EC-FPV Contract Ref: ENV-CT-2002-00178

# Linking Pan-European Land Cover Change to Pressures on Biodiversity

http://www.creaf.uab.es/biopress


## Final Report
## 1st January 2003 – 31st December 2005
## Sections 1 to 4

## Coordinator – France Gerard

# Contents

# Chapter 1 MANAGEMENT REPORT – JUL'05 TO DEC'05

## 1.1 THE OBJECTIVES OF THE REPORTING PERIOD

The objectives of BIOPRESS for the period between 1 July 2005 and 31 December 2005 were:

- To continue procedures aimed at securing access to relevant ancillary datasets relating to pressures on land-cover and land-use change in Europe by maintaining the in-house meta-database (WP1000).
- To further enhance the BIOPRESS database ready for delivery to the EEA.
- To disseminate the provisional results of the project through a web site and through participation, as appropriate, in scientific and policy meetings (WP0000 and WP6000).
- To continue work on the second phase of the project (WP4000) which aims at delivering quantified pressures which MIRABEL (DPSIR framework) will convert into assessments of biodiversity at the pan-European level. This is achieved through 5 closely linked Work Packages:
  - WP4400 to describe and predict the consequences (impact) of the observed land cover changes (state) and pressures on biodiversity. WP4400 will, with support of WP4500, advise WP4100, WP4200 and WP4300 on what is required to address the aim.
  - WP4300 to investigate the causes (pressures) of the observed land cover changes (state) and will develop a generic model for data integration to quantify these pressures.
  - WP3200/WP4100 to develop a GIS framework to support data extrapolation and facilitate data integration (WP4300) within realistic and appropriate regions.
  - WP4200 to investigate ways to improve the detection of change in land cover and landscape features from multi-scale remotely sensed data, covering the information needs of WP4300 and WP4400
  - WP4500 to investigate the propagation of error between the different stages of data processing.
- To revisit the working document summarising problems to the GMES Assessment Team.

## 1.2 SCIENTIFIC/TECHNICAL PROGRESS MADE IN DIFFERENT WORK PACKAGES ACCORDING TO THE PLANNED TIME SCHEDULE

### 1.2.1 WP1000 – DATA SEARCH AND DATA ACCESS

The work in WP1000 is a task that is scheduled to continue for the duration of the project.

In the final 6 months of the project the focus was on maintaining the data and meta-database allowing access to the data by the partners. The request for the Pan-European Natura 2000 geometry data was never resolved.

### 1.2.2 WP2000 - METHODOLOGICAL DEVELOPMENT FOR LAND COVER CHANGE MATRICES (1950 TO 1990)

### 1.2.3 WP2400 – DEVELOPMENT OF A QUALITY ASSURED METHOD FOR LAND COVER CHANGE DETECTION

The EC project officer requested a rewrite deliverable D15-D16: 'Report on Quality Assessment results'. The revised D15-D16 now also contains D33 'Evaluation of land cover change statistics (WP2000/3000 and WP7000) from independent / external expert'.

### 1.2.4 WP3000 – PRODUCTION OF THE LAND COVER CHANGE MATRICES (1950 – 1990)

#### WP3100 PRODUCTION OF THE LAND COVER CHANGE MATRICES (1950-1990)

Hamburg University has continued to maintain the BIOPRESS database which involved further improvements of the database design and further updating with revised change matrices. A general analysis of the land cover changes was carried out and specific analyses were initiated focussing on,

- forest dynamics, and
- forward and backward land cover changes.

The EEA land cover flow accounting was implemented for the windows and transects. The analysis was enhanced through a working visit of Konstantin Olschofsky (Univ. Hamburg) to ILESAS to assess how best to link the dominant habitats of Natura 2000 sites to interpreted land cover structures.

These analyses by the Univ. Hamburg were exploratory and many more avenues of investigation are possible with this data. So, although the database will be handed over to the EEA the team agreed to restrict access to the database for a full year, allowing the team to exploit the data further.

#### WP3300 EVALUATION OF RESULTS BY EXTERNAL EXPERTS

The fallback option (i.e. each partner to contact one or two external experts and ask for written feedback on their transect and window results) was implemented in the previous reporting period and a compilation of the local expert feedbacks has been produced by Hamburg University (D33 – 'Evaluation of land cover change statistics (WP2000/3000 and WP7000) from independent / external expert'). D33 was incorporated into D15-D16.

### 1.2.5 WP4000 - LINKING LAND COVER CHANGE TO PRESSURES ON BIODIVERSITY

#### WP3200/WP4100 DEVELOP EUROPEAN GIS FRAMEWORK

The report D27-D31&D37 on the extrapolation of changes has been finalized (GIM and Univ. Hamburg).

#### WP4200 IMPROVING DETECTION OF CHANGE IN LAND COVER AND LANDSCAPE FEATURES FROM MULTI-SCALE RS DATA, COVERING THE INFORMATION NEEDS OF WP4300 AND WP4400

The report D40 was merged with D38 ("Methodology for capturing land cover changes in Europe using medium resolution satellite data" and "Report describing the potential of medium resolution satellite imagery to detect land cover changes on the scale of CORINE ") and finalised (D38&D40).

#### WP4300 INTEGRATION OF SOCIO-ECONOMIC DATA TO QUANTIFY PRESSURES FROM LAND COVER CHANGE

ILESAS, CREAF, METLA and Alterra continued the work on Pilot windows located in their respective countries, Slovakia, Spain, Finland and The Netherlands. This involved the collection of basic statistical socioeconomic information for the pilot windows and the investigation of links between these data and the observed land cover

changes. A detailed analysis based on data mining (decision-tree) methods proposed by ALTERRA was also carried out. The results were, however, highly context-dependent and affected by the low resolution (NUTS 3 level at most) of the data available. The comparison between the Dutch and the Spanish windows was highly affected by the different quality of the national datasets. No comparisons with the rest of the pilot windows could be performed because of these differences, but also because of the contrasting methodologies of analysis proposed by partners.

All team members involved in this work package also continued to assist Monica Wachowicz (ALTERRA) in the defining of the methodological schema to integrate socioeconomic data with land cover change.

ALTERRA completed the data mining analysis at European level and integrated the results with the pilot windows (Slovakia, Finland, The Netherlands, Spain).

The finding of the work were summarised in D43 "The integration of the BIOPRESS land cover product with socio-economic statistics".

#### WP4400 IMPROVE SEMI-QUANTITATIVE PRESSURE IMPACT STATE MODEL BY INCORPORATING QUANTITATIVE MEASURES OF PRESSURES

In the previous reporting period, the BIOPRESS phase I results were explored by

- investigated the possibility of linking CORINE Land Cover classes to the EUNIS habitat classes for a set of windows in Slovakia and
- focussing on quantifying land cover changes and associated pressures that are relevant to biodiversity in the main bio-geographical regions of Europe.

These activities were extended to

- a European wide regional analysis of the relationships between CLC classes and the EUNIS habitat classification (D45 "Land cover translated to EUNIS Level 2 habitats")and
- a spatial analysis at the window and transect levels of changes in the spatial extent and distribution - number and size of patches - of CLC classes important for biodiversity.

These analyses enabled the production of regional impact tables in accordance to the MIRABEL framework. Finally the contribution of the BIOPRESS Phase I product to the MIRABEL Biodiversity assessment was assessed and discussed in the deliverable D46&D47 ("Integration of BIOPRESS Land cover product in the Pressure-State-Impact Model MIRABEL").

The partners contributing to this work were CEH, ILESAS and CREAF with support from ALTERRA and METLA.

#### WP4500 ERROR PROPAGATION BETWEEN DIFFERENT STAGES

Analyse of different error sources in the production chain and their relative impact on results (WP4500). The work included amongst others:

- Analysis of representativity of used samples
- Analysis of limitations of raw data (CLC2000, NATURA2000)

Part of this work involved a working visit of Konstantin Olschofsky (Univ. Hamburg) to CEH Monks Wood to exchange ideas, drawing from the extensive land cover mapping expertise of the Monks Wood section for Earth Observation.

### 1.2.6 WP6000 - DEMONSTRATION AND DISSEMINATION

The project leaflet which was produced by CREAF with support from CEH was printed in October 2006 (part of D34, "Mid-term CD -containing land cover change product report- and leaflet").

The webpage was improved further by CREAF in collaboration with CEH and University of Hamburg (http: www.creaf.uab.es biopress ). A reduced version of the BIOPRESS database was linked to the webpage and the web contents especially in the results page were improved.

BIOPRESS was successful in acquiring an exhibition space at the Communicating European Research 2005 event which took place in Brussels on 14-15 November 2005. CREAF and CEH organised the BIOPRESS presence in the exhibition. CREAF was the correspondence partner for registry, stand and furniture renting. CREAF produced a flash movie as the main attraction of the BIOPRESS stand and adapted several pre-existing BIOPRESS posters.

CEH took care of BIOPRESS bookmarks and pens to give away. The stand was manned by a team of people from CREAF, CEH and ILESAS. The BIOPRESS stand attracted a good number of people from a wide range of backgrounds.

GIM organized the final workshop in the premises of the Royal Museum for Central African in Tervuren (Brussels) on the 14 December 2005. The final workshop was separated into 2 sections, the morning session as the final technical meeting with the EC, the afternoon session presentating the key findings to the international and national stakeholders.

**A position paper: "Sampling framework and strategy for monitoring of European habitats"** (see Annex). A position paper was produced as a collaboration result between BIOPRESS and BIOHAB: Sampling framework and strategy for monitoring of European habitats. Position paper of BIOHAB & BIOPRESS research community. Version 2 (13th of December 2005). Principal contributors to this version: BIOHAB: Bob Bunce, Rob Jongman, Sander Mücher, Marta Pérez-Soba & Geert de Blust. BIOPRESS: Konstantin Olschofsky (Univ Hamburg), Sander Mücher (Alterra), Raul Köhler (Univ Hamburg), Mirko Gregor (GIM), Richard Wadsworth (CEH) and Sandra Luque (METLA). This paper has been and will be actively advertised by the BIOPRESS coordinator and partners.

**A Book: "Land cover change in Europe from the 1950'ies to 2000. Aerial photo interpretation and derived statistics from 59 samples distributed across Europe"** (see Annex). As part of the reporting activities in period Jan-Feb2006 the University of Hamburg and CREAF has with help from all partners compiled a book entitled "Land cover change in Europe from the 1950'ies to 2000. Aerial photo interpretation and derived statistics from 59 samples distributed across Europe". About 400 prints will be produced. The proof is attached. The team decided to substitute the CD by the Book and a BIOPRESS summary report adapted from Section 6 of the final report. The BIOPRESS summary report will be the responsibility of CEH, BIOPRESS coordinator and will be produced as a pdf file as part of the dissemination activities which will continue after February 2006 (Technology Implementation Plan).

***Publications:***

- Metzger, M.J., R.G.H. Bunce, R.H.G Jongman, C.A. Mücher and J.W. Watkins, 2005. A climatic stratification of the environment in Europe. In: Global Ecology and Biogeography, 2005, 14, 549-563. DOI: 10.1111/j.1466-822X.2005.00189.x. (Alterra)
- Clevers, J.G.P.W., M.E. Schaepman, C.A. Mücher, A.J.W. de Wit, R. Zurita Milla and H.M. Bartholomeus, 2005. Using MERIS on ENVISAT for Land Cover Mapping. IN: International Journal of Remote Sensing. Accepted for a special issue on MERIS. In press. (Alterra)
- Hazeu.G.W., C.A. Mücher & M. Wachwicz, 2005. Monitoring land cover changes inside and outside Natura2000 sites. In: Proceedings (on CDROM) of the International Cartographic Congress, 9-16 July 2005, La Coruña, Spain. (Alterra)
- Hazeu, G.W. and C.A. Mücher, 2005. Historic land use dynamics in and around Natura2000 sites as indicators for impact on biodiversity. Phase I of the BIOPRESS project for the Netherlands. Alterra Report 1077, Wageningen, the Netherlands. (Alterra).
- Hanna Huitu and Sandra Luque. (In preparation) Fifty years of changes in the Finnish Forest.

***Presentations:***

- Presentation by Gerard Hazeu at the International Cartographic Congress, 9-16 July 2005, La Coruña, Spain. Title of the presentation was: " Monitoring land cover changes in and around Natura2000 sites".(Alterra).
- Presentation by Konstantin Olschofsky of extrapolation work at the PEER conference. (Univ. Hamburg)
- Presentation by Konstatin Olschofsky of BIOPRESS results to national experts (BONN/ Dresden). (Univ Hamburg) IALE Workshop "Current Trends in Landscape Ecology"Presented by IALE officers,
- Presentation by S.Luque Invited Speaker as IALE Vice-President: "Quantifying pressures on biodiversity to Understand Spatial Patterns". Center for Environmental management (CEM), School of Geography, University of Nottingham, UK.
- Presentation by S. Luque, H. Huitu and S. Petit. Quantifying pressures on biodiversity to Understand Spatial Patterns: A temporal and Spatial approach. (Présentation oral) Conférence IALE France. Patrons et processus, Quels acquis pour l'Ecologie du Paysage ? Quelles orientations futures ? 16-18 novembre, 2005. Marseille, France.
- Presentation by S. Luque and H. Huitu. Can the quantification of pressures on biodiversity help to understand spatial patterns? (Oral presentation) Session: Understanding Biodiversity. The 6th Open Meeting of the Human Dimension of Global Environmental Change Research Community (IHDP), University of Bonn, Germany 9-13, October 2005.

- Presentation by Sandra Luque as Invited speaker, AlterNet (A Long-term Biodiversity, Ecosystem and Awareness Research Network - FPVI) workshop: Impacts of the main anthropogenic and natural drivers and pressures on biodiversity (Lead: Stefan Klotz & Lars Lundin). Presentation: Indicators to monitor changes and conservation in Natura 2000 sites: a focus on drivers, pressures and states. Hamburg, Germany. February 17-18.

*Meetings:*

- PEER Seminar "Geo-Information Pillar", 15-16 November 2005, Montpellier, France. Poster presentation BIOPRESS. (Alterra).
- BioHab - ILESAS is partners in this 5th Framework Programme project and attended the final workshop in Brussels (Belgium) in November 2005 (ILESAS).
- ALTER-net – ILESAS is partner in this 6th Framework Programme Network of Excellence and attended several workshops for respective research activities during reported period (ILESAS).
- BioScene – ILESAS is partners in this 5th Framework Programme project and attended the International conference"Biodiversity conservation and sustainable development in mountain areas of Europe" (Ioannina, Greece) in September 2005 (ILESAS).
- EEA EIONET meeting,, Copenhagen is planned for 1-2 March 2006: presentation of BIOPRESS results has been requested and will be prepared (ILESAS).

***Cooperation with other relevant institutions and (EU) projects:***

- A grant was obtained during the previous reporting period from AlterNet to link work between BIOPRESS and the EU funded network of excellence AlterNET: 2005-2006 "Indicators to monitor changes and conservation in Natura 2000 sites: A focus on Drivers, Pressures and States." ALTER-Net (A Long-term Biodiversity, Ecosystem and Awareness Research Network - FPVI) Internal funded project – Participants Institutions: Cemagref, ILESas, CEH, Alterra (coordinator: Sandra Luque, Cemagref). Euros 50. The work started in this reporting period and will continue after the conclusion of BIOPRESS.

- PEER (Partnership for European Environmental Research) initiative – from the side of Cemagref: Seminar. Global Earth Observation and Environmental Monitoring: The role of geoinformation. Sander Mucher (ALTERRA) Sandra Luque (Cemagref) session co-ordinator & rapporteur: "Biodiversity and ecosystem modelling". Montpellier, FRANCE.
- AlterNet – from the side of Cemagref: Participation on AlterNet joint workshop between Work Packages 13 (establishing a network of LTER sites), R3 (drivers and pressures on biodiversity) and R6 (forecasting of biodiversity). Klotz S., Luque S., Stadler J. Aims and methods in analyzing available studies of the impact of drivers and pressures on biodiversity (Oral Presentation): Madrid 6-9 June, 2005.

### 1.2.7 WP8000 REVIEW WORKPLAN FOR PHASE-II

D32 "Working document summarising problems to the Assessment Team" was revisited.

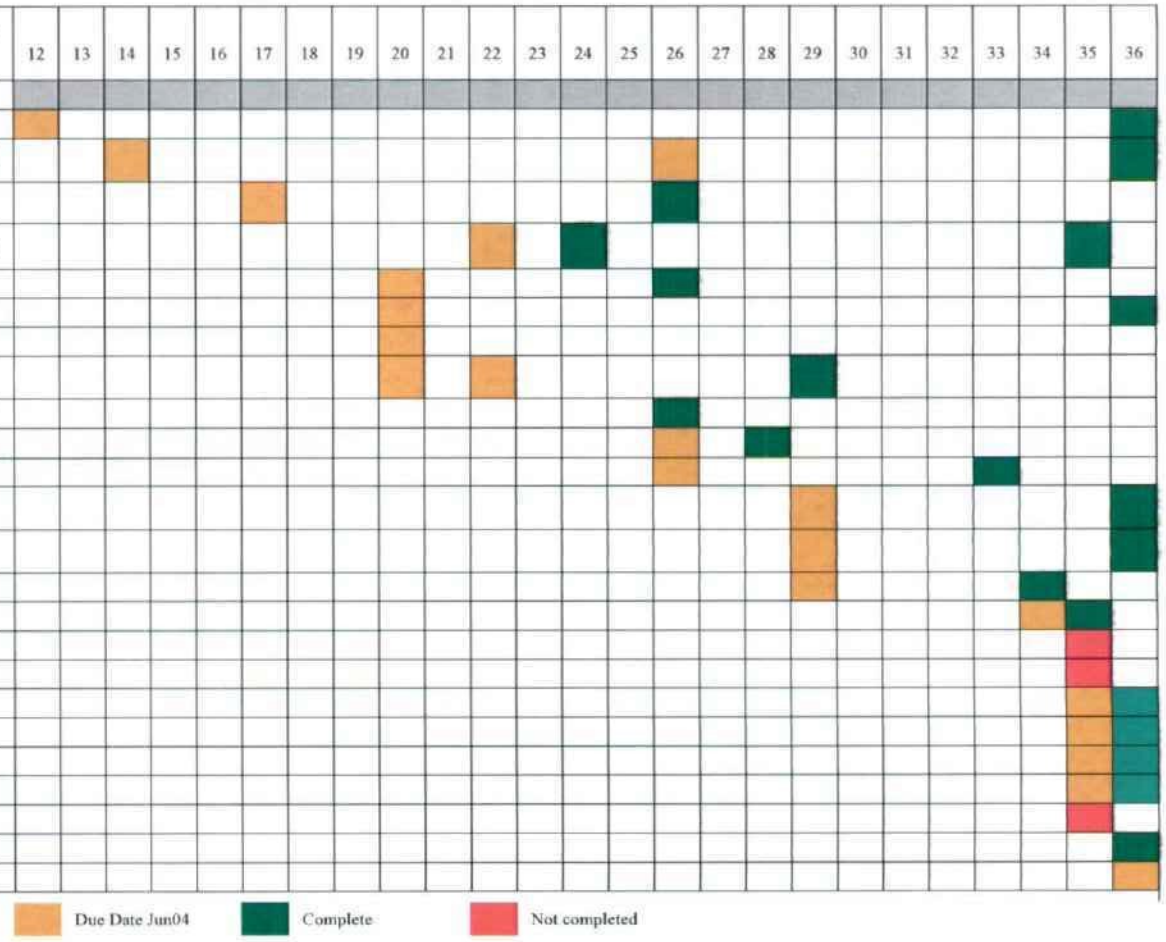
## 1.2.8 GANTT CHART UPDATE FOR MONTH 12 TO MONTH 36 OF THE PROJECT;

Changes since previous Management Report indicated in red.

