


Landscape ecology - pattern & process

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Gliederung der Vorlesung:

Was ist Landschaft ?

>>> *Einführung und Defintionen*

Was ist Landschaftsökologie ?

>>> *Konzepte, Methoden*

Wie arbeiten LandschaftsökologInnen ?

>>> *Anwendungsbeispiele*

Gliederung der Vorlesung:

Was ist Landschaft ?

>>> Einführung und Definitionen

Was ist Landschaftsökologie ?

>>> Konzepte, Methoden

Wie arbeiten LandschaftsökologInnen ?

>>> Anwendungsbeispiele

Sandstrand an der Nordküste Kretas

Geoökologie: *Ausgleichsküste, Winderosion*

Bioökologie: *Ökoton, Sukzession*

Humanökologie: *Ödland, Erholung*

Weisse Sahara / Ägypten

Geoökologie: *physikal.Verwitterung, Winderosion, arides Klima m.episod.Starkregen*

Bioökologie: *Extremlebensraum, artenarme Ökosysteme m.Spezialisten*

Humanökologie: *leerer Raum, Spritualität, Verkehrshindernis*

Colorado River / Canyonland NP Utah - USA

Geoökologie: *Sandsteinplateau, Fluviatile Tiefenerosion, Talmäander, semiarides Klima mit frostreichen Wintern*

Bioökologie: *störungsgeprägte Flussoase vs. ressourcengetönte Steppenlandschaft der Plateaus*

Humanökologie: *Wiege indigener Hochkulturen im Südwesten Nordamerikas, Bewässerungsfeldbau, Schutzbauten*

Dörfliche Sammelsiedlung – östliches Waldviertel

Geoökologie: *Rumpfhochfläche, oligotrophe Böden, kühl-trockenes Hochlandklima*

Bioökologie: *halboffene Agri-Kulturlandschaft, Arten- und Biotopreichtum, Randliniendichte*

Humanökologie: *hochmittelalterliche Kolonisation, Streifenflur, ländlicher Raum, sozio-ökonomische Marginalisierung*

What is a "landscape" ?

"a picture representing a view of natural inland secenery (prairie, woodland, mountain,...)"

(WEBSTER´s DICT. 1963)

"a portion of land or expanse of natural scenery as seen by the eye in a single view"

(OXFORD ENGL.DICT. 1983)

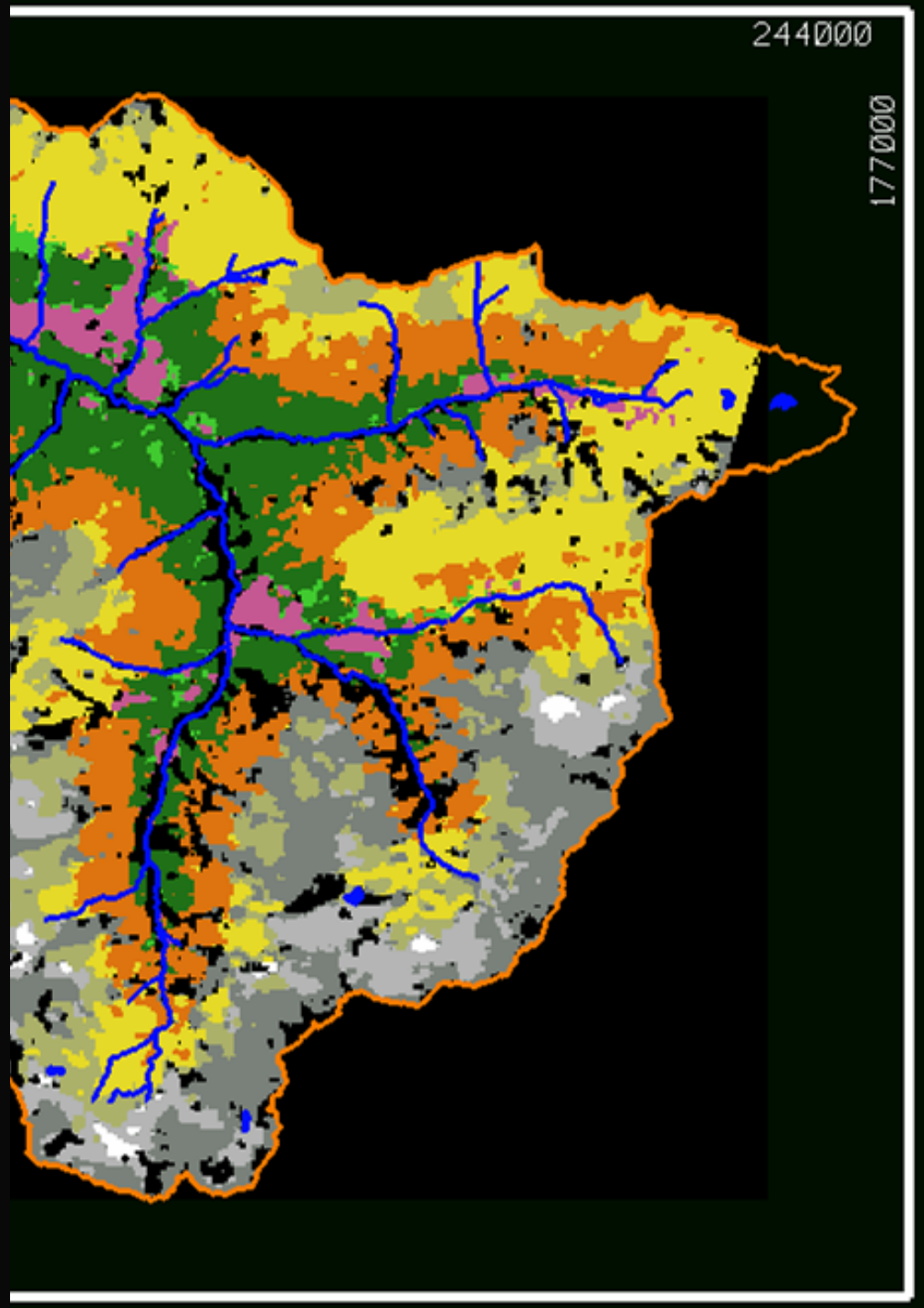
>>> eg. Scenery - approach

What is a "landscape" ?

"the landforms of a region in the aggregate"
(OXFORD DICTIONARY 1983)

"part of the earth´s surface which can be identified as a unit in respect to its processes and components as well as its spatial pattern"
(E.NEEF 1978)

>>> eg. Catchment -approach

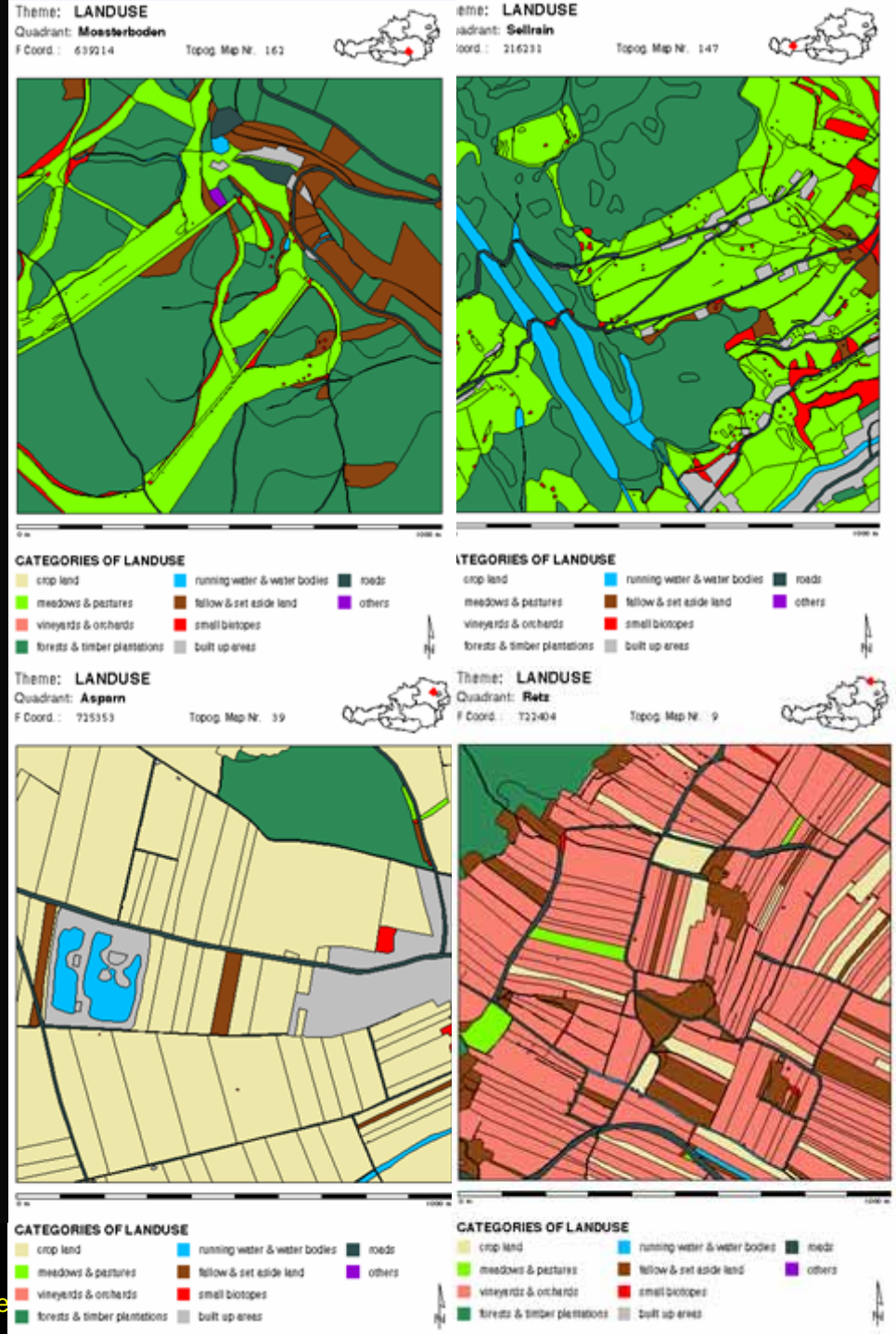


What is a “landscape” ?

