EUROPARC CONFERENCE.12 GENK - BELGIUM

Workshop Parks and Professors

Scientific research for the benefit of all

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National Parks and scientific research

- Long history of scientific research:
  - natural history, collecting permits, surveys
  - population management issues
  - ‘laboratories’: scientific research extended beyond the study of the park itself
  - integrated management, resource management

  However, often lacked continuity, coordination, and depth.

  Fragmented between divisions and branches,

  Has suffered because of a failure to recognize the distinctions between research and administrative decision-making,

  Has failed to ensure the implementation of the results of research in operational management.
- Plea for a "new vision" to meet the environmental challenges of the 21st C. , "a vision based on the principles of ecosystem management [and] on sound research."

- According to the National Park Service, the primary objective of the current science program is to conduct directed research studies that provide information in support of park planning, development, management, and visitor education and enjoyment. Because the resources that are studied run the gamut from biological (e.g., vegetation, wildlife, fisheries) to geophysical (e.g., water, air, caves, soils, islands, minerals) to cultural (e.g., archaeological ruins, monuments) to aesthetic (e.g., scenic vistas, quiet places), the NPS science program must include elements of the biological, geophysical, and social sciences.

SCIENCE AND THE NATIONAL PARKS; Committee on Improving the Science and Technology Programs of the National Park Service, NATIONAL ACADEMY PRESS Washington, D.C. 1992

National Parks and scientific research *today*

- a science program that
  - meets the needs of resource managers,
  - helps the public understand and enjoy park resources,
  - and contributes to understanding our changing world
- focus on
  - management, planning and operational practices,
  - visitors and stakeholders ‘education’ and interests
  - broaden scientific understanding

Mutual knowledge needs

- National Park is a *public space:* conservation area, recreation area, … AND a *laboratory*: a research platform
- Research demand of **National Park managers**:
  - the scientific foundation for the implementation of national park goals (high level policy support)
  - monitoring of the efficiency and effectiveness of national park management
  - knowledge and insight in the socio-economic and socio-ecological relationships between the national park, its visitors, and its periphery
  - optimization of the potentials for different ecosystem services
- Research demands of the **Scientific community**:
  - Analysis of the undisturbed development of the biocenoses and ecosystems
  - Determination of anthropogenic influences and their effects on the ecological communities
  - Understanding of the interrelations between different ecosystem services

Monitoring, *the functions*

- signalizing / early warning function
  - assessing the state of biodiversity, …

To yield reliable results: changes in the performance of a variable (for instance decline of a population) should be identified with a statistical test → an appropriate sampling design is necessary.

sufficient to decide about the next steps, 'what to do'?.

→ initiate proper research to elucidate the causes and mechanisms of the observed change: knowledge base for further tailored conservation action

- assessment / control function
  - assessment of the effect of particular measures, policies, societal activities and developments in general (i.e. comparison affected / not affected)
  - monitoring focuses on precisely the information needed to make conservation decisions (long-term objectives + highly dynamic context → cope with uncertainty)

→ *adaptive management*

- ✓ estimates of system state: state-dependent decisions
- ✓ estimates of system state: progress towards objective?
- ✓ estimates of system state: comparison against model predictions (discriminating among competing models of system response)

Improve project (adapt objectives, measures) based on new knowledge gained

- Wrong understanding of the system
- Management measures badly implemented
- Site conditions changed
- Monitoring unreliable

See also: (James D. Nichols & Byron K. Williams. 2006. Monitoring for conservation. *TRENDS in Ecology and Evolution*, 21:668-673.

Setting up appropriate *collaborative* monitoring strategies

- Involve stakeholders; increase partnership; distribute responsibilities

Land users monitor the effect of their management efforts

Example: *Integrated management of species-rich meadows in the Massif des Bauges, France*

Straightforward monitoring routine, developed by the Parc in collaboration with INRA-Avignon

The method is simple:
the objective is achieved when at least 4 plant indicator species from a pre-defined list of 24 species are present in each 1/3 of a parcel.
If so, the grassland is considered to have a good conservation status while, at the same time, it yields a high quality fodder for dairy cattle and cheese production.

Liste des plantes indicatrices des « prairies fleuries » du massif des Bauges

Common interests

- To increase public awareness regarding environmental and biodiversity problems and potentials, and to improve the understanding of the management policy and measures of the National Park authorities
- To communicate scientific research & practice and its results to the public
- To gain increased public support for proper scientific research

Characteristics of a National Park regarding scientific research

Scale combined with **less affected ecological conditions**

- Potential to study (nearly) undisturbed natural processes and phenomena

→ research should start from that, concentrate on that: *National Parks as reference areas*

- Optimal for the study of large scale processes and large scale (restoration) measures

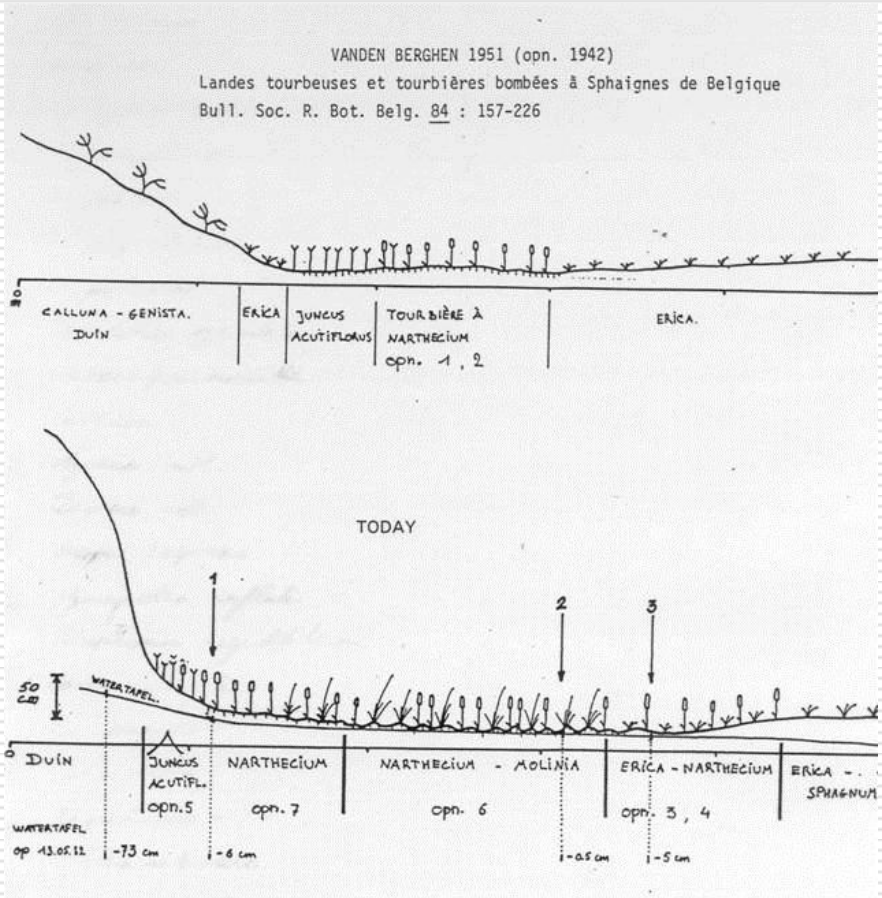
→ research questions should be selected in accordance with this scale;

seasonal migration, aeolian processes (erosion, sedimentation and landscape formation), fluvio-dynamic processes, etc.

