

THE CORNWALL LIFE PROJECT: DEVELOPING AN INTEGRATED ENVIRONMENTAL INFORMATION SYSTEM FOR CORNWALL, UK

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Introduction

The development of local environmental information systems is an important step towards achieving sustainable development through Local Agenda 21. Agenda 21 - a vision for sustainable development into the 21st century - was agreed between nations at the United Nations Conference on the Environment and Development (UNCED - the Earth Summit) in 1992. Local Agenda 21 is the application of these global commitments at the local level.

The inclusion of a wide range of types of data within a local environmental information system is important so that decision makers can be fully appraised of the effects of their actions on the environment. Availability of information at the strategic stage of the "policy, plan and programme" cycle is a critical factor in ensuring that the least environmentally damaging option is selected. The availability of environmental information, together with the means to analyse it, is essential for strategic assessment of the potential environmental impacts of development plans.

A partnership between the Cornwall Wildlife Trust (a local non-governmental nature conservation organisation in Cornwall, UK, which carries out surveys, provides advice and runs educational programmes) and Cornwall County Council (the local authority for Cornwall) has been formed to develop an integrated local environmental information system for the county. One of the main uses of the system will be provision of information at the strategic stages of the development plan process.

The partnership is supported by the LIFE fund of the DGXI of the European Commission. Other contributors to the project include the Societé pour l'Etude et la Protection de la Nature en Bretagne (SEPNB) and Laser-Scan UK Ltd.

The system being developed by the partnership is unusual because:

- It includes complex digital data sets which require specialised methods of capture
- A wide variety of data sets is included, which makes the system useful to decision makers across a range of sectors such as local government, agriculture, water and nature conservation
- It applies to a complete local government administrative region in the UK

This paper describes the aims of the Cornwall LIFE Project and then examines in detail a number of the areas of work within it. A full description of the project can be found in Cornwall LIFE Project (1994)

Aims of the Project

The main aim of the Cornwall LIFE Project is to establish an environmental information system for the county of Cornwall, UK, by linking digital maps with a relational database to form a Geographical Information System (GIS). In addition, the project aims to demonstrate specific applications of the system, and draw up a plan of action for the establishment of a similar system in part of Brittany, France. The Project started in February 1994 and runs until January 1997. A requirement of the European Commission funding is that dissemination materials are produced and that the methods and approach taken by the project are promoted to other potential partnerships in Europe.

In order to set up the environmental information system, the following activities are taking place.

- Data collection, capture and refinement. Data sets include information on the natural environment (land cover for 1988 and 1995, habitats and species), designations (national and local nature conservation designations and planning designations), and administrative boundaries (including parishes and districts). Data has been collected using a variety of methods including aerial photography, field survey and desk study. Capture of map-based information has been carried out using Laser-Scan VTRAK line following equipment, and databases have been established using a combination of operator input and semi-automated macro-routines.
- Hardware and software specification. Standard hardware and software packages are being used by the project, but they are being set up in ways which will be specific to the environmental information system. New routines will be created to make most efficient use of the data within the system.
- User consultation and training. A wide range of organisations and individuals have been invited to participate in the development of the new system through a series of consultative group meetings.

Demonstration of the use of the new system is centred around the following specific applications:

- Contribution to an overview of the nature conservation resource in Cornwall. The new system can provide detailed and accurate information on the extent and location of semi-natural habitats.
- Establishment of a scheme for monitoring the extent of semi-natural habitat in Cornwall. The relatively new concept of providing accounts for the natural environment is being developed as part of the project. Comparison of Land Cover data for 1988 and 1995 will show gains and losses according to a number of accounting categories.
- Protocols for use in the development plan process. Three main uses of the system will apply to the development plan process: Information in response to development proposals; Information for inclusion in development plans; and Audit of the effectiveness of development plan environmental policies.
- Positive nature conservation guidelines for Cornwall. The number of schemes for re-creating, restoring and managing farmland and semi-natural habitats is increasing and is likely to increase further with reform of the Common Agricultural Policy. The new environmental information system will aid the targeting of financial support to landowners and managers to provide the most benefit to the environment.
- Provision of information to national and international information networks. The Countryside Information System in the UK and the CORINE Programme within Europe both depend on provision of information from local sources. The project aims to show how data sets within the new system can be summarised and used to provide greater details, and in some cases validation, of the data provided in national and international systems.

Selected examples of work from the project

Capture and refinement of land cover data

Data capture represents a considerable proportion of the investment needed for any GIS project (Konecny cited in Jackson and Woodsford 1991). In the case of the Cornwall LIFE Project, the capture of land cover data for 183 1:10000 map sheets (covering the administrative area of Cornwall) represents the greatest single item of investment in the project. In addition, the state of the information in its raw format, the limited time available for its transfer to digital format and the complexity of the data required a specialised approach.