“heterogeneous land area composed of a cluster of interacting ecosystems that is repeated in similar form throughout”

(Forman & Godron 1986)

>>> eg. Pattern / Structure - approach



What is a “landscape” ?

“the total character of a region”
(A.v. Humboldt 1780)

“totality of physical, ecological, and geographical entities, integrating all natural and human caused patterns and processes”
(Naveh 1987)

“a particular configuration of topography, vegetation cover, land use and settlement pattern which delimits some coherence of natural and cultural processes and activities”
(Green et al. 1996)

>>> eg. Totality - approach

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Landscape Ecology: structure, function, change

Landschaftsdefinitionen:

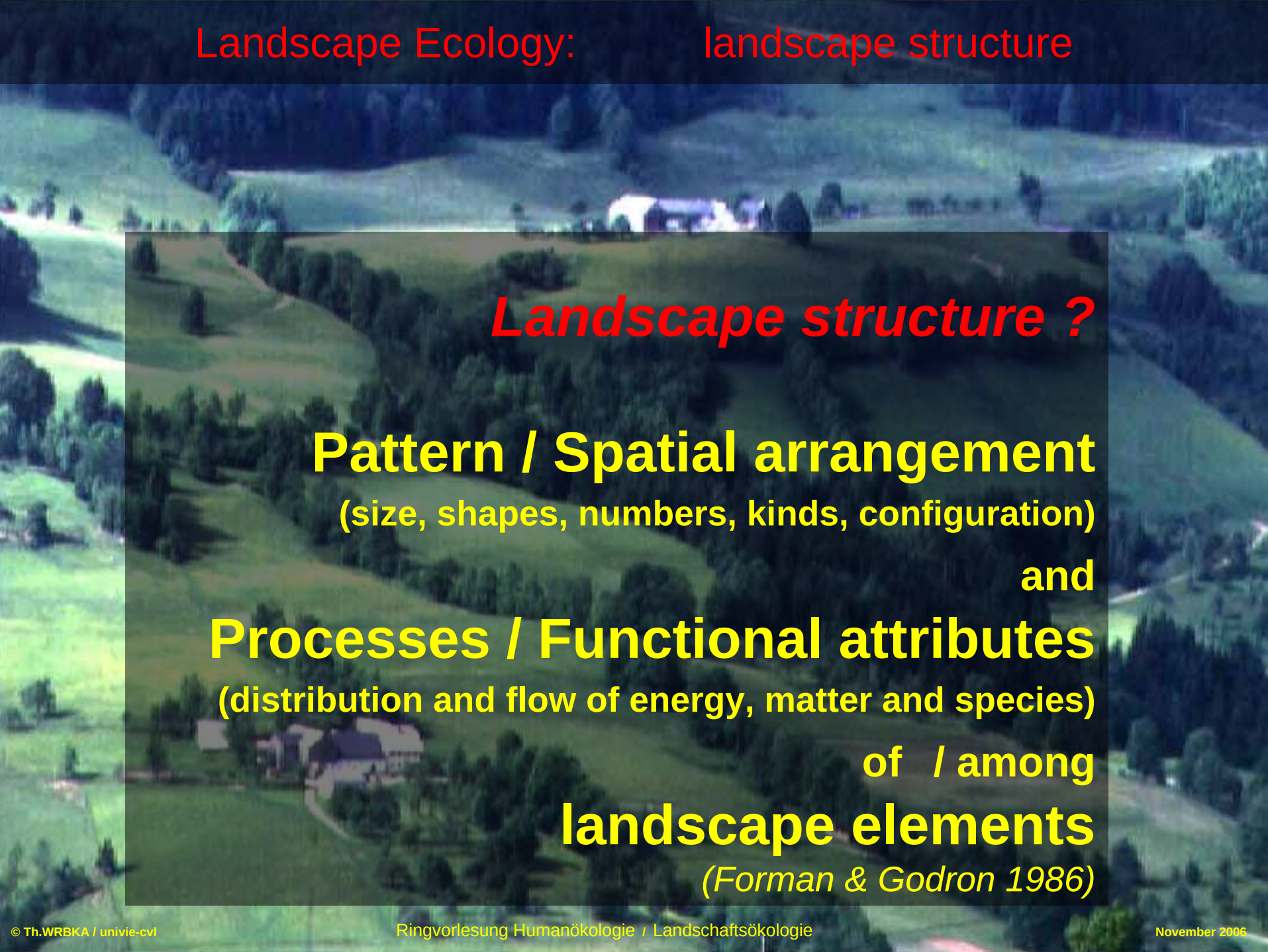
7. BIOÖKOLOGISCH

Landschaft / Landscape = a **part of the** space on the **earth's surface**, consisting of a **complex of systems**, formed by the activity of rock, water, air, plants, animals and man and that **by its physiognomy forms a recognizable entity**. (*I.ZONNEVELD 1979*)

Landschaft / Landscape = a **heterogeneous land area** composed of a **cluster of interacting ecosystems** that is **repeated** in similar form througout. L.can vary in size down to a few **kilometers** in diameter. L.have three fundamental characteristics:

1. **Structure**, the spatial relationship among the distinctive ecosystems or 'elements';
2. **Function**, the interactions among the spatial elements, that is the flow of energy, materials and species;
3. **Change**, the alteration in structure and function of the ecological mosaic over time.

(*FORMAN & GODRON 1986*)



Landscape structure ?

Pattern / Spatial arrangement

(size, shapes, numbers, kinds, configuration)

and

Processes / Functional attributes

(distribution and flow of energy, matter and species)

of / among

landscape elements

(Forman & Godron 1986)

Landscape Ecology: land units / landscape elements

Landscape Element ?

➲ **the basic, relatively homogeneous ecological land unit**

(general substrate conditions, vegetation, ecosystem functioning, land-use)

➲ **smallest mapable land unit**

(*Forman & Godron 1986*)

Landscape Ecology: matrix, patch, corridor - model

Landschaftselemente

= kleinste räumliche und funktionelle Einheiten der Landschaft

= "smallest possible land units that are still holistic units" (FORMAN & GODRON 1986)

drei Grundtypen können nach Form, Funktion und Genese unterschieden werden:

1. Matrix:

weist größte relative Fläche und hohe Vernetztheit auf, kontrolliert bzw. beeinflußt die ökologischen Schlüsselprozesse

2. Korridore

band- oder linienförmig;
üben Transport- oder Grenzfunktionen aus

3. Patches

kleinflächig, isoliert; können ressourcen- oder störungsbedingt, Reste einer früheren Zustandsform der Matrix, ephemer oder vom Menschen eingeführt sein