Opportunity for research, the *laboratory function*

Reference area

Scale → potential for undisturbed hydrological conditions

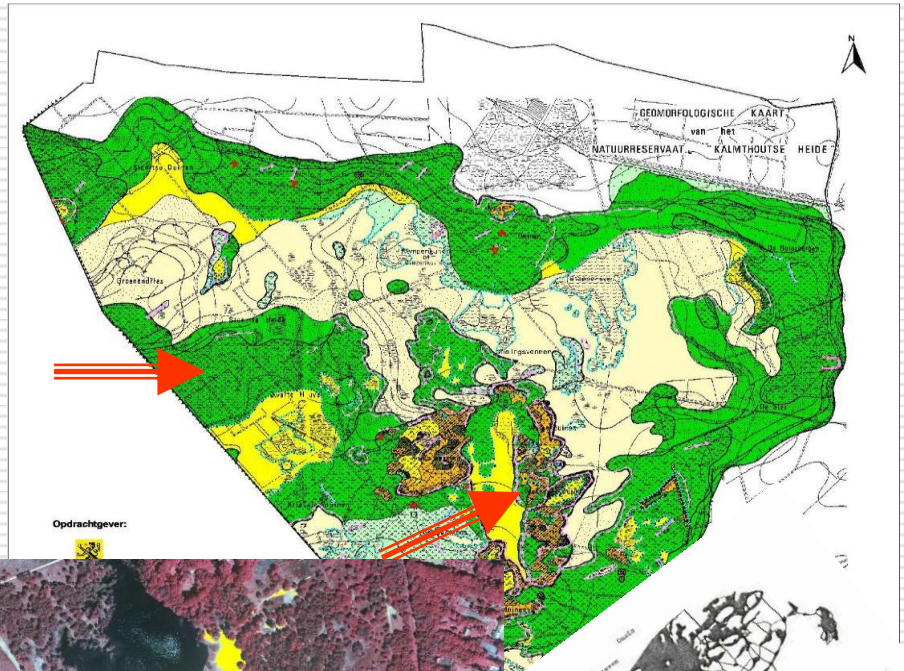


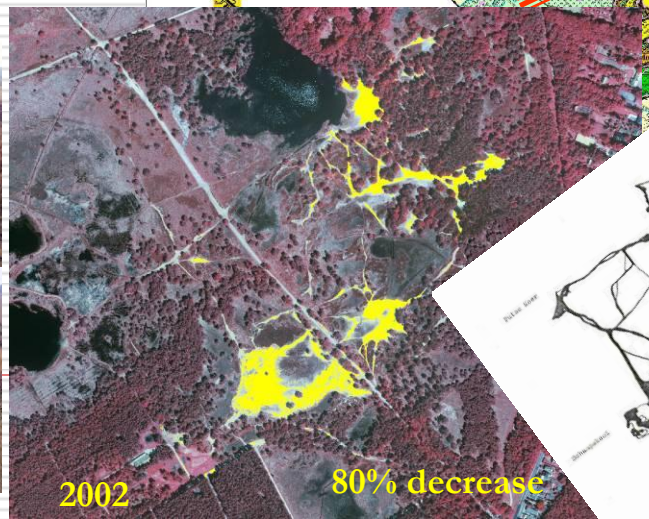
Large scale processes & measures

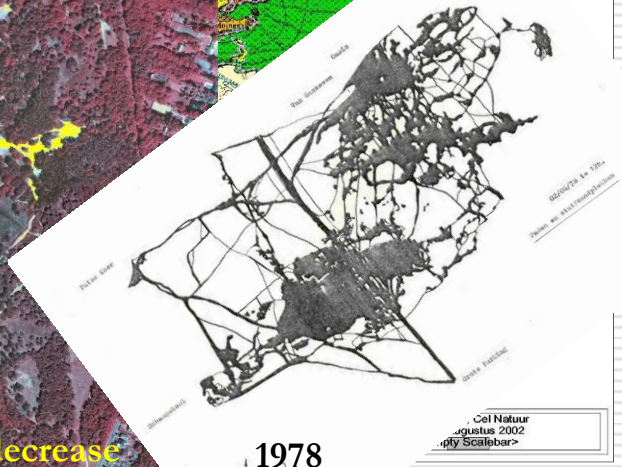
NP: relying on natural processes to reach set objectives ?

✓ (2330) Inland dunes with open Corynephorus and Agrostis grasslands

Threat: area of bare shifting sand is decreasing dramatically







Small scale removal of moss and grass carpet

Kambuusduinen

Before (September 2005)

Kambuusduinen

After (September 2008)

