Impact case study (REF3b)

**Institution: University of St Andrews**

Unit of Assessment: 17 – Geography, Environmental Studies and Archaeology

Title of case study: The construction and adoption of data zones as a new geography of Scotland

1. Summary of the impact

Successful planning in Scotland requires a set of geographical units for which data can be collected and analysed. Researchers at St Andrews have developed a new 'small area' geography for Scotland. 'Data zones' (DZs) provide a scientifically-based template for data mapping and has been adopted as the default geography used by public and private organisations to display and analyse data on topics as diverse as economic planning, health, education and transport, thus impacting how and where policy is enacted. To be statistically appropriate these units have to be compact, homogenous, with approximately the same size population and publically acceptable. This is not a trivial task, involving millions of potentially different solutions. In 2001, Scottish Neighbourhood Statistics (SNS) commissioned St Andrews to study how such units should be defined and to develop a methodology for creating them. Using the experience and skills developed over many years working in this area, the team developed a methodology and established the official small area geography of Scotland.
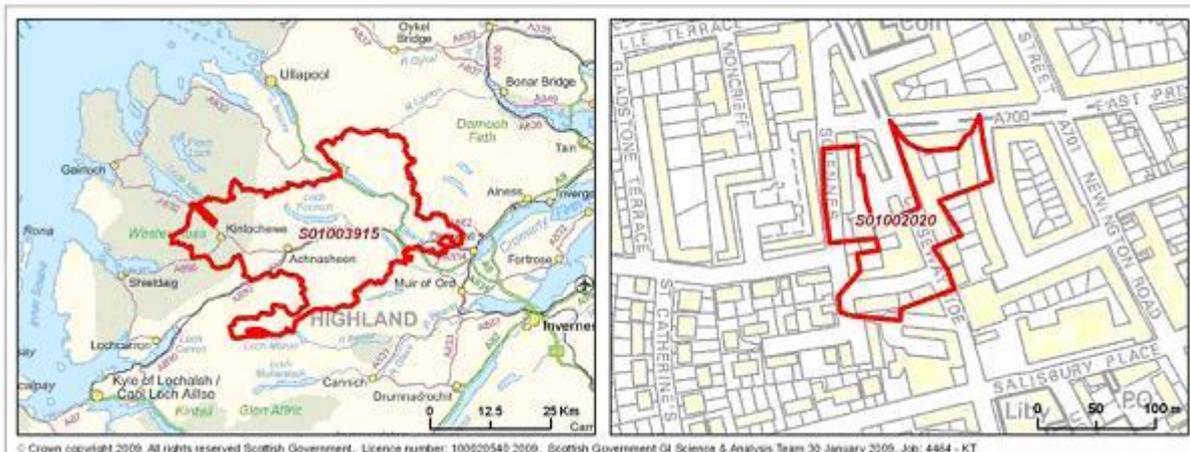
2. Underpinning research

Regionalisation and classification are long-standing interests for human geographers, and growth in GIS (geographical information science) has seen the development of software and data resources, at St Andrews and elsewhere. In addition to Graham (1980 to present), who worked on electoral districting in the 1990s, others joined the St Andrews team around 2000: Boyle in 1999 (moving to ESRC in 2010) and Flowerdew in 2000 as Professors, Feng (2000 to present) and Sabel (2000 to 2002) as Research Fellows, and Manley in 2003 as a Research Student (then Research Fellow until 2011). Flowerdew was team leader, and Feng took responsibility for software development and detailed zone construction.

The team had an established reputation for scientific (Flowerdew and Feng) and policy work (Graham as Boundary Commissioner for Scotland) on regionalisation and boundary definition before winning a competitive commission from the Scottish Government to develop the core geography – i.e. data zones (http://www.sns.gov.uk/). This research, which took place between 2002 and 2004 focused on:

  i.   data aggregation: how these representations affect the results of statistical and other analysis
  ii. zone design: how best to represent places by a set of geographical boundaries;

Data aggregation: how these representations affect the results of statistical and other analysis

Green and Flowerdew's (1996) work on ethnicity and unemployment showed how analytical results for spatial data (and hence interpretation of results) can be crucially dependent on the scale and configuration of geographical zones. This is an aspect of the modifiable areal unit problem (MAUP), also studied by Geddes and Flowerdew [4], Manley, Flowerdew and Steel [5], and more recently by Flowerdew [1]. The MAUP is encountered when the results of statistical analysis of areal data show a wide variation according to the zonal system used.