Landscape structure: patch origin

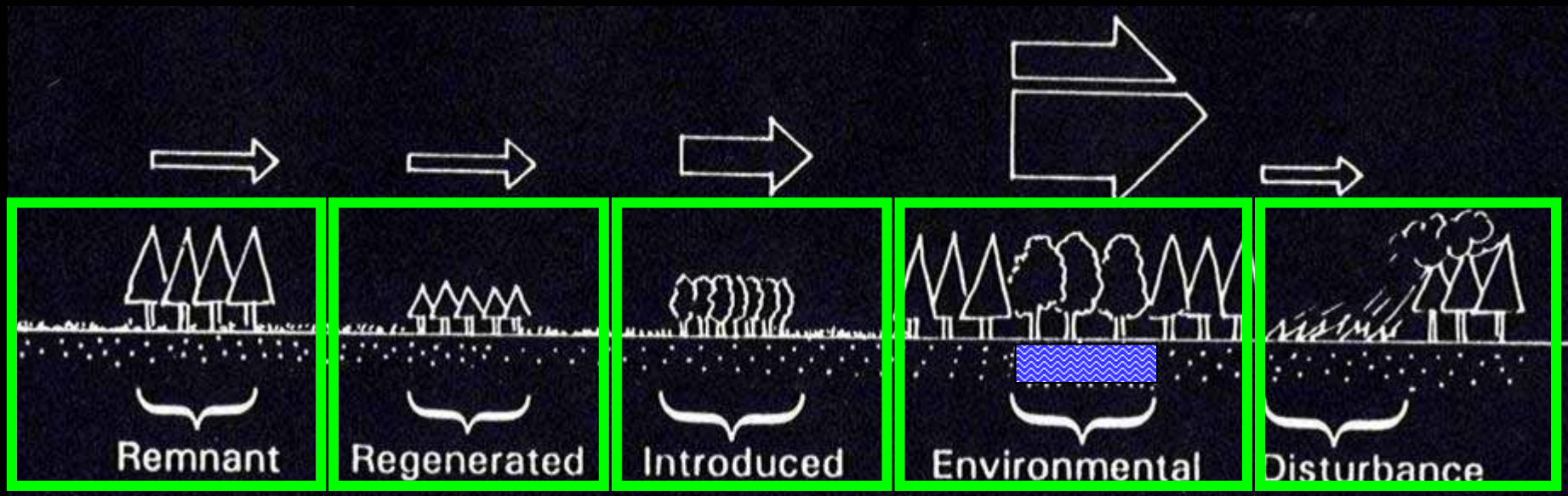
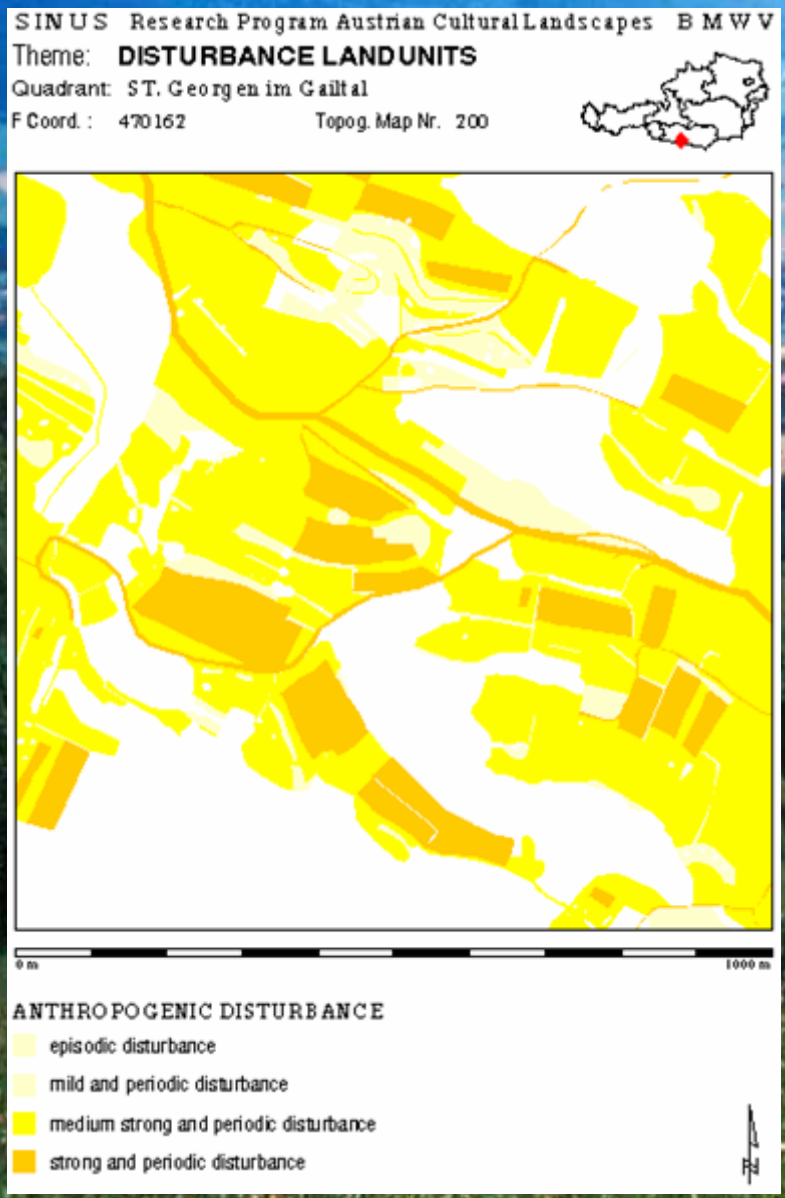


Fig. 2.1. Patch types, their origins and persistence. The five types illustrated assume the original landscape was mature coniferous forest. Thickness of arrow over each patch type is roughly proportional to its persistence or half-life.

Landscape Ecology: mapping, measuring and evaluating



Mapped attribute:
Anthropogenic disturbance
(ploughing, harvesting, grazing,..)

Measured indices:
Extent, connectivity, shape,…

Evaluation:
Medium strong and strong periodic disturbance intermingled

Landscape Ecology: pattern & process

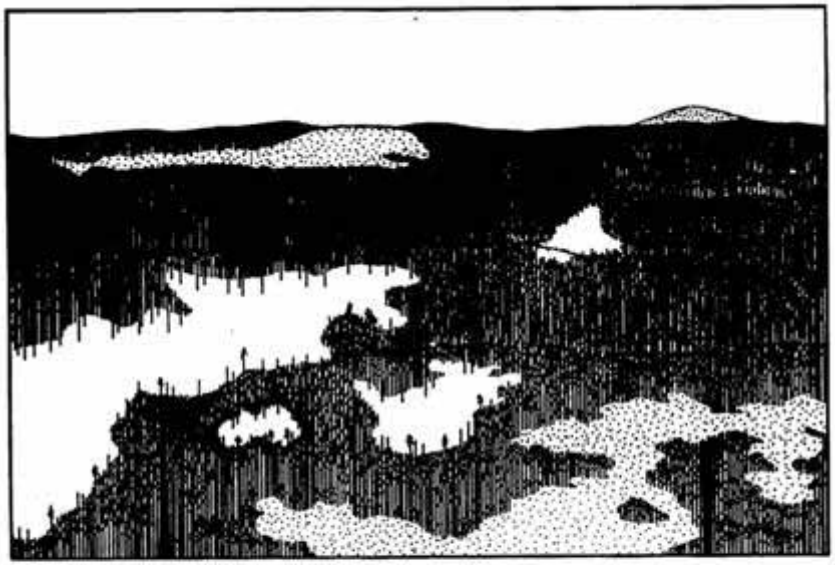


Figure 4.3. A drawing based on an aerial photograph taken in Yellowstone National Park that illustrates how fire and environmental factors combine in determining the vegetation mosaic in wilderness landscapes. The meadows, shown as stippled areas, are relatively stable in their location, occurring where edaphic conditions are less favorable for tree growth. The shape of the burned areas (white) can be attributed to a variety of factors including fuel discontinuities, the location of the lightning strike, fire brands (causing the smaller burned patches), shifting winds, and other factors such as those listed in Table 4.1. The fire burned until extinguished in the fall by rain and snow.

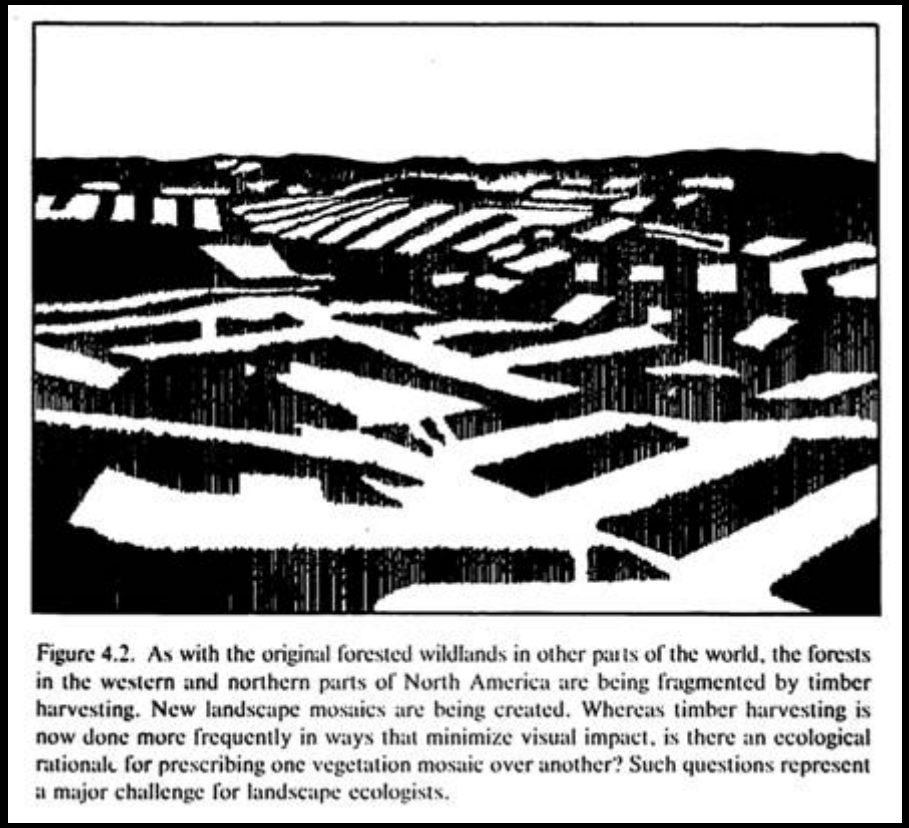


Figure 4.2. As with the original forested wildlands in other parts of the world, the forests in the western and northern parts of North America are being fragmented by timber harvesting. New landscape mosaics are being created. Whereas timber harvesting is now done more frequently in ways that minimize visual impact, is there an ecological rationale for prescribing one vegetation mosaic over another? Such questions represent a major challenge for landscape ecologists.