Stripped in winter 2003, state in January 2006

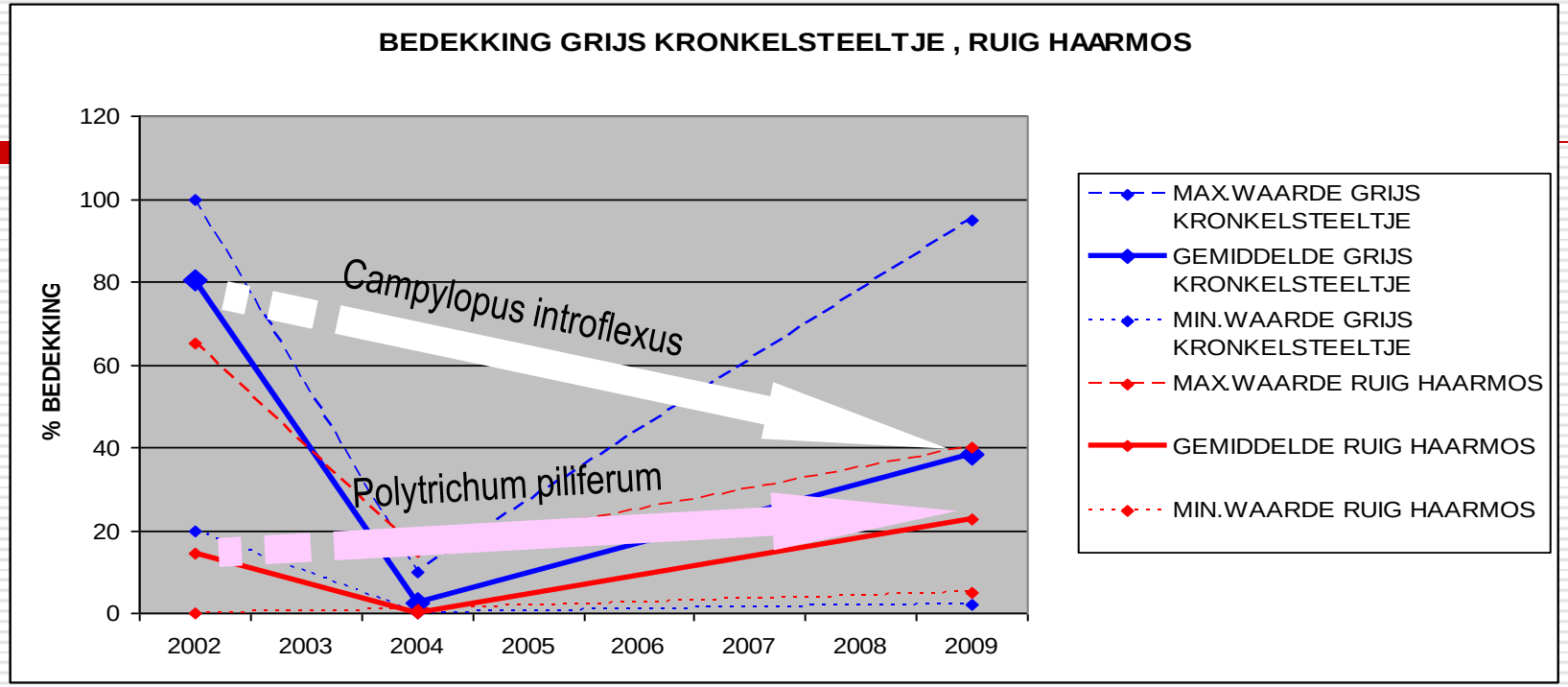
Stripped 2002 & 2003, state Oc

Active move restored?

Kambuusduinen *stripped October 2007*
state March 2009

Kambuusduinen *stripped October 2007 state March 2009*

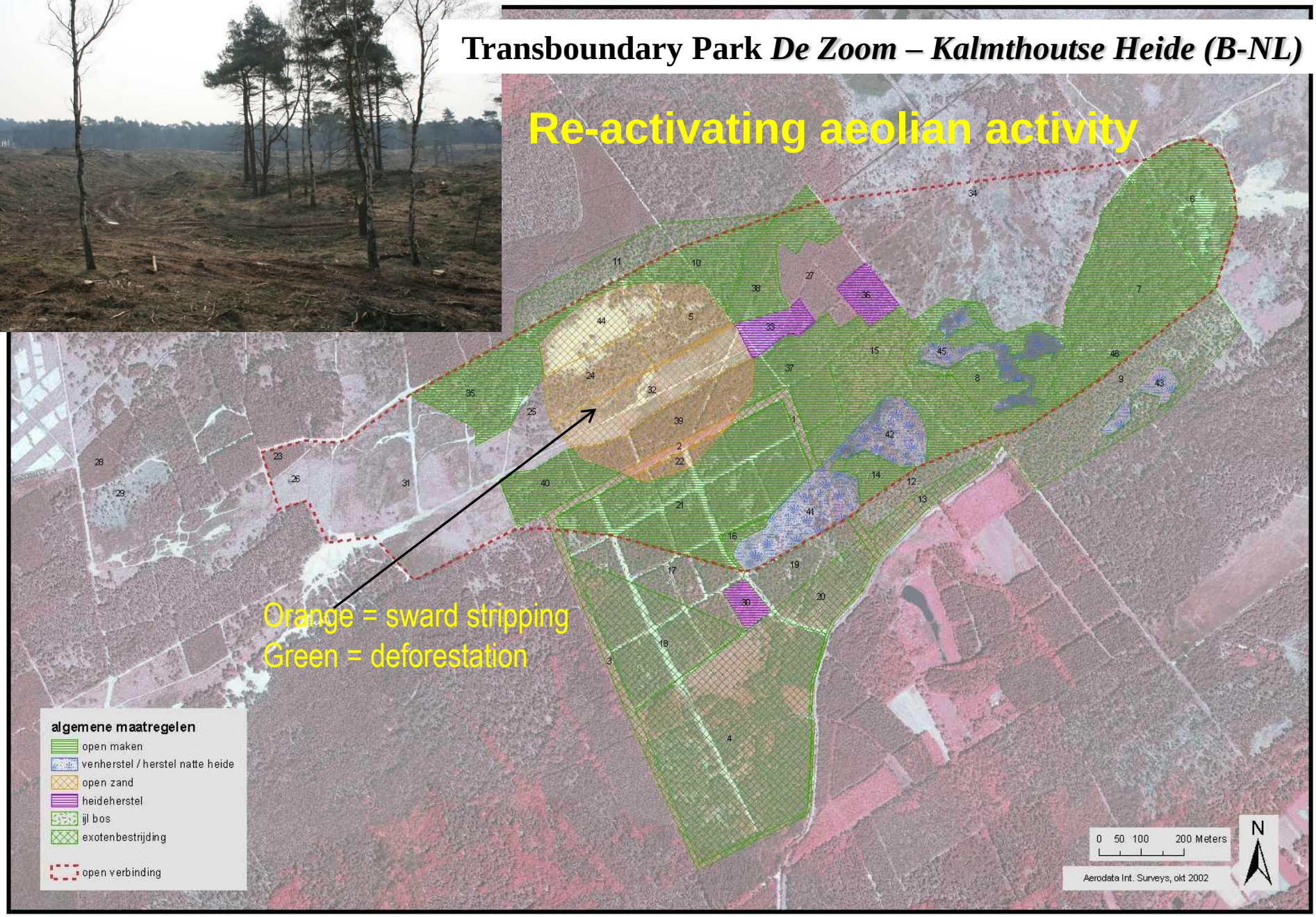
Moss cover ….