| WP | Title | Start month | End month | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000 | Project management / administration | 1 | 39 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1000 | Data search and access | 1 | 35 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Methodological developments for land cover change matrices (1950 – 1990) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2000 | Coordination | 1 | 10 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2100 | Development of interpreters' rules | 1 | 10 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2300 | Sampling sites across Europe & prepn. of aerial photos | 4 | 10 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2400 | Development of QA method for LCC detection | 7 | 12 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Production of the land-cover change matrices (1950-1990) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3000 | Coordination | 10 | 18 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3100 | Production of land cover change matrices (1950 – 1990) | 10 | 16 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3200 | Extrapolating the matrices to European LCC product | 17 | 18 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3300 | External evaluation of results | 17 | 18 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Developing & demonstrating monitoring concept for land-cover change and pressures on biodiversity | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4000 | Coordination | 18 | 36 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4100 | Develop European GIS framework | 18 | 26 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4200 | Improving detection of change in land cover and .... | 18 | 26 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4300 | Integrate socio-economic data to quantify LCC pressures | 22 | 29 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4400 | Incorporate quantitative pressures in pressure-state model | 26 | 34 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4500 | Error propagation | 18 | 35 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5000 | Assessing problems | 1 | 19 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6000 | Demonstration & dissemination | 1 | 48 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | CORINE1990 backdating | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7000 | Coordination | 1 | 21 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7100 | Production | 4 | 20 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7200 | Evaluation | 5 | 21 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8000 | Review workplan for Phase II | 14 | 16 | | | | | | | | | | | | | | | | | | | | | | | | | |

## 1.2.9 SCHEDULE OF DELIVERABLES FOR MONTH 12 TO MONTH 36 OF THE PROJECT (DELIVERABLES WHICH WERE DELIVERED PRIOR TO MONTH 24 ARE NOT SHOWN)

| Deliverable | Title | Month due |
|---|---|---|
| D2 / 6000 | Logo and web page | 7 |
| D15,16 / 2400 | Assessment of consistency between observers, between strata | 12 |
| D38,40/4200 D18 / 8000 | Report on high-and medium resolution satellites | 14 , 26 |
| D23,24 / 3100 D25 / 3200 | Statistical Analysis of sites (Variability within and between strata, comparison between photo interpretation and CORINE backdating) | 17 |
| D27-30 / 3200 D37 / 4100 | Estimates of land cover change at the Pan-European level (data) | 18, 22 |
| D31 / 3000 | Pan-European estimates of land cover change (report) | 18 |
| D33/ 3300 | Report on expert evaluation of land cover change statistics | 20 |
| D34,56 / 6000 | CD containing land cover change product report and leaflet | 20 |
| D35,36 / 4100 | Sensitivity analysis of the BRME or other GIS framework.<br>Report on the usefulness of the GIS framework for extrapolating | 20<br>22 |
| D39 / 4200 | Report describing the potential for identifying and monitoring small... | 26 |
| D41 / 4300 | Time series of socio-economic statistics for selected areas | 26 |
| D42 / 4300 | Report on utility of hierarchical boundaries in reconciling spatial ... | 26 |
| D43 / 4300 | Quantification of pressures using socio-economic data and the land cover change matrix | 29 |
| D44 / 4300 | Characterise relative importance of different indicators in quantifying a pressure, and its link to land cover changes | 29 |
| D45 / 4400 | Land cover translated to EUNIS Level 2 habitats | 29 |
| D46,47 / 4400 | Annotated quantified impact tables for sites, for European zones | 32 |
| D48 / 1000 | GIS layers containing all spatially referenced outputs | 35 |
| D49 / 4400 | Maps of pressures and impacts across Europe | 35 |
| D50 / 4500 | Report on class definition issues faced by the project | 35 |
| D51 / 4500 | Report on relative importance of different sources of error | 35 |
| D52 / 4500 | Maps of magnitude of most probable error | 35 |
| D53 / 4500 | Maps of most critical error variable by zone | 35 |
| D54 / 4000 | Final WP 4000 report summarising and demonstrating results of WP | 35 |
| D55 / 6000 | Dissemination Workshop | 36 |
| D32 / 5000 | D32- revisited, working document summarising problems to the Assessment Team | 36 |



## 1.2.10 MANPOWER DEPLOYMENT, JANUARY, 2003 TO DECEMBER, 2005 (PERSON-MONTHS)

| WP | CEH | | CREAF | | METLA | | ALTERRA | | GIM | | ILE SAS | | Univ. Hamburg | | *Total* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DoW | used | DoW | used | DoW | used | DoW | used | DoW | used | DoW | used | DoW | used | *DoW* | *used* |
| 0000 | 12.7 | 11.0 | 0.8 | 0.8 | 1.4 | 1.5 | 3.1 | 3.1 | 0.9 | 2.24 | 1.0 | 1.0 | 0.9 | 1.0 | *18.8* | *20.6* |
| 1000 | 0.5 | 0.3 | 0.4 | 0.4 | 1.0 | 1.0 | 0.5 | 0.6 | 5.7 | 6.02 | 0.5 | 0.5 | 0.5 | 1.0 | *9.1* | *9.82* |
| 2000 | 7.8 | 8.4 | 6.2 | 6.2 | 5.6 | 7.5 | 6.0 | 6.0 | 7.7 | 7.6 | 11.9 | 11.9 | 11.9 | 12.0 | *57.1* | *59.6* |
| 3000 | 6.9 | 12.1 | 7.0 | 7.0 | 8.5 | 12.8 | 7.0 | 7.0 | 7.5 | 6.51 | 7.3 | 7.3 | 16.9 | 23.0 | *67.9* | *75.71* |
| 4000 | 8.5 | 9.2 | 4.3 | 4.3 | 6.6 | 7.3 | 6.7 | 10.5 | 4.6 | 4.29 | 8.3 | 8.7 | 8.0 | 12.0 | *42.2* | *56.29* |
| 5000 | 2.3 | 2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | *2.3* | *2* |
| 6000 | 0.2 | 0.9 | 5.5 | 6.5 | 1.0 | 0.5 | 0.6 | 2.0 | 1.4 | 0.78 | 0.4 | 0.4 | 0.4 | 1.0 | *9.5* | *12.08* |
| 7000 | 0.6 | 0.2 | 0.3 | 0.3 | 0.5 | 0.8 | 0.5 | 0.6 | 0.5 | 0.2 | 0.5 | 0.5 | 0.5 | 1.0 | *3.4* | *3.6* |
| 8000 | 0.5 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 1.0 | *1.4* | *1.4* |
| *Total* | *40.0* | *44.5* | *24.5* | *25.5* | *24.6* | *31.4* | *24.4* | *29.8* | *28.3* | *27.64* | *29.9* | *30.3* | *40.0* | *52.0* | *211.7* | *241.14* |

## 1.2.11 MAIN EXPENDITURE (€) PER PARTNER, JANUARY, 2003 TO DECEMBER, 2005

| | CEH | | CREAF | | Metla | | Alterra | | GIM | | ILE SAS | | Univ. Hamburg | | *Total* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DoW | used | DoW | used | DoW | used | DoW | used | DoW | used | DoW | used | DoW | used | DoW | used |
| **Durable Equipment** | € 6,465 | € 4,017 | € 7,642 | € 2,783 | € 2,240 | € 1,680 | € 1,000 | € 1333 | € 2,500 | € 2,837 | € 5,850 | € 4,582 | € 3,200 | € 3,405 | *€ 28,897* | *€ 20637* |
| **Subcontracting** | € 0 | € 0 | € 16,800 | € 3,000 | € 0 | € 0 | € 0 | € 0 | € 0 | € 0 | € 260,000 | € 260,000 | € 0 | € 0 | *€ 276,800* | *€ 263000* |
| **Travel & Subsistence** | € 44,210 | € 28,926 | € 15,920 | € 7,607 | € 15,740 | € 15,108 | € 12,720 | € 13,225 | € 11,420 | € 6,946 | € 21,640 | € 13,160 | € 19,620 | € 11,510 | *€ 141,270* | *€ 96482* |
| **Consumables** | € 4,056 | € 8,769 | € 113,553 | € 85,473 | € 1,000 | € 1,741 | € 1,000 | € 5,835*** | € 4,045 | € 4,653 | € 19,000 | € 19,636 | € 5,800 | € 3,853 | *€ 148,454* | *€ 124125* |
| **Consumables revised**** | € 7,056 | | € 83,553** | | | | € 4,000 | | | | | | | | | |
| **Computing** | € 0 | € 0* | € 0 | 0 | € 5,200 | € 5,024 | € 0 | € 0 | € 0 | € 0 | € 7,000 | € 7,510 | € 0 | € 0 | *€ 12,200* | *€ 12534* |
| *Total* | *€ 54,731* | *€ 41,712* | *€ 153,915* | *€ 89,863* | *€ 24,180* | *€ 23,553* | *€ 14,720* | *€ 20,393* | *€ 17,965* | *€ 14,436* | *€ 313,490* | *€ 304,888* | *€ 28,620* | *€ 18,768.27* | € 607,621 | *€ 516778* |
| *Total Revised ** * | *€57,731* | | € 123,915 | | | | *€ 17,720* | | | | | | | | € 583,621 | |

*** Euro 30,000 of the dataset budget of CREAF was redistributed across all partners; 'Consumables revised' and 'Total revised' take the transfer of the Euro 30,000 into account.*

*** Printing of Alterra report 1077 "Historic land use dynamics in and around Natura2000 sites as indicators for impact on biodiversity". (Costs: 1758 euro).*

## 1.3 MILESTONES AND DELIVERABLES OBTAINED

The main milestones were:

- BIOPRESS participation (exhibition space) at the Communicating European Research 2005 event which took place in Brussels on 14-15 November 2005
- Final BIOPRESS event held in Brussels in Dec 06.
- Printing of leaflet.
- BIOPRESS impact tables and associated analysis (WP4400).
- Position paper produced jointly by BIOPRESS and BIOHAB.

The following outputs were delivered:

| Deliverable / WP | Description |
|---|---|
| D15&D16&D33 / WP2400 | Report on Quality Assessment Results |
| D18 / WP8000 | Assessment report on high resolution satellites |
| D27toD31&D37 / WP3200 | Pan-European estimates of land cover change (report – final version) |
| D32-revisited / WP8000 | Working document summarising problems to the Assessment Team - revisited |
| D38 & D40 / WP4200 | Methodology for capturing land cover changes in Europe using medium resolution satellite data |
| D42 / WP4300 | Integration of the BIOPRESS land cover product with socio-economic statistics for the analyses of land cover dynamics |
| D43 /WP4300 | Quantification of pressures using socio-economic data and the land cover change matrix |
| D44 / WP4300 | Characterise relative importance of different indicators in quantifying a pressure, and its link to land cover changes |
| D45 / WP4400 | Land cover translated to EUNIS Level 2 habitats |
| D46 & D47 / WP4400 | Annotated quantified impact tables for sites & for european zones |
| D50 – D53 / WP4500 | Error modelling and quantification of potential error sources on pan-European scale |
| D55 / WP6000 | Dissemination Workshop |

## 1.4 DEVIATIONS FROM THE WORK PLAN OR /AND TIME SCHEDULE AND THEIR IMPACT TO THE PROJECT

### 1.4.1 WP000 COORDINATION

D 54 "Final WP 4000 report summarising and demonstrating results of WP" was felt to be duplicating the role of Section 6 in the final BIOPRESS report to the EC and was therefore not produced.

### 1.4.2 WP1000 DATA SEARCH AND DATA ACCESS

Because the extrapolation of the land cover change results did not go ahead all outputs which would have been derived from this product did not materialise. So except for to BIOPRESS database which holds all the sample site interpretation results no other spatial data was produced. D48 "GIS layers containing all spatially referenced outputs" has therefore become irrelevant.

### 1.4.3 WP3300 EVALUATION OF RESULTS BY EXTERNAL EXPERTS

D33 "Report on expert evaluation of land cover change statistics (WP3000 & WP7000)" has been merged with the revised deliverable D15&D16 to become D15&D16&D33.

### 1.4.4 WP4200 IMPROVING DETECTION OF CHANGE IN LAND COVER AND LANDSCAPE FEATURES FROM MULTI-SCALE RS DATA, COVERING THE INFORMATION NEEDS OF WP4300 AND WP4400

D40 (Methodology for capturing land cover changes in Europe using medium spatial resolution ... satellite data) D38 and D18 were delayed but submitted at the end of the project. Although it was decided at the BIOPRESS Annual Meeting (18-20 May 2005) to merge deliverable D38/D18 (Report describing the potential of medium resolution satellite imagery to detect land cover changes on the scale of CORINE & Assessment report on high-and medium resolution satellites) with D40 (method) partners ended up producing 2 separate reports: D38&D40 by ALTERRA and D18 by Univ. Hamburg. The delay did not impact on the other project WP's.

### 1.4.5 WP4300 INTEGRATION OF SOCIO-ECONOMIC DATA TO QUANTIFY PRESSURES FROM LAND COVER CHANGE

Continuing difficulties in data collection and in defining an agreed methodological framework for WP4300 have affected the progress and its related deliverables (D42-D44 for WP4300):
D43 "Quantification of pressures using socio-economic data and the land cover change matrix" was not achieved as well as the team would have wished, although the landcover-to-pressure conversion matrix is seen as one of the main outcomes of BIOPRESS with scope for complementing and enhancing the land cover flow matrix developed by the EEA. There were major issues related to the quality and varying nature (sampling approaches, spatial and temporal characteristics, semantics) of the social and economic data acquired which could not be resolved within the relatively limited time available.
Also there were significant divergence between partners on the conceptual interpretation (i.e. the Pressure-LCC matrix) and methodology (i.e. data mining vs. parametric approaches).
On hind side, the team could have benefited from an extra member specialised in spatial data integration and an extra member drawn from the socio-economic research community.
So as a result D42 "Report on utility of hierarchical boundaries in reconciling spatial resolution mis-match" has been renamed to "Integration of the BIOPRESS land cover product with socio-economic statistics for the analyses of land cover dynamics", becoming the sole WP4300 report summarising the activities and finding of the work carried out under this WP.

### 1.4.6 WP4400 IMPROVE SEMI-QUANTITATIVE PRESSURE IMPACT STATE MODEL BY INCORPORATING QUANTITATIVE MEASURES OF PRESSURES

It was agreed at the annual meeting that D46 (Annotated quantified impact tables for sites) and D47 (Annotated quantified impact tables for European zones) would be merged in a single report assessing the strengths and weaknesses regarding the contribution of land cover statistics such as BIOPRESS phase I product to DPSIR biodiversity assessments. Site specific assessment would be addressed in 5 pilot windows and would focus on linking socio-economic information with land cover change and their ecological impacts.
D49 "Maps of pressures and impacts across Europe" were impossible to produce without the extrapolation of the land cover change results.

### 1.4.7 WP4500 ERROR PROPAGATION BETWEEN DIFFERENT STAGES

Deliverables D50, D51, D52 and D53 were merged into a single report D50 – D53 'Error modelling and quantification of potential error sources on pan-European scale'.

### 1.4.8 WP6000 - DEMONSTRATION AND DISSEMINATION

D34, "Mid-term CD -containing land cover change product report- and leaflet" and D56, "Second CD with all products and results of the project and leaflet": The CD idea included in the proposal did not materialise. The team decided to substitute the CD by the Book and a BIOPRESS summary report adapted from Section 6 of the final report. The BIOPRESS summary report will be the responsibility of CEH, BIOPRESS coordinator and will be produced as a pdf file as part of the dissemination activities which will continue after February 2006 (Technology Implementation Plan).

## 1.5 CO-ORDINATION OF THE INFORMATION BETWEEN PARTNERS AND COMMUNICATION ACTIVITIES.

The following tools and activities were used to facilitate information exchange and communication between partners:

- A BIOPRESS e-mail address.
- An FTP site dedicated to the BIOPRESS project and on which BIOPRESS partners can place and extract project related documents (e.g. minutes of meetings, final versions of deliverables, working documents, useful reference documents etc...). Access to the site is exclusively for BIOPRESS staff only. The FTP site can be accessed from the BIOPRESS webpage.
- A regularly updated meta-database (WP1000) listing the European datasets acquired by GIM for the project. The database is accessible via the web.
- A second database was created by TU-Dresden for input of the land cover change results of transects and windows. The database has been up and running since August 2004.
- Regular (every 2 months) teleconferences were held to deal with routine project management issues.
- The WP4300 and WP4400 teams held a Teleconference to ensure the activities in both work packages were integrated fully.
- The use of life working documents (located on BIOPRESS ftp site) was introduced to ensure continued integration between WP4300 and WP4400.
- The fifth and final 6-monthly project meetings was held in Tervuren, Belgium. 14-15 December 2005.

## 1.6 DIFFICULTIES ENCOUNTERED AT MANAGEMENT AND CO-ORDINATION LEVEL AND PROPOSED/APPLIED SOLUTIONS

Some partners were expecting to spend more man months on the project then originally planned (DoW). The situation is the worst for METLA. The redistribution of CREAF's unspent data budget to partners (see table below) was introduced in the previous reporting period to help resolve the problem for most of these partners. METLA has finished the planned work for WP4300 & 4400.

Table: Redistribution of euro 30.000 from CREAFs data budget to other partners

| partner no | | | EC contribution | total budget | allocated to |
|---|---|---|---|---|---|
| 1 | CEH | FC | 3857 | 7714 | staff time |
| | | | 1500 | 3000 | T&S to cover student support |
| 2 | CREAF | AC | 3857 | 3857 | staff time |
| 3 | Metla | FC | 3857 | 7714 | staff time |
| 4 | Alterra | FC | 3857 | 7714 | staff time |
| | | | 1500 | 3000 | T&S to cover student support |
| 5 | GIM | FC | 3857 | 7714 | staff time or consumables for final meeting |
| 6 | ILESAS | AC | 3857 | 3857 | staff time |
| 7 | Hamburg | AC | 3857 | 3857 | staff time |
| | **Total** | | **29999** | **48427** | |

# Chapter 2 EXECTIVE SUMMARY – JAN'05 TO DEC'05

| Contract n° | ENV-CT-2002-00178 | Reporting period: | January 04 – December 04 |
|---|---|---|---|
| Title | BIOPRESS - Linking Pan-European Land Cover Change to Pressures on Biodiversity | | |

**Objectives:**

BIOPRESS – Linking pan-European land cover change to pressures on biodiversity – is a 3 year EC-FPV project funded in the framework of the GMES 'Global Monitoring for Environment and Security' initiative (http://gmes.fdc.fr/what_is/home.html). It is the only GMES project under the priority theme "Land cover change in Europe".

BIOPRESS seeks to provide the EU-user community with quantitative information on how changes in land cover and land use has affected the environment and biodiversity in Europe. The project aims at producing consistent and coherent sets of historical (1950 – 1990 – 2000) land cover change information in and around circa 75 Natura2000 sites located from the boreal to the Mediterranean, and from the Atlantic to the continental regions of Europe. These land cover change statistics will subsequently be converted into quantitative measures of pressures on biodiversity.

The change statistics are produced by means of two parallel activities, the backdating of CORINE land cover 1990 of circa 75 windows (30km x30km) with aerial photography of the 1950'ies and, the interpretation of aerial photography from 1950, 1990 and 2000 for circa 50 transects (2km x 15km). The windows are interpreted to identify the CORINE level 3 land cover and use classes to a minimum mapping unit of 25 ha. The transects, at the other hand, are interpreted to a minimum mapping unit of 0.5 ha and are also interpreted for linear and point features such as hedges, small streams and cluster of houses.

**Scientific achievements:**

During the third 12 months of the project, only one new dataset was added to the BIOPRESS database of useful datasets. But still the European data policy appears to be the major obstacle for easy access to European datasets even in case of projects that are financed by the European Commission. The INSPIRE initiative as well as the GMES framework could benefit from the experiences made in the BIOPRESS project in order to streamline access to European wide data relevant for environmental monitoring.

The production of the land cover change database represented the main operational activities of the project. The database contains a unique set of land cover change matrices representing the past (1950, 1990, 2000) changes in land cover or 73 windows and 59 transects.

External restrictions impacted on the sampling strategy which was originally planned to be stratified random. The 73 windows were characterised thoroughly within a pan-European context with CLC90 and the sensitivity of the sampling scheme assessed in the context of the BRME and European landscape variability. It was concluded that BRME (Bio-geographical Regions Map of Europe) was the most suitable stratification for BIOPRESS given its wide user support and the small number of zones. Unfortunately, due to the high variability within in BRME zones, windows data was not sufficient to adequately describe the zones and their variability. The sensitivity analysis identified the need for more windows to adequately describe and differentiate between zones using a sample approach. A comparison between the population and sample results also suggested a bias in the sample selection toward Forest and Semi-natural related to the focusing of activity around Natura 2000 sites. The windows are therefore less representative of the BRME zones as a whole than a random sample would be. Overall it was concluded that the nature of the BRME and BIOPRESS sampling scheme for windows were not appropriate for extrapolation of land cover change results across Europe within the context of the BRME and with any level of confidence. Similar conclusions were drawn for the transect data set.