Figure 1 shows an example of land cover data in its raw format. This data was produced for a previous project, when the possibility of digital capture and use within a GIS was not foreseen. Particular problems with the data, which was produced using a combination of aerial photographs, field survey and desk study, included:

- i Uneven density of colour within land cover patches
- ii Lack of boundary lines for habitat patches
- iii Inclusion of wide boundary lines for nature conservation sites, which obscure some of the land cover data
- iv Combination of land cover categories using "hatching"
- v Large number of land cover patches per map sheet, with widely varying sizes of patches
- vi Some land cover patches wholly enclosed by other patches, which can cause problems with measurement of area if inappropriate data capture methods are used

[FIGURE 1]

An approach was needed that was efficient and accurate, and could be carried out in a relatively short period of time. A two stage approach was taken:

Stage 1

Single colour transparent film overlays were produced for each map. The overlays consisted of single lines drawn around land cover patches, labelled using letters to represent the appropriate land cover class or combination of classes. All land cover patches are by definition directly adjacent to each other, so all lines are shared by two land cover features. An example of a transparent film overlay is shown in Figure 2. This method meant that problems i-iv were solved: Uneven density of colour was eliminated in the film overlays; boundary lines were created; boundary lines for nature conservation sites were ignored; and hatched areas were identified using combinations of two, three or four letters. The latter problem seemed initially to be the most difficult to solve: It was estimated that there were upwards of 140 different combinations of land cover classes. By single letters to represent single land cover classes, any combination could be represented by combining the appropriate single letters.

[FIGURE 2]

Problems v and vi were solved by using a specialised sub-contractor, Laser-Scan UK Ltd. Three Laser-Scan products were used: VTRAK, LAMPS and LITES2. The line work (Figure 2) was scanned and then imported into VTRAK; the resulting images were registered to the National Grid; the registered images were then processed to generate vector line work. All line work was converted in a single pass, negating the need for a completeness check. Automatic processing optimises the number of points per line, bring benefits in accuracy and amount of data stored. The vector data was exported to LAMPS, where the vector data was structured into polygons, and then given seeds by an operator using the scanned data as a backdrop. The seed value allowed coding of features using VTRAK's automatic text recognition facilities, resulting in cost savings and data consistency benefits. Edge matching polygons on adjacent map sheets was then carried out in consultation with the Cornwall LIFE Project to ensure cartographic correctness in a continuous mapping environment. LAMPS was then used to polygonise

the data. The final stage was the use of LITES2 macro to automatically code each polygon according to the seed code using a correspondence lookup table. The use of a LITES2 macro and correspondence table ensured consistency throughout the 183 1:10000 5km x 5km map sheets covering Cornwall.

The resulting digital data closely resembles the original paper data. There have been some difficulties defining appropriate colours for mixtures of land cover classes, but this is only to be expected given the complex nature of the original data. An example of the output from the GIS is shown in Figure 3.

[FIGURE 3]

The original data was produced before current land cover and habitat classifications became widely used. It is of great advantage to the project to refine the land cover data to ensure that it is as compatible as possible with national and international classifications. A programme of refinement is currently taking place using existing surveys, geographical location and limited field survey. This will ensure that the classification will translate easily to national and international classifications.

Auditing effectiveness of development plan policies

One of the key applications of the environmental information system is to audit the effectiveness of development plan policies. Development plan policies, as described in county-wide strategic plans, are intended to direct policies in local plans and to therefore influence development control i.e. the response of local planning authorities to development proposals.

The environmental information system for Cornwall can take land cover data from 1988 and 1995 and analyse changes with respect to planning policy areas. In this way the change in land cover can be related to specific policies as well as specific planning authorities. The precise format of the results of the audit is flexible due to the use of a GIS to manipulate and analyse data.

The results of such an audit could be expected to include the following examples, which are hypothetical examples and are based on a county area of 360000 hectares, district areas of 60000 hectares, and policy areas of 7500 hectares for CNC¹ sites and 8000 hectares for AGSVs². Real results are not yet available, being dependent on 1995 aerial photographs. These photographs are being produced at the time of writing. The examples given below will be expanded to produce a full set of environmental accounts, showing the extent, type and reason for land use change.

All area values are in hectares.

District A 1988-1995

	Total area	Area inside AGSV	Inside CNC sites
Total habitat change	-65	-40	0
Woodland change	+20	+8	0
Wetland change	-10	-4	0
Built area change	+20	+15	+3

District B 1988-1995

	Hectares	Inside AGSV	Inside CNC sites
Total habitat change	-80	-30	-10
Woodland change	+12	+12	-15
Wetland change	-25	-20	0
Built area change	+12	+8	+8

¹ Cornwall Nature Conservation Sites - sites of at least county importance for nature conservation

² Area of Great Scientific Value - a county-wide designation intended to protect important areas of natural or semi-natural habitat

County 1988-1995

	Hectares	Inside AGSV	Inside CNC sites
Total habitat change	-350	-150	-56
Woodland change	+85	+30	-10
Wetland change	-50	-30	0
Built area change	+95	+45	+18

Summary

The usefulness of an environmental information system for providing strategic information is dependent on:

- Availability of quality data which covers the whole of the area of interest
- Analytical tools that enable data to be manipulated to provide answers for users

Laser-Scan UK Ltd. used semi-automated methods to ensure that the data available in Cornwall was captured to a high standard. Laser-Scan's Horizon GIS product and the underlying macro language ensured that the analytical tools were available to manipulate the data.

The applications developed through the Cornwall LIFE Project will ensure that land use planning is more fully integrated with the natural environment in Cornwall, and will act as demonstrations to other partnerships throughout Europe. The development of Local Agenda 21 initiatives in Cornwall will benefit from the availability of data through the environmental information system. Applications such as the audit of effectiveness of development plan policies described in this paper will assist in the revision and implementation of policies throughout the county.

Acknowledgements

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