SYMPOSIUM ON GEOGRAPHIC INFORMATION SYSTEMS: GIS AND MACHINE PEAT EXTRACTION

DEREK BOND* AND PAULA DEVINE
Northern Ireland Regional Research Laboratory

MARGARET CRUICKSHANK AND ROY TOMLINSON
School of Geosciences, Queen's University

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INTRODUCTION

This paper outlines the use of a Geographic Information System (GIS), in the form of map overlays, to assist in the identification of socio-economic and physical environmental factors affecting extraction of peat by machine from blanket bog in Northern Ireland. The spatially coincident distributions revealed, were further investigated by other means, to establish any casual relationships. PC Arc/Info, a proprietary GIS package installed on an IBM PS/2 Model 80 and the UNIRAS mapping system were used by the team, which comprised two geographers (RT and MC), an economist/computer programmer (DB) and a research assistant familiar with Arc/Info (PD). The work of the participants was therefore complementary. The paper is in four parts:

1. The issue to be investigated
2. GIS in a trial area
3. GIS for all the blanket peatland
4. Conclusions

*also Ulster Business School University of Ulster

1. THE ISSUE TO BE INVESTIGATED

Machine peat cutting/extraction spread widely in Northern Ireland during the 1980s; in blanket bogs on the hills it has been mainly for fuel peat, whereas lowland raised bogs have been cut mainly for horticultural peat. This paper is concerned with the former. The most common machines are small chain cutters, which use the power take-off from the rear of a tractor. These draw peat out of deep slits in the bog and extrude it as 'sausages' on the surface, where it is left to dry. The development of this extraction was paralleled in time by greater conservation interest in peatland - until then regarded as poor agricultural land, though traditionally it had yielded fuel; this fuel/turf was cut by hand from peatland held in turbary rights. Machine extraction may have greater adverse environmental impacts than hand cutting, and is therefore opposed by many conservationists. Possible impacts go beyond destruction of the peat blanket itself, to the loss of plant and animal species of the bog surface, effects on river flow and scarring some of the most valued landscapes. These impacts are being investigated currently, and it is hoped that any case against extraction will become clearer and better supported by empirical evidence. Those who oppose it are clearly in conflict with those doing it - the producers - some of whom were granted aided by the Local Enterprise Development Unit (LEDU), particularly in the early 1980s.

To further understand this practice, research was also needed, first into the extent of extraction and second, to identify the physical and social factors which drive and constrain it. The aim was to describe and explain its present occurrence and try to assess its likely future development. GIS, in the form of map overlays, was a useful tool to identify spatial coincidences between extraction and factors which might affect it or be affected by it. However, spatial coincidences do not establish causal relationships. For this, further enquiries, mainly with groups and individuals involved in the industry or affected by it, were used to complement the GIS work. The basic approach was attempted in a trial area, after which a contract form Countryside and Wildlife Branch, Department of Environment allowed it to be developed and extended to the whole of the blanket peat area of Northern Ireland.

2. GIS IN A TRIAL AREA

The trial area was a block 12 km E-W by 24 km N-S in mid-Tyrone; it ran from the high Sperrins in the north to lower hills around Carrickmore in the south; and it was to the east of Omagh. It was chosen in the knowledge that extraction was common, but seemed to be unevenly spread through the large extent of blanket peat in this area. Rapid field survey recorded 120 visible patches/incidences of extraction, which were grid referenced and their size estimated as large, medium or small. They were stored as an Arc/Info point coverage (see next paragraph) from which the distribution was mapped out. The pattern was uneven, being concentrated in the southern half of the area. The pattern also was uneven *within* the north and south. Further Arc/Info coverages were prepared (Table 1), mainly by digitising from existing maps, which were at different scales.

Arc/Info stores spatially referenced different layers of information, called coverages. These can be point, line or areal (polygon) in nature - i.e. rivers comprise a line coverage, District Council Areas would be a polygon coverage while the distribution of incidences of extraction a point coverage. The data related to each coverage are stored in attribute tables. These coverages can be laid on top of each other as long as they are spatially referenced using the same system, e.g. Irish Grid. The overlay of coverages enables spatial correlations between variables/coverages to be identified.

Table 1 Arc/Info coverages for the trial area

1	Selected contours for altitude	)
2	Selected rivers	) arc coverages
3	Selected roads	)
4	Rainfall isohyets	)
5	Scale of landholdings; jointly owned grazing - polygon	
6	Designated conservation areas (AONB, ASSI, NNR) - polygon	
7	Wading birds (RSPB) - grid square (raster)	
8	Peatland types - polygon	
9	Machine extraction incidences - point	

The peatland coverage was digitised from an earlier peatland survey map which was based on air photo interpretation. The wading bird coverage

was created as a polygon coverage comprising squares. The number of pairs of wading birds per km square was recorded in an attribute table.

Some coverages/maps help explain the distribution of extraction, while others are significant as subjects possibly adversely affected by it - namely the wading birds and designated conservation areas. In essence, we had assembled the beginnings of a Geographical Information System for this trial area, but focussed on machine peat extraction.