When looking into the future monitoring of European habitats, which are in general very small and fragmented, the best approach appears to be a sampling approach. A sampling approach is very convenient for integrating field surveys with EO data. Based on experiences from BIOPRESS and BIOHAB (FP5 EC funded Concerted Action) it was recommended that a monitoring framework should use:

- Stratified random sampling for statistical extrapolation

- Use environmental stratification of Europe
- Sampling of (1) Natura 2000 sites;(2) Twinned samples outside Natura 2000; (3) Long-term monitoring sites.
- Baseline survey with km square samples to provide spatial information;
- Use 15 sample units per stratum and 23 samples units if Natura 2000 sites are included;
- A total of 3.335 km2 (23*145) needs to be monitored if 145 European strata are being used.
- Survey based on interpretation of EO data in combination with field work according to BIOPRESS/BIOHAB methodology.

The small sample from the land cover changes observed in the 73 BIOPRESS windows have demonstrated a promising way for making measurements at different spatial and temporal scales, from large-scale assessments of regional trends to local-scale analysis of complex dynamics. The additional information obtained from social and economic statistics have also confirmed the importance of defining which socio-economic indicators contribute the most to an explanation of land-cover change, and their impact on biodiversity. However, our understanding of land-cover dynamics still remains inadequate for two reasons: (i) we lack accurate measurements of its rate and spatial pattern over time, and (ii) we have a very poor capability of modelling from empirical observations.

When assessing the consequences of the observed land cover changes on biodiversity, namely on the impact of changes in the extent and spatial distribution of habitats (BIOPRESS impact tables) it was found that a land cover product such as BIOPRESS phase I was suitable for quantifying some pressures on biodiversity but quite insufficient for the interpretation of land cover change related to other pressures:

- BIOPRESS contributed very positively to the quantification of urbanization across Europe between 1950 and 1990/2000.
- BIOPRESS land cover product made a useful contribution to the quantification of afforestation and deforestation across Europe between 1950 and 1990 but that these pressures could be better understood if (i) we had more points in time, closer together and (ii) more information on the condition of forest was derived from remote sensing and/or ancillary data was used to evaluate the ecological value of forested land.
- BIOPRESS will have underestimated the extent to which the pressure land abandonment is threatening biodiversity in Europe, in comparison to other existing assessments (e.g. MIRABEL but also national scale statements). However, it would be possible to increase the accuracy and the generic value of the BIOPRESS estimates by (i) broadening the definition of land abandonment i.e. modifying the pressure matrix, so that it matches what is meant in other assessments and (ii) by increasing the number of points in time.
- BIOPRESS was probably the first project to provide quantitative estimates about the shift from small scale to more large scale agriculture for such a large sample area across Europe and in this respect, this is a very important contribution to understanding changes in European biodiversity. However it is important to keep in mind that what has been quantified within BIOPRESS was only a small part of what is usually understood by farming intensification in biodiversity assessments. This means that, as was the case for land abandonment, BIOPRESS results will greatly underestimate the pressure farming intensification, compared to other assessments.

The error propagation study described each step of the production chain (from the test site selection through all its stages to the pan-European maps of land cover changes) and analysed the corresponding potential error sources. An error model was developed highlighting the error sources with the highest impact on the final product and identifying where errors could be potentially be reduced. The following was concluded from the analysis:

- Errors that occur in early stages of production chain and that can not be cleared by the user propagate to the next production step.
- Comparison of window and transect approach demonstrated differences as a result of different interpretation (spatial) scale. Transects showed three times more changes than windows and consistency in change detection is low between transects and windows.
- The CORINE nomenclature does not exploit to the full the information content of aerial photographs, but image quality and expertise of interpreter are major limiting factors.
- Use of historical aerial photographs with insufficient quality was the main source of error, followed by a weakly designed CORINE land cover nomenclature. High variability of different interpretations in level

three for the same sites demonstrates the need for enhancement of interpretation methodology.

- Diversity in terms of land cover proportion in Europe is very high and generalisation may lead to bias or under-estimation of changes. One general optimal sampling strategy on pan-European level for all kind of pressures on biodiversity is impossible.
- Various disturbances in used data sources such as geometric uncertainties between CLC 1990 and CLC 2000 and highly generalized data which do not show, for example, the location of habitats inside of NATURA2000 sites leads to errors in quantitative and qualitative analysis.

**Socio-economic relevance and policy implications:**

The project supported the needs of DG-Environment and EEA in helping to implement and assess European policy on nature and biodiversity and contribute to the objective of enhancing the quality of the environment by helping to understand pressures on biodiversity arising from land cover change in the member states and accession countries.

**Conclusions:**

The third year of the project has proceeded well.

BIOPRESS was one of the first wave of thematic projects which were funded through the GMES initiative. As a result its main objective was to produce information at European level which in the case of BIOPRESS was information on historical land cover change for the purpose of assessing past pressures on habitats and their associated biodiversity. A large part of the project's resources were used to deliver the land cover change database successfully and the outcome has not only been the delivery of data but also a set of tools for future European wide land cover monitoring. The real challenge was when trying to establish a link between land cover change and pressures on biodiversity. The development of the land cover change - pressure association matrix as a first step enabled the grouping of types of land cover changes related to one of the six pressures under consideration in BIOPRESS. This matrix has the potential to enhance the similar 'Land Cover Flow' matrix developed by the EEA as part of the EEA Land Accounting System. In theory the idea of integrating socio-economic data with land cover change data made sense but in practice the team struggled with the wide variety of data types, spatial and temporal resolutions. To assess the consequences of the observed Land cover changes on habitats and their biodiversity, BIOPRESS impact tables were developed using the same conceptual approach as that establish for the DPSIR assessment MIRABEL. The overall agreement between MIRABEL and the BIOPRESS tables, which unlike MIRABLE provided quantitative estimates for a selected sample of land in each region, was an important result. This part of the work concluded that a land cover change product such as that produced by BIOPRESS was suitable for quantifying some pressures on biodiversity but quite insufficient for the interpretation of land cover change related to other pressures. The error propagation, quality assessment and data search exercises highlighted the importance of the availability of good quality, affordable data (e.g. aerial photography, digital elevation data, social and economic indicators) which for long term monitoring should be continuously collected in a consistent manner.

Key to the success of BIOPRESS is the continuing use of the data products it will be producing. The EEA, is an active advisory group member and will be one of the main users of the data.

**Keywords: Historical land cover change, pressures, biodiversity, Natura2000, GMES**

# PUBLICATIONS (CUMULATIVE LIST)

## Refereed journals

Clevers, J.G.P.W., M.E. Schaepman, C.A. Mücher, A.J.W. de Wit, R. Zurita Milla and H.M. Bartholomeus, 2005. Using MERIS on ENVISAT for Land Cover Mapping. IN: International Journal of Remote Sensing. Accepted.

Metzger, M.J., R.G.H. Bunce, R.H.G Jongman, C.A. Mücher and J.W. Watkins, 2005. A climatic stratification of the environment in Europe. In: Global Ecology and Biogeography. In print.

A.G. Thomson, S.J. Manchester, R.D. Swetnam, G.M. Smith, R.A. Wadsworth, F.F. Gerard. 2006. The use of digital aerial photography and CORINE-derived methodology for monitoring recent and historic changes in land cover near UK Natura 2000 sites for the BIOPRESS project. International Journal of Remote Sensing. Accepted.

Feranec, J., Hazeu, G.W., Christensen, S. & Jaffrain G., 2006 (accepted). CORINE Land Cover change detection in Europe (Case studies of the Netherlands and Slovakia). Land Use Policy.

Feranec, J., Cebecauer, T., Hazeu, G.W. & Jaffrain, G., 2006 (submitted). Cartographic aspects of land cover change detection (over- and underestimation in the I& CORINE Land Cover 2000 Project). The Cartographic Journal.

## Book

Gerard et al. 2006. Land cover change in Europe from the 1950'ies to 2000. Aerial photo interpretation and derived statistics from 59 samples distributed across Europe. K. Olschofsky and R. Kohler (eds). Pp 309. (proof in Annex).

## Conference proceedings

Bugár, G., 2003: Evalaution of the land cover and biodiversity changes in Europe (BIOPRESS project) (in Slovak). - In: Novák, S. (ed.) 2003: Geographical aspects of the region of Central Europe (in Czech). Geografie XIV., Pedagogická fakulta MU Brno, Brno, p. 270-274., ISBN 80-210-3208-1

Bugár, G., Hreško, J. 2003: Land cover and biodiversity changes from the sustainability of natural resources point of view (in Slovak). – In: Izakovičová, Z. (ed.): Proceedings of the conference „Slovakia one year after Johannesburg". Bratislava, ILE SAS: 143-148

Hazeu.G.W., C.A. Mücher & M. Wachwicz, 2005. Monitoring land cover changes inside and outside Natura2000 sites. In: Proceedings (on CDROM)of the International Cartographic Congress, 9-16 July 2005, La Coruña, Spain.

Gerard, F., Brems E., Bugar G., Gregor M., Hazeu G., Janssens E., Kohler R., Kolar J., Luque S., Manchester S., Mucher S., Olschofsky K., Oszlanyi J., Petit S., Pino J., Pons X., Roscher M., Smith G., Sustera J., Thomson A., Tuominen S., Halada L., Hresko J., Wachowicz M., Wadsworth R., Wyatt B., Ziese H. 2004. BIOPRESS - Linking Pan-European Landcover Change to Pressures on Biodiversity. NERC Earth Observation Conference

Smith, G., Gerard, F., Brems E., Bugar G., Gregor M., Hazeu G., Janssens E., Kohler R., Kolar J., Luque S., Manchester S., Mucher S., Olschofsky K., Oszlanyi J., Petit S., Pino J., Pons X., Roscher M., Sustera J., Thomson A., Tuominen S., Halada L., Hresko J., Wachowicz M., Wadsworth R., Wyatt B., Ziese H. 2004. Deriving long term land cover change from aerial photography to assess pressures on biodiversity. Macaulay workshop - RSPSoc 2004

Luque, S., Gerard, F., Brems E., Bugar G., Gregor M., Hazeu G., Janssens E., Kohler R., Kolar J., Manchester S., Mucher S., Olschofsky K., Oszlanyi J., Petit S., Pino J., Pons X., Roscher M., Smith G., Sustera J., Thomson A., Tuominen S., Halada L., Hresko J., Wachowicz M., Wadsworth R., Wyatt B., Ziese H. 2004. 2004. Historical land cover change in and around Natura2000 sites for assessing and predicting impact on biodiversity. PEER Conference.

Luque S., Huitu H. Petit, S. 2005. Quantifying pressures on biodiversity to Understand Spatial Patterns: A temporal and Spatial approach. - Abstract in Proceedings - IALE France. November 16-18 Marseille, France.

Luque, S., Huitu, H. 2005. Can the quantification of pressures on biodiversity help to understand spatial patterns? Abstract in Proceedings. The 6th Open Meeting of the Human Dimension of Global Environmental Change Research Community, University of Bonn, Germany 9-13 October.

Gerard, F. M. Wachowicz, K. Olschofsky, G. Smith, S. Luque, E. Brems, G. Bugar, M. Gregor, G. Hazeu, Huitu, H E. Janssens, R. Kohler, J. Kolar, S. Manchester, S. Mucher, , J. Oszlanyi, S. Petit, J. Pino, X. Pons, M. Roscher, J. Sustera, A. Thomson, S. Tuominen, L. Halada, J. Hresko, R.Wadsworth, B. Wyatt, H. Ziese. 2005. Quantifying past pressures on biodiversity in Europe by combining socio economic indicators with land cover change data. Abstract in Proceedings. The 6th Open Meeting of the Human Dimension of Global Environmental Change Research Community, University of Bonn, Germany 9-13 October.

Oszlányi, J., Halada, Ľ., Hreško, J., Bugár, G., 2003: Linking pan-European land cover change to pressures on biodiversity. FP-V global monitoring for environment and security (GMES). – In: 13th International Symposium on Problems of Landscape Ecological Research, 30 September – 3 October, 2003 Mojmírovce

## Reports

Wachowicz, M.and C.A. Mücher, 2005. Space-Time Modelling for the Explanation of Convergence patterns. In: Proceedings LUCC Conference, 28-30 October 2004, Institute for Environmental Studies, Amsterdam. Report number: W-05/04, p. 27-28, published on February 2005.

Hazeu, G.W. and C.A. Mücher, 2005. Historic land use dynamics in and around Natura2000 sites as indicators for impact on biodiversity. Phase I of the BIOPRESS project for the Netherlands. Alterra Report 1077, Wageningen, the Netherlands.

# Chapter 3 PROGRESS MADE – JAN'05 TO DEC'05

## 3.1 WP1000 – DATA SEARCH AND ACCESS

### 3.1.1 OBJECTIVES

The objectives of work package WP1000 are:

- To identify existing European datasets related to land cover, land use and the four pressures (intensification, abandonment, afforestation, urbanisation) acting on the environment
- To streamline and coordinate access to these datasets by developing and implementing an in-house meta-database
- To coordinate access to the metadata of aerial photos acquired in the framework of other work packages (WP2000, WP3000 and WP7000).

### 3.1.2 METHODOLOGY AND SCIENTIFIC ACHIEVEMENTS INCLUDING CONTRIBUTION FROM PARTNERS

The methodological approach followed during WP1000 is parallel to the three objectives stated above:

- identification of datasets,
- organising access to these datasets and
- organising access to metadata of national datasets.

The methodology has been described in detail in the Annual Report for 2003.

One of the datasets being crucial to the BIOPRESS project is the European Natura 2000 boundaries. Despite important efforts, it appeared impossible to obtain the dataset. It is hold by the SADL of the KU Leuven on behalf of the DG Environment, but they refuse to hand out the Natura2000 boundaries yet.

With respect to the SABE data, GIM found out this data are no longer provided by Eurostat, but by EuroGeographics. Since the license user agreement was no longer valid anymore and could not be renewed, the team voted for excluding the SABE data.

Table 2 gives an overview of the data sets that are currently available to the BIOPRESS consortium. Since the last annual report CLC2000 and changes data have been obtained from the EEA for almost all European countries. The datasets include a metadata quality rating. The quality of the metadata is rather variable and depends strongly on the source of the data.

**Table 1 Overview of the data sets that are currently available to the BIOPRESS consortium,**

| Data set # | Dataset name | Source | Rating | Comments |
|---|---|---|---|---|
| 22 | Environmental Classification of Europe | Alterra, Netherlands | * | |
| 31 | Biome Classification | Vito, Belgium | * | |
| 42 | Biogeographical Regions Map of Europe | EEA | ** | |
| 23 | Pan-European Land Cover Monitoring (PELCOM) | Alterra, Netherlands | ** | |
| 36 | Digital Map of European Ecological Regions (DMEER) | EEA | * | |
| 10 | CLC90 European 250 m Grid | EEA | *** | |
| 10 | CLC90 European 100 m Grid | EEA | *** | |
| 3 | CLC90 European Vector dataset | EEA | *** | |
| 33 | Nationally designated areas | EEA | * | |
| 5+24 | SABE Commune boundaries (1991, scale 1/1.000.000), and population figures (1981,1991) | EuroGeographics | **** | Metadata extracted from GISCO metadatabase |
| 5+24 | SABE Communes (1991, point objects), and population figures (1981,1991) | EuroGeographics | **** | Metadata extracted from GISCO metadatabase |
| 5+24 | SABE Commune boundaries (1991, scale 1/100.000), and population figures (1981,1991) | EuroGeographics | **** | Metadata extracted from GISCO metadatabase |
| 45 | Modelled light emissions for EU | Imperial College, London | * | |
| 41 | CORINE biotopes | EEA | ** | |
| 46 | NewCronos | Eurostat | * | Further investigation required in order to extract relevant themes. |
| 47 | Europe Level 1 Provinces | ESRI | **** | |
| 48 | Europe Level 2 Provinces | ESRI | **** | |
| 51 | EU gridded roads | Imperial College, London | * | |
| 52 | CLC2000 vector database | ETC-TE (EEA) | *** | |
| 53 | CLC1990-2000 change database | ETC-TE (EEA) | *** | |

Metadata rating :

* no metadata sheet available; metadata extracted from other sources (reports, flyers, ...)

** metadata sheet available, dataset poorly documented

*** metadata sheet available, fairly well documented dataset – no standardized metadata

**** metadata sheet available, well documented dataset using standardized metadata

The BIOPRESS metadatabase is created in ArcGIS through the ArcCatalog application and is published to a ArcIMS metadata service. It can be explored either by using ArcCatalog or by using the Metadata Explorer via an Internet browser.

ArcIMS Metadata Services are made up of the ArcIMS Spatial Server combined with data residing in a relational database. The data in this database is accessed using ArcSDE, which is required to use ArcIMS Metadata Services.

The two metadata standards that are most commonly used for metadata of geospatial data are the following:

- FGDC (Federal Geographic Data Committee) Metadata Standard (FGDC-STD-001-1998) (http://www.fgdc.gov/metadata)
- ISO Technical Committee (TC)211 Metadata Standard 19115 (previously known as 15046-15) (http://www.isotc211.org/ )

Due to technical characteristics of the ArcGIS software, the FGDC standard was adopted for describing the datasets available within the BIOPRESS project.

### 3.1.3 SOCIO-ECONOMIC RELEVANCE AND POLICY IMPLEMENTATION

The activities performed in WP1000 provide an important input into the discussion on the developing European spatial data infrastructure (INSPIRE) by identifying access and access constraints for European datasets, by reporting on temporal delays for obtaining data and by identifying gaps in the information needed to establish a European monitoring capacity.

### 3.1.4 DISCUSSION AND CONCLUSION

During the third 12 months of the project, only one new dataset was added to the database. But still the European data policy appears to be the major obstacle for easy access to European datasets even in case of projects that are financed by the European Commission. The INSPIRE initiative as well as the GMES framework could benefit from the experiences made in the BIOPRESS project in order to streamline access to European wide data relevant for environmental monitoring.

## 3.2 WP2000 – METHODOLOGICAL DEVELOPMENT FOR LAND COVER CHANGE MATRICES

### 3.2.1 OBJECTIVES

The objective of WP2000 was to develop a quality assured method for the production of land cover change matrices from the interpretation of aerial photographs. The work involved the following steps:

- The provision of interpreters' rules for (i) backdating CORINE1990 and (ii) for photo to photo interpretation (WP2100).
- The development of an optimal stratification strategy for (i) sampling Natura2000 sites and (ii) extrapolating the change matrices to Europe (WP2200).
- The selection of Natura-2000 sites for the CORINE backdating (1990 – 1950) of 30km x 30km windows and a subset of these sites for the photo-to-photo interpretation (1950, 1990 and 2000) of 5km x 12 km transects (WP2300).
- The acquisition of the aerial photographs required for the transect interpretation (WP2300).
- The interpretation of the aerial photographs and production of land cover change matrices for an initial small set of Natura2000 sites (WP2400).
- The assessment of preliminary results to quantify consistency between interpreters and across Europe and to review the interpreters' manual (WP2400).

### 3.2.2 METHODOLOGY AND SCIENTIFIC ACHIEVEMENTS INCLUDING CONTRIBUTION FROM PARTNERS

Most of the activities in WP2000 were completed in the first year. In the second year the number of samples for the Mediterranean was increased by replacing 5 windows (of total of 41 windows) for which CAR ltd experienced problems in acquiring aerial photos by 4 windows in Greece and one window in Italy. The quality assurance measures continued to be implemented throughout the lifetime of WP3000.

### 3.2.3 SOCIO-ECONOMIC RELEVANCE AND POLICY IMPLICATION

The method development activities in WP2000 were important for ensuring the delivery of historical land cover change information from aerial photography that is consistent across Europe. By involving the European Environmental Agency at every stage of the methodological development it will be possible to incorporate the acquired land cover change results from both windows and transects into the 2005 'State of the Environment Report'. BIOPRESS will deliver information that is currently not available from any other information source to support relevant EU Directorates and Agencies in developing appropriate policies, assessing their effectiveness and adapting them to future circumstances. The project may also be able to contribute to the development of specific IRENA agro-environmental indicators http://agrienv.jrc.it/ (e.g. topological change) by delivering more detailed information on both permanent and transient land cover change.

### 3.2.4 DISCUSSION AND CONCLUSION

The activities in WP2000 were completed mainly in year 1 and some in year 2. The work has ensured the BIOPRESS team has the appropriate tools (list of 30km x 30km window sites, list of 2km x 15km transect sites, interpretation manual, quality assurance protocol and meta database designed to follow progress) and material (aerial photography) to successfully carry out WP3000 and WP7000.

