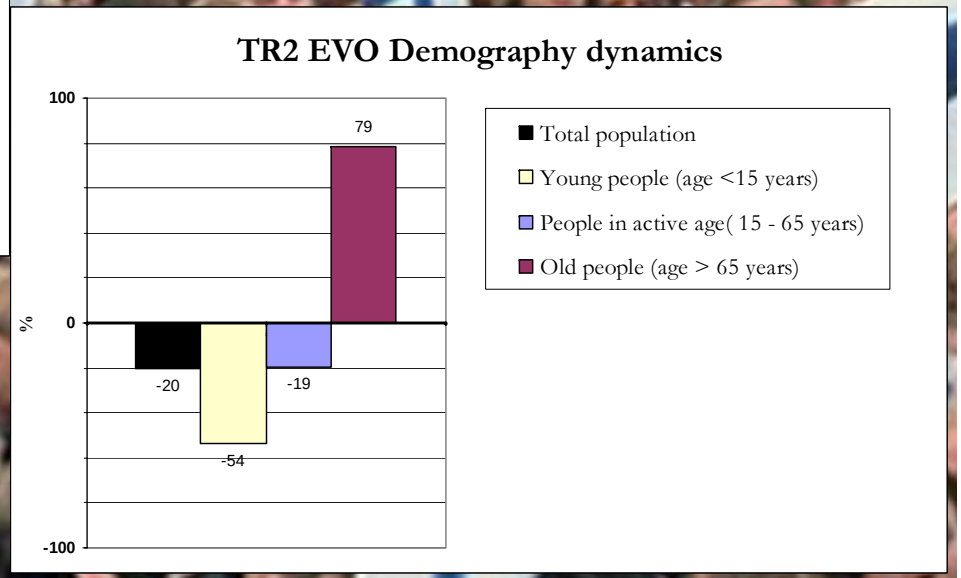
DPSIR
Finland - Riihimäki - Hyvinkää

DRIVING FORCES	Demographic trends Transport network Urban sprawl	Economic pressures Urban sprawl	Agricultural policies Economic trends Subsidies	Economic trends
PRESSURES	**Urbanisation**	**Deforestation**	**Afforestation**	**Intensification**
STATE Land Cover Changes	Increase in artificial surfaces increase of major roads	Forest and transitional woodlands turn into artificial surfaces Forest turned into transitional woodland	agricultural areas tuned into forest	decrease of arable land and pastures afforestation--intensification
IMPACT Impact on Biodiversity	Forest fragmentation loss a valuable habitat urban sprawl takes over agricultural land and forest	Forest area that turn into urban-forest loss clearcuts- loss of valuable forest habitats	Lake-and riverside fields with scattered farmhouses turned into managed forest	Loss of valuable open habitat types and ecotones Increase of pine forest with no biodiversity value
RESPONSES:	Not Applicable here			