Overall effect (mosses + grasses): after +/- 7 years, open habitat is covered again

Action on landscape level is necessary

Transboundary Park *De Zoom – Kalmthoutse Heide (B-NL)*



LIFE project **wind corridor**

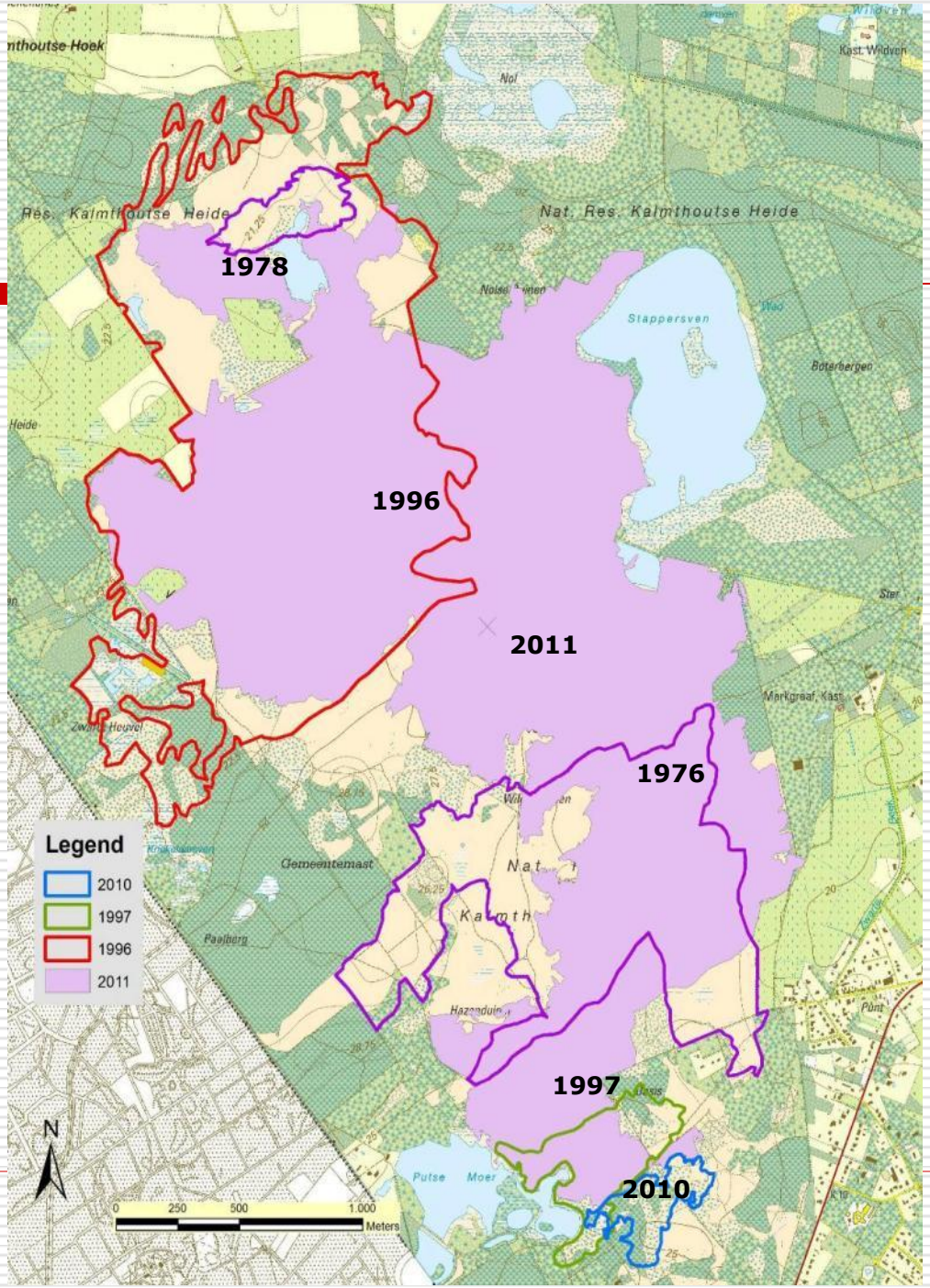
Changed conditions (internal: fuel accumulation; external: residential areas and intensive land use) …special attention: the risk for wildfires


Foto's Marc Slootmaekers
1996

Kalmthoutse heide

35 years wildfires

- ✓ (late) spring (and summer)
- ✓ Large areas 40 – 450 ha)
- ✓ Different frequencies



Climate change and wildfires

- Milder winters → more biomass/fuel → greater risk of wildfire
- Milder winters → early start of the growing season → decrease risk of fire in spring and early summer
- More frequent intens and longer summer drought → extend of the high risk summer period for wildfires

Albertson et al. 2010. … wildfires in the Peak District, UK. *Climate Research*

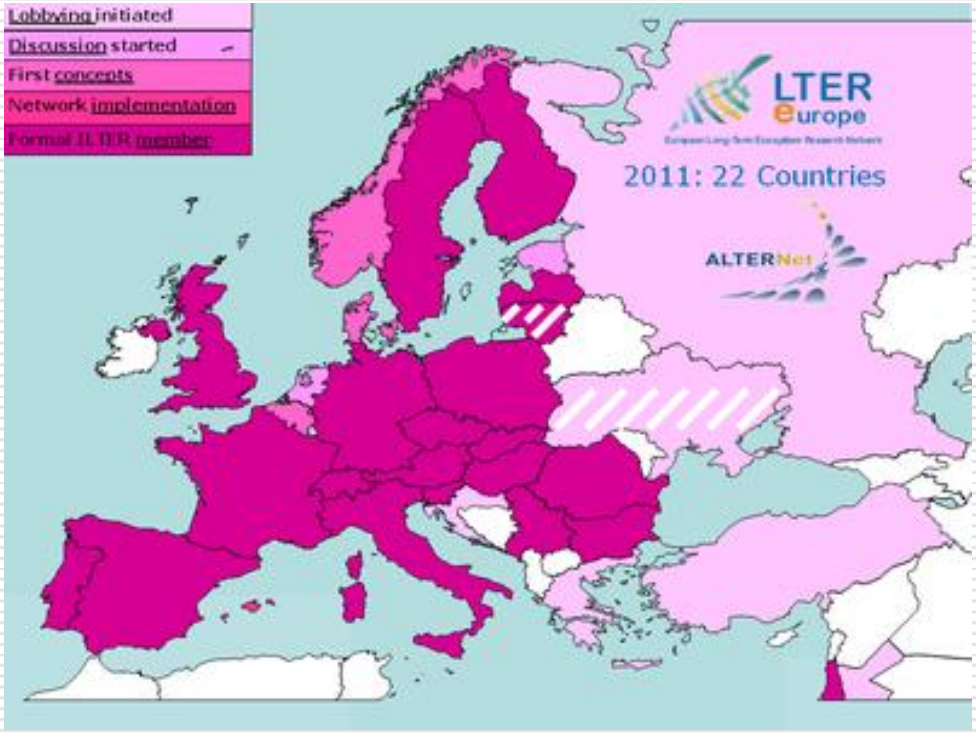
- Scenario limited emission: no major change in incidence of wildfires for the next 50 years
- Scenario high emission: increase of wildfires during spring and summer

Uncertainties!!