## 3.3 WP3000 - PRODUCTION OF THE LAND COVER CHANGE MATRICES

### 3.3.1 OBJECTIVES

The objectives of the work packages WP3100, 3200 and 3300, coordinated by WP3000 were the following:

- To generate a sufficient number of cover and transition statistics from extra sites for reliable statistics using the approved methodology developed in WP2000.
- To scale the information gained about sites and strata to provide estimates of pan-European levels of land cover change.
- To organise and summarise the evaluation of results by independent /external experts of interpretation and land cover change results from WP2000/3000 and WP7000.
- To coordinate the activities in WP3100 and 3200 with respect to progress, milestones and deliverables, gathering data and reporting to the coordinator.

A number of distinct tasks had to be performed for WP3000. The main task for this work package was the interpretation of the transects by the consortium partners (WP3100). The total number of transects per partner is as follows: United Kingdom 9, Spain 9, Finland 7, Belgium 8, The Netherlands 10, Germany 10, Slovakia 8. Each partner has interpreted 3 pilot transects in the framework of WP2400, so the total number of remaining transects for WP3000 was 40.

From the interpretation results, the following outputs and analysis were to be produced:

- Generation of change matrices in a uniform way
- Generation of statistics per country, per stratum, per date
- Generation of change matrices and statistics of WP7000
- Comparison of 2 scale levels 1:20.000 and 1:100.000
- Interpretation of results
- Comparison of land cover interpreted from aerial photos with CLC90
- Extrapolate results to pan-European estimates (WP3200)

### 3.3.2 METHODOLOGY AND SCIENTIFIC ACHIEVEMENTS INCLUDING CONTRIBUTION FROM PARTNERS

Most of the work under WP3000 was completed in the previous 2 years. One remaining task was the compilation of Pan-European estimates which were produced using a BRME stratification. A second remaining task was the evaluation of the results by external experts (WP3300). The idea, to acquire expert feedback through a dynamic web-database interface did not crystallise due to lack of time and budget limitations. So the fallback option, which is for each partner to contact one or two external experts and ask for written feedback on their transect and window results, was implemented.

The work related to development of a stable and reliable extrapolation algorithm for the production of Pan-European estimates of land cover change (WP3200 / WP4100) is described under WP4100.

### 3.3.3 SOCIO-ECONOMIC RELEVANCE AND POLICY IMPLICATION

The land cover maps and change matrices resulting from the manual transect interpretation of samples distributed across the different biogeographical regions form a good basis for the analysis of historical pressures and their impact on biodiversity.

### 3.3.4 DISCUSSION AND CONCLUSION

This work package represented the main operational activities of the project which produced a unique database of land cover change matrices. The external restrictions which impacted on the sampling strategy made meaningful extrapolation impossible. However the variability of the European landscape in terms of its land cover composition has been characterised and new ideas for extrapolating to spatial products were developed and tested.

## 3.4 WP4100 DEVELOP EUROPEAN GIS FRAMEWORK

### 3.4.1 OBJECTIVES

The original objective of the WP was to develop a GIS framework to support and facilitate data integration within realistic and appropriate regions. Parcel-based systems were proposed as they offer an accurate representation of regions and landscapes and easily support the hierarchical structures which it was thought would be required to accommodate the range of spatial scales present within the landscapes at a pan-European level. WP4100 was to draw upon a searchable meta-database of available data sets, statistics on the sensitivity, accuracy and precision of different zonation schemes and a report detailing the optimal choice of zonation from WP1000, 2000 and 3000.

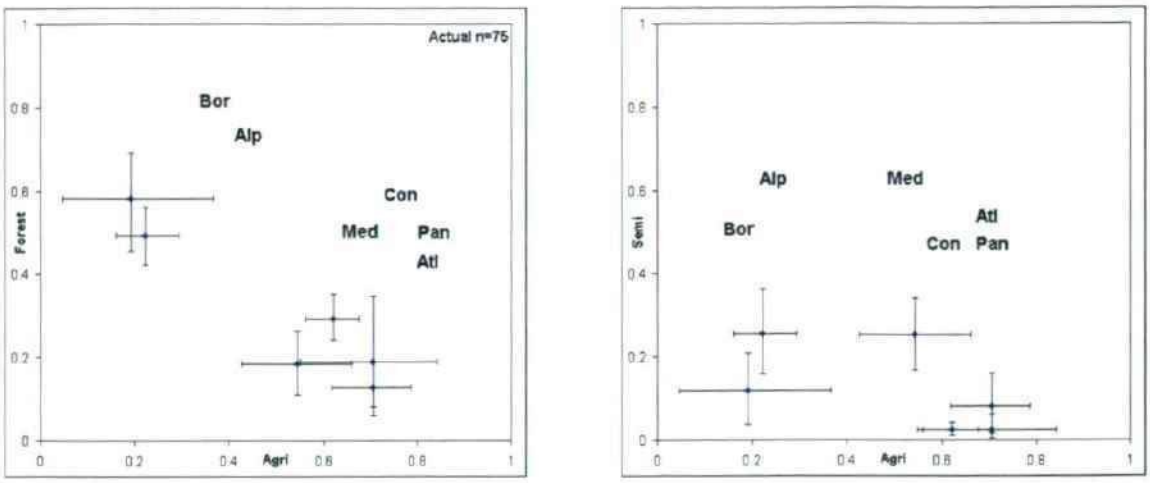
The work in WP4100 was to built on the results of WP2200 'Development of optimal stratification strategy'. The report from WP2200, 'A report on the characterisation of the selected 30 km windows and Pan-European stratification' (Document Ref: BIOPRESS-D6-D7-2.1), concluded that the choice of the BRME, made by the BIOPRESS team and the end-user representatives at the Kick Off Meeting, should be supported. The BRME stratification when characterised with CORINE Land Cover data from 1990, showed a general trend and clustering for Agricultural and Forest dominated biogeographic regions. The sample site super set provided by the EC went some way to addressing the differences in land cover characteristics between biogeographical regions across Europe, but was not of sufficient size or distribution to allow statistically sound extrapolation of the results of WP3000 and WP7000 to a pan-European level via the BRME stratification. The sample site subset derived in part from the super set represneted the significant biogeographical regions within Europe, but the results from the sample sites were not representative enough to describe and accommodate the variations between and within regions.

Based on the results of WP2200 and within the context of the restructuring of the whole of WP4000 'Developing and demonstrating monitoring concept for land cover change and pressures on biodiversity', WP4100 was also revised. The new objective of WP4100 was to assess the suitability of one or more GIS frameworks to support and facilitate data integration within realistic and appropriate regions. The key objective for WP4100 was therefore sensitivity analysis of the sample windows.

### 3.4.2 METHODOLOGY AND SCIENTIFIC ACHIEVEMENTS RELATED TO WORK PACKAGES INCLUDING CONTRIBUTION FROM PARTNERS

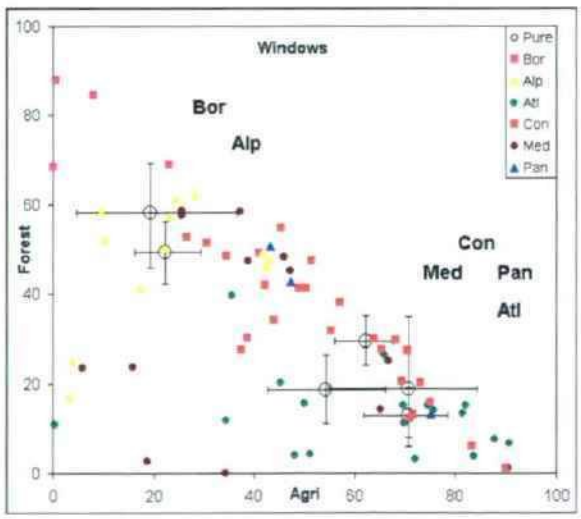
To assess the sensitivity of a sampling approach for the selected subset it was necessary to estimate the variability present in the whole population of possible sampling units. A sample population was created from which a subset could be drawn. In this case the sample population was derived by the aggregation of the proportions of CLC1990 land cover information onto an appropriate grid related to the sample support. The subset was required to be stratified by the BRME zones so the population was subdivided based on the same zonation scheme. The full subsets were therefore made up of a number of separate subsets each related to a BRME zone.

A subset was then drawn randomly from the sample population and the characteristics of the subset assessed. The drawing and assessment of subsets was repeated a large number of times so that the distribution of the characteristics of the subsets could be obtained. From this distribution the variability caused by the sub-setting procedure was obtained. One thousand mean proportion results for each BIOPRESS land cover aggregation were sorted and the 50th and 950th were extracted as estimates of the variability for each land cover within the BRME zone.




The scatterplots above for Agriculture and Forest (left) and Agriculture and Semi-natural (right) show the results of using the actual number of windows per BRME zone (Bor: 6, Alp: 12, Atl: 19, Con: 23, Med: 12 and Pan: 3. Total: 75) used in BIOPRESS when repeatedly sub-setting the sample population. The BMRE zones are divided into two clusters in the scatterplot of Agriculture against Forest, but within each cluster there is a lot of overlap of the bars representing the variability within each BRME zone. The Agriculture against Semi-Natural scatterplot is similar although the Atlantic, Continental and Pannonian zones are closer together with small amounts of Semi-Natural while the Mediterranean zone forms another cluster with large amounts of Semi-Natural.

The land cover proportions of the selected windows (below) were compared to the scatterplot of Agriculture against Forest for the sensitivity analysis using the actual number of samples per BRME to see how the selected windows related to the BRME zone means and their variability.




It can be seen that many of the points representing the selected windows lie considerable distances away from the means of their BRME zone. Even though the Continental zone has quite small variability bars the Continental zone windows cover a broad area. The same can be said to a slightly lesser extent for the windows within the other BRME zones. This situation results in a considerable number of windows, appearing to be more similar to BRME zones other than the one they occupy in terms of their CLC land cover proportions. In one instance, three of the Mediterranean windows lie close to the Boreal BRME zone mean, in this case due to having unusually large proportions of forestry.

### 3.4.3 SOCIO-ECONOMIC RELEVANCE AND POLICY IMPLICATION

Sample size and representativity, extrapolation and zonation of Europe are ongoing issues which go hand in hand with the production of European wide information on the state of the environment. The EEA have shown great interest in the work carried out under WP2200 (development of stratification scheme and sample selection), WP3200 (extrapolation of sample based land cover change information) and this WP as these are very relevant to the 'Land Ecosystems Account System' the EEA is hoping to implement.

### 3.4.4 DISCUSSION AND CONCLUSION

The work within WP2200 and WP4100 thoroughly characterised the BIOPRESS windows within a pan-European context with CLC90 and assessed the sensitivity of the sampling scheme in the context of the BRME and European landscape variability. WP2200 concluded that BRME was the most suitable stratification for BIOPRESS given its wide user support and the small number of zones. Unfortunately, due to the high variability within in BRME zones, it was unlikely that the BIOPRESS windows data set would be adequate to describe the zones and their variability.

The sensitivity analysis identified the need for more windows to adequately describe and differentiate between zones using a sample approach. A comparison between the population and sample results also suggested a bias in the sample selection toward Forest and Semi-natural related to the focusing of activity around N2000 sites. The windows are therefore less representative of the BRME zones as a whole than a random sample would be.

Overall it was concluded that the nature of the BRME and BIOPRESS sampling scheme for windows were not appropriate for extrapolation of land cover change results across Europe within the context of the BRME and with any level of confidence. Similar conclusions were drawn for the transect data set.

## 3.5 WP4200 IMPROVING DETECTION OF CHANGE IN LAND COVER AND LANDSCAPE FEATURES FROM MULTI-SCALE RS DATA

### 3.5.1 OBJECTIVES

Actual and reliable information on land use and land cover (LUC) is required for many application fields at various scale levels (Clevers et al. 2005). The European landscape is continuously undergoing changes caused by a combination of socio-economic and natural processes. LUC changes play a major role in studying climate change and in impacts on biodiversity. Conversion of landscapes, in particular forests, grasslands and agricultural lands and many other landscape elements have a major impact on their biodiversity. Remotely-sensed data from satellites provide a good basis for mapping LUC and LUC changes (Gutman et al. 2004). Since a new generation of satellite sensors has become available during the last years concerning very high resolution satellite sensors such as Quickbird and IKONOS and medium resolution satellite sensors such as MERIS and MODIS research concentrated especially on the added value of these sensors. WP4200 concentrated on improving the detection of change in land cover and landscape features (eg. linear elements such as line of trees) using multi-scale Remote Sensing data. For the detection of European land cover changes the research concentrated on the use of medium resolution satellite data (D38/D40) and for the segmentation of small landscape features the research concentrated on the use of very high resolution satellite data (D39). In both research lines the use of segmentation software eCognition played an important role.

The more specific research objectives were:

- Evaluate the potential of MODIS / MERIS medium resolution satellite imagery to follow-up land cover changes with a higher temporal frequency than the CORINE updates.
- Evaluate the potential for semi-automated detection of certain landscape characteristics from aerial photos and VHR satellite images.
- Development of a cost-efficient and semi-automated methodology for detecting small landscape elements using an object-oriented feature extraction approach.
- Application of the methodology to both black and white aerial photos, colour aerial photos and VHRSI (very high resolution satellite images).

Which were implemented through the following tasks and outputs:

Tasks

- Task 4210 (Alterra): Obtain medium resolution satellite data from MODIS/MERIS at a similar scale to CORINE interpretation.
- Task 4220 (Alterra / CEH): Assessment of the utility of medium spatial resolution (250 – 1000 m), but high temporal resolution (weekly – monthly) satellite data to identify land cover change and phenological signals.
- Task 4230 (GIM / CEH): For a selection of transects, a methodology for the semi-automatic detection of small landscape elements will be developed using an object-oriented feature extraction technique, an upcoming and powerful concept in image processing and information extraction. It is expected that each landscape element (e.g. small pond, row of trees, isolated farm house) will require a customised approach in terms of optimal scale definition for segmentation, texture measures, etc (parameter optimization).

### 3.5.2 METHODOLOGY AND SCIENTIFIC ACHIEVEMENTS RELATED TO WORK PACKAGES INCLUDING CONTRIBUTION FROM PARTNERS.

Discussion about future monitoring concept starts with the general framework which could be implemented according to the following different strategies:

1. Sampling. Stratified random sampling is the preferred sampling methodology. Studies like the Country Side Survey in the UK and the BIOHAB project on habitat monitoring advocate the use of stratified random samples using climatic information as the main data source for stratification. When information is needed at a very detailed scale the samples can be monitored using very high resolution satellite data such as QUICKBIRD, IKONOS and SPOT-5 panchromatic. The advantage of systematic sampling is that very detailed information can be gathered, as for example on linear features, which is very valuable information from an ecological point of view.

2. Full cover monitoring. This can be implemented using low (eg. SPOT-VEGETATION) or medium resolution satellite data (eg. MERIS or MODIS), or even using high resolution satellite data (eg. Landsat-TM or SPOT-XS), as has been done in the CORINE land cover project.

3. Using Temporal Land Cover Model. For the identification of land cover changes it is also a good possibility to exploit the wealth of multi-temporal time series of satellite images. When the land cover change has been identified the time-series can also be exploited to characterise the change in it's timing (i.e. when did the change exactly occur?) and the rate of change (i.e. rapid or gradual change). CEH has undertaken a program of work to test the feasibility of exploiting phenological signals in high frequency multi-temporal satellite data to detect areas of land cover change.

In this study major emphasis was placed on the exploitation of medium resolution satellite data to detect land cover changes within a full cover monitoring. A first hypothesis was that the update of CORINE land cover could be accelerated and at lower costs using MODIS or MERIS data. A second hypothesis was that CORINE land cover objects can be identified in a more automated and objective manner using MODIS/MERIS satellite data, reflecting the right information at the landscape level.

Most relevant conclusions with respect to this research were:

- Identification of CORINE objects (level 2) on basis of MODIS satellite images and eCognition give reasonable to good results.
- Major exceptions are heterogeneous CORINE classes.
- Major advantage of segmentation of MODIS/MERIS satellite images is consistency, speed, actuality en low costs (CORINE land cover differs very much in approach for the Netherlands and Belgium).
- MODIS will be at least useful for monitoring expansion urban areas.
- Use of phenological signals for land cover mapping and change detection could be an important complimentary approach to the conventional high spatial resolution mapping of CORINE land cover mapping.

Within the BIOPRESS there was a general interest in the detection of historic dynamics of landscape features, next to the detection of historic land use changes. The dynamics of the landscape elements, such as linear features and small biotopes, have a major impact on the landscape structure and therewith on the sustainability of the landscapes for specific populations and therefore on biodiversity. The manual identification and interpretation of linear and point features on aerial photographs within the BIOPRESS project appeared to be very time consuming. However, identifying these elements is relevant in the framework of biodiversity. Therefore, this work has been carried out to support the interpretation of small landscape elements via semi-automated image processing algorithms. Evaluation of the potential for semi-automated detection of certain landscape characteristics using the segmentation software eCognition and VHR satellite images led to the following conclusions:

- The use of very high resolution satellite imagery for the detection of small landscape elements allows a cheaper collection of data at the scale of BIOPRESS transects, compared to airborne images. This implies that time series are more likely to be acquired. Satellite imagery permits the harmonisation of the data, as there are only a few different satellites.
- Detection and classification of small landscape elements using an object-oriented approach offers more possibilities than a pixel-based method. It allows bringing texture, colour and shape of the formed objects into account. Further on, it allows working at different scales, because landscape objects over the world have a multitude of different dimensions.
- This object-oriented approach facilitates the elaboration of a semi-automated small landscape element detection that can be used on all European BIOPRESS transects. The specific strength of this method is to sensibly facilitate the work of an image interpreter (operator) as it indicates where the elements are located and if they meet all necessary criteria.
- As a result, there exists a large potential to extract small landscape elements from VHRSI. Even if it is already time and cost efficient for some small landscape elements, further research on this object-oriented classification can still sensibly contribute to a time and cost efficient, objective and high-quality BIOPRESS element detection technique.

## 3.3. SOCIO-ECONOMIC RELEVANCE AND POLICY IMPLICATION

A wide variety of national and international legal instruments (e.g. Convention on Biodiversity, Habitats Directive and the Special Measures under the EU Common Agricultural Policy) have, as their primary or secondary aim, environmental protection, with a view to achieving sustainable use of natural resources and maintaining an acceptable level of biodiversity. BIOPRESS delivered information that was currently not available from any other information source to support relevant EU Directorates and Agencies in developing appropriate policies, assessing their effectiveness and adapting them to future circumstances. BIOPRESS delivered information about historic land cover changes in very detailed and consistent manner. It was shown that the land cover changes in the past have been substantial and that the rate of change is continuing which results not only in habitat destruction but also has an impact on the quality of nature. Therefore it is necessary to monitor land cover changes also in the future. Such a monitoring system on land cover needs to fulfil many different needs and user requirements and therefore should not aim at one product but a collection of methodologies and products that fulfil the user requirements. It has also become very clear that multi-scale sensors are playing a crucial role in the monitoring system and are complementary to each other. However, the major concern at this moment is the political commitment to the long term provision of satellite-sensor systems dedicated for monitoring at various scales (e.g. launch of new LANDSAT-TM and SPOT-XS satellites are not yet foreseen and the definition studies for the satellites within the GMES ESA Sentinel family have only just started (2005)). This could create major limitations in maintaining a good monitoring system.

## 3.4. DISCUSSION AND CONCLUSION

The general framework of a monitoring system to detect land cover changes should integrate different approaches, namely, full cover monitoring, temporal monitoring using time-series and sampling approach for detailed recording. However, especially for the monitoring of European habitats, which are in general very small and fragmented, the best approach appears to be a sampling approach. A sampling approach is very convenient for integrating field surveys with EO data. Based on experiences from BIOPRESS and BIOHAB (FP5 EC funded Concerted Action) it was recommended that a monitoring framework should use:

- Stratified random sampling for statistical extrapolation
- Use environmental stratification of Europe
- Sampling of:
    - Natura 2000 sites;
    - Twinned samples outside Natura 2000;
    - Long-term monitoring sites (eg. Alternet.)
- Baseline survey with km square samples to provide spatial information;
- Use 15 sample units per stratum and 23 samples units if Natura 2000 sites are included;
- A total of 3.335 km2 (23*145) needs to be monitored if 145 European strata are being used.
- Survey based on interpretation of EO data in combination with field work according to BIOPRESS/BIOHAB methodology.