Zone design: how best to represent places by a set of geographical boundaries

The DZ project depended on using zone design methods to determine definitional criteria, bearing in mind competing interests. In 2002 we identified four basic criteria for general zone design: equality of size, compact shape, social homogeneity and public acceptance. A further stipulation was that zone size must be sufficient to preserve people's privacy and discourage inappropriate inferences from very small samples (Flowerdew, Feng and Manley [3]). We also evaluated the relative merits of zone identification using (a) an automated method and (b) a panel of experts. Flowerdew, Manley and Sabel [2] showed the importance of zone design when studying the relationships between neighbourhood and health.

Our research, including focus groups with the general public (in 2002), established that comparable areas could not be designated as 'neighbourhoods' (as originally envisaged) because of the large variation of settlement sizes in Scotland. The more neutral term 'data zones' was therefore adopted. We also found that primary school catchment areas were often reasonable approximations for local communities. The DZ design was automated using a specially written amalgamation program. Allocations were then subject to operator scrutiny and adjusted where problems arose. Resultant DZs maps were sent to all Scottish local authorities, and final adjustments were informed by their feedback [3].

3. References to the research

1. Flowerdew R (2011) How serious is the Modifiable Areal Unit Problem for analysis of English census data? *Population Trends* 145, 106-118 doi:10.1057/pt.2011.20 http://www.palgrave-journals.com/pt/journal/v145/n1/abs/pt201120a.html

2. Flowerdew R, Manley D and Sabel C (2007) Neighbourhood effects on health: Does it matter where you draw the boundaries? *Social Science and Medicine* 66, 1241-1255 http://dx.doi.org/10.1016/j.socscimed.2007.11.042 http://www.sciencedirect.com/science/article/pii/S0277953607006272

3. Flowerdew R, Feng Z and Manley D (2007) Constructing data zones for Scottish Neighbourhood Statistics *Computers, Environment and Urban Systems* 31, 76 -90 http://dx.doi.org/10.1016/j.compenvurbsys.2005.07.008 http://www.sciencedirect.com/science/article/pii/S0198971506000366

4. Geddes A and Flowerdew R (2004) 'The effect of the modifiable areal unit problem in modelling the distribution of limiting long-term illness in Northern England', in Boyle P, Curtis S, Graham E and Moore E (eds) *The geography of health inequalities in the developed world: views from Britain and North America* (Ashgate), 267-292 0754613984, 9780754613985

5. Manley D, Flowerdew R and Steel D (2006) 'Scales, levels and processes: studying spatial patterns of British census variables' *Computers, Environment and Urban Systems* 30, 143-160 http://dx.doi.org/10.1016/j.compenvurbsys.2005.08.005 http://www.sciencedirect.com/science/article/pii/S0198971505000621

Quality indicators:
Selection by BMJ Faculty of 1000: [2]
Rigorously peer-reviewed papers [2,3,5]
Peer-reviewed funding – British Academy [1]
Peer-reviewed selection for publication from conference papers – [2,3,4,5]

4. Details of the impact

Our data zones are now the core geography for Scottish Neighbourhood Statistics (SNS) and the common spatial framework for mapping and analysis of almost all small-area data in Scotland.

"*We had no 'standard' small area geography, and very few government statistics were produced for areas other than local authority areas. Now, data zones are certainly the standard which is extremely widely used by a very wide range of users. There has been an enormous increase in the statistics made available. It is very easy to compare different statistics, and to compare different areas and changes over time. The benefits of this have been huge*" [S1] The Head of Household Estimates and Projections at National Records for Scotland.

Examples of their impact are outlined below:

(1) Policy deliberations

DZs are employed by Westminster and Scottish Governments, as well as every local authority in Scotland, for monitoring and planning economic, social and infrastructural investments, and for targeting resources. In Fife Council, data zone design "*has had a significant impact on the availability of small area data, which has given us better information to use for better decision-making and better community involvement*" [S2], while the senior planning analyst noted that, "*In Glasgow City Council we make extensive use of data zones. … My Housing colleagues have defined a set of neighbourhoods (amalgamations of data zones), which allows us to consider demographic change at a sub-City level*" [S3]. The detailed, localised information provided at DZ level was pivotal to work carried out by an Economist for Highlands and Islands Enterprise, and stressed its use both "*to inform decision making and resource allocation and in wider research and briefings.*" [S4]

[National Records of Scotland](#) (NRS) publishes official population estimates for DZs, which are used by government for planning purposes (Graham served on the Small Area Population Estimates working group). DZs have also been used by Scottish Government to report on Long-Distance Commuting and HMRC to monitor the distribution of child benefit claimants [S6], the House of Commons Scottish Affairs Committee in their *[Report on Poverty in Scotland](#)*, NHS-Scotland for analytical work in health and health services, Scottish Funding Council to monitor HE participation rates [S7], and by Transport Scotland to develop a new national transport model [S8]. The policy impact of DZs is confirmed in Scottish Government publications: *[All Our Futures: Planning for a Scotland with an Ageing Population](#)* and *[Caring Together: The Carers Strategy for Scotland 2010 – 2015](#)*.