Pattern created by natural disturbance process (wildfire):

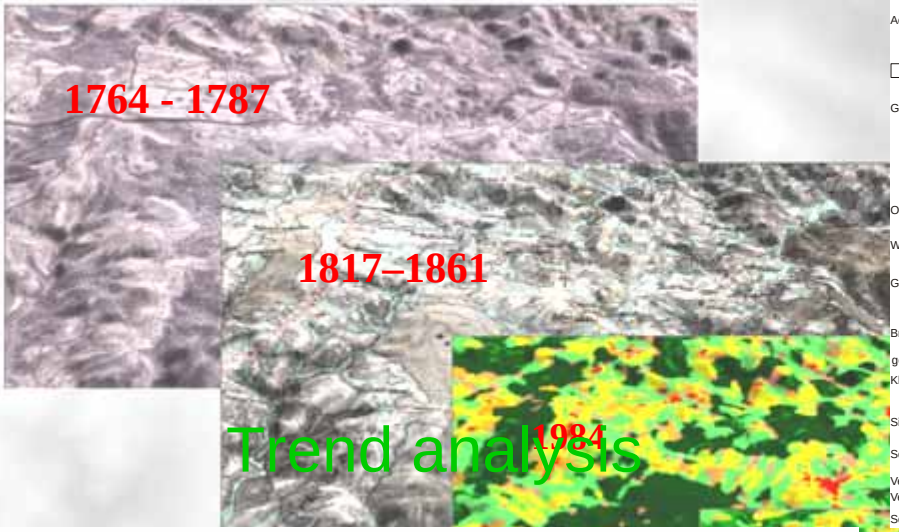
- Irregular pattern
- Transition zones

Pattern created by anthropogenic disturbance process:

- Regular „geometric“ pattern
- Sharp contrasting boundaries

>> describing patterns and relating them with (ecological) processes

Landscape Ecology: detecting changes



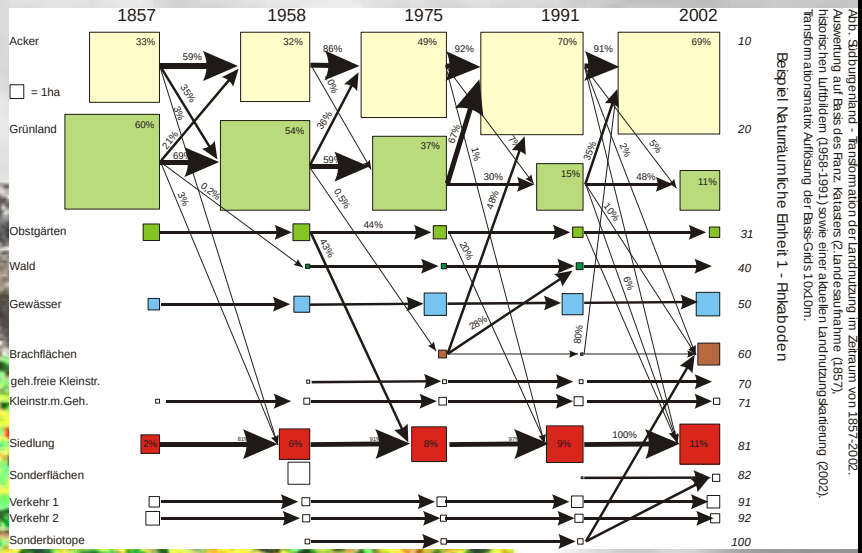
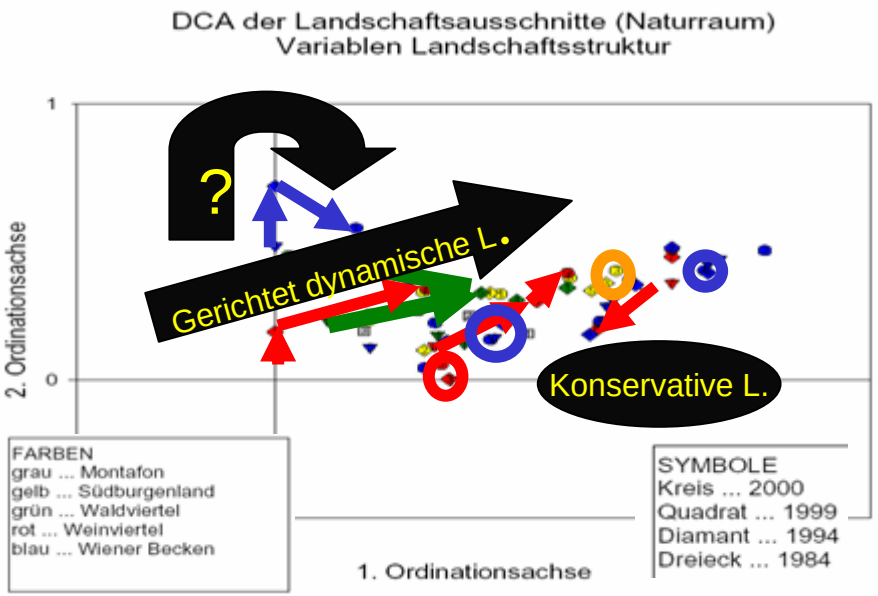
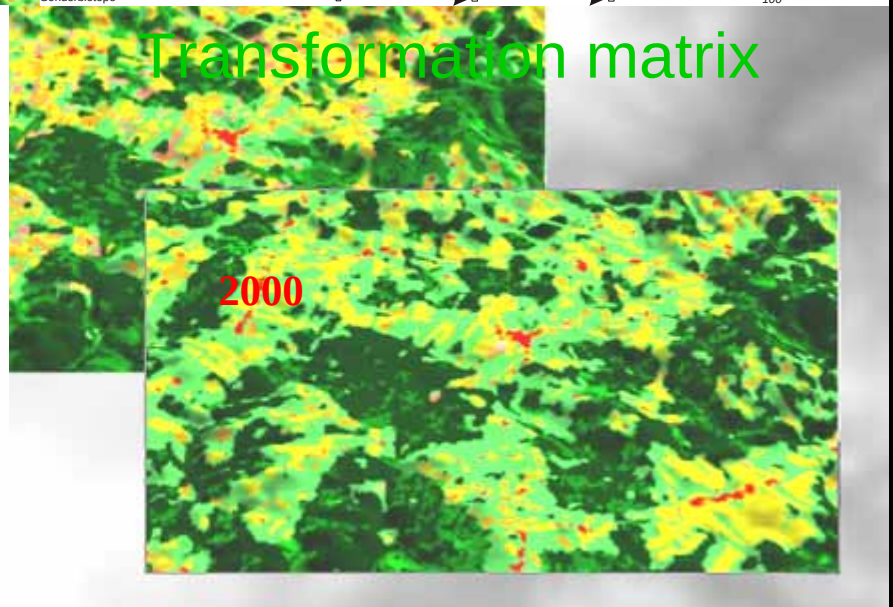
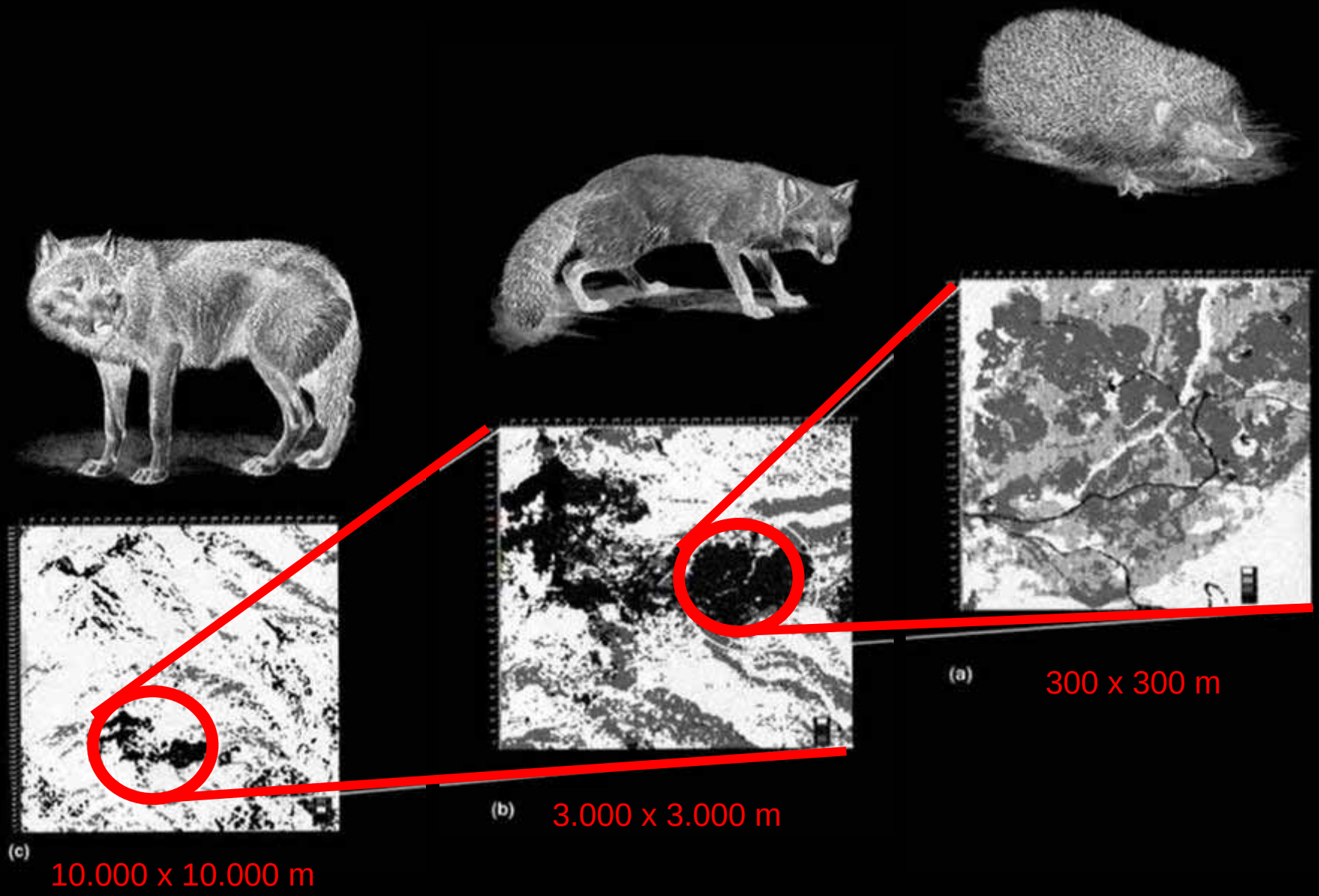