This led to the following conclusions at the final BIOPRESS workshop:

- Past and potential changes in land cover, land use and habitats are essential information for many policy issues.
- Although there is a good synoptic overview of the European land cover much is still missing for habitats and pressures.
- Link between land cover changes and pressures is not straightforward.
- Next to update of CORINE land cover it is recommended to:
    - have a monitoring framework based on consistent EO data in combination with field surveys using stratified random sampling. This enables better identification processes and statistical extrapolation to produce European figures.
    - have a full cover monitoring system based on medium resolution satellite data that can have an alarm function and that enhances the temporal characterization of the change.
- Integration with in-situ data is much more needed to identify all the pressures that have an impact on biodiversity.
- Increase time steps in equal time-periods.
- Future monitoring systems should be based on a combination of various satellite systems and field surveys.

## 3.6 WP4300 - INTEGRATION OF SOCIO-ECONOMIC DATA TO QUANTIFY PRESSURES FROM LAND COVER CHANGE

### 3.6.1 OBJECTIVES

WP4300 aimed at investigating the causes (pressures) of the observed land cover changes (state) and developed a generic model for data integration and analysis in order to quantify these pressures. Therefore, the main objectives were identified:

- Analysis of land cover changes observed in the 73 BIOPRESS windows. This has included the development of a land cover change matrix , the definition of what kind of processes can be derived from the BIOPRESS land cover change product, and the selection of socio-economic indicators which can represent the socioeconomic activity that is also impacted by different types of land cover changes at different scales (D43).
- Development of a multi-representation model for the six most important identified land cover processes using the data collected in the Phase I of the BIIOPRESS project and historical socio-economic data sets. The model shows how the integration of the extent of land cover changes with socio-economic data have been achieved in order to link their patterns to a specific anthropogenic process, and thus to understand better the socio-economic dimensions of land cover changes (D41).
- Analysis on how the two important issues named as sampling scale and pattern analysis of spatial data (Ecological Fallacy), as well as the aggregation and scale effects in analytical zoning (Modifiable Area Unit Problem); have been treated within the proposed multi-representation model (D42).
- Development of the methodology which has been performed at both regional (European) and local levels. The focus was on defining a robust methodology which could deal with the issues related to multi-scaling (D44).
- Implementation of three pilot studies carried out in Finland. Slovakia and Spain.

### 3.6.2 METHODOLOGY AND SCIENTIFIC ACHIEVEMENTS RELATED TO WORK PACKAGES INCLUDING CONTRIBUTION FROM PARTNERS

The main research challenge faced in the WP4300 was to define a pattern-process model of land cover dynamics in space and time in order to combine the local level measurement of the land cover changes (e.g. BIOPRESS windows) and the socio-economic indicators of a larger region (e.g. the countries). The proposed multi-representation model is based on the degree of variability in the behaviour of generalised statistics and their dependency of the spatial generalisation of the variable values at different spatial scales.

Geographic Knowledge Discovery (GKDD) is a response to the complexity and volumes of data being generated and stored in operational and scientific databases. Data mining is only one component of the larger GKDD process, which goes beyond the traditional domain to accommodate data not normally amenable to statistical analysis. Statistics involves a small clean (noiseless) numeric database scientifically sampled from a large population with specific questions in mind. Many statistical models require strict assumptions (such as independence and normality). In contrast, the data being collected and stored in many enterprise databases are noisy, non-numeric, and possibly incomplete. These data are also collected in an open-ended manner without specific questions in mind. Certainly, the data sources used in the WP4300 have such characteristics.

Data mining is more strongly inductive than traditional statistical analysis. The generalisation process of statistics is embedded within the broader deductive process of science. Statistical models are confirmatory, requiring the analyst to specify a model a priori based on some theory, test these hypotheses, and perhaps revise the theory depending on the results. In contrast, the deeply hidden and interesting patterns being sought by applying data mining techniques are difficult to specify a priori, at least with reasonable degree of completeness. Data mining is more concerned about prompting researchers to formulate new predictions and hypothesis from data as opposed to testing them.

The small sample from the land cover changes observed in the 73 BIOPRESS windows have demonstrated a promising way for making measurements at different spatial and temporal scales, from large-scale assessments of regional trends to local-scale analysis of complex dynamics. The additional information obtained from statistics have also confirmed the importance of defining which socio-economic indicators contribute the most to an explanation of land-cover change, and their impact on biodiversity. However, our understanding of land-cover dynamics still remains inadequate for two reasons: (i) we lack accurate measurements of its rate and spatial pattern over time, and (ii) we have a very poor capability of modelling from empirical observations.

### 3.6.3 SOCIO-ECONOMIC RELEVANCE AND POLICY IMPLICATION

Selecting indicators involves choosing measures, but also considering WHAT, WHERE and WHEN the data supporting these measures should be gathered. The efforts made by the WP4300 team in selecting a list of indicators has shown the importance of developing data policies to test assumptions and statistical historical trends of socio-economic indicators before they are fully implemented within a monitoring programme. Three main issues have been identified; they are:

- **Set up of reliable monitoring programmes dealing with the representativeness of environmental and socio-economic indicators**

A perennial problem has always been about determining how many indicators (data) is needed for modelling. In WP4300, this was definitely the case for determining how many indicators were needed to explain the processes at different scales within our model. Getting all data, all of the time (i.e. data for the 140 indicators for example), is a fine principle, and if can be achieved, a worthwhile objective. However, for various reasons is not a practical solution. Even if as much data as possible is to be examined, survey and modelling, still require representative data sets. It is critical to build up a structure of representative indicators at different levels of scale, both in space and time. This structure will actually be part of a model which will be able to show how the indicators relate to each other. It will be certain indicators that will allow samples to be taken, and as a result, selecting a suitable level of detail for a set of indicator will be a consistent and logical decision.

- **Investment on the capture of consistent socio-economic statistics to avoid the large number of existing missing values**

In the WP4300, missing values formed a very important issue in preparing the data sets from 1950's until today. Missing values can cause considerable distortion in the analysis if their values are replaced without elsewhere capturing the information that they were missing. Although missing-value estimating methods are available to

produce mathematically optimal values, they are very complex, and vary with the type of data they are applied to (e.g. categorical versus numerical data). The method taken in the WP4300 was to use unbiased estimators that have produced an estimate whose expected value was the value that would be estimated by the population. Therefore, the estimated values have not changed important characteristics of the values present when the estimates were included with the existing values. However, in some cases the number of missing values was higher than 50% of their population. Therefore, 24 BIOPRESS windows were not taken into account in the statistical analysis because of their large amount of missing values which are present in the European and national statistics.

- **Investment on long-term monitoring geo-referenced data sets**

Indicators are variables that may change in importance according to the pressure being analysed. The actual values that an indicator can have contain some sort of pattern and are distributed across the variable's range in some particular way. They also may change their conditions at a defined location over time. It may be, for example, that for some countries, the range of the values of an indicator has taken a limited number of values, meanwhile for other countries, many instances were bunched together. Unfortunately, current monitoring programmes still use different basic data formats for geo-referencing which hampers a spatial variability analysis. The data sets used in the analysis carried out in the WP4300 presented a variety of temporal and spatial scales, as well as unknown accuracy. Because of a lack of long-term monitoring data, it was not easy to differentiate between population fluctuations and real trends (patterns).

### 3.6.4 DISCUSSION AND CONCLUSION

The spatial distribution of the BIOPRESS windows shows the important role of a sampling scheme for the statistical analysis of land cover dynamics, mainly in terms of the following issues:

- What are the implications for sampling land cover changes at one particular spatial scale?

The sampling carried out to collect information about land cover changes using the BIOPRESS windows has shown the need to have a coherent spatial distribution of samples which should be representative at one particular scale. Therefore, it is clear that the BIOPRESS windows are not representative of any specific spatial distribution at a particular scale (regional, national, or local scale).

- What should be sampled, where, and how often?

This was probably the most difficult question to be dealt with in the WP4300. The sampling of the 73 BIOPRESS windows should be regarded as a first attempt to tackle this issue. More research is needed to be able to define a sampling strategy across scales.

- How conditional are observations (i.e. the BIOPRESS widows) of each other?

The results of the spatial correlation analysis as well as the data mining results shows that the land cover changes observed within the BIOPRESS windows were not correlated at all. Therefore, each BIOPRESS windows should be considered as an independent sample, not correlated to any other window in space. This was very unfortunate, since it has brought more challenges in the delineation of a multi-representation model.

- Do different land cover change processes require different sampling schemes?

The answer to this question is most likely to be YES. Anthropogenic processes are distinguished by patterns at different scale levels (both spatial and temporal). For example, the results illustrate the fact that the sampling scheme of the BIOPRESS windows was inadequate for the characterisation of land abandonment at the regional level.

## 3.7 WP4400 - LINKING LAND COVER CHANGE TO PRESSURES ON BIODIVERSITY

### 3.7.1 OBJECTIVES

The link between land cover change and pressures on biodiversity is the heart of the BIOPRESS project. The main objective of WP4400 was to look at the consequences of the observed LCC on biodiversity, namely on the impact of changes in the extent and spatial distribution of habitats. It was agreed from the start of the project that WP4400 would build upon the MIRABEL DPSIR framework funded by the EEA to underpin the assessment of European biodiversity by extending the existing "impact tables" to include quantified pressures associated with land use change. It was also envisaged that the development of WP4400 would allow us to assess to what extent

land cover change statistics, and more specifically BIOPRESS phase I product, could contribute to biodiversity assessment.

### 3.7.2 METHODOLOGY AND SCIENTIFIC ACHIEVEMENTS INCLUDING CONTRIBUTION FROM PARTNERS

The objectives mentioned above were addressed in two ways. The first was a regional analysis of the relationships between CLC classes and the EUNIS habitat classification and the second step a spatial analysis at the window and transect levels of changes in the spatial extent and distribution -number and size of patches - of CLC classes important for biodiversity. These analyses enabled us to produce regional impact tables according to the MIRABEL framework and discuss the contribution of the BIOPRESS Phase I product to the MIRABEL Biodiversity assessment.

**1) Quantifying relationship between CLC classes and habitats (D45)**

It is clear that the 44 categories of land cover in CORINE are far too broad to consider habitats per se. In WP4400, a systematic analysis of spatial coincidence between land cover types in CLC1990 and Annex1 habitat types recorded in Natura 2000 sites was carried out, translated into the EUNIS habitat classification and summarised per Biogeographical region (BIOPRESS deliverable D45).

Out of the 44 CLC classes, 23 had a one to many links with Annex 1 habitats and therefore could be analysed. Another 2 CLC classes were excluded because they represented a mosaic of habitats, meaning a link too loose to be accurately quantified (2.4.2 and 2.4.3)

This work showed that significant improvement could be made by adopting a regional approach. D45 provided neater and more specific links between CLC classes and habitats than what has been available so far. It also identifies what the limitations are in attributing habitat types to CLC classes.

**2) Change in the spatial distribution of CLC classes (D46-D47)**

This assessment focussed on land cover types that (i) are known to be important for biodiversity and (ii) have changed drastically in extent between 1950 and 1990 in the sampled areas. This assessment is using BIOPRESS phase I data at the three spatial levels at which they are available, i.e the 73 30km * 30 km windows (low redsolution) and the 59 15*2 km transects (high resolution). BIOPRESS phase I product was processed in ArcInfo and polygons dissolved according to the land cover type at one time. We estimated the average land cover extent per window / transect (ha) as well as information on the spatial distribution of habitats, i.e. the average number of patches per window / transect and the average size of patches per window/transect.

It appears from this analysis that BIOPRESS phase I results have given interesting estimates for changes in land cover resulting from specific pressures. It should be kept in mind that these estimates are only valid for the BIOPRESS sample itself. However, we have observed some consistent trends across the whole sample of windows and transects which tends to give such particular trends a generic value. One example was the repetitive and systematic decline by 10 to 30% of CLC units 2.4.2 and 2.4.3, which represent small scale agriculture.

**3) Regional assessment (D46-D47)**

This regional assessment builds upon the previous DPSIR assessment MIRABEL (Petit et al., 2001). There was little to be gained in reassessing biodiversity impacts in great detail as this was the task carried out in MIRABEL and little knowledge has been made available since. Instead, we focused on BIOPRESS phase results I and assessed to what extent the trends observed in windows and transects were in line with the MIRABEL assessment, and if not, for what reasons.

MIRABEL was carried out by gathering as much available information as possible for regions of Europe and then by summarising this information in impact tables. BIOPRESS, on the other hand, provided quantitative estimates for a selected sample of land in each region. Given the fact that both exercises used very different approaches for assessing threats to biodiversity in Europe, it is fair to say that the agreement between the two is rather important.

When there were differences, it resulted either from discrepancies in the definition of some pressures in BIOPRESS and MIRABEL, e.g. land abandonment and farming intensification or from known and quantified biased in the BIOPRESS sample, e.g. urbanization was overrepresented in transects.

WP4400 has taught us that a land cover product such as BIOPRESS phase I was suitable for quantifying some pressures on biodiversity but quite insufficient for the interpretation of land cover change related to other pressures:

- BIOPRESS contributed very positively to the quantification of urbanization across Europe between 1950 and 1990/2000.
- BIOPRESS land cover product made a useful contribution to the quantification of afforestation and deforestation across Europe between 1950 and 1990 but that these pressures could be better understood if (i) we had more points in time, closer together and (ii) more information on the condition of forest was derived from remote sensing and/or ancillary data was used to evaluate the ecological value of forested land.
- BIOPRESS will have underestimated the extent to which the pressure land abandonment is threatening biodiversity in Europe, in comparison to other existing assessments (e.g. MIRABEL but also national scale statements). However, it would be possible to increase the accuracy and the generic value of the BIOPRESS estimates by (i) broadening the definition of land abandonment i.e. modifying the pressure matrix, so that it matches what is meant in other assessments and (ii) by increasing the number of points in time.
    - BIOPRESS was probably the first project to provide quantitative estimates about the shift from small scale to more large scale agriculture for such a large sample area across Europe and in this respect, this is a very important contribution to understanding changes in European biodiversity. However it is important to keep in mind that what has been quantified within BIOPRESS was only a small part of what is usually understood by farming intensification in biodiversity assessments. This means that, as was the case for land abandonment, BIOPRESS results will greatly underestimate the pressure farming intensification, compared to other assessments.

### 3.7.3 DISCUSSION AND CONCLUSION

Our main conclusion is that remote sensing products such as the BIOPRESS phase I land cover change product can provide very helpful information in the field of biodiversity assessment. There is potential for improving this information, e.g. by adding time steps in the monitoring or using external data to help in the interpretation of land cover change. However, our work also shows that there are clear limitations in this contribution and that remote sensing will only provide part of the information.

One important recommendation that would lead to improve facilities for large scale biodiversity monitoring would be the integration of remote sensing products with in situ information.

## 3.8 WP4500 ERROR PROPAGATION BETWEEN DIFFERENT STAGES

### 3.8.1 OBJECTIVES

The objectives of the work package WP4500 were to understand, quantify and rank the sources of uncertainty in the final pan-European land cover change products. This was accomplished through the following steps:

- Model the propagation of errors from the raw data (un-corrected air photos) through all its stages to the pan-European maps of land cover changes.
- Compare estimates of land cover change from WP7000 with land cover change from WP3000.
- To understand sources of errors due to different definitions and imprecise definitions of land cover and land cover change.
- Map the most probable error to evaluate the final pan-European land cover change product.

Which translated into a number of distinct tasks with as main task the construction of an error model related to the processing chain of phase I:

- Generation of process chain and
- Deriving of errors sources within this process chain
- Generation of general error model for interpretation

- Determination of sampling error to verify extrapolation results (WP3200)
- Comparison of 2 interpretation scale levels 1:20.000 (WP3000) and 1:100.000 (WP7000)
- Discussing the influence of imprecise land cover/use definitions

Inputs for these tasks were the results of the quality assurance work (WP2400), the land cover interpretations and change statistics (WP3000), and the results of the extrapolation (WP3200).

### 3.8.2 METHODOLOGY AND SCIENTIFIC ACHIEVEMENTS INCLUDING CONTRIBUTION FROM PARTNERS

#### PRODUCTION CHAIN AND DERIVED ERROR SOURCES

Figure 1 gives an overview on the production chain and determined errors of final output as it was used in the BIOPRESS project. Errors that occur in early stages of production chain and can not be cleared by the user propagate to the next production step. For example, insufficient image quality interfere the classification process.

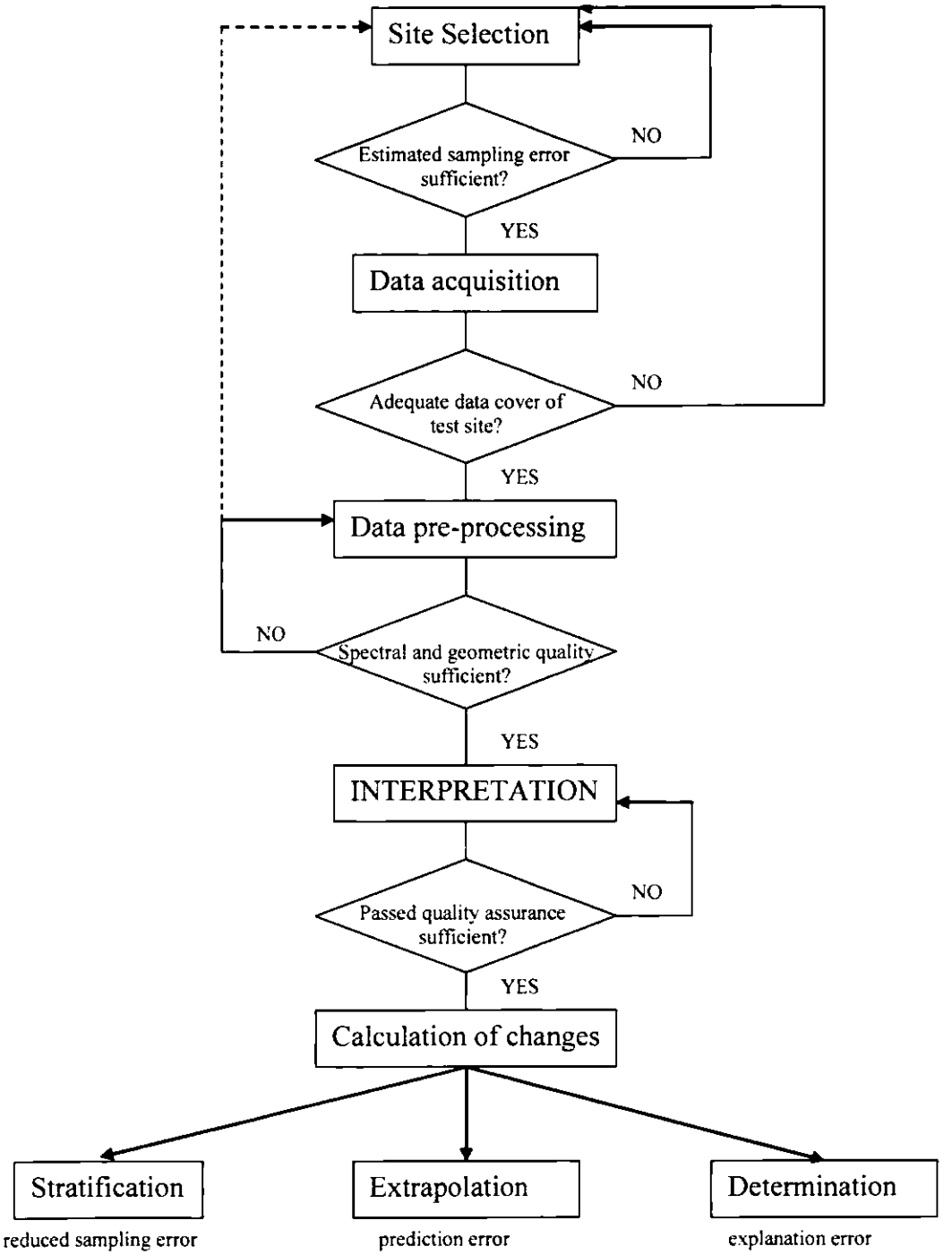



**Figure 1: Production chain for 1950, 1990 and 2000**

## Selection of test sites

Finally 59 transects with sufficient data cover and quality for all three time horizons were analysed. Selection was biased in consideration the use of Natura2000 sites, by local expert knowledge to include pressure impact and by focusing on project partner countries. Further 73 windows across Europe could be analysed for 1950 with the available budget. In the BIOPRESS project data availability and data quality proved to be also constricting the sample location in reality.