Population Dynamics Finland 1950 - 2000

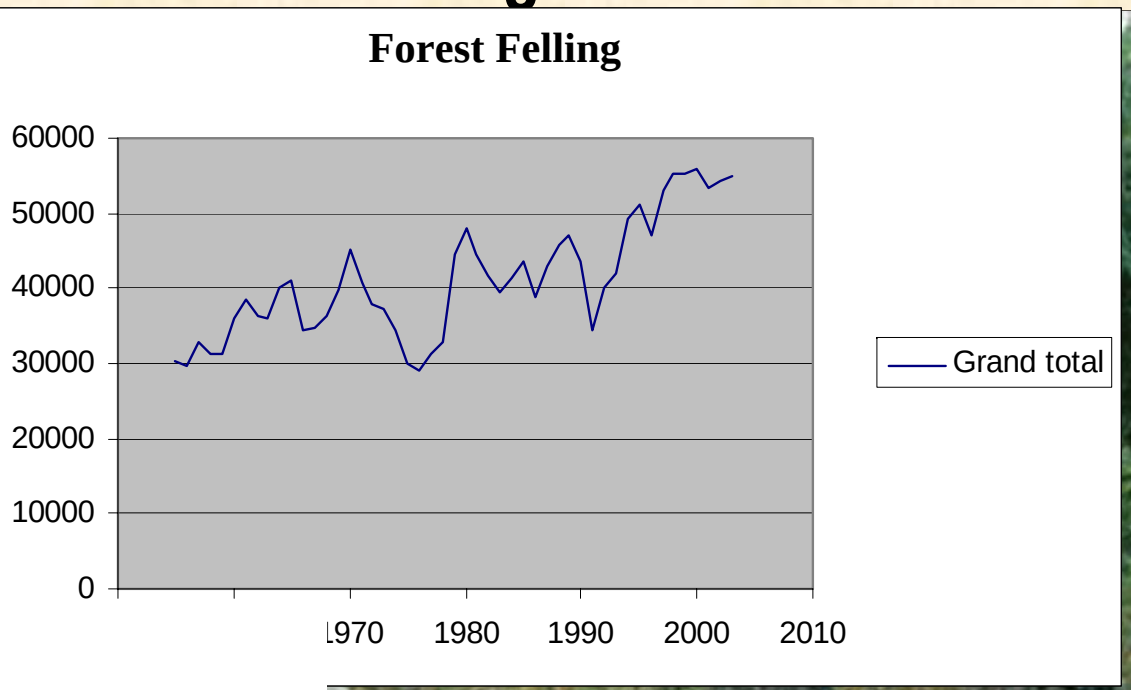


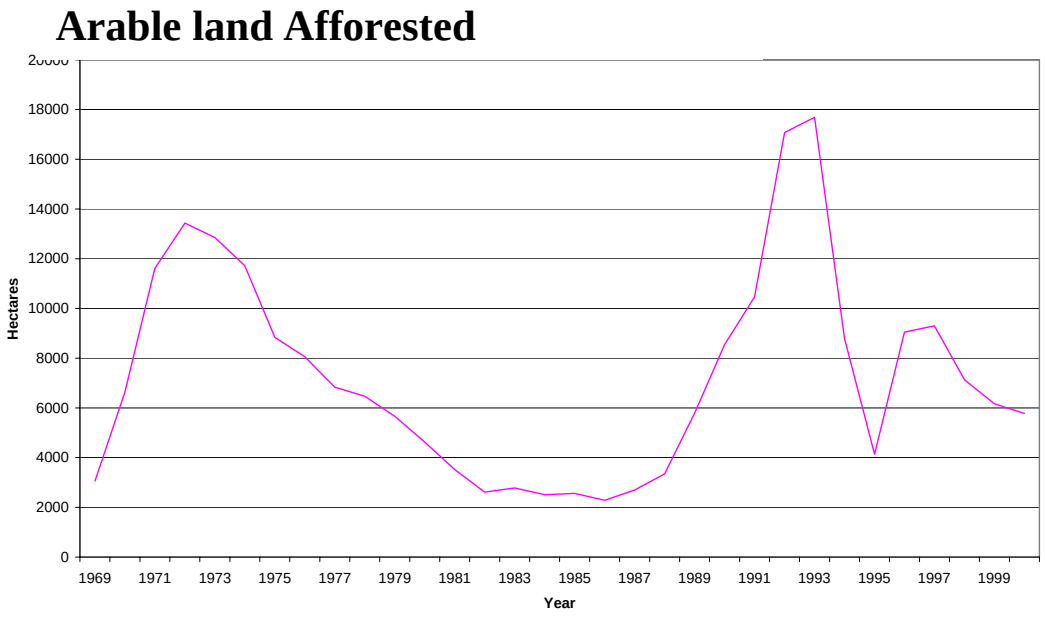




FINNISH FOREST RESEARCH INSTITUTE
METLA

Afforestation/Deforestation = Forest management