Vegetation composition an phenology not taken into account
Uncertainty about wind speed
Changes in human behaviour not taken into account

National Park: Laboratory function
Long-Term Ecological Research network

- Co-operation for fundamental ecological pressure – state – response research
- Research potentials of National Parks recognized and appreciated by LTER



LTER network main objectives

- to identify drivers of ecosystem change across European environmental and economic gradients
- to explore relations between these drivers, responses and developmental challenges
- to elaborate a common research agenda, harmonized parameters and methods
- to develop criteria for LTER Sites and LTSER Platforms to support cutting edge science with a unique in-situ infrastructure
- to improve co-operation and synergy between different actors, interest groups, networks, etc.

- **LTER Site**: LTER-facility of limited size (up to 10 km²) and comprising mainly one habitat type and form of land use. Activities concentrate on small-scale ecosystem processes and structures (biogeochemistry, selected taxonomic groups, primary production, disturbances etc.). There are often unique long-term datasets associated with LTER sites

LTER Germany

WEB-Site LTER Germany: http://www.lter-d.ufz.de/

Name of Site	Info – base ID	Site Type	Bio Geographi-cal Region	Contact Person	Contact e-mail	Web-Site
Bornhöveder Lake District	314	Complex site	Atlantic	Felix Müller	fmueller@ecology.uni-kiel.de	www.ecology.uni-kiel.d site in prep.)
Darss-Zingst Bodden	315	Complex site	Continental	Hendrik Schubert	hendrik.schubert@biologie.uni-rostock.de	
DFG Exploratories for functionell biodiversity	316	Complex site	Continental	Simone Pfeiffer	simone.pfeiffer@uni-potsdam.de	
German Bight (Helgoland)	317	Simple Site	Atlantic	Justus van Beusekom	jbeusekom@awi-bremerhaven.de	http://www.awi-bremerhaven.de/BAH/i
LH-BadLauchstädt	1301	Simple Site	Continental	Mark Frenzel	mark.frenzel@ufz.de	
LH-Friedeburg	1294	Simple Site	Continental	Mark Frenzel	mark.frenzel@ufz.de	
LH-Gimritz	1298	Simple Site	Continental	Mark Frenzel	mark.frenzel@ufz.de	
LH-Greifenhagen	1296	Simple Site	Continental	Mark Frenzel	mark.frenzel@ufz.de	
LH-Schafstaedt	1297	Simple Site	Continental	Mark Frenzel	mark.frenzel@ufz.de	
LH-Wanzleben	1295	Simple Site	Continental	Mark Frenzel	mark.frenzel@ufz.de	
LTSER Leipzig-Halle	318	LTSER platform	Continental	Mark Frenzel	mark.frenzel@ufz.de	
National Park (NP) Hainich	319	Simple Site	Continental	Manfred Großmann	gross-mann.mannfred@forst.thueringen.de	www.nationalpark-hain
National Park (NP) Mueritz	1512	Complex site		Matthias Schwabe	m.schwabe@npa-mueritz.mvnet.de	http://www.nationalpark
NP Bayerischer Wald	320	Complex site	Continental	Heinrich Rall	heinrich.rall@npv-bw.bayern.de	http://www.nationalpark bayerischer-wald.de/
NP Eifel	321	Complex site	Continental	Heye Bogena	h.bogena@fz-juelich.de	www.nationalpark-eifel
Research Farm Scheyern	322	Simple Site	Continental	Jean Charles Munch	munch@helmholtz-muenchen.de	http://fam.weihensteph
Rhein-Main Observatory	1513	Complex Site		Thomas Michl	Thomas.Michl@senckenberg.de	
Schorfheide-Chorin	323	Complex site	Continental	Vera Luthardt	vluthardt@fh-eberswalde.de	http://www.schorfheide
SH Wadden sea I	324	Complex site	Atlantic	Volker Siegel	volker.siegel@ish.bfa-fisch.de	
SH Wadden sea II	325	Complex site	Atlantic	Klaus Kossmagk-Stephan	klaus.kossmagk-stephan@nationalparkamt.de	http://www.wattenmeer nationalpark.de
Siedenburg Dumping ground	326	Simple Site	Atlantic	Hartmut Koehler	a13r@uni-bremen.de	
Solling	327	Simple Site	Continental	Michael Bredemeier	mbredem@gwdg.de	http://wwwuser.gwdg.d ee/sollingt.htm
Uckermark	328	Complex site	Continental	Wilfried Hierold	whierold@zalf.de	

Simple sites; what is the interest for the NP?

- NP, what does it get in return for the facilities offered?
  - → infrastructure for highly sophisticated manipulation experiments and data collection, not dependent on the large area of the NP, can be conducted and installed in other save sites?

For instance CLIMAITE (DK), a Danish research centre to investigate how climatic changes will affect biological processes and natural ecosystems (manipulation of CO_2 concentration, temperature and precipitation, to simulate the climate predicted for Denmark in 70 years time) (www.climaite.dk)