## Acquisition of image data

Insufficient image cover or image quality of input data result in an iterative additional selection process of samples sites, but especially for point of time 1950 images are limited in geometric and spectral image quality and gaps in the transects/windows cover needed to be accepted. American and British military archives appeared to be the main source for pan-European available historical air photos. The lack of data is not a source of error but it is a limitation for the final user, as no statements on changes could be given for these regions.

## Image data pre-processing

Quality of input aerial photographs seems to have a major impact of interpretation accuracy in BIOPRESS. Geometric correction and geo-referenced adaptation of single photograph by using a set of pass points is a legal method to decimate the error caused by distortion through optical and topographic impacts. For this point of errors in the process chain, the solely error, which can be estimated authentically is the Mean Square Error (MSE), given for the set of reference points. Spectral correction of image data is advisable for better differentiating of mapping classes on detail transect interpretation level. For visual interpretation of aerial photography an adaptation of grey values for merging particular photos is not essential necessary, but this process can assist the classification accuracy.

## Interpretation

Next to image quality the major error in the BIOPRESS project is caused by interpretation errors, due to imprecise definitions of land cover classes or missing training of interpreters. Depending on the experience of the interpreter this can be an important source of error which is hardly quantifiable. The clarity of class definitions has a huge impact on the interpretation accuracy. Within the scope of this project the minimum mapping unit (MMU) plays an important role for the classification accuracy. The summary of interpretation error consists of a chain of systematic, random and individual interpreter errors. The overall interpretation error is described more in detail in chapter 0.0.0

## Quality assurance

In BIOPRESS no historical reference data for 1950 ties and limited ground truth for 1990 and 2000 were available. Therefore the interpretation of systematically chosen samples has been repeated by independent interpreters for verification. Window interpretations were checked by a most change related sampling strategy. Another opportunity for verification was the interaction with local experts or comparison with other auxiliary data (like for example biotope maps) that every partner implemented in the interpretation process. Quality assurance showed the applicability of the used methodology for historical photographs for the windows and transects at least for CLC level 2. CLC level 3 show only slight increase of changes in windows compared to CLC level 2. For transects most inconsistency were found in CLC level 3 as result of insufficient image quality and confusions of used land cover definitions.

## Calculation of land cover changes

Land cover changes between two time periods can be calculated by intersecting two independent interpretations in a GIS system. As both interpretations can biased by specific interpretation errors, derived changes are biased too. The interacting of interpretation error between two interpretations is described in report D15_16 in detail.

## Stratification

Stratification focuses on grouping elements to minimise variation of a certain variable of interest within these groups (strata) and maximising between groups. For the variable of interest the sampling error can be calculated by weight (for example area) of individual strata. The ratio of sampling error with stratification and sampling error without stratification is called the stratification gain. General stratification schemata like biogeographical regions reduced the variation and also the sampling error, but for each landscape element specific optimal stratification schemata can be defined.

## Extrapolation

The aim of extrapolation is to upscale results from samples to regional or pan-European level. The error depends on the binding between variables, here land cover characteristic in test sites and pan-Europe, and the quality of sample selection (see chapter 0.0.0). Analysis of similarity between land cover structures of the samples and European land cover characteristics illustrates the quality of sampling as demonstrated in work package 3200. However, it is questionable if landscape structure is sufficient for change prediction and therefore it would be dangerous to apply for results of this product.

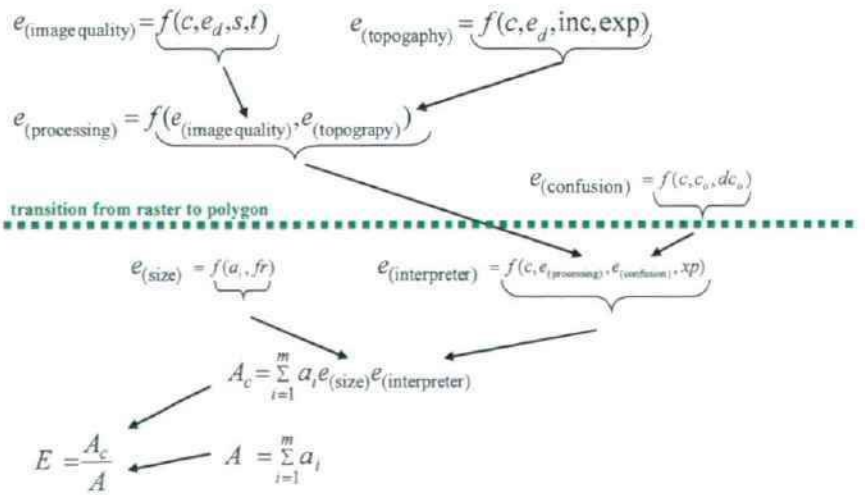
## Determination

For a better understanding of land cover changes and driving forces for changes, socio economic data were collected for each transect and analysed by geo-statistical models and the semi-quantitative pressure state model MIRABEL. Highly generalised models on pan-European level can result in misinterpretation of regional situation and pressures. Main reasons are on the one hand very specific local developments and on the other hand too general socio-economic data which are based on larger spatial level than transect interpretation.

## ERROR MODEL

There are different sources of errors in the interpretation process. These errors depend on each other in complex manner. Some errors within the process chain, especially if they have random nature, can compensate each other, so the output seems correct. Error sources, which occur at an early stage of process chain, for example image quality, can have major effect than errors occurring in the end of the process chain. Figure 2 illustrates the developed error model for land cover interpretation for one time period. The simplest form of an error model would have been one equation, which depends from all possible error sources and circumstances that may lead to misinterpretation. For a better understanding of error propagation individual errors with specific impacting variables have been separated. The overall error $E$ is the proportion of wrong interpreted area $A_c$ and the total interpreted area $A$. The proportion of incorrect interpreted area is calculated, depending on the size or fragmentation of polygons $e_{(size)}$ and the interpreter's expertise $e_{(interpreter)}$. The quality of interpretation depends on the image quality, site characteristics like topography and the precise, well-defined interpretation methodology. The process of interpretation relays on these influences and it is one major error source as it tries to generalise pixel elements with a coherent attributes like trees, houses and other objects to land cover classes. Due to the class dependency of this developed general error model, it can be used to quantify the impact of each error and increase the interpretation accuracy by this information for a number of selected validated samples. It could be implemented, together with geo-statistic methods into a classification supporting program that reflects empiric results from the verification and error quantification. Use of digital ortho-rectified images from satellite or new airborne photo cameras support such a cost efficient automated system. The project BIOPRESS could provide the theoretic background, however it did not aim on a realisation of such a system.

This developed error model depends on different options of impact sources. Limitations were for example the used interpretation methodology, as it was demonstrated in work package 2400. Particularly the use of ambiguous classes for forest and agricultural classes cause this result, which was due to a combination of insufficient image quality and uncertainties in the class definition.




c = land cover class
$e_d$ = error distance from nadir (image centre)
s = contrast, brightness, and proportion of any kind of artefacts, for example clouds
inc= inclination
exp = exposition object towards sensor
$c_o$= neighbourhood land cover class o next to c

t = time of day and season

fr = degree of fragmentation of delineated object
xp= Experiences and local knowledge of interpreter
$A_e$= sum of area of incorrect classified polygons

$dc_o$ = distance to neighbourhood land cover class o next to c
$a_i$ = area of polygon I
A= total area

**Figure 2 Error model for estimation of total classification error E (%) for one interpretation**

## SELECTION ERROR

As described in chapter 0.0.0 the selection of test sites was biased in consideration the use of pre-selected Natura2000 sites, by local expert knowledge to include pressure impact and by focusing on project partner countries. To determine the accuracy of sampling strategy a bootstrapping approach was executed using the functionality of ArcInfo and MySQL. A defined set of square samples which simulate windows with 30km edge length were randomly selected across Europe. The land cover characteristics of these samples were calculated by intersecting of samples with the pan-European CLC90 vector data set. Figure 3 shows the results of the bootstrapping analysis. The figure indicates the relation between sampling error of specific land cover class proportion and number of samples. The mean sampling error of proportion of artificial surface is around twice the error of forest and semi-natural surface, or agricultural surface. At least 300 samples should be selected and classified to achieve a stable sampling error concerning land cover classes. Additionally the test site locations in BIOPRESS were constricted by data availability and data quality.

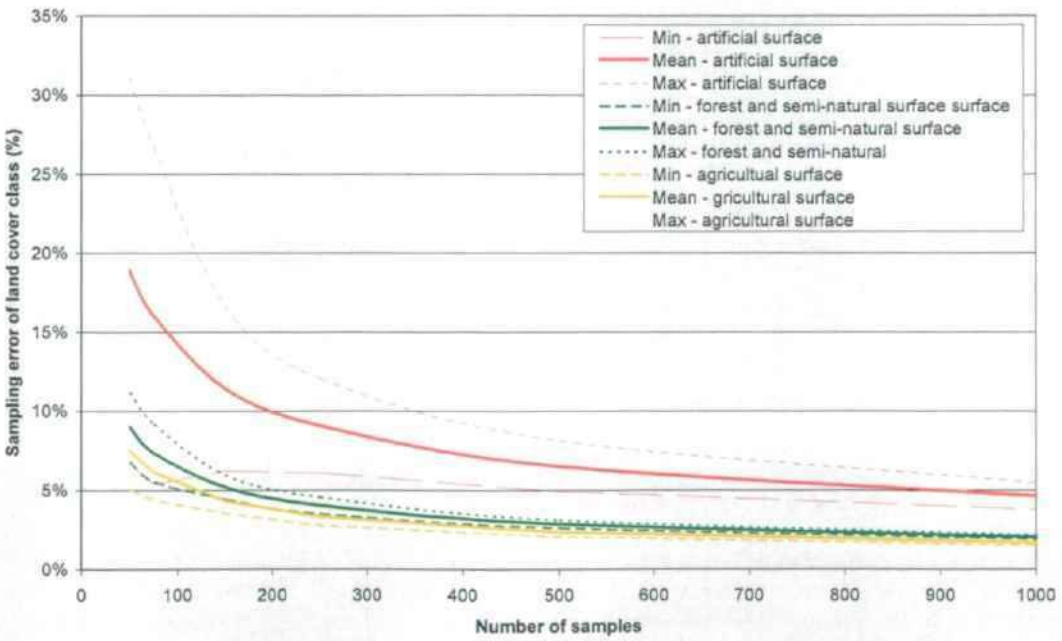



**Figure 3 Estimation of sampling error using a bootstrapping approach, The solid line indicates the mean and the discontinuous lines show the minimum and maximum of sampling error per land cover class (probability value = 0.05). Red = artificial surface, Yellow = agricultural surface, Green = forest and semi-natural surface.**

## SCALE DEPENDENCY OF INTERPRETATION METHODOLOGY

shows the land cover changes in the intersecting parts of transects and windows. Higher CLC level results in higher proportion of land cover changes within both transects and windows. The different proportions of

changes at transect and window level indicate the differences between the interpretation scales. The minor consistency between the locations of land cover changes observed in both interpretation levels (transects and windows) increases with more detailed CLC level. In contrast, the consistency between location and class of land cover changes decreases with higher CLC level.

The interpretation scale should be adapted to the needs of user. Therefore the aim of study has to define the detail of interpretation. For example, classification of small habitats which could not be exactly determined is not meaningful at scale 1:100.000.

**Table 2 Mean proportion of land cover changes occurred in transect and windows**

| | Level1 | Level2 | Level3 |
|---|---|---|---|
| **Transects changes** | 15,5% | 32,0% | 37,1% |
| **Windows changes** | 6,9% | 11,3% | 11,5% |
| **Consistency in change location** | 5,0% | 7,9% | 8,5% |
| **Consistency in changes location and classes** | 3,5% | 2,5% | 1,7% |

IMPRECISE DEFINITION OF LAND COVER AND LAND USE

The CORINE nomenclature has been developed to face pan-European characteristics, technical aspects of used data source and needs of potential users like environmental protection agencies or landscape planers. Thus the final nomenclature was a compromise including pure land cover classes like water bodies and land use classes like for example annual crops associated with permanent crops. These combined classes differ in their characteristics across Europe and specific structures are associated with them. Because of this complexity the interpreter knowledge of structure and local conditions needs to be high. To understand sources of errors due to different definitions and imprecise definitions of land cover and land cover change the producer's accuracy of different land cover classes are calculated. **Error! Reference source not found.** shows the result of this analysis for all transects at CLC level 2.

**Table 3 Producer's accuracy of CLC level 2 classes for three different time horizons in all 59 transects**

| | producer's accuracy | | |
|---|---|---|---|
| **CLC** | **LC50** | **LC90** | **LC00** |
| **11** | 0,75 | 0,81 | 0,80 |
| **12** | 0,56 | 0,72 | 0,73 |
| **13** | 0,42 | 0,54 | 0,43 |
| **14** | 0,35 | 0,41 | 0,45 |
| **21** | 0,84 | 0,84 | 0,85 |
| **22** | 0,50 | 0,47 | 0,43 |
| **23** | 0,55 | 0,55 | 0,54 |
| **24** | 0,24 | 0,17 | 0,18 |
| **31** | 0,90 | 0,90 | 0,91 |
| **32** | 0,78 | 0,80 | 0,79 |
| **33** | 0,59 | 0,59 | 0,60 |
| **41** | 0,68 | 0,69 | 0,68 |
| **42** | 0,56 | 0,72 | 0,77 |
| **51** | 0,85 | 0,87 | 0,85 |
| **52** | 0,80 | 0,84 | 0,83 |

By reducing the CLC level, which is equivalent to reducing the interpretation detail depth and therefore reducing potential misinterpretation by further general class descriptions, the accuracy increases. Some classes like for example 21 have higher consistency than other like 12. This may be caused by the low number of samples for verification, missing interpreter knowledge or unclear methodology for application on aerial

photographs. The uses of ambiguous classes on dominant land cover classes, for example 316 for forests, lead to uncertainties in CLC level 3.

For a stable investigation of errors due to imprecise definition of land cover and land use classes a specific verification methodology would be needed BIOPRESS were not designed for. Different site land cover compositions across Europe, different quality of aerial photographs and very different interpreter experiences resulted in misinterpretations within this project. One methodological approach for estimation of these uncertainties could be the interpretation of a set of equal sized land cover samples that should be analysed by different interpreters for more land cover and land use driven methods to quantify the results in detail.

### 3.8.3 SOCIO-ECONOMIC RELEVANCE AND POLICY IMPLICATION

The ability to produce land cover classifications on pan-European level exceeds the ability to meaningful quantify their accuracy. Thus, the work of WP4500 is an important tool for the analysis of error sources and accuracy of results in BIOPRESS and can be assigned to other European data sets.

### 3.8.4 DISCUSSION AND CONCLUSION

This part of report concludes the results of error investigation, modelling and reviewing in relation to achievements of the BIOPRESS project. Each step of the production chain has been described and analysed towards potential error sources to model the propagation of errors from the test site selection through all its stages to the pan-European maps of land cover changes. An error model was developed and the potentials for limitation of errors were discussed. The selection error is calculated by use of bootstrapping approach and examples on the relation between sampling error and number of samples for selected land cover classes are presented. Supported by quality assurance results from work package 2400 and experiences from image interpretation hypotheses for potential limitations in land cover interpretation were derived. Therefore distribution of potential error sources in Europe could be plotted on pan-European maps, by use of auxiliary data.

Following conclusions can be drawn from WP4500 analyses:

- Errors that occur in early stages of production chain and can not be cleared by the user propagate to the next production step.
- Comparison of window and transect approach demonstrated differences as result of different interpretation scale. Transects showed three times more changes than windows and consistency in change detection is low between transects and windows.
- Aerial photographs show much more structures and differences than being assessed by the applied methodology with CORINE nomenclature, but image quality and expertise of interpreter are major limiting factors.
- Use of historical aerial photographs with insufficient quality was the main limiting factor, followed by weaknesses of the land cover definitions. High variability of different interpretations in level three for the same sites demonstrates the need for enhancement of interpretation methodology.
- Diversity in terms of land cover proportion in Europe is very high and generalisation may lead to bias or under-estimation of changes. One general optimal sampling strategy on pan-European level for all kind of pressures on biodiversity is impossible.
- Various disturbances in used data sources like geometric uncertainties between CLC 1990 and CLC 2000 and too generalized information like missing location of habitats inside of NATURA2000 sites lead to errors in quantitative and qualitative analysis (see report D50-53).

In BIOPRESS a method for quantification of land cover changes has been developed and applied to various samples. Most errors, that reduced the interpretation quality like image quality, unclear class definition and confusion caused by lax use of land cover and land use, can be almost completely reduced by modern data sources and after adjustment of interpretation methodology. However, knowledge and the experience of the interpreter play an important role in manual visual interpretation of remote-sensing data.

## 3.9 WP5000 - ASSESSING PROBLEMS

This work package was completed successfully in the first 12 months. The report summarising problems to the assessment team was revisited and independent feedback on the project included (WP8000).

## 3.10 WP6000 - DEMONSTRATION AND DISSEMINATION

### 3.10.1 OBJECTIVES

The objectives of WP6000 are:

- To ensure the distribution of the generated final and intermediate products and corresponding documentation to relevant EU users, national users, the research community and the private sector.
- To archive the products and ensure their stewardship beyond the lifetime of the project.
- To ensure widespread international exposure of the project through appropriate and targeted publicity and well designed web-page

### 3.10.2 METHODOLOGY AND SCIENTIFIC ACHIEVEMENTS INCLUDING CONTRIBUTION FROM PARTNERS

The project leaflet was produced by CREAF with support from CEH.

The webpage was improved further by CREAF in collaboration with CEH and University of Hamburg (http://www.creaf.uab.es/biopress/). A reduced version of the BIOPRESS database was linked to the webpage and the web contents especially in the results page were improved.

BIOPRESS was successful in acquiring an exhibition space at the Communicating European Research 2005 event which took place in Brussels on 14-15 November 2005. CREAF produced a flash movie as the main attraction of the BIOPRESS stand. CEH took care of BIOPRESS bookmarks and pens to give away. The BIOPRESS stand attracted a good number of people from a wide range of backgrounds.

The afternoon session of the final workshop in the premises of the Royal Museum for Central African in Tervuren (Brussels) on the 14 December 2005 presented the key findings to international and national stakeholders.

A position paper was produced as a collaboration result between BIOPRESS and BIOHAB: Sampling framework and strategy for monitoring of European habitats. Position paper of BIOHAB & BIOPRESS research community. Version 2 (13th of December 2005). Principal contributors to this version: BIOHAB: Bob Bunce, Rob Jongman, Sander Mücher, Marta Pérez-Soba & Geert de Blust. BIOPRESS: Konstantin Olschofsky (Univ Hamburg), Sander Mücher (Alterra), Raul Köhler (Univ Hamburg), Mirko Gregor (GIM), Richard Wadsworth (CEH) and Sandra Luque (METLA). This paper has been and will be actively advertised by the BIOPRESS coordinator and partners.

The University of Hamburg and CREAF has with help from all partners compiled a book entitled "Land cover change in Europe from the 1950'ies to 2000. Aerial photo interpretation and derived statistics from 59 samples distributed across Europe". About 400 prints will be produced. The team decided to substitute the CD by the Book and a BIOPRESS summary report adapted from Section 6 of the final report. The BIOPRESS summary report will be the responsibility of CEH, BIOPRESS coordinator and will be produced as a pdf file as part of the dissemination activities which will continue after February 2006 (Technology Implementation Plan).

Presentations at targeted workshops and conferences continued.

The project coordinator has been involved in commenting on the GMES fast track services proposed for land cover.

Although the EEA will still become the steward of the BIOPRESS data after the completion of the project, the team also decided to have copies of the database and electronic copies of the original photo mosaics with all partners.

### 3.10.3 SOCIO-ECONOMIC RELEVANCE AND POLICY IMPLICATION

Most of the dissemination efforts in the third year have continued to focus on the GMES community but have also targeted the wider community. During the last year of the project there has been a growing interest from the GMES community in the experiences and the methods developed by the BIOPRESS team: The GMES project GEOLAND and the ESA GSELAND project were both provided with the BIOPRESS photo-to-photo interpretation manuals on their request. The decision of the team to release the database to the public one year after the conclusion of the project will hopefully ensure a continuing use of the invaluable data.