Abb. Südburgenland - Transformation der Landnutzung im Zeitraum von 1857-2002. Auswertung auf Basis des Franz. Katasters (Landesaufnahme (1857), historischen Urbildern (1958-1991) sowie einer aktuellen Landnutzungskartierung (2002). Transformationsmatrix Auflösung der Basis-Grids 10x10m.





Landscape ecology: a matter of scales!



Landscape Ecology: nested hierarchies

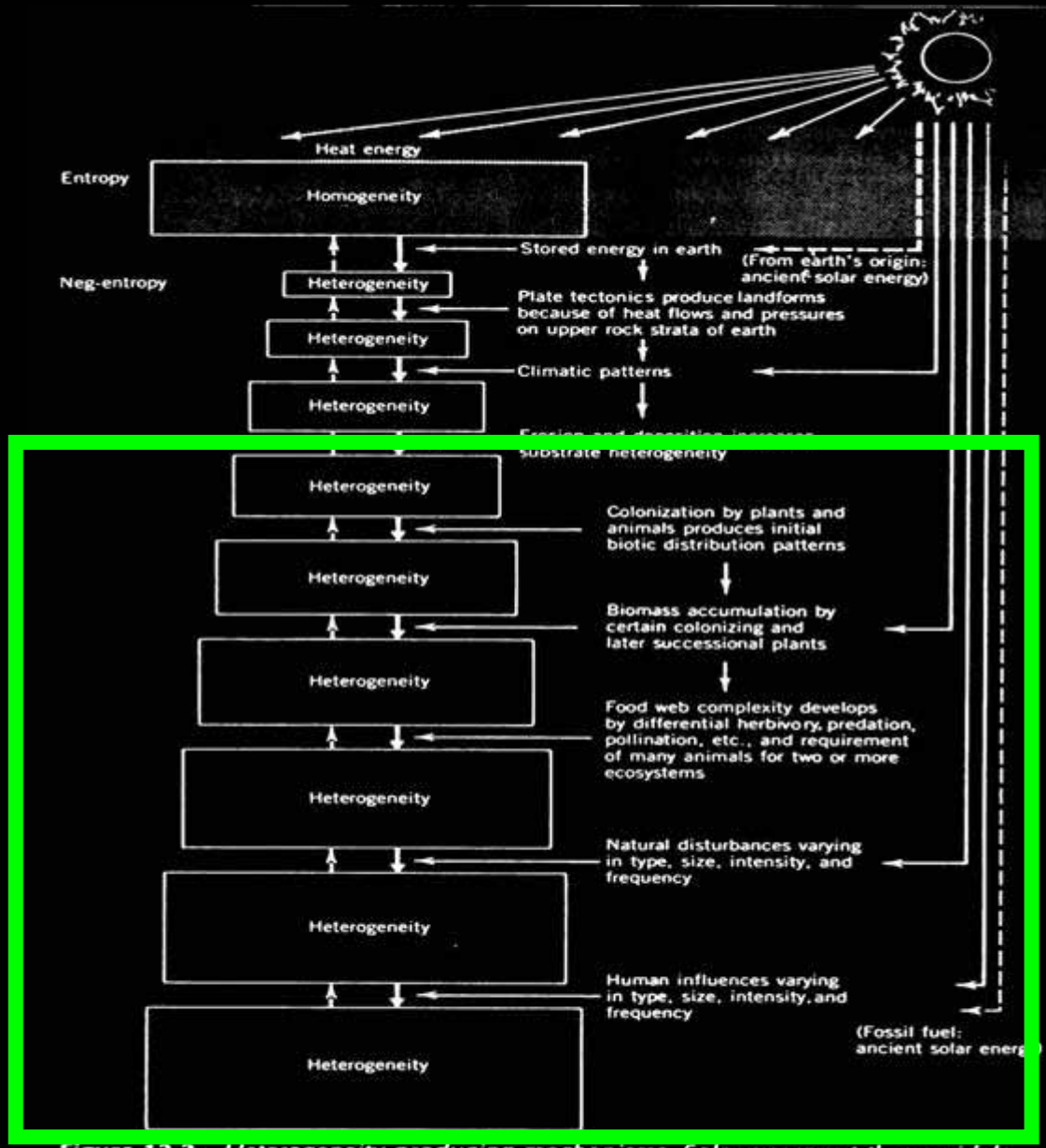


Figure 13.3 *Heterogeneity-producing mechanisms. Solar energy at three widely separated time periods drives processes that progressively increase the heterogeneity of the planet and its landscapes. Many feedbacks among the processes exist.*

Landscape Ecology: spatio-temporal domains

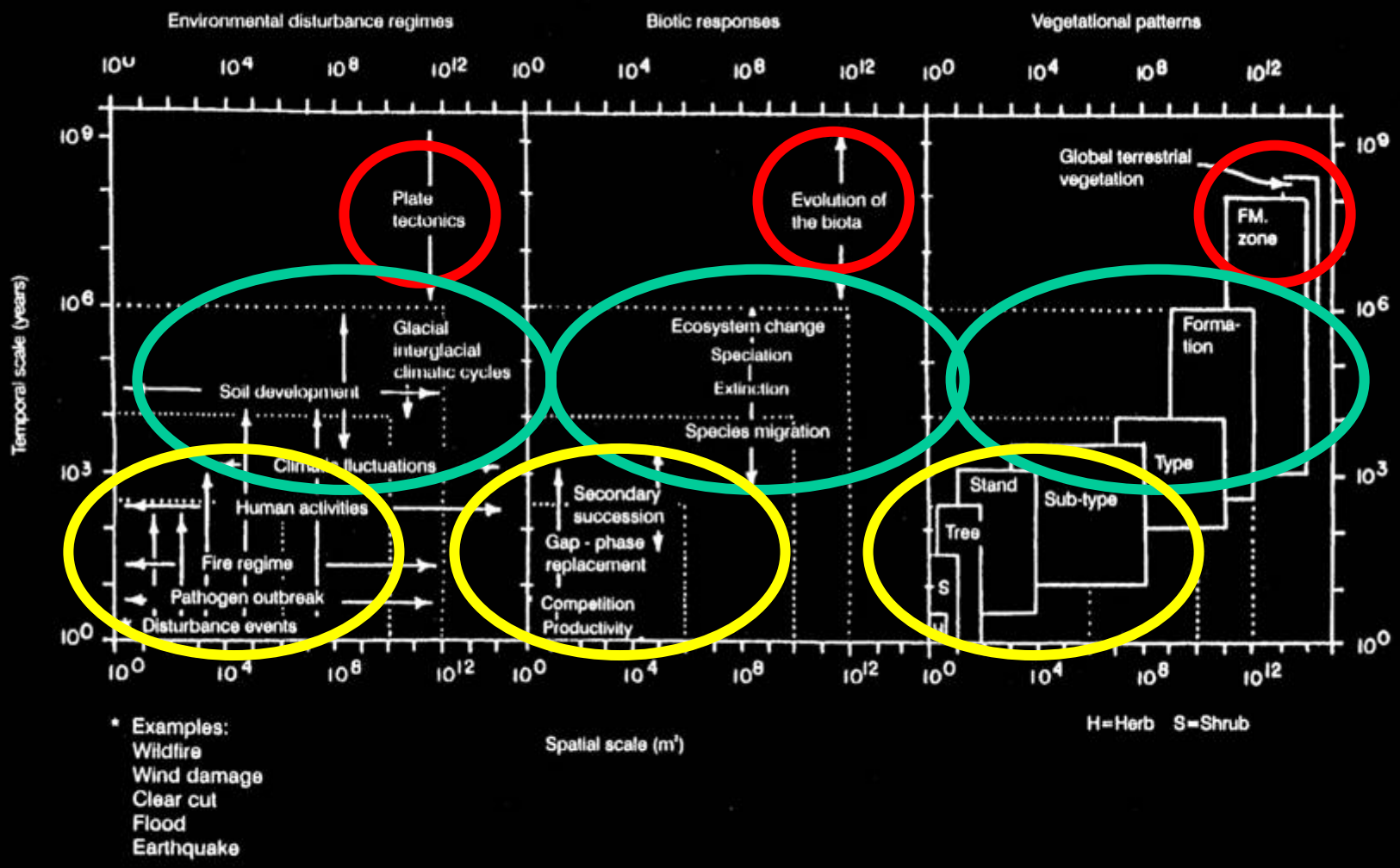


Figure 3.7 Effects of different disturbance regimes, biological responses and vegetational patterns in three spatiotemporal domains (from Delcourt and Delcourt 1988, with permission).