By overlaying the maps, machine extraction was found to be most common in:

- areas of former hand cutting
- lower altitudes and rainfall
- within 0.5 km of roads. Arc/Info has a buffering facility whereby all areas > 0.5 km from a road can be defined as a polygon coverage
- medium or small scale land holding units
- single ownerships (not in joint grazing)

The Nature Reserve was not affected, and extraction sites occurred only round the edges of the ASSI; but some were in the proposed Sperrins AONB. Higher densities of wading birds were largely unaffected, but it was common where birds had been recorded at lower densities. Figure 1 reproduces in monochrome, overlays of extraction sites onto altitude and the road network; areas beyond 0.5 km from a road are shaded.

3. GIS FOR ALL THE BLANKET PEATLAND

As in the trial area, the first task was to find the distribution of extraction throughout the blanket peatland; this was done from a combination of field survey and examination of satellite imagery. Incidences were grid referenced, sizes in hectares estimated and heights were recorded from OS (NI) maps. The earlier peatland survey maps were consulted to find the peatland type on which each incidence occurred - namely, intact, formerly hand cut, drained etc. This information was stored in a SIR database

for machine cutting. The grid references were downloaded to create a point coverage from which the distribution could be mapped out (Figure 2). Point symbols simply locate the incidences, but another option would be to classify them by size in mapping out. The blanket peatland area is shown by outlining km grid squares in which blanket peat was recorded. Regions 1-11 were based on the frequency of machine cutting.

The next step was to assemble as Arc/Info coverages, a range of other distributions to which machine cutting might be linked at the regional scale (Table 2) - these would not necessarily be the same factors as were examined within the trial area, i.e. a local area. Some factors relevant at the local scale were too complex or too large to handle at the regional scale, e.g., the road and track network for the whole of upland Northern Ireland, while other factors were most evident over large areas. Maps of each factor were then overlaid on the distribution of machine extraction, to reveal that it was most common in:

- severely disadvantaged LFAs
- wards and TTWAs with the highest unemployment rates
- DCAs with the highest % employed in agriculture
- wards with high % of the population which declared themselves to be Roman Catholic

In general, these suggest economic need as a major force affecting the distribution. However, some areas which meet these criteria either do no have much blanket peat, or it is of types not attractive for machine cutting; this explains its absence from Down and Armagh - Region 11 in Figure 2. In some other areas it is known to be absent due to prevention by large landowners. In terms of possible environmental and conservation impacts/problems, it was common in several AONBs and the catchments of some salmonid rivers.

Table 2

Arc/Info coverages for Northern Ireland: - rainfall isohyets - arc - Less Favoured Areas - polygon - AONBs - polygon - salmonid rivers - arc
SIR databases: - incidences of active hand cutting - incidences of machine cutting - peatland types/km grid square
NI Population Census 1981 - unemployment by wards) - religion) polygons - age structure)
DED October 1990 (TTWAs) - unemployment; male, female, total
NIERC (DCAs) - % employed in agriculture

This constitutes part of a Geographical Information System for Northern Ireland, but centred around the issue of machine peat extraction.

As pointed out earlier, some factors were too complex or large to examine at the regional scale, therefore five more sample areas were used to consider these at the local level; findings in the trial area about proximity to roads and avoidance of jointly owned grazing were confirmed. But no simple conclusions could be drawn about the effect of turbary rights or estate ownership on the distribution of machine cutting.

By the time the contract work was being done, the earlier peatland survey maps had been re-measured to give areas of different peatland per km grid square. These were stored in another, but much larger SIR database, which required UNIRAS for mapping; UNIRAS maps can then be overlaid on Arc/Info coverages. It then became possible to analyse the frequency of machine extraction in relation to the extent of peatland types throughout the blanket peat. This showed it to be overwhelmingly concentrated in

formerly hand cut peatland, suggesting a link to turbary rights (although the samples had not demonstrated this clearly) and one reason why this possibly environmentally damaging activity has so far been very difficult to control.

4. CONCLUSIONS

1. GIS was a useful tool in the form of simple map overlays, to look for spatial coincidences between machine cutting and other variables that might affect it or be affected by it. Arc/Info and UNIRAS together can handle data inputs in diverse forms and quantities. Even this simple type of GIS was time consuming and technical problems had to be solved.

2. A major obstacle to realising the potential of GIS will be data availability, since so much is protected by copyright. Permission was obtained to use OS (N.I.) and Met. Office maps, but this cannot be assumed for other studies. Data is valuable, so that those who create it cannot simply donate it to others to feed into a GIS. Value can be added to data by others, but some of that value stems from the original data and therefore must accrue to those who created it originally.

3. Simple map overlay, to give a visual linkage between data sets, identified factors to which machine cutting might be related, but GIS itself can go further. In this case, it would be possible to link data sets quantitatively, to predict its likely future spread, and thus the peatland most at risk from it.

4. Spatial coincidences do not necessarily imply causal relationships; the GIS work had to be supplemented by other enquiries. However, it can be a valuable tool to analyse spatially distributed phenomena, whether they be physical or social and to stimulate further enquiry.