### 3.10.4 DISCUSSION AND CONCLUSION

Key to the success of BIOPRESS is the continuing use of the data products it will be producing. The EEA, BIOPRESS' main stakeholder, is an active advisory group member and will be one of the main users of the data. However it was important to increase the attention of a wide range of potential user groups and the general public which the team. The transect book and the release of the database to the general public will hopefully ensure a continuing use of the BIOPRESS data.

## 3.11 WP7000 – CORINE 1990 BACKDATING

This work package was completed successfully in the second year.

## 3.12 WP8000 - REVIEW WORKPLAN FOR PHASE-II

The report (D32) summarising problems to the assessment team was revisited and independent feedback on the project included.

# PARTICIPANT INFORMATION

| N° | Institution/ Organisation | Street name and number | Post Code | Town/City | Country Code | Title | Family Name | First Name | Telephone N° | Fax N° | E-Mail |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Centre for Ecology and Hydrology CEH | Monks Wood Abbots Ripton | PE28 2LS | Huntingdon Cambridgeshire | UK | Dr | Gerard | France | +44 (0)1487 772482 | +44 (0) 1487 773467 | ffg@ceh.ac.uk |
| 2 | Center for Ecological Research and Forestry Applications CREAF | Universitat Autonoma de Barcelona | E-08193 | Bellaterra | SPAIN | Dr | Pino | Joan | +34 (0) 93 581 2915 | +34 93 581 1312 | Joan.Pino@uab.es |
| 3 | Finnish Forest Research Institute METLA | Unioninkatu 40 A | FIN-00170 | Helsinki | FINLAND | Prof | Erkki | Tomppo | + 358 10 211 2170 | + 358 10 211 2101 | erkki.tomppo@metla.fi |
| 4 | Green World Research Center for Geo-information ALTERRA | Droevendaalse-steeg 3, PO Box 47 | 6700 | AA Wageningen | THE NETHERLANDS | Dr | Mucher | Sander | +31 317 474 200 | +31 302 441 318 | Sander.mucher@wur.nl |
| 5 | Geographic Information Management NV/SA GIM | Rue J. P Sauvage 3 | L-2514 | Luxemburg | LUXEMBURG | Ir | Gregor | Mikro | +352 26 44 09 55 | +352 26 44 09 56 | mirko.gregor@gim.lu |
| 6 | Institute of Landscape Ecology of the Slovak Academy of Sciences ILE SAS | Stefanikova 3 PO Box 254 | 814 99 | Bratislava | REPUBLIC OF SLOVAKIA | Dr | Oszlanyi | Julius | +421 2 52493882 | +421 2 52494508 | Julius.oszlanyi@savba.sk |
| 7 | University of Hamburg Institute for World Forestry | Leuschnerstrasse 91 | 21031 | Hamburg | GERMANY | Dr | Olschofsky | Konstantin | +49 40 73962 107 | +49 4042891 2665 | k.olschofsky@holz.uni-hamburg.de |
| | Geoinformation Service GISAT | Charkovska 7 | 101 00 | Praha 10 | CZECH REPUBLIC | Dir | Kolar | Jan | +420 2 7174 1935 | +420 2 7174 1936 | Jan.kolar@gisat.cz |

# Chapter 4 TECHNOLOGICAL IMPLEMENTATION PLAN

# TECHNOLOGICAL IMPLEMENTATION PLAN

## Description of project

| | |
|---|---|
| **EC PROGRAMME:** | **EESD** |
| **PROJECT TITLE:** | Linking pan-European land cover change to pressures on biodiversity |
| **ACRONYM:** | **BIOPRESS** |
| **PROGRAMME TYPE:** | 5th FWP (Fifth Framework Programme) |
| **CONTRACT NUMBER:** | EVK2-CT-2002-00178 |
| **PROJECT WEB SITE (if any):** | http://www.creaf.uab.es/biopress/ |
| **START DATE:** | 01 Jan 2003 |
| **END DATE:** | 31 Dec 2005 |
| **COORDINATOR DETAILS:** | **Name:** France Gerard<br>**Organisation:** Centre For Ecology and Hydrology<br>**Address:** Monks Wood, PE28 2LS Abbots Ripton, UK<br>**Telephone:** +44 (0)1487 772482<br>**E-mail:** ffg@ceh.ac.uk |

| **PARTNERS NAME:** |
|---|
| **Institut for World Forestry, University of Hamburg,** Konstantin Olschofsky<br>**CENTRE DE RECERCA ECOLOGIA I APLICACIONS FORESTALS,** Joan Pino<br>**G.I.M. - GEOGRAPHIC INFORMATION MANAGEMENT N.V.,** Mirko Gregor<br>**THE FINNISH FOREST RESEARCH INSTITUTE,** Sandra Luque<br>**ALTERRA B.V.,** Sander Mucher<br>**INSTITUTE OF LANDSCAPE ECOLOGY OF THE SLOVAK ACADEMY OF SCIENCES,** Julius Oszlanyi<br>**Institute of Geography of the Slovak Academy of Sciences,** Jan Feranec<br>**Geoinformation Service,** Jan Kolar |

| | |
|---|---|
| **Commission Officer Name:** | Michel Cornaert |

**Executive summary**

**Original research objectives**
The European environment is continually undergoing change caused by a combination of socio-economic and climatic processes. To protect the environment and ensure sustainable use of natural resources a wide variety of national and international legal mechanisms have been established which in their turn have spurred on a wide range of environmental monitoring activities. Today Europe urgently needs to consolidate these monitoring efforts. The GMES initiative aims at achieving this 'European capacity for Global Monitoring for the Environment and Security' by2008. This project will help realize this ambitious goal. The focus of the project is to develop a standardised product that will be extendable to Europe. The

product will link measures of historical and recent land cover change to pressures on biodiversity and is aimed at the EU-user community concerned with the impact of land cover/use changes on the environment and biodiversity.

**Expected deliverables**

The core of BIOPRESS consists of two closely linked but consecutive phases: Phase-I which consists of WP7000 (ending at month 12), WP 2000 and WP 3000 (ending at month 18) and Phase-II which consists of WP 4000 (starting at month 18 and terminating at month 36) (see Figure 2.2). Phase-I (months 1-18): 1. The characterisation of land cover change in and around a representative stratified sample of Natura2000 sites. · For a sample of Natura2000 sites and their surrounding landscape land cover change matrices will be produced by back dating CORINE land cover 1990 (level 3) with aerial photos of the 1950'ies. By end 2003, an area of approximately 100,000km2 will be covered distributed across the main biotope types and the European countries (Europe 15+) for which CORINE 1990 level 3 is available. The estimated total number of sites and area covered is based on an assumed cost of 2.5 EUR/km2 that includes data search, acquisition and interpretation. The output will depend on the availability and cost of aerial photographs of the 1950'ies · For a sample of approximately 50 to 70 Natura2000 sites and their surrounding landscape land cover change matrices will be produced from a more detailed interpretation and analysis of aerial photographs acquired in 1950, 1990 and 2000. The sample will be a subset of the sites used for backdating CORINE1990 and will be selected to represent biotopes types specified by the user community. The final number of sites and total area covered will depend on the availability of aerial photographs and the size of selected sites. · The land cover change matrices from both exercises will be extrapolated using CORINE land cover 1990. 2. To report on the lessons learned and problems encountered during the production and extrapolation of the land cover change matrices. Phase –II (months 19-36): · To set up a GIS framework that will not only support the extrapolation of the change matrices but also facilitate the integration of pan-European spatial data sets building upon existing European led initiatives and concepts (e.g. EEA TERRIS database). · To develop a pan-European land cover change (1990-2000 and beyond) monitoring concept based on the integration of CORINE Land Cover, Earth observation and field data and focusing on the area in and around the Natura 2000 sites. · To develop a spatially referenced product showing the main pressures on biodiversity (intensification, abandonment, afforestation, urbanisation) from the integration of data on land cover change (1950-1990/2000) and other biological, environmental and socio-economic data. A state-of-the-art semi- quantitative pressure state-model called MIRABEL will convert the quantified pressures into assessments of biodiversity. The characteristics of the pressures product will be defined by the EU-user community and the pressure – state model operating on the product. This part of the project intends to add value to land cover change product and will involve research which will look into specific problems related to data integration, land cover change detection, pressure-state models and error propagation, with the aim of improving the tools used for monitoring the environment at pan-European level.

**Project's actual outcome**

Phase-I: A fully illustrated interpretation manual for CORINE backdating. A list of suitable 30km x 30km windows centred on Natura2000 sites for which land cover change matrices will be produced (CORINE land cover backdating and photo-to-photo interpretation 15km x 2km transects). A report assessing the choice of 30km x 30km windows with respect to their habitat types, the CORINE land cover classes and the Emerald zonation scheme. A report reviewing the accessibility of the European databases required by the project.

**Broad dissemination and use intentions for the expected outputs**

Current ouputs are internal documents.

**Overview of all your main project results**

| No. | Self-descriptive title of the result | Category A, B or C* | Partner(s) owning the result (s) (referring in particular to specific patents, copyrights, etc.) & involved in their further use |
|---|---|---|---|
| 1 | Land cover change data for 132 samples across Europe; timepoints: 1950, 1990, | A | Institut for World Forestry, University of Hamburg |

| | | | |
|---|---|---|---|
| | 2000; aerial photography; Corine Land Cover level 3 | | CENTRE DE RECERCA ECOLOGIA I APLICACIONS FORESTALS<br>G.I.M. - GEOGRAPHIC INFORMATION MANAGEMENT N.V.<br>THE FINNISH FOREST RESEARCH INSTITUTE<br>ALTERRA B.V.<br>INSTITUTE OF LANDSCAPE ECOLOGY OF THE SLOVAK ACADEMY OF SCIENCES<br>Centre For Ecology and Hydrology |
| 2 | Fully illustrated manual for photo-to-photo interpretation | A | Institute of Geography of the Slovak Academy of Sciences |
| 3 | Sampling framework and strategy for monitoring of European habitats. Position paper of BIOHAB & BIOPRESS research community. | A | Institut for World Forestry, University of Hamburg<br>G.I.M. - GEOGRAPHIC INFORMATION MANAGEMENT N.V.<br>ALTERRA B.V.<br>THE FINNISH FOREST RESEARCH INSTITUTE<br>Centre For Ecology and Hydrology |
| 4 | land cover change - pressure association matrix | A | Institut for World Forestry, University of Hamburg<br>CENTRE DE RECERCA ECOLOGIA I APLICACIONS FORESTALS<br>G.I.M. - GEOGRAPHIC INFORMATION MANAGEMENT N.V.<br>THE FINNISH FOREST RESEARCH INSTITUTE<br>ALTERRA B.V.<br>INSTITUTE OF LANDSCAPE ECOLOGY OF THE SLOVAK ACADEMY OF SCIENCES<br>Centre For Ecology and Hydrology |
| 5 | Manual of Computer Aided Visual Interpretation of Aerial B&W Photographs | A | Institute of Geography of the Slovak Academy of Sciences |

*A: results usable outside the consortium / B: results usable within the consortium / C: non usable results

**Quantified Data on the dissemination and use of the project results**

| Items about the dissemination and use of the project results (consolidated numbers) | Currently achieved quantity | Estimated future* quantity |
|---|---|---|
| Product innovations | 0 | |
| Process innovations | 0 | |
| New services (commercial) | 0 | |
| New services (public) | 0 | |
| | | |

| | | |
|---|---|---|
| New methods | 3 | |
| Scientific breakthrought | 0 | |
| Technical standards to which this project has contributed | 2 | |
| EU regulations/directives to which this project has contributed | 4 | |
| International regulations to which this project has contributed | 1 | |
| PhDs generated by the project | | 1 |
| Grantees/trainees including transnational exchange of personnel | 2 | |

** "Future" means expectations within the next 3 years following the end of the project*

| **Comment on European Interest** |
|---|

## Community added value and contribution to EU policies

| |
|---|
| **European dimension of the problem**<br>The European Community's Sustainable Development Strategy has set the goal to achieve a European capacity for the Global Monitoring for the Environment and Security (GMES) by 2008. BIOPRESS will demonstrate the current state-of-the-art and report on the problems involved in making the prototype production fully operational. BIOPRESS will also report on the methods, tools and results developed to link land cover to pressures on biodiversity. The outcomes of BIOPRESS will contribute to the GMES strategy by establishing the foundations for a long term European capacity to efficient collection of independent and quantitative information on the state of the environment |
| **Contribution to developing S&T co-operation at international level. European added value**<br>Economically, the project will contribute to the growing market sector of value-added spatial data products (from Earth Observation and other sources). The skills base in the participating organisations in information technology, data integration, conservation and biodiversity will be increased through multi-disciplinary and trans-boundary collaboration. This will have spin-off effects on the technical skills present in Europe's regions, and enhance Europe's competitiveness globally by pooling experts from different disciplines concerned with environmental monitoring. |
| **Contribution to policy design or implementation**<br>The European Environment Agency will be provided with a unique Pan-European sample of land cover change in and around nature protection sites, which will help the EEA assess and report on the State of the Environment. BIOPRESS will support the implementation of the Habitats Directive by providing an assessment of pressures on biodiversity related to land cover change at the selected representative sites using the MIRABEL framework, which has been used in the last EEA report. This assessment will also support the European Union's reporting requirements under the UN Biodiversity Convention. |

## Contribution to Community social objectives

| |
|---|
| **Improving the quality of life in the Community:**<br>BIOPRESS aims at generating a representative sample of land cover change products from 1950-2000, which is indicative of states and trends in biodiversity in the selected nature protection sites. The project will support the needs of DG-Environment and EEA in helping to implement and assess European policy on nature and biodiversity. It will contribute to the objective of enhancing the quality of the environment by helping to understand pressures on biodiversity arising from land cover change in the member states and accession countries. |
| **Provision of appropriate incentives for monitoring and creating jobs in the Community (including use and development of skills):**<br>In the less economically favoured countries the project will improve employment opportunities by enhancing the information technology skills and bringing experts from accession countries together with experts from EU member states. BIOPRESS supports an Equal Opportunities policy and supports career development of women by having a female project coordinator and an above-average proportion of female scientists (1/3) in responsible functions of the project (see C.7) |

**Supporting sustainable development, preserving and/or enhancing the environment (including use/conservation of resources):**
The land cover change product will aid future research on the Natura-2000 sites and on how biodiversity is affected by landscape structure and land use change. The integrity of natural ecosystems is now recognised as being crucial to the health of market systems and continuing global prosperity. Biological diversity is now recognised as a valuable natural resource. BIOPRESS will help the EU and Member States to take appropriate measures to create and/or maintain an environment that fulfils ecological, cultural and economic requirements in a sustainable manner. The improved understanding of how land cover changes between 1950 and today affects biodiversity in the wide variety of European biogeographical zones will contribute to the formulation of policies aiming at sustainable development.

**Expected project impact (to be filled in by the project coordinator)**

| EU Policy Goals | I SCALE OF EXPECTED IMPACT OVER THE NEXT 10 YEARS -1 0 1 2 3 | II other | |
|---|---|---|---|
| | | Not applicable to project | Project Impacttoo difficult to estimate |
| 1. Improved sustainable economic development and growth, competitiveness | 0 | √ | |
| 2. Improved employment | 2 | | |
| 3. Improved quality of life and health and safety | 0 | √ | |
| 4. Improved education | 1 | √ | |
| 5. Improved preservation and enhancement of the environment | 0 | √ | |
| 6. Improved scientific and technological quality | 2 | | |
| 7. Regulatory and legislative environment | 3 | | |
| 8. Other | 0 | √ | |

| 1. Economic development and growth, competitiveness | Scale of Expected Impacts over the next 10 years (2) | |
|---|---|---|
| | By Project End -1 0 1 2 3 | After Project End -1 0 1 2 3 |
| a) Increased Turnover for project participants - national markets | | |
| b) Increased Turnover for project participants - international markets | | |
| c) Increased Productivity for project participants | | |
| d) Reduced costs for project participants | | |
| e) Improved output quality/high technology content | | |

| 2. Employment | Scale of Expected Impacts over the next 10 years (2) | |
|---|---|---|
| | By Project End | After Project End |

| | -1 0 1 2 3 | -1 0 1 2 3 |
|---|---|---|
| a) Safeguarding of jobs | 1 | 1 |
| b) Net employment growth in projects participants staff | 1 | 0 |
| c) Net employment growth in customer and supply chains | 0 | 0 |
| d) Net employment growth in the European economy at large | 0 | 0 |

| **3. Quality of Life and health and safety** | **Scale of Expected Impacts over the next 10 years (2)** | |
|---|---|---|
| | **By Project End** -1 0 1 2 3 | **After Project End** -1 0 1 2 3 |
| a) Improved health care | | |
| b) Improved food, nutrition | | |
| c) Improved safety (incl. consumers and workers safety) | | |
| d) Improved quality of life for the elderly and disabled | | |
| e) Improved life expectancy | | |
| f) Improved working conditions | | |
| g) Improved child care | | |
| h) Improved mobility of persons | | |

| **4. Improved education** | **Scale of Expected Impacts over the next 10 years (2)** | |
|---|---|---|
| | **By Project End** -1 0 1 2 3 | **After Project End** -1 0 1 2 3 |
| a) Improved learning processes including lifelong learning | 0 | 0 |
| b) Development of new university curricula | 0 | 1 |

| **5. Preservation and enhancement of the environment** | **Scale of Expected Impacts over the next 10 years (2)** | |
|---|---|---|
| | **By Project End** -1 0 1 2 3 | **After Project End** -1 0 1 2 3 |
| a) Improved prevention of emissions | | |
| b) Improved treatment of emissions | | |
| c) Improved preservation of natural resources and cultural heritage | | |
| d) Reduced energy consumption | | |

| **6. S&T quality** | **Scale of Expected Impacts over the next 10 years (2)** | |
|---|---|---|
| | **By Project End** -1 0 1 2 3 | **After Project End** -1 0 1 2 3 |
| a) Production of new knowledge | 3 | 0 |

| | | |
|---|---|---|
| b) Safeguarding or development of expertise in a research area | 2 | 0 |
| c) Acceleration of RTD, transfer or uptake | 0 | 0 |
| d) Enhance skills of RTD staff | 2 | 0 |
| e) Transfer expertise/know-how/technology | 1 | 1 |
| f) Improved access to knowledge-based networks | 0 | 0 |
| g) Identifying appropriate partners and expertise | 1 | 1 |
| h) Develop international S&T co-operation | 0 | 0 |
| i) Increased gender equality | 3 | 2 |

| **7. Regulatory and legislative environment** | **Scale of Expected Impacts over the next 10 years (2)** | |
|---|---|---|
| | **By Project End** -1 0 1 2 3 | **After Project End** -1 0 1 2 3 |
| a) Contribution to EU policy formulation | 0 | 0 |
| Contribution to EU policy implementation | 3 | 3 |

| **8. Other (please specify)** | **Scale of Expected Impacts over the next 10 years (2)** | |
|---|---|---|
| | **By Project End** -1 0 1 2 3 | **After Project End** -1 0 1 2 3 |
| | | |

# Description of Results

| No. | Title |
|---|---|
| 1 | Land cover change data for 132 samples across Europe; timepoints: 1950, 1990, 2000; aerial photography; Corine Land Cover level 3 |

**CONTACT PERSON FOR THIS RESULT**

| | |
|---|---|
| Name | France Gerard |
| Position | Head of Biophysical Modelling Group |
| Organisation | Research Council |
| Address | CEH Monks Wood<br>PE2 28LS, Abbots Ripton<br>United Kingdom |
| Telephone | +44 1487 773467 |
| Fax | +44 1487 772482 |
| E-mail | ffg@ceh.ac.uk |
| URL | |
| Specific Result URL | |

**SUMMARY**

Land cover change data for 59 transects (2kmx15km) and 73 windows (30kmx30km) sampled across Europe. The sites were chosen so that they contained at least part of a Natura2000 site. The data was produced through interpretation of aerial photography acquired for 1950'ies, 1990'ies and 2000 (± 5 years); The land cover was identified following the Corine Land Cover class nomenclature - level 3. Output data are land cover maps for the 3 time points and land cover change matrices for 1950-1990, 1990-2000 and 1950-2000. All data is stored in an ACCESS database which also contains information about the Natura 2000 sites the samples are related too. The database will be made available to the general public and scientific community from January 2007 through the project partner's webpages. The data is valuable for research requiring measured long term land cover change data at European scale, e.g. Climate change modelling activities, socio-economic studies, land degradation studies.