Landscape Ecology: sampling methods

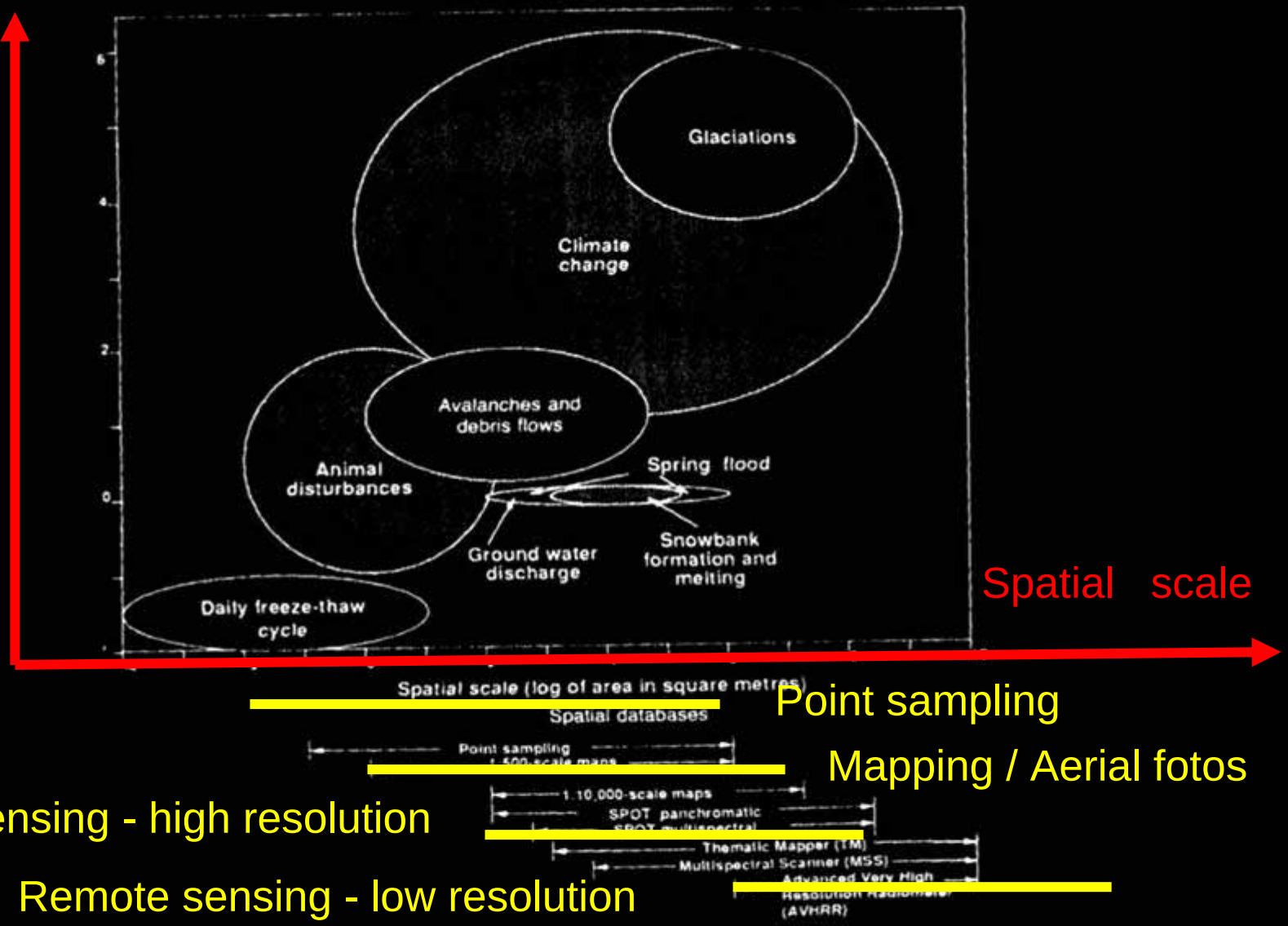
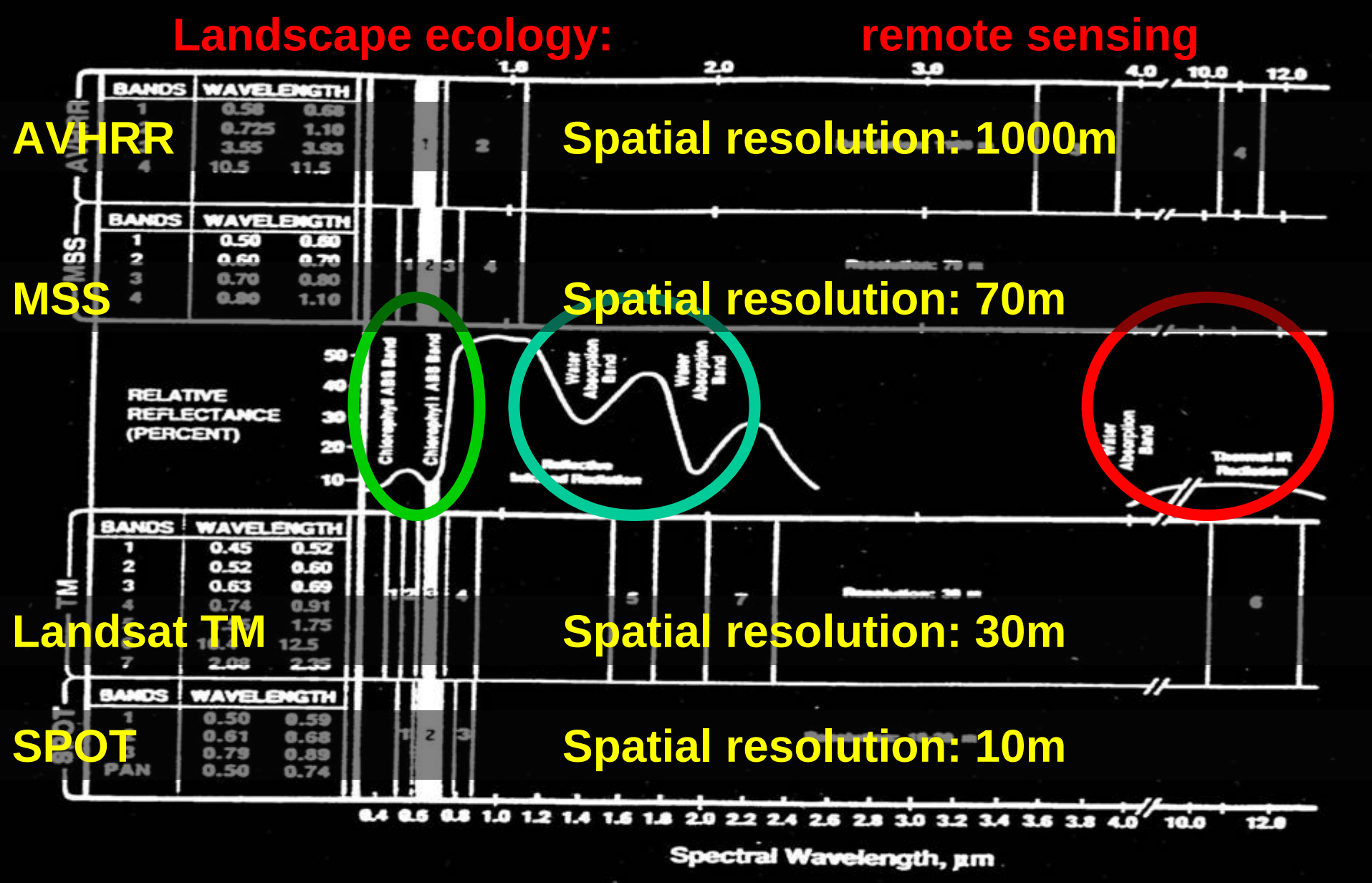


Figure 4.3 Frequency of the disturbance and the spatial scale of resolution in a cold climate. The available data types are indicated at the bottom of the figure as an example of the application of a multiscale approach, ranging from data input by field survey (quadrant plots) to remote sensing technique (advanced very high resolution radiometer, AVHRR) (from Walker *et al.* 1993, with permission).