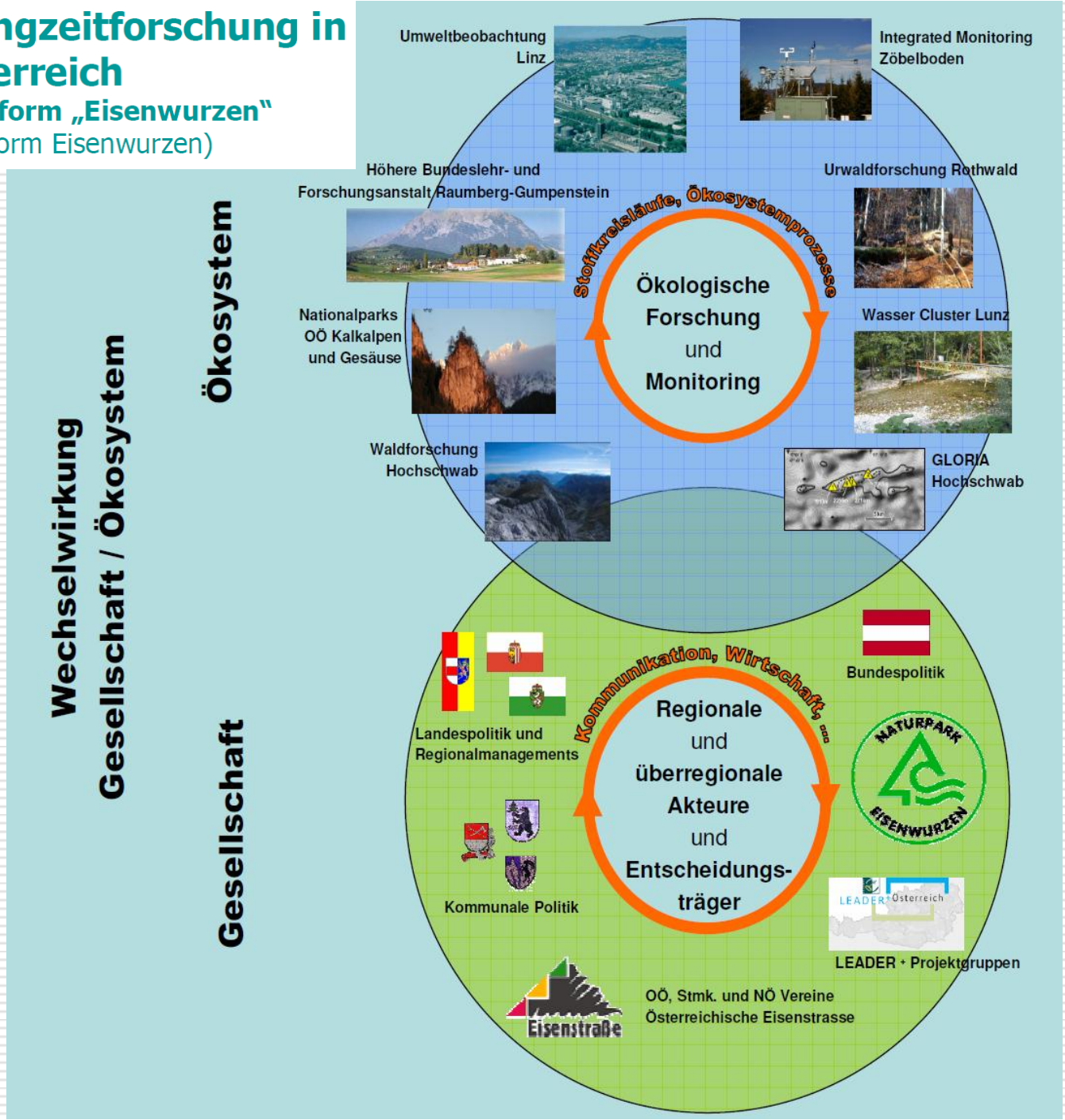
Complex sites; research meets the needs of NP

- **LTSER Platform** (Long-Term Socio-Ecological Research): Modular LTER-facility consisting of sites which are located in an area with defined boundaries. LTSER-Platforms provide multiple services
  - networking of client groups (e.g. research, local stakeholders),
  - data management,
  - communication and representation (management component).
- The elements of LTSER Platforms represent the main habitats, land use forms and practices relevant for the broader region (up to 10000 km²) and cover all scales and levels, from local to landscape.
- LTSER-Platforms should represent economic and social units or coincide / overlap with such units where adequate information on land use history, economy and demography is available to allow for socio-ecological research.

Ökologische Langzeitforschung in Österreich

Forschungsplattform „Eisenwurzen"

(LTSER-Plattform Eisenwurzen)



Defining knowledge needs, research questions for complex socio-ecological systems

- Successful implementation and functioning of a NP depends on regional and local collaboration → active involvement of different stakeholder groups.
  - Challenge: recognize different interests; **integrate different knowledge bases**

Combine exact scientific knowledge and layman knowledge of a system to achieve a common understanding, at least a collaborative specification and agreement on common certainties, uncertainties and real knowledge needs in developing management plans in areas with complex ecological and societal characteristics.

- How to formulate knowledge needs, problems, objectives?
- How to achieve collaboration and active involvement of various stakeholders.

Fuzzy Cognitive Mapping

- A **Fuzzy cognitive map** is a cognitive map within which the relations between the elements (e.g. concepts, events, project resources) of a "mental landscape" (in our case, the perception of a living landscape) can be used to compute the "strength of impact" of these elements. (after Wikipedia)

Used for creating and using models of uncertainty and complex processes and systems.

FCM in Western Polesie Biosphere Reserve (Poland)