Additionally, DZs have been used in survey sampling, as in the DWP survey of disabled people, and in evaluating the success of urban regeneration measures. The Scottish NHS Information Services Division (ISD) uses DZs to analyse and display data on health indicators, mortality and hospitalisation rates, healthy life expectancy estimates, and in applying the NHS Scotland Resource Allocation formula. A Principal Information Analyst within Information Services Division (of the NHS in Scotland) recognised DZs as 'fundamental' to their work. [S5]

(2) Open government

DZs play a pivotal role in promoting Open-Scottish Government, from providing the geography for reporting summary statistical data to supporting the delivery of interactive mapping. Many local authorities communicate with their electorate using DZ-based data (see Argyll and Bute Council Quick Facts and Figures, Moray Council's report to the Community Engagement Group, and Aberdeenshire Council's December 2012 Report on findings from the Scottish Index of Multiple Deprivation). Communication is enhanced by visual analytics and interactive mapping, and web-based organisations like 'Geocommons' provide access to mapped data which is dependent on the DZs developed by the St Andrews team.

(3) Resource allocation

Data zones have been used in evaluating the success of urban regeneration measures. Regeneration areas are defined as the most deprived 15% of data zones in Scotland, according to the Scottish Index of Multiple Deprivation (SIMD 2004, 2006, 2009). For financial years 2008/09 to 2010/11, £145 million per year has been allocated to target regeneration in these areas. Along

with the update of SIMD, the movement of data zones in and out of the most deprived 15% is consistently monitored by central and local government in evaluating the impact of the regeneration programme [S10].

(4) Use by health and private sector organisations

DZs have further indirect impact through underpinning policy-relevant research (326 hits on Google Scholar) by organisations such as Public Health Observatories and local authorities [S9]. Moreover, private consultancy firms use the DZ. In the case of Cogentsi they used DZ for their economic modelling of the Cairngorms National park. So they were "able to make a much better approximation of the actual Park boundaries, using an area defined by statistical datazones, which much more closely approximates the actual designated boundaries" .

In summary DZs have widely adopted by many different organisations throughout Scotland (including policy agencies, local authorities and the general public). This has allowed many new and important analyses which would not otherwise have been feasible and decisions made and enacted on those analyses.

5. Sources to corroborate the impact

The following corroborate policy deliberations in local and national government:

[S1] National Records of Scotland - Head of household estimates and projections

[S2] Policy co-ordinator; Fife Council, Senior planning analyst.

[S3] Senior Planning Analyst- Glasgow City Council.

[S4] Economist, Highlands and Islands Enterprise.

[S5] Geography Analysis Support Team, NHS Information Services Division – health indicators. See http://www.isdscotland.org/Products-and-Services/Deprivation/Deprivation-Overview/

[S6] HM Revenue – examination and presentation of data on child benefit claims - see http://www.hmrc.gov.uk/statistics/child-small-stats.htm; Scottish Government report on Long-Distance Commuting - see http://www.scotland.gov.uk/Publications/2006/07/31141549/0

[S7] Scottish Funding Council – participation rates for entrance to higher education - http://www.sfc.ac.uk/statistics/PublishedStatistics/ParticipationIndicatorsScottishHEIs2011-12.aspx

[S8] Transport Scotland – development of transport model for Scotland http://www.transportscotland.gov.uk/analysis/LATIS/models/National/TMfS07

[S9] Licensing Board – use of liver disease mapping by DZs to influence licensing law for one example see

http://www.highland.gov.uk/businessinformation/licensing/liquorlicensing/highland-licensing-forum/2012-09-25-hlf-min.htm

[S10] Andrew Fyfe, Katy MacMillan, Tara McGregor and Steven Reid (2009) Informing Future Approaches To Tackling Multiple Deprivation In Communities: Beyond The Fairer Scotland Fund ODS Consulting http://www.scotland.gov.uk/Resource/Doc/290862/0089371.pdf