FINNISH FOREST RESEARCH INSTITUTE
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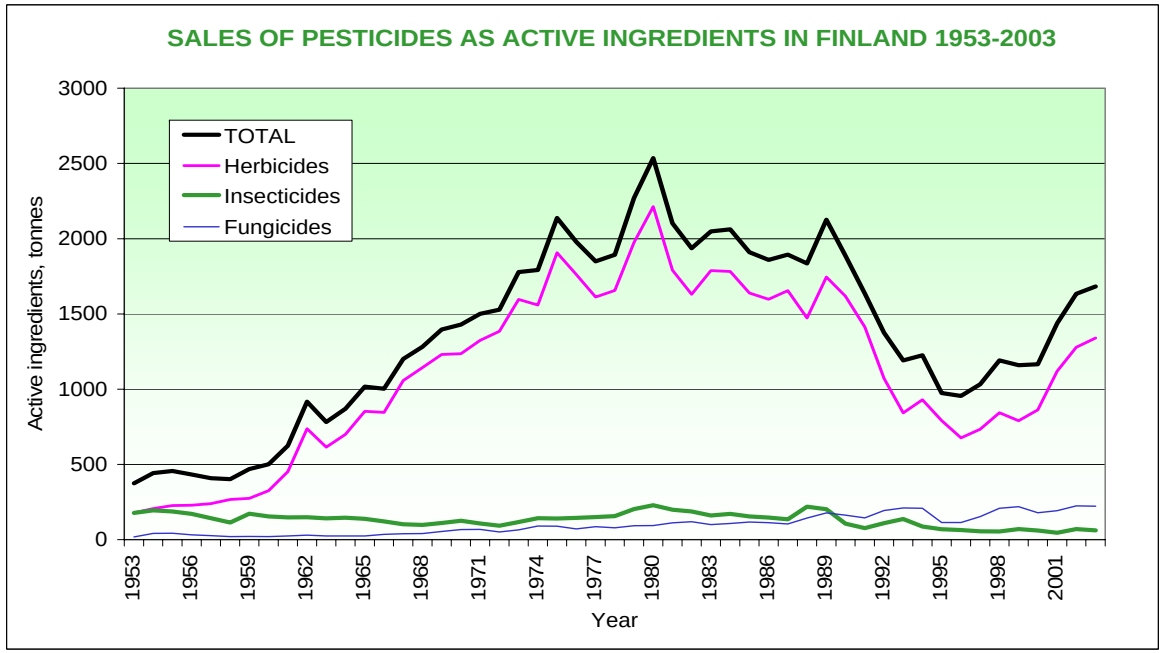
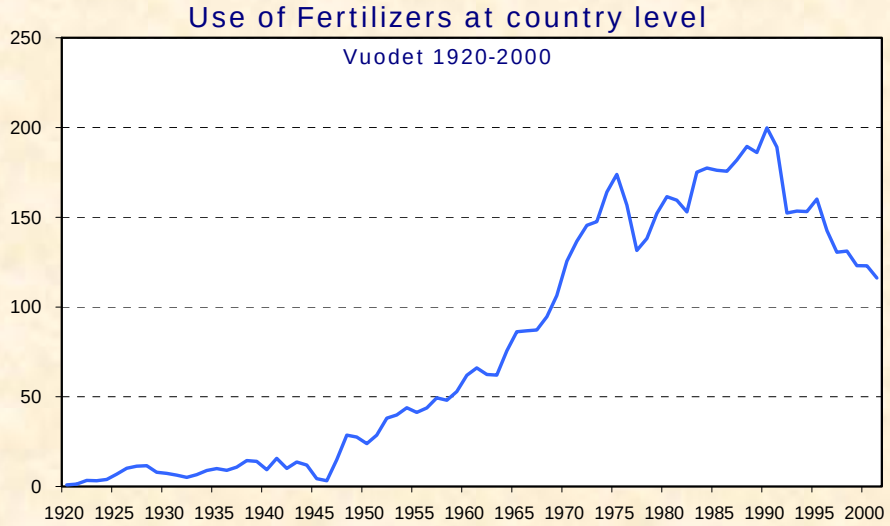
Intensification