Landscape ecology: remote sensing



AVHRR — Spatial resolution: 1000m

MSS — Spatial resolution: 70m

Landsat TM — Spatial resolution: 30m

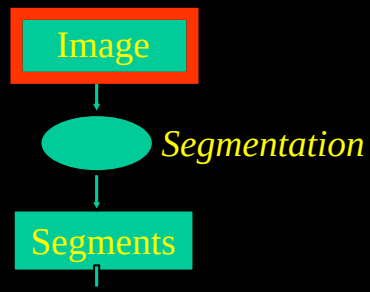
SPOT — Spatial resolution: 10m

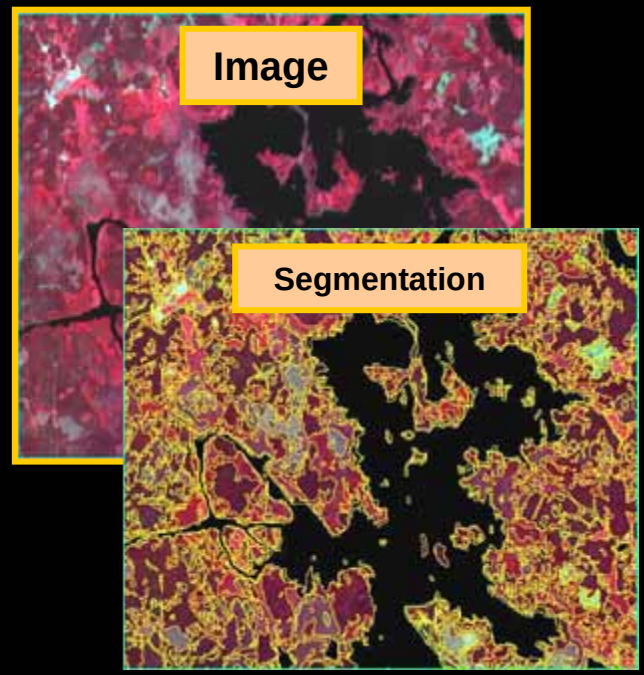
Figure 8.41 Spectral and spatial resolutions for the most common civilian satellites, AVHRR, MSS, TM and SPOT, and the electromagnetic spectral response curve for green vegetation (from Iverson *et al.* 1989, with permission).

Landscape ecology: sequence of RS & GIS procedures

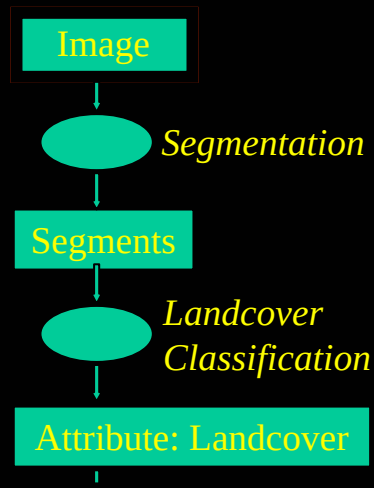
Image

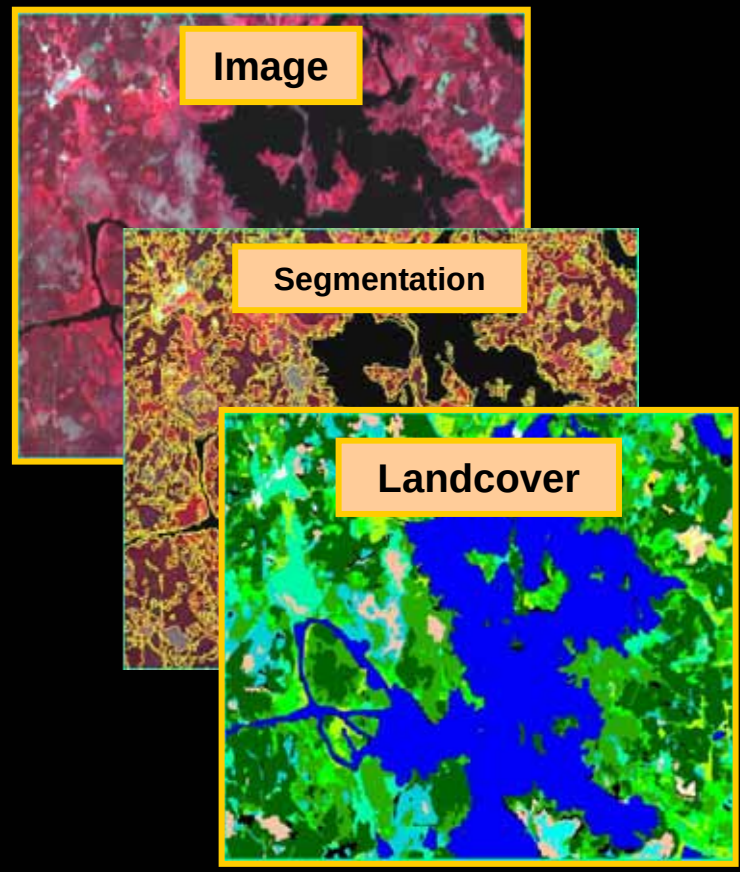
Landscape ecology: sequence of RS & GIS procedures



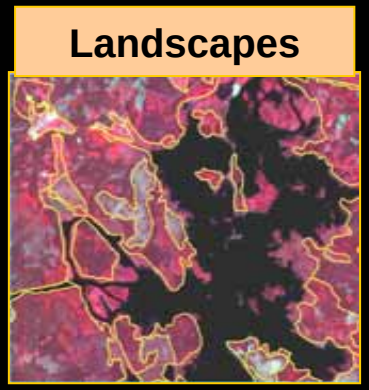


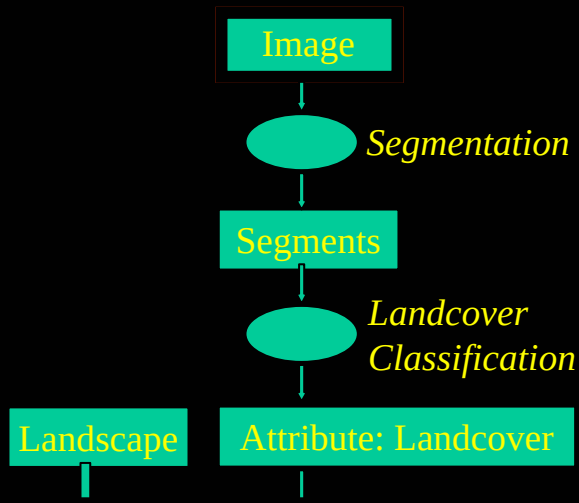
Landscape ecology: sequence of RS & GIS procedures

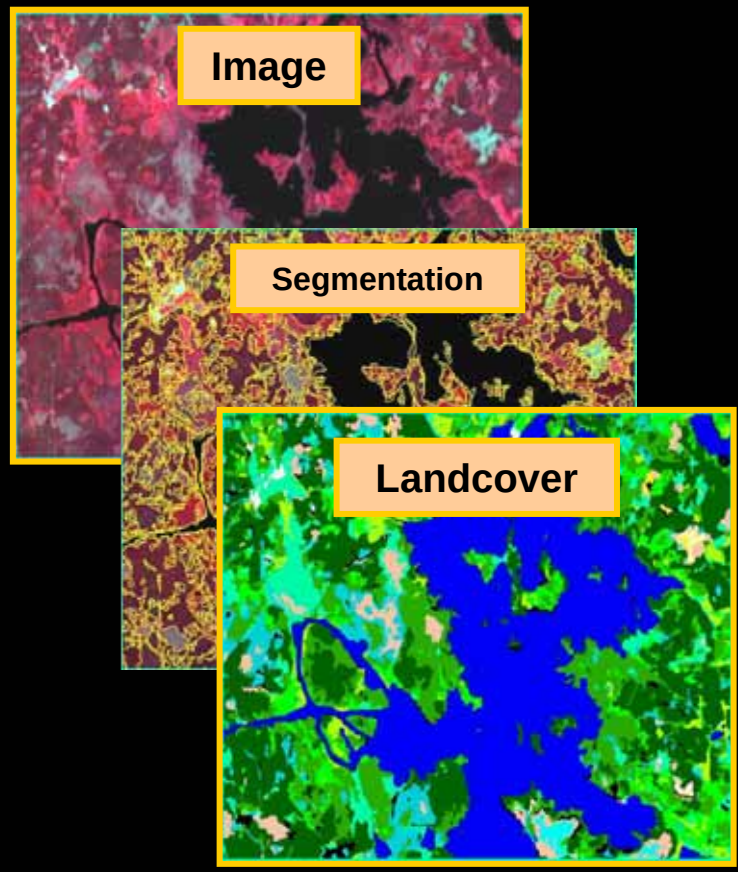




Landscape ecology: sequence of RS & GIS procedures







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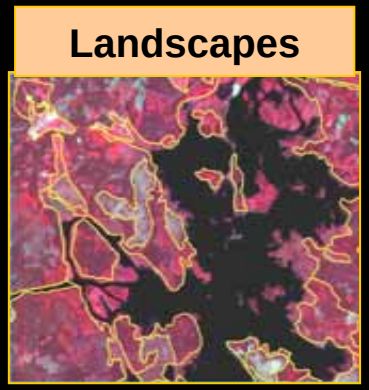