| SUBJECT DESCRIPTORS CODES |
|---|
| 274 GLOBAL CHANGE: LAND COVER AND DEGRADATION<br>211 ENVIRONMENTAL INDICATORS/MONITORING/RISK ASSESSMENT<br>171 EARTH OBSERVATION APPLICATIONS AND POLICY<br>64 BIODIVERSITY |

**DOCUMENTATION AND INFORMATION ON THE RESULT**

| Documentation type | Details (Title, ref. number, general description, language) | Status: PU=Public CO=Confidential |
|---|---|---|

**INTELLECTUAL PROPERTY RIGHTS**

| Type of IPR | KNOWLEDGE: Tick a box and give the corresponding details (reference numbers, etc) if appropriate | Pre-existing know-how Tick a box and give |
|---|---|---|

| | | | | | | the corresponding details(reference numbers, etc) if appropriate | |
|---|---|---|---|---|---|---|---|
| | Current | | | | Foreseen | Tick | Details |
| | Tick | NoP[1)] | NoI[2)] | Details | Tick | | |
| Patent applied for | | | | | | | |
| Patent granted | | | | | | | |
| Patent search carried out | | | | | | | |
| Registered design | | | | | | | |
| Trademark applications | | | | | | | |
| Copyrights | | | | | | | |
| Secret know-how | | | | | | | |
| Other - please specify: | | | | | | | |

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

**MARKET APPLICATION SECTORS**

| **Market application sectors** |
|---|
| 73 Research and development |

**CURRENT STAGE OF DEVELOPMENT**

| | |
|---|---|
| **Current stage of development** | Scientific and/or Technical knowledge (Basic research) |
| **Other:** | |

**Quantified data about the result**

| **Items (about the results)** | **Actual current quantity** | **Estimated (or future) quantity** |
|---|---|---|
| Time to application / market (in months from the end of the research project) | 0 | 0 |
| Number of (public or private) entities potentially involved in the implementation of the result: | 0 | 0 |
| of which: number of SMEs: | 0 | 0 |
| of which: number of entities in third countries (outside EU): | 0 | 0 |
| Targeted user audience: of reachable people | 0 | 0 |
| S&T publications (referenced publications only) | 5 | 10 |
| publications addressing general public (e.g. CD-ROMs, WEB sites) | 2 | |
| publications addressing decision takers / public authorities / etc. | 1 | |
| Visibility for the general public | YES | |

**Further collaboration, dissemination and use of the result**

**COLLABORATIONS SOUGHT**

| | | | | | |
|---|---|---|---|---|---|
| **R&D** | Further research or development | √ | **FIN** | Financial support | |
| **LIC** | Licence agreement | | **VC** | Venture capital/spin-off funding | |
| **MAN** | Manufacturing agreement | | **PPP** | Private-public partnership | |
| **MKT** | Marketing agreement | | **INFO** | Information exchange/training | |
| **JV** | Establish a joint enterprise or partnership | | **CONS** | Available for consultancy | |
| **Other** | (please specify) | | | | |
| **Details:** | Collaborative research work with any of the project partners is the favoured option, however, the data produced will be freely available from Jan 2007 for use for further research and development. Acknowledgement of the BIOPRESS project is expected in return. | | | | |

**POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE**

Not applicable

**PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE**

Not applicable

| No. | Title |
|---|---|
| 2 | Fully illustrated manual for photo-to-photo interpretation |

**CONTACT PERSON FOR THIS RESULT**

| | |
|---|---|
| Name | Jan Feranec |
| Position | Researcher |
| Organisation | Institute of Geography of the Slovak Academy of Sciences |
| Address | Stefanikova 49<br>814 73, Bratislava<br>Slovakia |
| Telephone | +421 2 52495587 |
| Fax | |
| E-mail | feranec@savba.sk |
| URL | |
| Specific Result URL | |

**SUMMARY**

This Photo-to-Photo Interpretation Manual was compiled as part of Work Package 2000 of the FP-5 project BIOPRESS. It is intended as a guide to interpretation of aerial B&W photographs, with the purpose of mapping land cover classes, linear and point features at 1:20 000, and estimating land cover changes for the years 1950, 1990 and 2000. The manual will also serve as a reference work for future similar land-cover mapping activities elsewhere in Europe. The document is a development of an earlier Manual of Computer Aided Visual Interpretation of Aerial B&W Photographs, compiled to demonstrate interpretation of aerial B&W photographs in the framework of the CORINE land cover (CLC) mapping at 1:100 000, to detect land cover changes between 1950 and 1990. Within the BIOPRESS project, it is intended to use B&W aerial photographs from 1950, 1990 and 2000, scanned at 1m raster resolution, to estimate change within transects representative of European land cover. A method is to be applied, based on back-dating from interpretations of the most recent photographs (from 2000). These results will constitute a baseline for interpretation of an older horizon (1990), and these results will again provide the starting-point for the 1950 photograph interpretation. This Photo-to-Photo Interpretation Manual provides the interpreters with methodological guidelines for delineation of 44 classes of the CLC nomenclature, the linear and point features and land cover changes with reference to B&W aerial photographs. The manual can be acquired from Jan Feranec, the BIOPRESS webpage and the BIOPRESS coordinator

| SUBJECT DESCRIPTORS CODES |
|---|
| 172 EARTH OBSERVATION TECHNOLOGY AND INFORMATION EXTRACTION<br>347 LAND USE PLANNING/LANDSCAPE/LANDSCAPE ARCHITECTURE<br>536 REMOTE SENSING |

**DOCUMENTATION AND INFORMATION ON THE RESULT**

| Documentation type | Details (Title, ref. number, general description, language) | Status: PU=Public CO=Confidential |
|---|---|---|

**INTELLECTUAL PROPERTY RIGHTS**

| Type of IPR | KNOWLEDGE: Tick a box and give the corresponding details (reference numbers, etc) if appropriate | Pre-existing know-how Tick a box and give the corresponding details(reference numbers, etc) if |
|---|---|---|

| | | | | | appropriate | |
|---|---|---|---|---|---|---|
| | Current | | | | Foreseen | Tick | Details |
| | Tick | NoP[1)] | NoI[2)] | Details | Tick | | |
| Patent applied for | | | | | | | |
| Patent granted | | | | | | | |
| Patent search carried out | | | | | | | |
| Registered design | | | | | | | |
| Trademark applications | | | | | | | |
| Copyrights | | | | | | | |
| Secret know-how | | | | | | | |
| Other - please specify: | | | | | | | |

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

**MARKET APPLICATION SECTORS**

| **Market application sectors** |
|---|
| 73 Research and development |

**CURRENT STAGE OF DEVELOPMENT**

| | |
|---|---|
| **Current stage of development** | Guidelines, methodologies, technical drawings |
| **Other:** | |

**Quantified data about the result**

| **Items (about the results)** | **Actual current quantity** | **Estimated (or future) quantity** |
|---|---|---|
| Time to application / market (in months from the end of the research project) | | |
| Number of (public or private) entities potentially involved in the implementation of the result: | | |
| of which: number of SMEs: | | |
| of which: number of entities in third countries (outside EU): | | |
| Targeted user audience: of reachable people | | |
| S&T publications (referenced publications only) | | |
| publications addressing general public (e.g. CD-ROMs, WEB sites) | 1 | |
| publications addressing decision takers / public authorities / etc. | | |
| Visibility for the general public | YES | |

**Further collaboration, dissemination and use of the result**

**COLLABORATIONS SOUGHT**

| | | | | | |
|---|---|---|---|---|---|
| **R&D** | Further research or development | √ | **FIN** | Financial support | |

| | | | | | |
|---|---|---|---|---|---|
| **LIC** | Licence agreement | | **VC** | Venture capital/spin-off funding | |
| **MAN** | Manufacturing agreement | | **PPP** | Private-public partnership | |
| **MKT** | Marketing agreement | | **INFO** | Information exchange/training | √ |
| **JV** | Establish a joint enterprise or partnership | | **CONS** | Available for consultancy | |
| **Other** | (please specify) | | | | |
| **Details:** | The interpretation manual is available freely in electronic format. Acknowledgement of the author (Jan Feranec) and the BIOPRESS project are expected in return. | | | | |

**POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE**

| |
|---|
| Not applicable |

**PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE**

| |
|---|
| Not applicable |

| No. | Title |
|---|---|
| 3 | Sampling framework and strategy for monitoring of European habitats. Position paper of BIOHAB & BIOPRESS research community. |

**CONTACT PERSON FOR THIS RESULT**

| | |
|---|---|
| Name | Sander Mucher |
| Position | researcher |
| Organisation | ALTERRA B.V. |
| Address | Droevendaalsesteeg 3 PO Box 47<br>6700 AA, WAGENINGEN<br>NETHERLANDS |
| Telephone | +31 317 474320 |
| Fax | +31 317 419000 |
| E-mail | sander.mucher@wur.nl |
| URL | |
| Specific Result URL | |

**SUMMARY**

The objective of this position paper is to provide a recommendation on the design of a sampling and monitoring strategy of European habitats to provide statically reliable European estimates on the extent of habitats and their associated changes. The habitat methodology that is recommended for a European monitoring system are the General Habitat Categories (GHC's) of the BIOHAB project which are the lowest common denominator for linking existing classifications and are pragmatic for field surveys in Europe. It is recognised to provide a basis for policy formulation that enables to collect information on EUNIS habitat categories (EEA) or Natura 2000 habitat categories (Habitat Directive). It is suggested to record these typologies in the field were possible. This position paper has the flexibility to choose between one or more habitat typologies but focuses especially on the stratification and sampling design. This manuscript can be acquired through the BIOPRESS webpage or by contacting Sander Mucher (ALTERRA) or the project coordinator (France Gerard - CEH Monks Wood).

| SUBJECT DESCRIPTORS CODES |
|---|
| 211 ENVIRONMENTAL INDICATORS/MONITORING/RISK ASSESSMENT |

**DOCUMENTATION AND INFORMATION ON THE RESULT**

| Documentation type | Details (Title, ref. number, general description, language) | Status: PU=Public CO=Confidential |
|---|---|---|

**INTELLECTUAL PROPERTY RIGHTS**

| Type of IPR | KNOWLEDGE: Tick a box and give the corresponding details (reference numbers, etc) if appropriate | | | | | Pre-existing know-how Tick a box and give the corresponding details(reference numbers, etc) if appropriate | |
|---|---|---|---|---|---|---|---|
| | Current | | | | Foreseen | Tick | Details |
| | Tick | NoP[1)] | NoI[2)] | Details | Tick | | |
| Patent applied for | | | | | | | |
| Patent granted | | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Patent search carried out | | | | | | |
| Registered design | | | | | | |
| Trademark applications | | | | | | |
| Copyrights | | | | | | |
| Secret know-how | | | | | | |
| Other - please specify: | | | | | | |

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

**MARKET APPLICATION SECTORS**

| **Market application sectors** |
|---|
| 73 Research and development |

**CURRENT STAGE OF DEVELOPMENT**

| | |
|---|---|
| **Current stage of development** | Guidelines, methodologies, technical drawings |
| **Other:** | |

**Quantified data about the result**

| **Items (about the results)** | **Actual current quantity** | **Estimated (or future) quantity** |
|---|---|---|
| Time to application / market (in months from the end of the research project) | | |
| Number of (public or private) entities potentially involved in the implementation of the result: | | |
| of which: number of SMEs: | | |
| of which: number of entities in third countries (outside EU): | | |
| Targeted user audience: of reachable people | | |
| S&T publications (referenced publications only) | | |
| publications addressing general public (e.g. CD-ROMs, WEB sites) | | |
| publications addressing decision takers / public authorities / etc. | 1 | |
| Visibility for the general public | YES | |

**Further collaboration, dissemination and use of the result**

**COLLABORATIONS SOUGHT**

| | | | | | |
|---|---|---|---|---|---|
| **R&D** | Further research or development | √ | **FIN** | Financial support | |
| **LIC** | Licence agreement | | **VC** | Venture capital/spin-off funding | |
| **MAN** | Manufacturing agreement | | **PPP** | Private-public partnership | |
| **MKT** | Marketing agreement | | **INFO** | Information exchange/training | |
| **JV** | Establish a joint enterprise or partnership | | **CONS** | Available for consultancy | √ |
| **Other** | (please specify) | | | | |

| **Details:** | The position paper is available freely in electronic format. Acknowledgement of the authors,the BIOHAB and BIOPRESS project are expected in return. |
|---|---|

**POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE**

Not Applicable

**PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE**

Not Applicable

| No. | Title |
|---|---|
| 4 | land cover change - pressure association matrix |

**CONTACT PERSON FOR THIS RESULT**

| | |
|---|---|
| Name | France Gerard |
| Position | Head of Biophysical Modelling Group |
| Organisation | Centre For Ecology and Hydrology |
| Address | Monks Wood<br>PE28 2LS, Abbots Ripton<br>UK |
| Telephone | +44 (0)1487 772482 |
| Fax | +44 (0)1487 3467 |
| E-mail | ffg@ceh.ac.uk |
| URL | |
| Specific Result URL | |

**SUMMARY**

A land cover change - pressure association matrix was developed. This matrix enabled the grouping of types of land cover changes related to one of the six pressures under consideration in BIOPRESS: Urbanisation, intensification, afforestation, deforestation, abandonment and drainage. This cross-tabulation matrix is a fundamental starting point in the analysis of land cover change, because it provides a national-scale assessment of not only the losses or gains in the area of specific land categories but what these changes represent in terms of types of pressures. This matrix has the potential to enhance the similar 'Land Cover Flow' matrix developed by the EEA as part of the EEA Land Accounting System. Additional research is needed to analyse this matrix according to its various components in order to gain more insight into the potential processes that determine a pattern of land cover change. The matrix is mentionned in several of the BIOPRESS reports and will be described in at least one scientific paper. The European Environment Agency has been made aware of this development.

| SUBJECT DESCRIPTORS CODES |
|---|
| 211 ENVIRONMENTAL INDICATORS/MONITORING/RISK ASSESSMENT |

**DOCUMENTATION AND INFORMATION ON THE RESULT**

| Documentation type | Details (Title, ref. number, general description, language) | Status: PU=Public CO=Confidential |
|---|---|---|

**INTELLECTUAL PROPERTY RIGHTS**

| Type of IPR | KNOWLEDGE: Tick a box and give the corresponding details (reference numbers, etc) if appropriate | | | | | Pre-existing know-how Tick a box and give the corresponding details(reference numbers, etc) if appropriate | |
|---|---|---|---|---|---|---|---|
| | Current | | | | Foreseen | Tick | Details |
| | Tick | NoP[1)] | NoI[2)] | Details | Tick | | |
| Patent applied for | | | | | | | |
| Patent granted | | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Patent search carried out | | | | | | |
| Registered design | | | | | | |
| Trademark applications | | | | | | |
| Copyrights | | | | | | |
| Secret know-how | | | | | | |
| Other - please specify: | | | | | | |

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

**MARKET APPLICATION SECTORS**

| **Market application sectors** |
|---|
| 73 Research and development |

**CURRENT STAGE OF DEVELOPMENT**

| | |
|---|---|
| **Current stage of development** | Guidelines, methodologies, technical drawings |
| **Other:** | |

**Quantified data about the result**

| **Items (about the results)** | **Actual current quantity** | **Estimated (or future) quantity** |
|---|---|---|
| Time to application / market (in months from the end of the research project) | | |
| Number of (public or private) entities potentially involved in the implementation of the result: | | |
| of which: number of SMEs: | | |
| of which: number of entities in third countries (outside EU): | | |
| Targeted user audience: of reachable people | | |
| S&T publications (referenced publications only) | | 2 |
| publications addressing general public (e.g. CD-ROMs, WEB sites) | | |
| publications addressing decision takers / public authorities / etc. | | |
| Visibility for the general public | YES | |

**Further collaboration, dissemination and use of the result**

**COLLABORATIONS SOUGHT**

| | | | | | |
|---|---|---|---|---|---|
| **R&D** | Further research or development | √ | **FIN** | Financial support | |
| **LIC** | Licence agreement | | **VC** | Venture capital/spin-off funding | |
| **MAN** | Manufacturing agreement | | **PPP** | Private-public partnership | |
| **MKT** | Marketing agreement | | **INFO** | Information exchange/training | |
| **JV** | Establish a joint enterprise or partnership | | **CONS** | Available for consultancy | |
| **Other** | (please specify) | | | | |

| | |
|---|---|
| **Details:** | The conversion matrix is available in electronic format for anyone wishing to collaborate on this subject with BIOPRESS partners. |

**POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE**

**PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE**

| No. | Title |
|---|---|
| 5 | Manual of Computer Aided Visual Interpretation of Aerial B&W Photographs |

**CONTACT PERSON FOR THIS RESULT**

| | |
|---|---|
| Name | Jan Feranec |
| Position | researcher |
| Organisation | Institute of Geography of the Slovak Academy of Sciences |
| Address | Stefanikova 49<br>814 73, Bratislava<br>Slovakia |
| Telephone | +421 2 52495587 |
| Fax | |
| E-mail | feranec@savba.sk |
| URL | |
| Specific Result URL | |

**SUMMARY**

The Manual of Computer Aided Visual Interpretation of Aerial B&W Photographs (Feranec et al. 2003), provides interpretation rules of aerial B&W photographs in the framework of the CORINE land cover (CLC) identification for the scale 1:100 000, and land cover changes for the years 1950-1990 through the backdating of CORINE Land Cover 1990. The manual can be acquired from the BIOPRESS webpage or by contacting the author, Jan Feranec (GI-SAS) or the project coordinator, France Gerard (CEH Monks Wood)

| SUBJECT DESCRIPTORS CODES |
|---|
| 211 ENVIRONMENTAL INDICATORS/MONITORING/RISK ASSESSMENT |

**DOCUMENTATION AND INFORMATION ON THE RESULT**

| Documentation type | Details (Title, ref. number, general description, language) | Status: PU=Public CO=Confidential |
|---|---|---|

**INTELLECTUAL PROPERTY RIGHTS**

| Type of IPR | KNOWLEDGE: Tick a box and give the corresponding details (reference numbers, etc) if appropriate | | | | | Pre-existing know-how Tick a box and give the corresponding details(reference numbers, etc) if appropriate | |
|---|---|---|---|---|---|---|---|
| | Current | | | | Foreseen | Tick | Details |
| | Tick | NoP[1)] | NoI[2)] | Details | Tick | | |
| Patent applied for | | | | | | | |
| Patent granted | | | | | | | |
| Patent search carried out | | | | | | | |
| Registered design | | | | | | | |
| Trademark applications | | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Copyrights | | | | | | |
| Secret know-how | | | | | | |
| Other - please specify: | | | | | | |

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

**MARKET APPLICATION SECTORS**

| **Market application sectors** |
|---|
| 73 Research and development |

**CURRENT STAGE OF DEVELOPMENT**

| | |
|---|---|
| **Current stage of development** | Guidelines, methodologies, technical drawings |
| **Other:** | |

**Quantified data about the result**

| **Items (about the results)** | **Actual current quantity** | **Estimated (or future) quantity** |
|---|---|---|
| Time to application / market (in months from the end of the research project) | | |
| Number of (public or private) entities potentially involved in the implementation of the result: | | |
| of which: number of SMEs: | | |
| of which: number of entities in third countries (outside EU): | | |
| Targeted user audience: of reachable people | | |
| S&T publications (referenced publications only) | | |
| publications addressing general public (e.g. CD-ROMs, WEB sites) | 1 | |
| publications addressing decision takers / public authorities / etc. | | |
| Visibility for the general public | YES | |

**Further collaboration, dissemination and use of the result**

**COLLABORATIONS SOUGHT**

| | | | | | |
|---|---|---|---|---|---|
| **R&D** | Further research or development | √ | **FIN** | Financial support | |
| **LIC** | Licence agreement | | **VC** | Venture capital/spin-off funding | |
| **MAN** | Manufacturing agreement | | **PPP** | Private-public partnership | |
| **MKT** | Marketing agreement | | **INFO** | Information exchange/training | √ |
| **JV** | Establish a joint enterprise or partnership | | **CONS** | Available for consultancy | |
| **Other** | (please specify) | | | | |
| **Details:** | The interpretation manual is available freely in electronic format. Acknowledgement of the author (Jan Feranec) and the BIOPRESS project are expected in return. | | | | |

**POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE**

| NA |
|---|

**PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE**

NA

## Exploitation plans

## CONFIDENTIAL

I am the Co-ordinator of the above project, and confirm on behalf of the contracted Partners the information contained in this Technological Implementation Plan, and I authorise its public dissemination.

**Signature:** **Name:**

**Date:** **Organisation:**

close