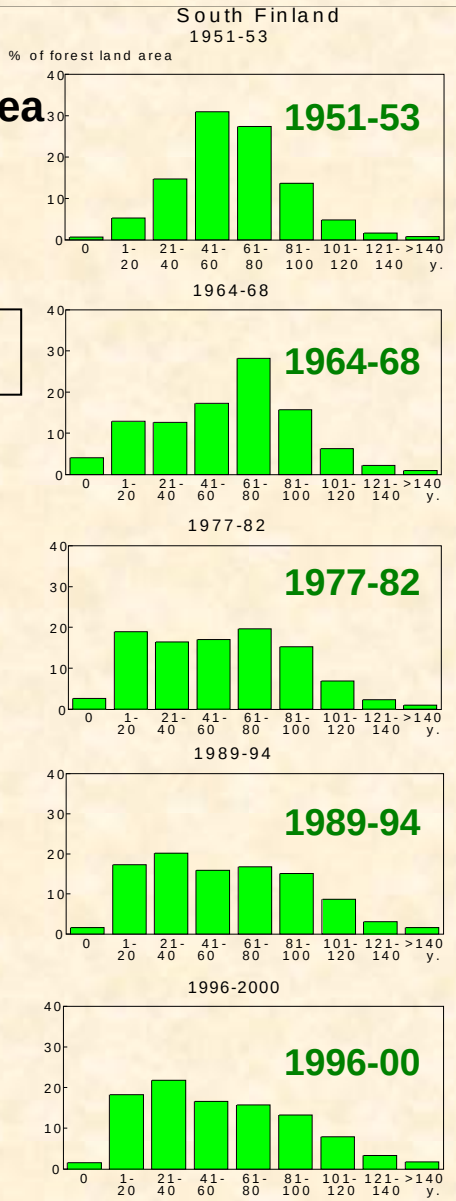




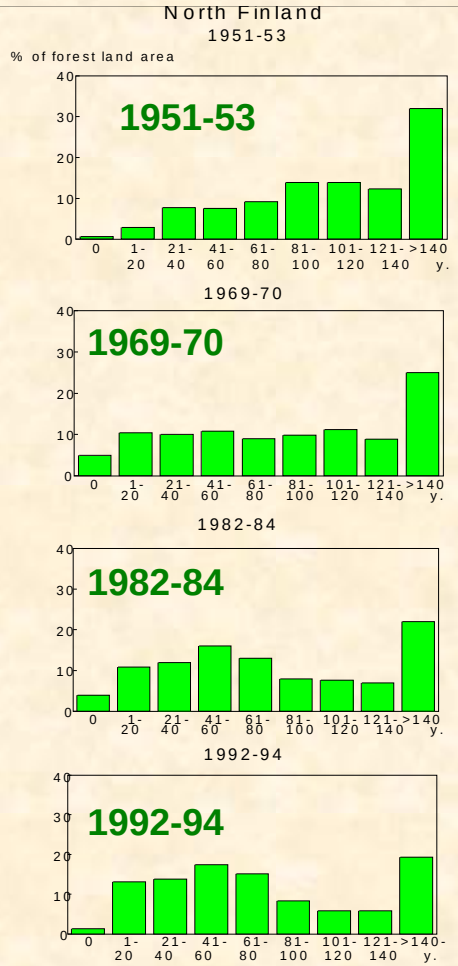
Age distribution of stands on forest land in South and North Finland 1951 - 2000

% of Forest land area

South Finland



North Finland



Punch lines

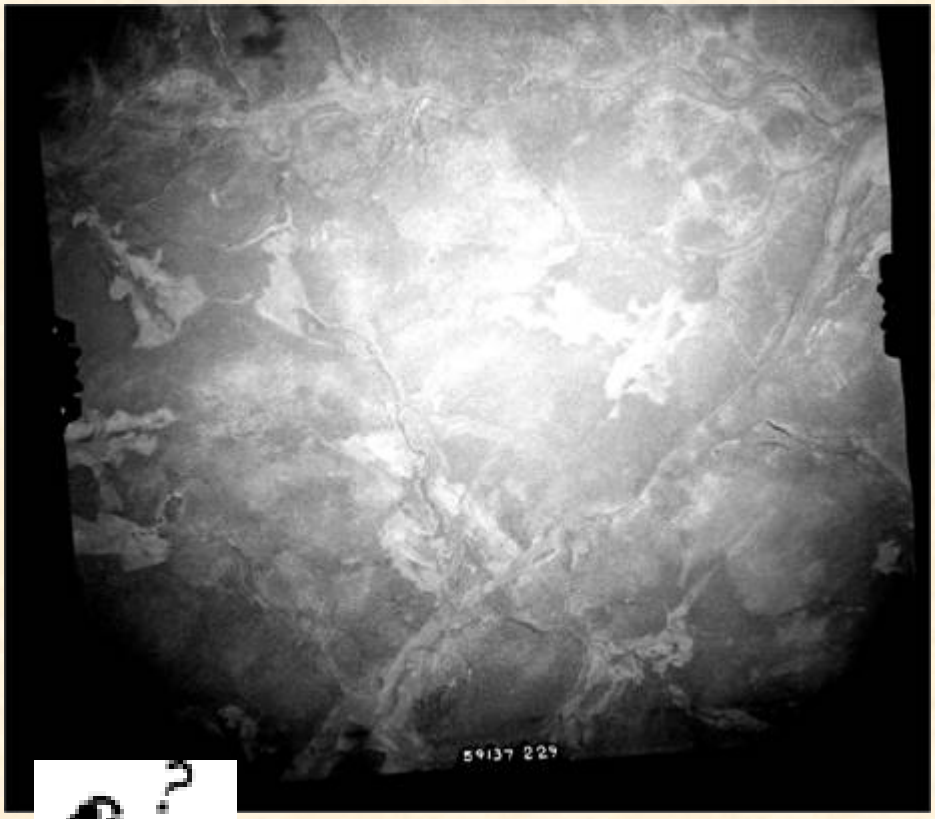
- **Indicators must be designed to deliver information at spatial and temporal scales that reflect the pressures variability.**

- **Conformity of geographical scale, spatial resolution, reporting period/intervals and data formats across the different information sources is vital.**

- **Integrate land cover change and selected indicators: Bottom-up approach & use of analytical zoning**

- **Use a spatial framework to compute and integrate indicators with a spatial component (e.g. Bio-geographical regions map of Europe or newly developed Landscape map from ALTERRA: *http://www.elcai.org/full_descr.pdf*)**

- **Describe and predict the consequences (impact) of the observed land cover changes (state) and quantified pressures on biodiversity.**



Salla – Tuntsa Region
1949
Northern Boreal

Salla – Tuntsa 2000

Syöte – Raatevaara Site
1999 / 1958