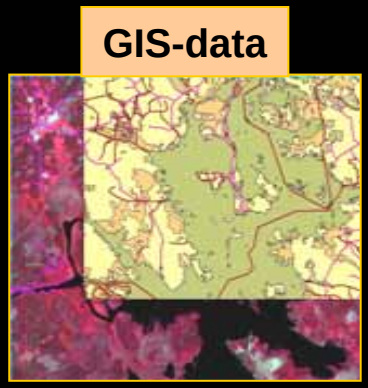

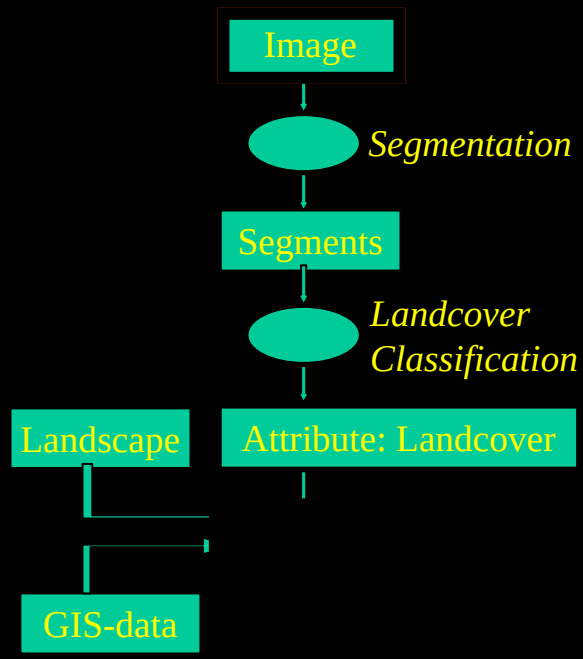

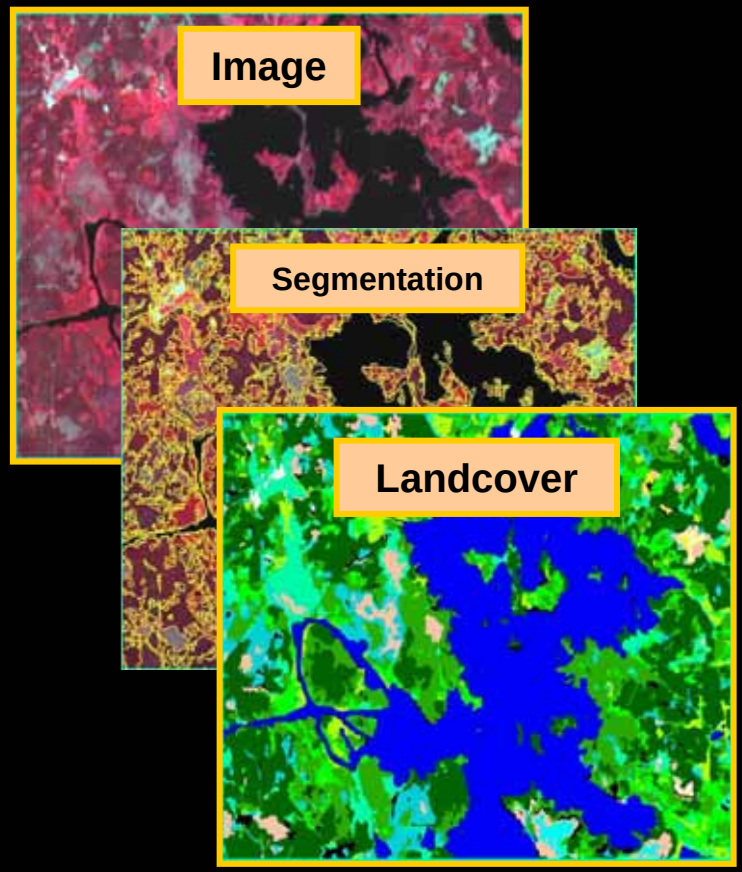

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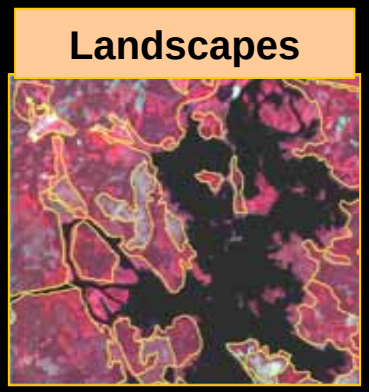

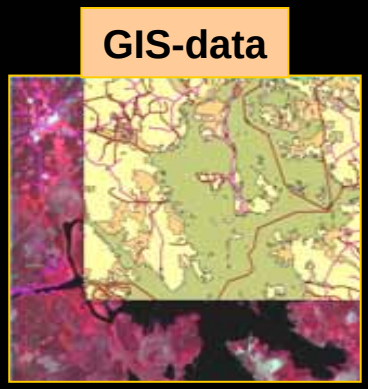

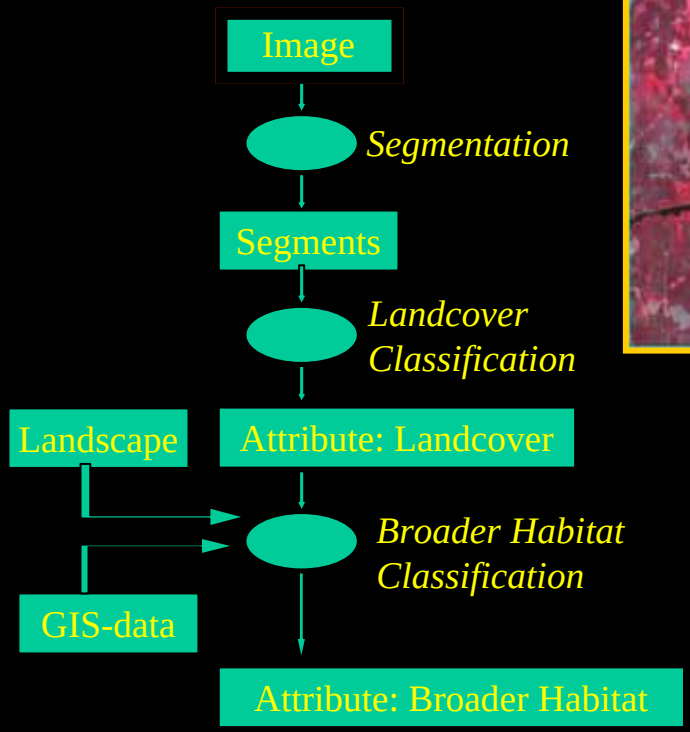

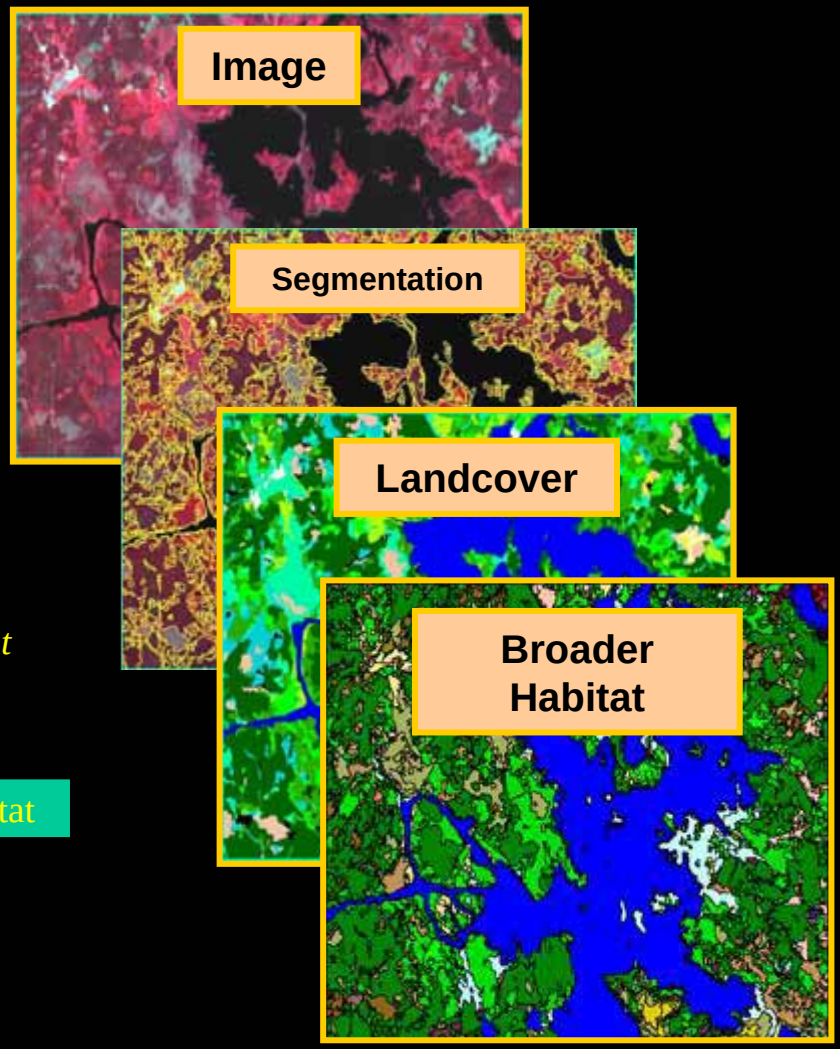

Landscape ecology >> Conservation Biology: Assessment of Habitat Suitability

Indices		*Broader habitat*				
		2.2 bare rock	2.1 Screes	5.3 Alpine / subalpine grassland	*3.4 standing water*	*9.1/9.2 Urban / industrial*
Area	Area proportion	+	+	-	-	-
	Mean patch size			+		-
	Variation of patch size					
Shape	Compactness					
	Elongation					
Distribution	Isolation			+		+
	Patch density					

Reference for rules:

Expert knowledge about

✓ favourable conservation status

✓ habitat requirements of umbrella species

e.g. Ptarmigan

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