

# Deriving long term land cover change from aerial photography to assess pressures on biodiversity

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### Who are we?

### Why?

#### Funded by EC – Framework 5:



#### Project coordinator: Dr. France Gerard (CEH Monks Wood) Team of 8 partners:





Global Monitoring for Environment and Security

#### **Question:**

How have past changes in land cover affected Biodiversity ? Why:

Legislative imperative to protect the environment. EEA is our key stakeholder

#### How:

- Manual interpretation of aerial photos
- Pressure State Impact models



# Background

- Long term change (50 years)
- Aerial photography: time span, spatial detail, spectral detail of historic photos limited.
- Satellite images: limited time span, coarse spatial detail, rich spectral information.
- Manual interpretation to integrate and extract sufficient info to identify pressures



# Background





# Estimation of past land cover changes in Europe

- Sample, based on Natura2000 sites
- Manual interpretation of historical aerial photos:
  - Backdating CORINE Land Cover 1990 to 1950
    - 75 windows (30 x 30 km), MMU 25 ha, 1:100K
  - Photo-to-photo interpretation for 50s, 90s and 00s
    - 50 transects (15 x 2 km), 1:20K
- CORINE Land Cover level 3 (44 classes)



# Sample of Natura 2000 Sites

#### Stratification:

Biogeographical Regions Map of Europe (BRME)



Focus on 4 Annex-I habitats in main bio-geographical regions:

- (i) Freshwater habitats
- (ii) Natural and semi-natural grassland formations
- (iii) Raised bogs and mires and fens
- (iv) Forests
- Also linear features



### Key steps



# **Acquisition of aerial photos**

#### Strategy:

- Check as many sources as practically possible
- Transects: partner search and acquisition
- Windows: subcontract to CAR Ltd. and partner search
- Variability in availability across Europe

#### Scales:

- Transects: 50 cm res., scale 1:10K to 1:25K
- Windows: 2 m res., scale 1:25K to 1:60K

#### **Delivery:**

- Hard copy of original print to orthorectified and mosaicked digital format.
- 1950s: Black and white 1990 & 2000: Colour
- Variations in price
- Variations in number of photos per window/transect



# **Pre-processing of aerial photos**

Worst case scenario = all steps have to be performed

- 1. Scanning of hard copy
- 2. Introducing fiducial marks
- Ortho-rectification using 'Topomaps', Landsat TM or orthorectified aerial photos (most recent time point) and DEMs (if available at reasonable price)
- 4. Mosaicking



#### Photo quality 1999 1958



Aerial photographs for the Syöte – Raatevaara Site, Finland





# Challenges

#### **Photo quality:**

- Varies between countries, sites and years.
- Timing of the campaign has an effect on the quality.

#### **Orthorectifcation:**

• Suitable DEMs are not always cheap.

#### **B&W photography:**

• Class discrimination e.g. grassland and arable difficult to differentiate.



# **Change detection methodology**





### **Corine back-dating to 1950**



75 30 x 30 km windows



# **Backdating CORINE 1990**



CLC90 & AP 50



CLC90 & TM 90

## **Backdating CORINE 1990**





#### CLC50 & AP50

#### CLC50-90 changes



# Challenges

#### **Backdating from CORINE 1990:**

- 'Compare apples with pears'
  Landsat TM and air photos
- Issues associated with:
  - No access to 1990 TM images
  - National products have different projections
  - Access to ancillary data used in 1990.

#### • Errors in CORINE 1990

 CORINE Land Cover 2000 update is carrying out corrections but at the moment not yet finished



### **Orthorectification & TM/AP mismatch**





# **Backdating - result**

#### **Change matrix**

		CLC	90																
		111	112	121	122	124	133	141	142	211	231	242	243	311	313	322	511	512	Sum
50	111	46																	46
ပု	112		1508	24	23					8		16	22						<b>1601</b>
ប	121		34	472								8	6						521
	122				213														213
	124			67		459													526
	133																		0
	141							8											8
	142								62										62
	211		410	579	121	424	21		41	1530	14	146	65	9					3360
	231																		0
	242																		0
	243		32	76	26					19			91						244
	311		95							12				224					331
	313		10												11				21
	322															17			17
	511																20		20
	512																	13	13
	Sum:	46	2089	1219	384	883	21	8	103	1569	14	171	184	233	11	17	20	13	6983



## **Full window examples**



### Windows and transects





### **Photo to Photo Interpretation**

15 x 2 km transects from the centre of Natura2000 sites

Sant Llorenç del Munt Natural Park (Barcelona, Spain)

CORINE land cover 1990 European Topic Centre on Terrestrial Environment (ETC-TE)

### Photo to photo interpretation

Continuous urban fabric Discontinuous urban fabric Industrial or commercial units Road and rail networks associated land Airports Construction sites Green urban areas Sport and leasure facilities Non-irrigated arable land Pastures. Complex cultivations patterns Land principally occupied by agriculture Broad-leaved forest Mixed forest Moors & heathland Water courses Water bodies



### Photo to Photo Interpretation

Sant Llorenç del Munt

Changes in town surroundings (Terrassa, NE of Spain)

1956





### **Results database - windows**

BIOPRESS



Please klick individual window for further information



### name: Rokoš

#### window acronyme: SK176

biogeographical region:	Alpine	a star	the of	288	N
country:	6 SK / ILESAS	1. 1. 1.	4		24
center coordinates:	x: 18.43 y: 48.77		6 63	÷, –	4
description:		See - 4	3	t la s	S. 1
The main part of the wir corner belongs to Tríbe in Podunajská nížina lov	ndow lies in Strážovské vrchy Mts., SE c Mts. and lower parts of the transect lies vland and Hornonitrianska kotlina	I © B		ESE	
basin.Forests dominate calcareo	in mountains - mainly beech forest on		A A		72
				Aug	





### **Results database - transects**





#### transect nr.: SK6

#### name: Belianske Tatry (Belian. Tatry – Spišská Belá)

transect description	sect description <u>natura2000</u> <u>interpreta</u>		change explanation	back to map			
window including:							
region:	Alpine						
country:	6 SK / ILESAS						
center coordinates:	x: 20.35						
	y: 49.21						
description:							
The W part of the trans	sect lies in the Tatra Nation	nal Park, in 🔰 🔀 🌆					
its limestone area, calle	d Belianske Tatry. Natura	l alpine and 📗 🔽 🌾	A REAL REPORT				
high-mountain landscap	e are typical for this part (	of the 🛛 🔤 🎫 🥨		TROD_			
transect. Also in this tra	insect is still natural zonatio	on of habitats					
fr							
umbrella habitat:	453054558						



# Finally, conclusions

- Project now at halfway point
- Generation land cover change information is nearing completion
- Process quality assured to cope with interpreter bias
- Web service established for project members to examine results and add comments
- Strategies for extrapolation to the European level are being tested
- Assess pressures on biodiversity
- Point and linear features