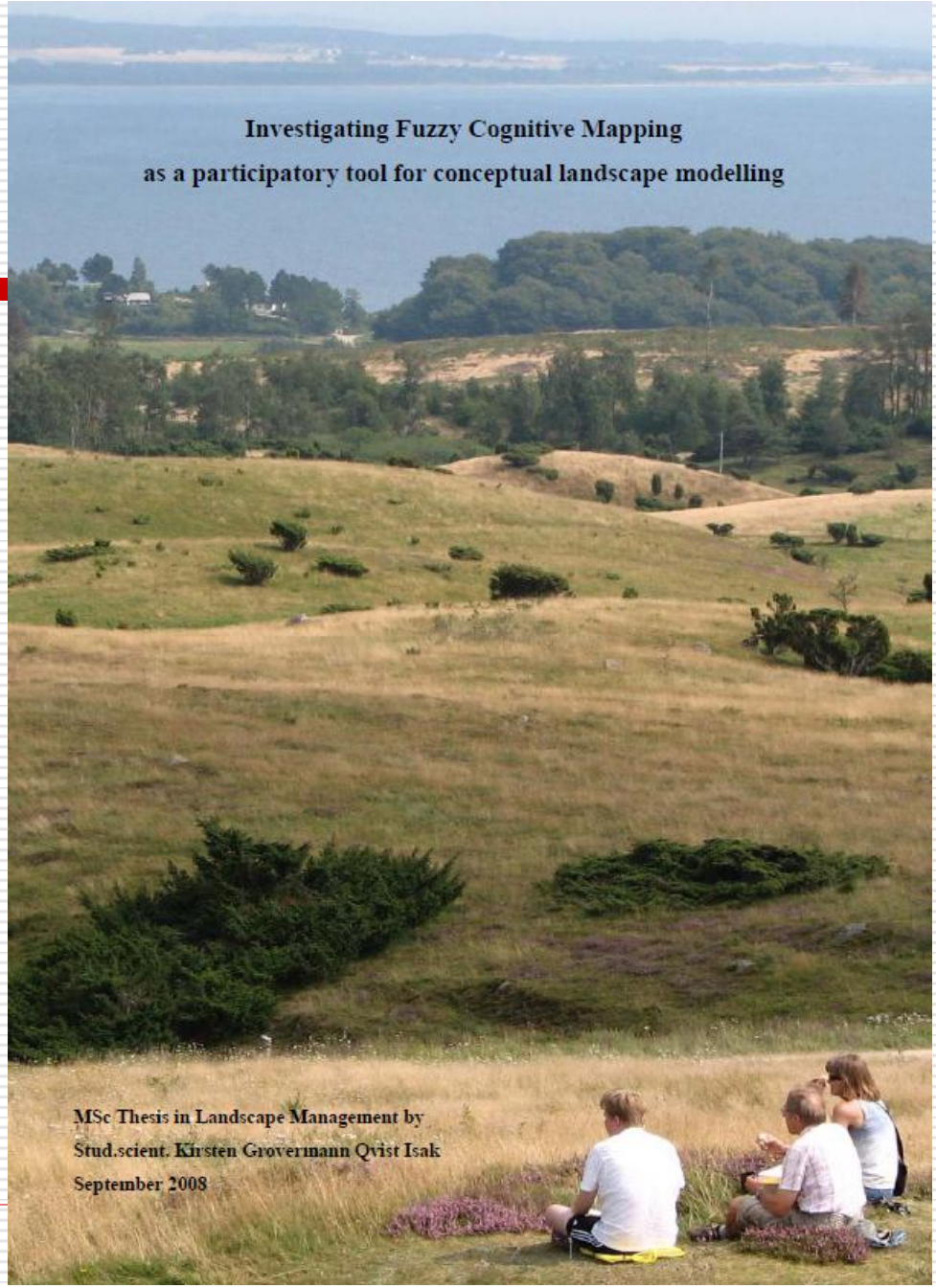
- We applied FCM in Western Polesie Biosphere Reserve (Poland) to analyze cause-effect relationships affecting characteristics of the park that were valued by the different stakeholders.

Kirsten G.Q.Isak, Martin Wildenberg, Mihai Adamescu, Flemming Skov, Geert De Blust & Riku Varjopuro. 2009. Manual for applying Fuzzy Cognitive Mapping – experiences from ALTER-Net, report 4.R6.D2; FP7

FCM in National Park Mols Bjerge (Denmark)

- Also applied in the National Park Mols Bjerge (Denmark) as a collaborative learning tool to improve communication between stakeholders when being confronted with opposing interests in the landscape while debating desirable and feasible changes in that landscape.

Kirsten G.Q.Isak. 2008.



FCM in practice

- The process of creating a FCM is done in three steps:
  1. Listing the concepts
  2. Connecting the concepts with arrows and indicating negative or positive influence
  3. Determine the strengths of the connections.

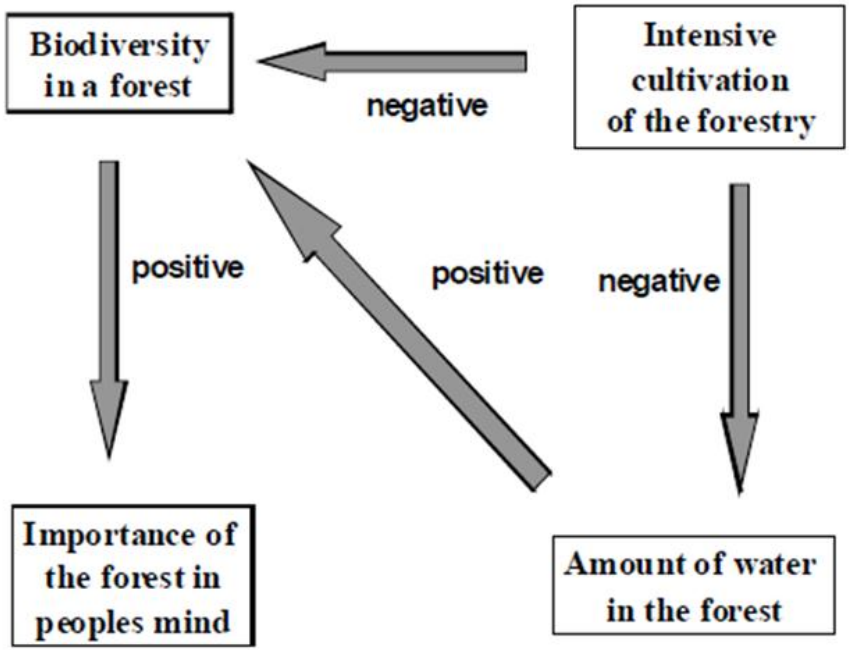
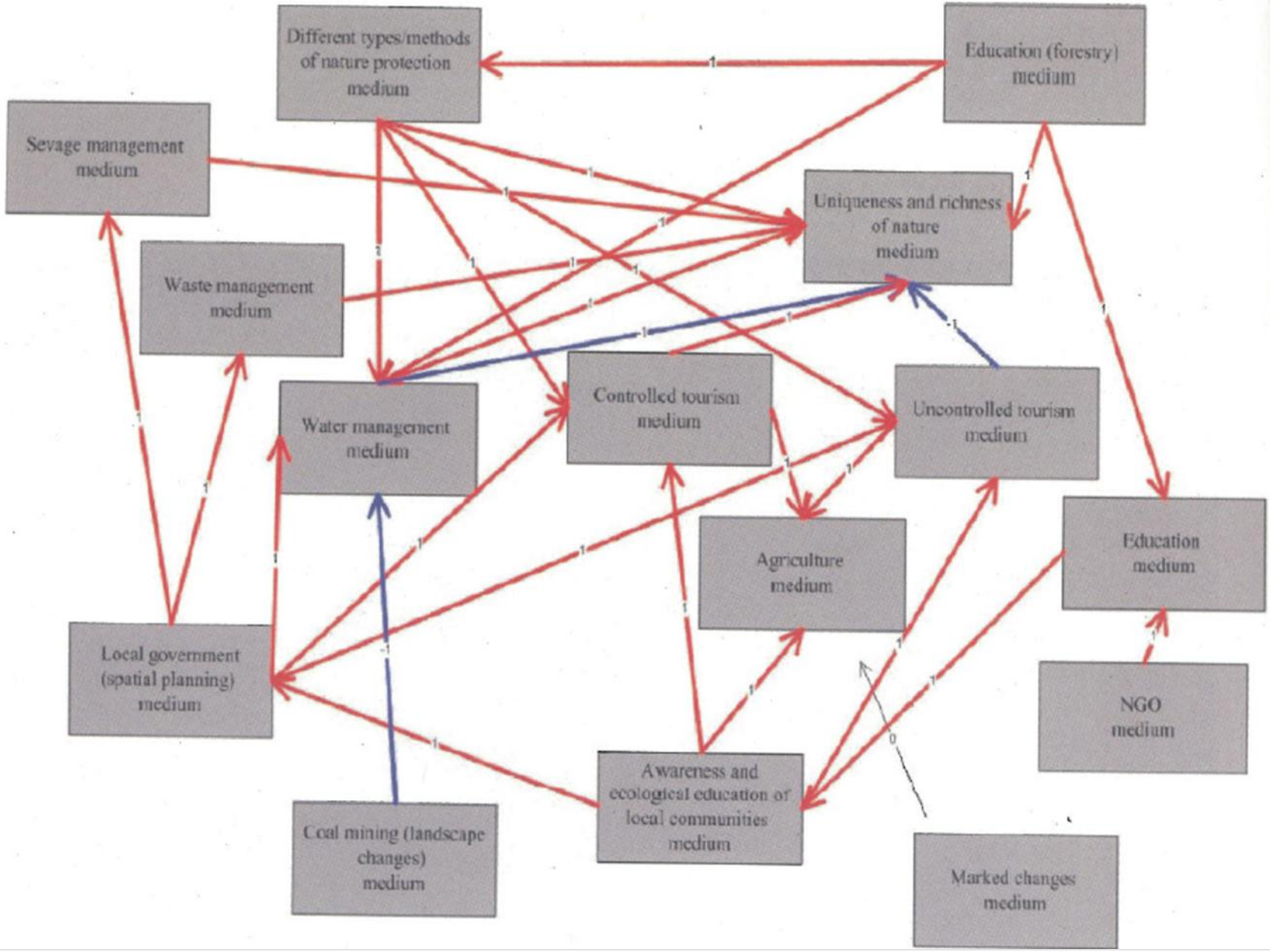


Figure 1: An example of a fuzzy cognitive map describing a forest in a simplified manner. The maps contains of four elements: *Biodiversity in a forest*, *Intensive cultivation of the forest*, *Amount of water in the forest* and *Importance of the forest in the peoples mind*. The four elements are linked through positive and negative effects on each other.



Asked: draw a FCM starting from the concept of ‘unique landscape’. A box contains the name of the concept and its value (here set to medium). Positive effects: red lines; negative effects: blue lines

Interview guide from a case study in Mols Bjerge, Denmark (Isak 2008).

Research questions	Interview questions
What does the informant perceive as important concepts in this landscape, and how is this being influenced by other concepts?	When you experience this place: • What is important for you? • What do you appreciate? • What do you not like? What: • Affects X • Causes X to have the value you describe?
Which factors (natural changes, human activities etc) can change this system?	What • Do you believe can change this picture? • Have changed since you started coming here? (natural changes / changes caused by humans What if: • More people are coming? • More noisy people are coming? • There are decided limitations to the management? • There are decided limitations to the traffic?
How affects these concepts each other (positively, negatively, feed back mechanisms)?	What happens with X when Y becomes larger/smaller? What happens then with Z?
How strong are these effects (small, medium, large)?	How: Large effect positive/negative effect does concept X have on concept Y (small/medium/large)? Important is it for concept X that concept Y changes (small/medium/large)?

Concepts for landscape description

List of possible concepts for describing a landscape with the use of FCM.
First column shows four landscape themes, column 2, 3 and 4 shows how these four themes can be described in more and more detailed concepts, and column 5 shows a list of possible concept to be used in FCM.

Themes				Concepts
Nature	Processes			Erosion
				Inundation
				Ecosystem functioning
	Species			Conservation status
				Number
				Diversity
				Characteristic species
	Habitat			Conservation status
				Size of area
				Characteristic habitats
Values	Individual			Memories
				Spirituality
				Sense of place
				Ownership
	Cultural (common)			Material
				Stories
Landscape scenery	Human			Landscape pattern
				Infrastructure
				Archaeological
	Natural			Terrain
				Hydrology
				Shoreline
				Landscape pattern
Human activities	Economic	Production		Industry
			Agriculture	Area with agriculture
				Intensity of agriculture
			Forestry	Area covered by forest
				Intensity of forestry
				Drinking water
		Services		Tourism
				Housing
	Recreational			Types of recreational activity
				Intensity of activities
	Politics and planning	Nature conservation		Management
				Restoration
				Education and information

FCM Structural and dynamic analyses

- Tables are used to map FCMs into matrices for further computation:
- The structure of fuzzy cognitive maps can be analysed and used when comparing maps created by a number of informants or groups. It can be investigated how many times a given concept is mentioned, and if many informants mention the same concept, it can be interpreted as important for the system.
- Fuzzy cognitive maps can also be compared through three indices, *the density index*, *the hierarchy index* and *the complexity index*.
- Fuzzy cognitive maps can also be analysed in a dynamic manner by investigating what happens if some variables (e.g. variables which are acting as drivers in the system) are given specific values continuously.

FCM can not make predictions but works as a tool for gaining an understanding of the system.

Experience from the Western Polesie Biosphere Reserve

- When created, a majority of the locals, especially farmers, expressed their disapproval.
- Local authorities however were convinced of the positive effects of the National Park for their communes
- Managers of the sites, together with local authorities and scientists had to go on developing suitable methods for the integrated management of the sites in harmony with the sustainable development of the region. Group and individual discussions were organized to explore fields and issues of common interest and mutual benefit
- Goals and priority tasks included, amongst others, a better conservation of green areas, soil protection, the improvement of water quality and water supply by building treatment plants and a supply system.
  - *Chmielewski*, T.J. (Ed.) (2007). *Nature conservation* management : from idea to practical results. European Commission: *Lublin*. ISBN 83-87414-98-0. 263 pp.

Questions for discussion

- How to explore the knowledge gaps?
- How to take different stakeholders' knowledge needs into account?
- How to go bridge the gap between knowledge demand and knowledge supply?
- How to organize the selection of relevant research questions?
- How to stimulate the evolution from thematic research towards true integrated research?
- How can scientific research and its results contribute to and stimulate social learning, increase shared and common understanding of the complex socio-ecological system?
- Is it desirable and feasible that NP define own research agendas and guide or 'control' research initiatives?
- What are the conditions to achieve successful collaborative research?
- What are the threats and constraints in this respect?